Regulation of gas infrastructure expansion

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Voor Jasmijn en de tweeling

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Preface and acknowledgements

Sometime in September 2003, while working at the Dutch Bureau for Economic Policy Analysis (CPB), dr. Machiel Mulder, my supervisor, was the first person to encourage me to explore the idea of doing a PhD in energy economics. This resulted in a preliminary research proposal on socially optimal investment in gas storage facilities. In January 2004, I discussed my preliminary ideas with Professor Cees Withagen, who had supervised my MSc research project, and several researchers in the gas sector whom I met during my time at CPB: Professor Mannes Wolters, dr. Rob Aalbers and dr. Aad Correljé. Although the meeting itself did not immediately lead to the start of a PhD research, I consider it to be the start of the adventure that has now come to an end with this dissertation.

A little more than a year later, a colleague of dr. Aad Correljé at Delft University of Technology, dr. Laurens de Vries, responded to my research proposal and asked me if I would be interested in undertaking a PhD study at the faculty of Technology, Policy and Management. At that time, I was working with the Energy research Centre of the Netherlands (ECN). As I was interested in working on a PhD while continuing to work for ECN, and both ECN and Delft were interested in collaborating more strongly, together we managed to set up this interesting PhD research project. The project is supported by the two organisations but could not have been done without the support of the Next Generation Infrastructures Foundation. From May 2005 onwards, I started researching the topic of gas infrastructure regulation under the supervision of my promotor Professor Margot Weijnen and copromotor dr. Laurens de Vries.

Although my dissertation is an individual work and the writing of it has sometimes been quite a lonely exercise, I really could have never finalised it without the help, support, and guidance of many people.

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In addition, I would like to take this opportunity to thank all my colleagues, both at ECN and in Delft, for the pleasant company and cooperation throughout the years. At ECN I would in particular like to thank Herman Snoep for the many interesting discussions we had on gas market policy and developments and for his constructive feedback on important parts of my dissertation towards the end. In addition, I thank Lachlan Cameron for being such a fun room-mate and for being so supportive during the last stretch of my research. Special thanks also to Özge Özdemir, Adriaan van der Welle, Sytze Dijkstra, Ad Seebregts and Arjan Plomp for their pleasant cooperation over the years. Thanks as well to my colleagues at the Energy & Industry section in Delft who gave me all such a warm welcome from the start. I would specifically like to mention the following people: Emile Chappin, Catherine Chiong Meza, Koen van Dam, Michiel Houwing, Hanneke de Jong, Hamilcar Knops, Andreas Ligtvoet, Angelique Nauta and Anish Patil. And of course: 'makker' Rob Stikkelman for his original, entertaining way of looking at things and for his characteristic way of encouraging me in my research.

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Finally, and most importantly, I thank my wife Birgit. You know I couldn't have done this without you. Your patience and encouragement had no limits and pushed me to successfully finalise this dissertation. Especially the past year or so, you arranged everything around me so that I could focus on my PhD project. Now that this project has finished, I look forward to spending more time with you, our beautiful daughter Jasmijn and the twins that are underway (our 'new, joint project'). Let us celebrate!

Jeroen de Joode
Den Haag, May 2012

1 Introduction

1.1 Problem statement

Whereas competition has been introduced in the European gas market, the infrastructure parts of the gas value chain have largely remained in the regulated domain because they were considered essential facilities (or even natural monopolies) requiring strict regulation. A variety of regulatory regimes has been applied to different types of gas infrastructure. While transmission system operators (TSOs) across the EU are regulated monopolies, infrastructures like import terminals for liquefied natural gas (LNG) and storage facilities are not, or not necessarily, part of the TSO's responsibilities. Other infrastructures, like pipeline interconnections, may or may not be included in the regulated TSO's domain. Within the general regulatory framework for gas infrastructure in the EU – covering pipelines, LNG terminals and gas storage facilities – there is room for Member States to make different regulatory choices. In practice, differences exist in regulatory choices for specific types of infrastructure (transmission pipelines, LNG import terminals, storage facilities) between countries. Gas storage facilities in Germany are regulated on the basis of negotiated third party access, whereas the same type of facilities in Italy and Hungary are regulated on the basis of regulated third party access.[1] Recently, a gas storage facility in the Czech Republic succesfully acquired a merchant status, implying that no third party access requirements are imposed at all (EC, 2011a). Even within a country, regulatory choices sometimes differ from infrastructure project to project. For example in France, new LNG terminal projects that are under development have been subjected to different regulatory regimes (CRE, 2008). In Germany, unregulated transmission pipelines have been built or are under construction (such as the OPAL and NEL pipeline projects) parallel to regulated transmission pipelines.

[1] Data on existing and proposed gas storage facilities, including the regulatory regime to which facilities are subjected, is available on the website of Gas Infrastructure Europe (GIE): http://www.gie.eu.com/ (last accessed: 20-05-2012).

Since the implementation of the first Gas Directive, the EU regulatory framework has evolved. New legislative packages have been adopted (EC 2003, 2009a) that have facilitated or enforced increased cooperation and coordination between Member States. This is for example illustrated by the creation of platforms such as the Madrid forum and the enactment of the Agency for the Cooperation of Energy Regulators (ACER). Over time, regulatory frameworks across the EU have converged to some degree, but differences are still observed today (Klop, 2007; Haase, 2009), including the regulatory regimes for gas infrastructure expansion.

This study focusses on the regulation of the expansion of gas infrastructure facilities in the EU that are not necessarily part of the national gas transmission pipeline infrastructure. The approach to regulation is not the same in the various Member States of the EU, which prompts the question of what would be the best approach under different circumstances. Are there country-specific, or even case specific, factors that would merit different approaches? In some cases, policy-makers may be concerned that the regulatory framework does not provide adequate incentives for investment; in other cases, the concern may be that the potential for competition does not appear to be fully utilized, which may reduce system efficiency. The two policy objectives of safeguarding infrastructure capacity adequacy and achieving efficient market outcomes can be at odds with one another (Helm, 2005). The revealed regulatory choices may be interpreted as being the result of balancing these two objectives. What are the factors that lead to the regulatory choices concerning the regulation of infrastructure expansion, and how can improved insight contribute to regulatory choices that better meet public policy objectives?

EU gas market developments require expansion of gas infrastructure

The need for investment in new gas infrastructure was limited in the wake of liberalisation but has significantly increased since. At the start of the liberalisation process, the focus of regulatory authorities across the EU was more on ensuring an efficient use of existing gas infrastructure capacity than on expansion of infrastructure. This can be explained by the fact that infrastructure capacity at the time was adequate, or in cases even overdimensioned, given the demand for gas infrastructure services. However, since then, gas market developments have led to an increased demand for new gas infrastructure capacity. The integration of national markets not only stimulated efficient use of existing capacity but also increased the need for new cross-border pipeline capacity. In addition, the growth in gas demand in combination with an increasing depletion of EU indigenous gas reserves increased the need for different other types of gas infrastructure expansion such as investment in gas supply pipelines to the European border, investment in LNG import facilities, investment in gas storage facilities, and investment in national and cross-border pipelines within the EU. Future demand for gas is uncertain but is expected to stay at the current high level for the next decades. A key uncertainty concerns the role for gas in the electricity generation sector, which has strong implications for new infrastructure investment. Gas can play a large role in the transition towards a more sustainable energy system, for example by replacing relatively dirtier energy technologies in the energy mix and by providing the necessary energy system flexibility required as a consequence of an increasing share of intermittent electricity producing technologies (such as wind and solar based technologies).

Investment incentives and efficiency in gas infrastructure

From a public perspective, there are two objectives at stake in regulating gas infrastructure expansion. On the one hand the combined regulatory framework and market environment should provide incentives that ensure a sufficient level of infrastructure investment, and on the other it should not lead to largely inefficient market outcomes that unnecessarily increase the cost of gas supply for final consumers.

Inefficiencies of the gas supply system before liberalisation were one of the triggers for market liberalisation – an other was the ideal of creating a common European market. Liberalisation of the competitive parts of the gas value chain would unleash competitive forces and encourage gas companies to deliver gas system services at lower cost than before. The non-competitive parts of the gas value chain (or at least perceived as such) remained in the regulated domain and were subjected to third party access regulation – with different types of infrastructures subjected to different types of access regulation. The institutional changes on the gas market negatively affected investment decision-making for gas infrastructure. Incentives for cross-border transmission pipeline investment were insufficient due to, among other barriers, a lack of vertical unbundling, differences between regulatory choices in respective Member States, and the largely national focus of energy regulators (EC, 2007a; de Joode and van Oostvoorn, 2007). In particular the requirement of third party access (TPA) on gas transmission pipelines, gas storage facilities and LNG import terminals negatively affected the incentive for investment as it fully exposed the investor to the downside risk of investment, but did not allow it to fully capture upside risks of investment. In order to remedy the negative impact of default TPA regulation, the second EU Gas Directive (EC, 2003a) introduced the instrument of exemptions from infrastructure access regulation. This instrument allowed for competitive investment outside of the regulatory domain in exceptional cases. In parallel, the second and third Gas Directive, and accompanying Regulations (EC, 2003a; 2005; 2009a; 2009b; 2009c) aimed to improve the functioning of the internal market by imposing new or amended provisions.

Irrespective of the evolving of EU legislation and enhanced cross-border coordination and cooperation, differences in the way Member States regulate investment in transmission pipelines, LNG terminals and storage facilities still exist with differences even between different projects within Member States.

1.2 Research subject: the regulation of gas infrastructure expansion

For the gas market as a whole, 'regulation' or 'a regulatory regime' can refer to a large range of regulatory variables such as degree of market opening, network access conditions and tariffication, balancing rules, access to gas storage, gas release programs, trading facilities, and network unbundling on transmission and distribution level (Haase, 2009). The focus in this study is not on the regulation of the gas market as a whole, but on the regulation of the gas infrastructure in particular. When making regulatory choices regarding the expansion of gas infrastructures, regulatory decision-makers are faced with a range of challenges.

Firstly, gas infrastructure investments are generally characterised by high upfront investment costs, lumpiness, long payback times and asset-specificity. Combined with the uncertain future demand for serivces provided by gas infrastructure this causes for potentially high levels of investment risks. If the regulatory framework insufficiently allows investors to mitigate these risks via private contractual arrangements, new investment may be delayed or put-off indefinitely.

Secondly, the same factors as mentioned above can also lead to a lack of competition on the market for infrastructure services. This may allow the investor in new gas infrastructure facilities to earn monopoly rents.

Thirdly, individal gas infrastructure facilities are part of an interdependent gas infrastructure system. Decentralised investment decision-making may have strong implications for infrastructure operations elsewhere. The investment in a new gas infrastructure facility may require capacity upgrades elsewhere in the system. Coordination between different gas infrastructure elements may need to be safeguarded via regulation.

Fourthly, gas infrastructure investment may have considerable external effects. External effects are unintended effects that are not reflected in private decision-making on the level of individual infrastructure projects. Investment in new gas infrastructure facilities may, for example, contribute to an increase in the level of competition on the commodity market for gas, or enhance the level of security of supply of the gas supply system.

Regulatory authorities may respond differently to these challenges in different situations. Tariffs and access conditions can be regulated, but sometimes a regulatory holiday (a temporary waiver of regulations) may be needed to attract investment. In some cases, unregulated investment has the best results, whereas in other cases a facility is best included in the TSO's monopoly, for instance because of a dominant need for coordination that cannot be safeguarded by alternative arrangements at lower cost. A number of factors may affect regulatory decision-making about gas infrastructure expansion. Regulatory decision-makers may pursue different regulatory objectives or may give priority to certain regulatory challenges. In addition, although different types of gas infrastructure seem to share a number of basic economic characteristics, this does not necessarily need to imply that similar regulatory choices are made. Regulatory authorities in different EU Member States in practice make different choices .

This study focuses on explaining choices regarding gas infrastructure expansion across different types of gas infrastructure and across different projects of the same type of infrastructure. Why does the role for competitive investment differ in different situations? This study aims to analyse which infrastructure, project and context-dependent factors affect the decision of how to regulate a specific gas infrastructure facility. New insights into the underlying factors may identify possible improvements of current regulation of gas infrastructure investment at the EU and Member State level.

1.3 Relevance

1.3.1 Social relevance

Natural gas is an important fuel in the current energy mix and remains important in the transition to a sustainable energy future (IEA, 2011a). Although the direct economic importance of the natural gas industry in Europe may be limited to about 2.5% of total gross value added (at basic prices) and 0.6% of total employment[2], the actual social relevance is much bigger due to its role in the electricity generation sector and residential heating sector. Currently, about 23% of electricity generated within the EU is natural gas based.[3] Interruptions in the supply of electricity can do a lot of social and economic damage, as could be observed in the cases of the California electricity crisis in 2000/2001 and the 2006 and 2009 European gas crises following interruptions in Russian gas supply to Ukraine (Stern, 2006; Pirani *et al.*, 2009; Kovacevic, 2009). In northwestern Europe, gas is the primary fuel for heating purposes in the residential sector. An interruption in the supply of natural gas in particularly in winter would cause significant discomfort to final consumers. The total social cost of an interruption in gas supply can be as much as €41 million per hour for a specific region in the Netherlands (de Joode *et al.*, 2004).[4] As the gas market is an infrastructure-bound market, a continuous provision of natural gas to endusers depends on the realisation of sufficient infrastructure capacity. In order to realize a sufficient amount of infrastructure in the next decades, investment in new gas infrastructure assets in the order of billions is needed according to the International Energy Agency (IEA,

[2] The figures cited here are obtained from the Eurostat database and reflect the combined share of sector CA11 (Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying) and E40 (Electricity, gas, steam and hot water supply) in respectively total gross value added and number of persons working in the EU-27 in 2007.

[3] This figure is based on 2009 data obtained from the online database of the International Energy Agency (IEA.

[4] This figure has been calculated by using the concept of the value of lost load (VoLL). It is an estimate for the social cost that would result from a one hour interruption in gas supply to final consumers in the part of the Netherlands with highest economic production and highest population density. The cost estimate includes an estimate for the social damage for households (de Joode *et al.*, 2004).

2011a) and the European Commision (EC, 2010a). It is in the interest of the consumer that these investments are realised in an efficient manner, within a regulatory framework that allows competition where possible and when desirable given public objectives. Although achieving a higher level of efficiency in realising infrastructure investment projects may not translate into significant reductions in the yearly gas bill for the final consumer – as the major share of the bill concerns the cost of the commodity and energy taxes (CIEP, 2009) – it can amount to significant savings over a larger period of time from a public perspective.

1.3.2 Scientific relevance

There is a rich body of economic literature on the regulation of infrastructures and specifically the regulation of infrastructures with natural monopoly characteristics (Averch and Johnson, 1962; Baumol and Klevorick, 1970; Demsetz, 1968; Vogelsang, 2000; Laffont and Tirole, 1993). However, economic theories do not provide clear indications of the conditions under which efficient levels of investment can be achieved and which factors lead to over- or underinvestment (von Hirschausen, 2008). neoclassical-based welfare economics and public interest theory (den Hertog, 2000) provide explanations for regulatory intervention through the concept of market failures, but fail to explain differences observed in the implementation of regulation in different markets or network industries. Its focus on external effects is relevant, however, external effects are not the only reason for different regulatory choices. Klein (1996) defines a range of competition modalities that may be applied in the case of network industries and provides a number of conditions that need to be satisfied for successful adoption of a particular option in a particular context. New institutional economics (Williamson 1998; Joskow 2005; Glachant, 2002), provides a better framework for analysing infrastructure regulation as it is based on more realistic behavioural assumptions and acknowledges the key role of institutions and the institutional environment in the functioning of markets. In particular the field of transaction cost economics, which puts the transaction at the centre of analysis, seems well-equiped to assist in explaining differences in the regulation of different types of gas infrastructure expansion in different contexts. Though new institutional economics provides a better framework, as it includes more explanatory factors, it needs to be further operationalized for the case of regulating gas infrastructure investment. Others have already demonstrated the added value of using a new institutional economic perspective in analysing energy markets such as the electricity and gas market (Glachant, 2002; Joskow, 2005; Makholm, 2006; Makholm, 2007; Glachant *et al.*, 2008; Correljé and de Vries, 2008; Spanjer, 2009; Haase, 2009; Rüster, 2010; Hallack, 2011, Makholm, 2012).

The challenge, taken up in this study, is to uncover the causal relation between the factors affecting investment and the regulatory choice implemented, based on an operationalisation of neoclassical economics and new institutional economics in the context of gas infrastructure. New insights into this causal relation are expected to contribute to the explaining of different regulatory choices in different types of gas infrastructure and in different EU Member States.

1.4 Research objective and questions

Different regulatory choices regarding the expansion of different types of gas infrastructure are observed in practice, both between and within countries. The hypothesis is that a range of infrastructure-, project- and context-specific factors and regulatory objectives play a role. Different streams in economic literature provide interesting insights, but there is not yet a theoretic framework that is capable of explaining these differences.

The objective of this research is: *to explain and improve regulatory choices regarding gas infrastructure expansion for different types of gas infrastructure and in different contexts*.

The research questions addressed in this study are:

1. What are the drivers for and barriers to gas infrastructure expansion?
2. How can current regulatory choices regarding investment in gas infrastructure be explained?
3. How can regulatory choices regarding the regulation of gas infrastructure expansion be improved?

1.5 Research scope and assumptions

The focus in this study is on the regulation of expansion of gas infrastructure within the European Union (EU). This implies that the focus is on investment in gas infrastucture in a liberalized market, as the EU has introduced competition into the competitive elements of the gas value chain in 1998 (EC, 1998).

The term infrastructure is used to denote physical structures that are needed in facilitating transactions in the gas value chain and are characterised by sunk costs (i.e. asset-specificity) and lumpiness of investment (i.e. increasing economies of scale). These characteristics are generally associated with natural monopolies. The term network industries is also used to represent this type of infrastructures (Klein 1996, von Hirschhausen *et al*. 2004). In this study, the focus is on infrastructure investments of three particular types: gas transmission pipelines, LNG import facilities, and gas storage facilities.

In the context of this study, pipelines refer to high pressure transmission pipelines that are part of a national transmission system or provide a connection between two national transmission systems. This implies that upstream pipeline networks, used for collecting gas from gas producing fields to the national transmission system are excluded from this analysis. Also excluded from the analysis are upstream pipelines that transport gas to the EU border. Low-pressure pipelines in distribution pipeline systems are also outside the scope as they are considered a natural monopoly where the scope of introducing competition is much smaller than for other pipeline systems.

This study includes the regulatory treatment of investments in LNG import terminal facilities within the EU. LNG exporting terminals are not covered in this study as the EU currently has none of such facilities, and is not expected to develop these given the continuing decline in indigenous gas reserves.

Gas storage facilities as interpreted in this study involve a range of possible gas storage technologies, whether small-scale or large-scale and whether based on depleted oil and gas fields, salt caverns, aquifers or LNG peak shaver facilities.

Although assets deployed in the production of gas or the conversion of gas quality can be referred to as gas infrastructures, these are not included in the scope of this study.

Static evaluation of revealed regulatory choices

In this study, the regulation of gas infrastructure expansion is analysed from a static perspective. The objective is to explain regulatory choices regarding gas infrastructure investment at a certain point in time, and not per se to explain changes in regulatory choices over time. In practice, regulation does change over time in response to changing circumstances. Regulation may respond to changes in the balance of political power, the relative power of competing interest groups, technology, risks (of for example supply disruptions), international competitive pressure, or investment needs (Newberry, 2001). The focus is on regulatory choices as revealed in practice and laid down in different kinds of documentation. This means that the research approach is more factual and less subjective.

Problem owner: a public interest perspective

The problem owners of the research problem addressed in this study are policy makers and regulatory authorities, both at the national and the European level. A clear-cut choice for one of these two cannot be made since national policy and regulation is intertwined with European policy and legislation. The problem owners may have different public policy objectives in mind when deciding on the regulatory design of gas infrastructure investment. The two main public policy objectives are affordability and availability. The public policy objective of affordability of the gas system is related to the economic concept of efficiency: an efficient gas system is generally expected to lead to low prices and an affordable gas system. An efficient allocation of resources implies that no other allocation exists at lower system costs. The public policy objective of availability is related to concepts of security of supply, reliability and adequacy. A particular security of supply level indicates whether a system, or in the context of this study an infrastructure, is capable of providing sufficient services in both the short and long-term. Reliability refers to the short-run security of supply of gas infrastructure capacity whereas adequacy refers to the long-term security of supply of gas infrastructure capacity. Since this study addresses the issue of investment in new gas infrastructure capacity, security of supply in the context of this study always refers to adequacy and not to reliability. Within the context of this study, the public policy objective of availability is related to the economic concept of effectiveness. An effective design of regulation of infrastructure investment leads to capacity adequacy.

1.6 Research method

In achieving the goal of this study, the following research method is adopted. In order to explain regulatory choices observed in practice, and provide suggestions for improving upon them, initially, a hypothesized view on elements deemed relevant in explaining the choice of regulation applicable to gas infrastructure investment is used. This is depicted in figure 1. The basic hypothesis put forward is that there is a range of investment issues that may lead regulatory decision-makers (i.e. the problem owner in this study) to decide upon some form and some degree of regulatory intervention.

The term regulatory framework will be used to reflect the overall set of rules and regulations to which a company is subjected. It may relate to both rules and regulations at the EU level and the EU Member State level. The term regulatory choices is used to refer to single regulatory decisions made at the Member State level. In the context of this study this term is generally used to refer to regulatory choices that affect the expansion of gas infrastructure. Finally, the term regulatory model is used to refer to a set of regulatory choices that affect gas infrastructure expansion. Based on literature, a range of regulatory models is identified in chapter 3.

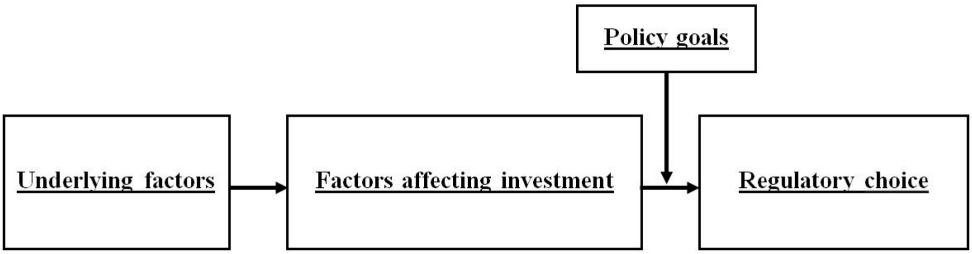

Figure 1 Conceptual framework for explaining the choice of regulation

The implemented regulatory models in practice diverge across different types of gas infrastructure and across EU Member States. This leads to the hypothesis that there are important infrastructure, project, and context-dependent factors at play. One particular variable that is assumed to have a role in explaining regulatory choices between countries are the preferences of policy-makers regarding public policy objectives that can be at stake in gas infrastructure policy. This study does not address the question why the one public objective is prioritized over the other when public objectives are in conflict with one another. The choice in balancing different, possibly competing objectives is political (Helm, 2005). What is assumed, however, is that a different focus may have consequences for the trade-off and thus for the choice of regulatory model to adopt. The optimal level of investment cannot be quantified in practice and is thus not known to policy-makers and regulatory authorities. Hence, there is no clear benchmark that can be used for comparison. As a consequence, there is always a need for the public decision-maker to balance different objectives and in the end make an informed political decision.

The conceptual framework is used as starting point for an analysis of relevant economic literature in the domain of regulation of infrastructure investments. The main theories used are new institutional economics – and then in particular transaction cost economics – on the one hand, and neoclassical economics – and in particular public interest theory – on the other. As indicated in section 1.3.2, both provide interesting and valuable building blocks for further operationalization of the proposed conceptual framework. Public interest theory provides for a range of market failures that may justify some form of regulatory intervention, whereas new institutional economics refers to transaction costs, property rights and institutions as key concepts for explaining what we see in practice.

Chapter 3 will review relevant literature in these domains in order to further operationalize the conceptual framework that aims to explain differences in regulatory models adopted across gas infrastructure investment projects and across countries. The literature analysis will cover an assessment of the different factors affecting investment, the range of regulatory models identified in theory and practice, and scan literature on relevant applications in the gas sector. The systematic assessment of relevant economic literature results in an adapted version of the conceptual framework presented in figure 1.

In order to empirically test the conceptual framework a case study approach is adopted that is qualitative, explanatory and descriptive in nature. This choice can be motivated by pointing to the scarce availability of literature aiming at explaining different regulatory choices regarding the type and degree of competition in general, and for the case of energy markets and gas infrastructure in particular. Via in-depth case study analysis the basic relations underlying specific regulatory choices may be uncovered. Section 3.5 elaborates why this particular approach is adopted and sets out the framework for case study research.

1.7 Structure of this study

This study is structured as follows. Chapter 2 provides the relevant background for the research presented in this study. It includes a description of the gas value chain, the gas market and its actors, and it characterises the demand and supply-side developments on the (European) gas market. Chapter 3 presents the adopted research approach. It contains a literature analysis of the key theoretical concepts in this study that culminates in a theoretical framework for analysis. This framework is the point of departure for the development of the case study approach: this part illustrates how theory and practice are confronted in the context of this study. Chapters 4 to 7 each present a case study analysis of a gas infrastructure investment project. Each chapter provides a description of the context of the project and the applicable regulatory framework before empirically testing the theoretical framework for analysis. Chapter 8 provides a synthesis of case study findings. Finally, chapter 9 concludes by addressing the research questions, presenting recommendations for policy-makers and future research, and reflecting on the adopted research method and assumptions.

2 Background

The goal of this chapter is to provide the background to the subject of study. It describes the gas value chain, the key gas demand and supply developments in the EU, and summarizes key EU legislation relevant for the domain of gas infrastructure.

2.1 Introduction to the gas value chain and its actors

Figure 2 presents a stylised representation of the gas value chain. The gas value chain subsystem describes the basic separable physical activities in the gas system. The elements in the gas value chain are described below.

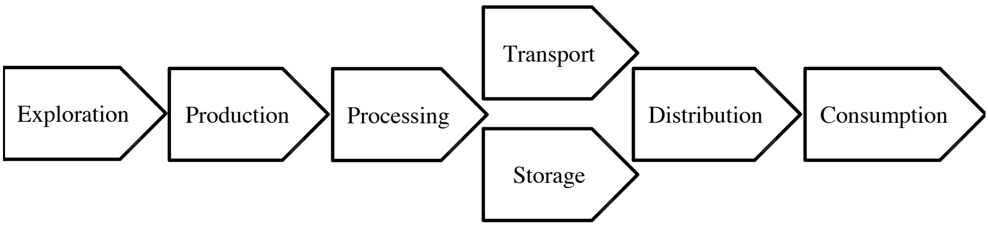

Figure 2 Overview of elements in the gas value chain

After the extraction of gas from a reservoir and before the transport of the gas through the natural gas transport network, the gas needs to undergo different processes. These processes for example involve the removal of water, higher hydrocarbons, CO_2 (carbon) and H_2S (hydrogen sulfide) as these can damage network assets or end-use appliances. Gas processing generally takes place directly after extraction close to the location of extraction. However, in case of offshore gas production gas is often transported to the mainland first since offshore processing of gas is relatively costly. Additionally, the processed natural gas needs to adhere to the common gas quality standard. If the produced gas is not of the correct quality the gas quality can be converted via nitrogen injection. The exploration and production of gas are generally referred to as the upstream activities.

The transport of gas encompasses the long-distance transport through high-pressure gas pipelines or the transport of liquefied natural gas (LNG) via tankers. Long-distance pipeline transports involve the transport of gas through the transmission pipeline network from the production or gas treatment facilities to either local distribution systems (e.g. distribution networks to which small to medium-sized gas consumers are connected) or to large gas consumers that are directly connected to the transmission pipeline network. Compared to pipelines used in distribution networks, transport pipeline networks are generally larger in size (diameter), due to the larger transport volumes required, and operate under a higher pressure. Non-producing gas reservoirs can have a gas pressure of about 500 bar, whereas the gas pressure on the side of small residential endusers in the Netherlands is about 30 mbar.[5] Long-distance transport pipelines from for example Russian production facilities to the European border operate under about 150 to 220 bar. The pressure in gas pipelines that are part of the national transmission network typically ranges from about 40 to 80 bar. At the local distribution network point (also referred to as the 'city gate'), the gas pressure is reduced to about 8 bar. After this point, the pressure is further reduced to a minimum of about 30 mbar underpressure for small end-user appliances. Another option for the transport of natural gas over long distances is LNG. Bringing down the temperature of the gas to about -164 to -161°C turns it into a fluid which can then be more easily transported via tankers. After re-gasification at the point of destination the gas can be injected back into a pipeline system.

Gas storage can serve multiple purposes and can be located both upstream and downstream (i.e. close to the customer). Gas storage facilities may contribute to system optimisation (balancing) or may serve strategic purposes (as a reserve to be deployed during a security of supply incident). There are different technical options for the storage of gas. Natural gas can be stored in depleted gas and oil fields, salt caverns, aquifers and tanks (such as an LNG tank). The different types of facilities have different characteristics with respect to rate of injection and extraction (CIEP, 2006). Gas pipelines can also be used for short-term storage of small volumes; this is called line-pack.

The consumption of gas serves a range of purposes. Firstly, it is a major source for electricity generation through the use of gas turbines and steam turbines.[6] The scale of the

[5] These figures are taken from course slides prepared by Prof. Wolters for his course on gas technology at Twente University.

[6] Particularly the combination of a gas and steam turbine allows for high efficiency in electricity production. These are the Combined Cycle Gas Turbine (CCGT) power plants.

application may vary and involve large-scale centralized electricity generation or small-scale decentralized electricity generation, for example via Combined Heat and Power (CHP) that simultaneously produce electricity and heat. In the residential sector, gas is an important heating and cooking fuel. Industrial gas use serves heating, cooling and cooking purposes, mainly in industries such as the paper, metal, glass, plastic and food process industry. In addition, gas may be used as a feedstock for the production of chemicals and fertilizers. Finally, gas be used in as a fuel in the transport sector.

Different actors are involved in each activity in the gas value chain. Upstream (i.e. in exploration and production), a distinction needs to be made between gas producing companies and gas trading companies. In the Netherlands, the NAM is the largest gas producer, wheras GasTerra is the main gas trading company. However, gas production and gas trading activities may be integrated within one company. An example of an integrated company is GDF. Gas producing and trading companies may have different business strategies depending on the type of organization and the shareholder structure. Companies may be publicly or privately owned, or may involve a public-private partnership (PPP).

The gas infrastructure required in the different steps in the gas value chain can be owned by different individual companies but may also be integrated with other non-infrastructure based value chain activities. Upstream pipeline networks that are used to collect gas from different gas producing fields are generally owned by a joint-venture of gas production companies that each have an interest in realising economies of scale in bringing gas to a nearby gas treatment facility and / or entry point of the transmission pipeline network. The transmission pipeline system is generally operated by a transmission system operator (TSO), who is responsible for the allocation of available capacity, the balancing of the system and the planning of maintenance and expansion of transmission capacity. Before the start of the European liberalization process, transmission pipeline systems were organized nationally, which led to the creation of different national TSOs in the first years of liberalization.[7] Over time, some formerly national TSOs have acquired transmission pipeline assets across the border, thereby creating international transmission

[7] Formally, EU Member States were required to designate TSOs with the adoption of the second Gas Directive (EC, 2003a).

companies. However, from a national regulatory perspective national TSOs still exist when it comes to the safeguarding of public service obligations and the regulation of access conditions. In practice, national TSOs may thus be part of an international gas infrastructure company. Ownership of transmission pipeline assets varies across Europe. In the United Kingdom, the infrastructure company National Grid is privately owned and not only owns and operates the UK gas transmission pipeline network, for which it is the designated TSO. However, it also owns other infrastructure assets, such as an LNG import terminal. In the Netherlands, gas infrastructure company Gasunie is fully state-owned and consists of different business units. One of these units, GasTransportServices, is the designated owner and operator (TSO) of the Dutch transmission pipeline network. Other infrastructure activities within the Gasunie holding include the operation of an LNG terminal and a pipeline connection to the UK. Transmission and gas producing or trading activities may be integrated within one company. The company is vertically integrated when it covers multiple, sequential steps in the gas value chain. This for example applies to offshore gas producing companies that own part of the pipeline infrastructure that is required in bringing the gas to the national transmission pipeline network. Users of the transmission pipeline network (or gas infrastructure in general) are referred to as 'shippers'. Shippers book entry and exit capacity in the transmission pipeline network in order to accommodate gas flows associated with transactions on the commodity market for gas. Gas trading companies and large-gas consumers (i.e. shippers) enter supply contracts on the commodity market and need to ensure that the gas can be injected and taken from the network by buying the necessary transport capacity.

Gas retail companies may be considered intermediaries between the gas producing and trading companies on the the one hand, and the endusers connected to regional distribution pipeline systems on the other. They by gas on the wholesale market (from gas producing or trading companies) and sell to endusers on the retail market. Before liberalization of the gas market, the retail companies were generally vertically integrated with the distribution network companies.

Distribution networks have been separated from the retail business and may be in public or private hands. The owner and operator of a distribution network is commonly referred to as the distribution system operator (DSO). They ensure the transport of gas from the point of connection with the transport pipeline system to the end-consumers connected to its distribution network.

The ownership and operation of either transmission or distribution network assets does not necessarily need to be integrated with one company, but may be separated as they involve separate economic functions. However, because of economies of scope and scale these functions are often organized within one organization.

Companies owning and operating gas storage facilities may be independent from other activities in the value chain, but are often part of a larger company with interests in other parts of the gas value chain. Gas trading or retail companies may be active in gas storage in order to optimize their deliveries to endusers. On the other hand, large gas users such as electricity generation companies may develop own gas storage facilities to optimize their supply portfolio over time. Irrespective of ownership, capacity in storage facilities may be sold to any actor active in the market, from producers to consumers. Actors interested in the use of storage capacity need to secure capacity rights and gas volumes via separate transactions: storage capacity rights may be bought from the storage company but the commodity needs to be bought from gas traders or producers in the wholesale market for gas.

LNG import terminals are considered part of the upstream gas sector and are generally owned by companies with interests in gas production or gas trade. Alternatively, the LNG import terminal may be considered an extension of the gas transport business. Transmission pipeline companies entering the LNG terminal business may be considered an example horizontal integration. Similarly to gas storage facilities, parties interested in LNG supplies need to secure LNG import capacity and LNG shipments via separated transactions.

Depending on their level of consumption, gas consumers are connected to either the transmission pipeline network or the distribution network. Large-scale industrial users, in for example the chemical industry, and electricity producers with gas-fired power plants are connected to the transmission pipeline network. Small residential consumers and companies in the services sector are generally connected to the distribution network.

2.2 European gas market developments

The goal of this section is to inform the reader of the key trends and developments in EU gas demand and supply.

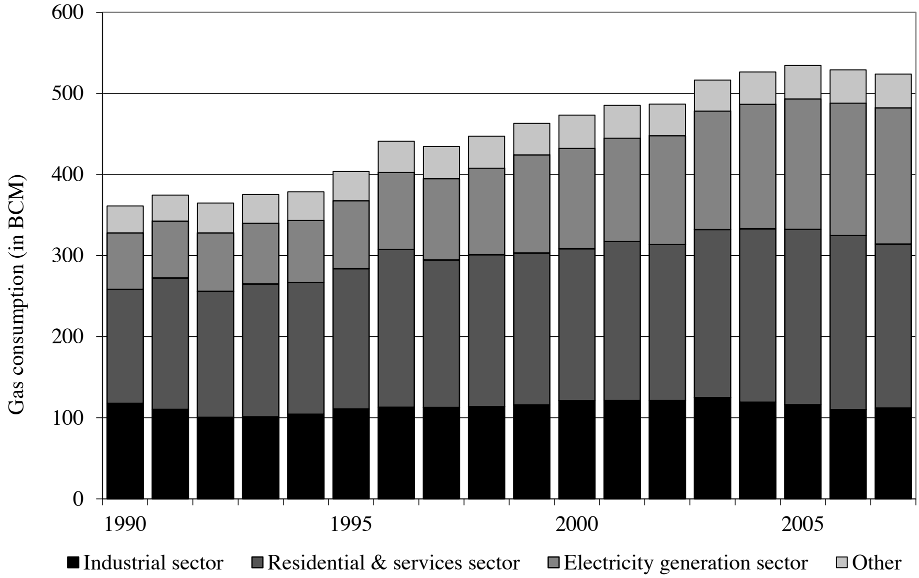

Figure 3 Development of sectoral gas demand in the EU between 1990 and 2007[8]

The demand for gas in the EU-27 mainly originates from three sectors: the industrial sector, the residential and services sector, and the electricity sector (see figure 3). Together they take up 91% of total gas demand. In the past 20 years. Especially the demand for gas in the electricity generation sector has increased. This is referred to as the 'dash for gas' (Helm, 2003; Stern, 2004; Honoré, 2006). Gas has increasingly penetrated the electricity generation mix in a number of EU countries. For the EU-27 countries, gas contributes to about 23%% of total electricity generated. In comparison, the demand for gas in the industrial sector and the residential and services sector has remained relatively constant in the past 20 years. The demand for gas in the residential sector is strongly affected by the demand for heating and cooling. Although the demand for gas in the residential sector has remained relatively constant over time for the EU as a whole, the gas consumption per household has been strongly in decline. This is mainly due to improved energy efficiency, for example through enhanced isolation.

The role for gas in the energy system varies from country to country (see figure 4). Countries with a large dependence on natural gas in the energy mix are for example the

[8] Based on data from the IEA gas balance.

United Kingdom, the Netherlands and Germany. Countries like Poland, France and Norway mainly rely on other energy sources (coal, nuclear and hydropower respectively).

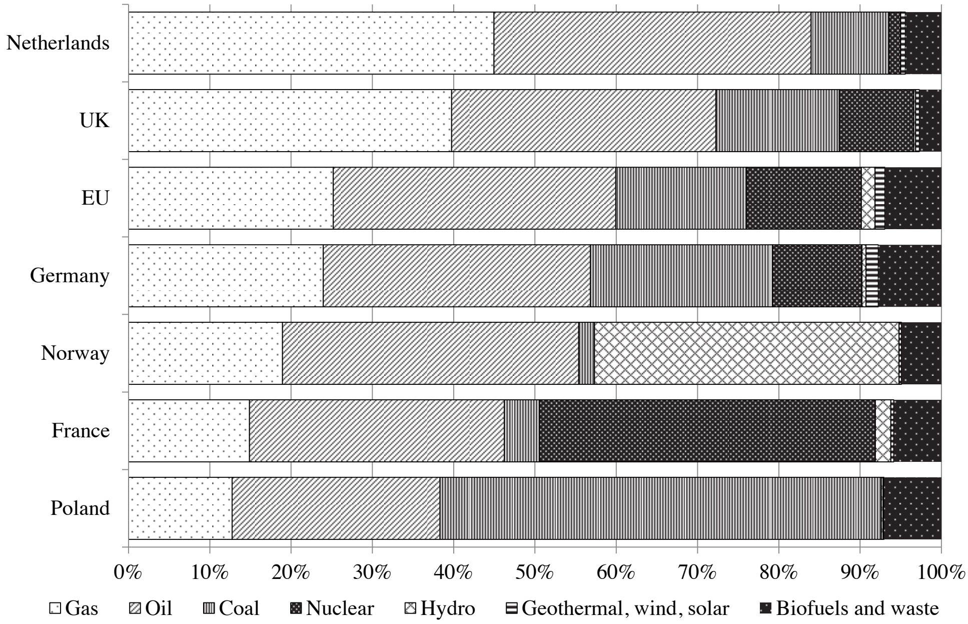

Figure 4 Energy mix of the EU and a selection of EU Member States[9]

For the future, a further increase in the demand for gas in the EU is foreseen by the IEA (2011a; 2011b), especially in the electricity generation sector. Figure 5 presents EU gas demand since 1990 and the IEA projection for EU gas demand until 2035 (and the origin of supplies). Two key characteristics of gas-based electricity generation play a role in this projection.

Firstly, when used in combustion, gas is a fuel that is relatively cleaner than for example coal and oil: it emits far less CO_2 and other pollutants in the atmosphere compared to these alternatives (IPCC, 2006). The introduction of the EU emission trading scheme (ETS) aimed to reduce CO_2 emissions by putting a market-based price on every unit of CO_2 emitted. Via this 'penalty' on CO_2 emissions, the EU aimed to discourage the use of relatively dirty energy technologies and encourage the development of clean energy

[9] This figure is based on energy balance data of the IEA for the year 2009. Data is available at: http://www.iea.org/stats/index.asp (last accessed: 16-05-2012).

technologies. Dependent on the strenght of the financial incentive that follows from the ETS in practice, a substitution of generation technologies may be expected over time, putting gas in a relatively more competitive position. The scope for reducing CO_2 emissions in the electricity generation sector varies across countries.

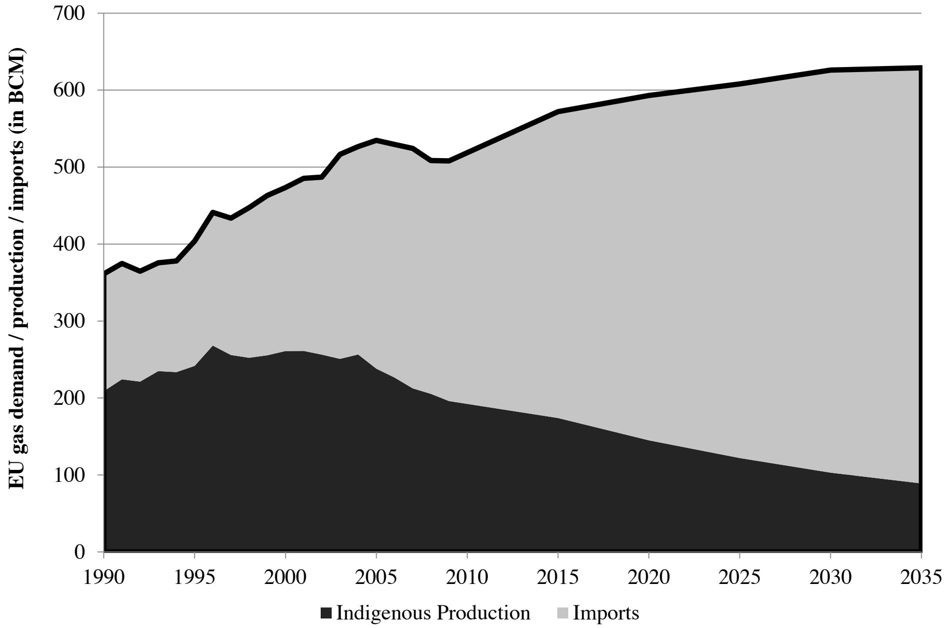

Figure 5 Historic and projected development EU gas demand[10], production and imports[11]

Secondly, gas-based electricity generation may be a preffered technology in dealing with large fluctuations in electricity demand and supply in the system. Both the demand for and supply of electricity are volatile. Electricity demand has a clear daily pattern and the balance between demand and supply in the system needs to be maintained at all times, as large-scale storage of electricity is not (yet) cost-efficient. The required flexibility in the

[10] The two depicted categories of indigenous production and imports together add up to total gas demand in the EU.

[11] This figure is based on data from IEA. Data until 2009 are taken from the IEA gas balance database, whereas data from 2009 to 2035 are taken from the IEA World Energy Outlook New Policies Scenario (IEA, 201b).

system can be provided by different means, such as for example pumped hydro storage, demand response, connections with neighboring electricity systems, and gas-based electricity generation units. Gas-based power plants are capable of ramping up and down very quickly at relatively little cost compared with other generation technologies. As the amount of intermittent renewable energy technologies, such as wind and PV solar cells, is expected to further increase, also the need for system flexibility will increase (Rogers, 2011; CIEP, 2011).

Whether the demand for gas will remain at the same high level after 2035 is debated. If the EU stays commited to a reduction in CO_2 emissions of 80 to 95% in 2050 (compared with the level in 1990), then the demand for gas may be expected to go in decline. In general, the level of gas demand in the future depends on its competitive position versus other energy technologies in the different demand sectors. Factors that influence this position are climate policy (which broadly affects the 'penalty' on CO_2 emisions), the level of support for renewable energy technologies, technological development, the public acceptance of different technologies. If the 2050 energy system is only to emit 5-20% of the 1990 level of CO_2 emissions, this necessary implies that energy consuming sectors (almost) fully need to shift to renewable energy technologies and that only the sectors that have the highest cost of shifting to renewable energy technologies will continue to use some CO_2-emitting technologies. In order for the overall system to achieve this level of reduction, projections show that the electricity generation needs to be fully decarbonized in 2050. This overall picture puts strong limitations on the use of gas in meeting energy demand 2050. Gas may still have a role electricity generation if combined with the capture and storage of CO_2 emitted (Blyth *et al.*, 2007). Moreover, natural gas may substituted with green gas. Green gas can be produced by either chemical or biological processes. Synthetic natural gas (SNG) is produced via a chemical process while biogas is produced via a biological process. Biogas is a type of biofuel that is produced via digestion or fermentation of organic matter. Materials from which biogas can be produced include manure, sewage sludge and waste. Biogas can be applied locally or fed into the natural gas pipeline system for use at other locations. Replacing natural gas via green gas can effectively decarbonise the energy supply to any gas consuming sector.

The production of gas in the EU is expected to decline in the next decades as its traditional gas producers, mainly the Netherlands and the United Kingdom (UK), are nearing depletion of indigenous gas reserves. The current reserve-to-production ratio for the Netherlands and the UK is 16.6 and 4.5 respectively (BP, 2011). This means that the current level of Dutch and UK production can be sustained for about 16 and 4 years before reserves are depleted. Figure 5 illustrates how the level of EU gas production changed in the past decades and how the IEA (2011b) expects it to change until 2035. This projection does not take into account potentially large developments in the development of unconventional gas[12] across Europe. The commercial production of unconventional gas in the US has surged in recent years (Newell, 2010) and there are suggestions that there are also substantial deposits in Europe (EIA, 2011). However, its commercial viability in Europe is not proven yet and a succesfull development of these reserves first needs to deal with a number of hurdles of various kinds. Gény (2010) provides a comparison of the US and European case for shale gas, whereas de Joode *et al.* (2012) analyse the potential impact of shale gas developments in Europe on the supply side of the market.

The EU as a whole has been import dependent for some decades. As illustrated by figure 6, the EU imports gas from a range of countries. The largst external suppliers to the EU are Russia, Norway and Algeria. Together they accounted for 80% of the EU's gas import needs in 2010. Whereas historically gas was mainly imported via pipelines, recent decades have seen a large increase in LNG import capacity across the EU. According to Gas LNG Europe, the amount of LNG regasification capacity in Europe has increased with 113 BCM (annual caapcity) between 2005 and 2011: an increase of about 155% (GLE, 2011). Nevertheless, pipeline supplies from particularly Russia, Norway, and Algeria are expected to meet the majority of gas supplies to the EU in the future (de Joode and Veum, 2011). The continued dominance of Russian, Norwegian and Algerian supplies in EU gas imports can be explained by the proximity of the EU to remaining gas reserves in the world. From an EU perspective, gas supplies from these countries are the most economical to transport to its borders as other reserves are located even further away.

[12] Unconventional gas resources comprise the total of gas resources that are deemed to be unrecoverable with the state of technology at a certain point in time. When technology advances it allows for additions of formerly unconventional gas resources to the conventional reserve base. Six categories of unconventional gas resources are distinguished: tight gas, deep gas, geo-pressurized gas, shale gas, coal-bed methane and methane hydrates (IEA, 2008).

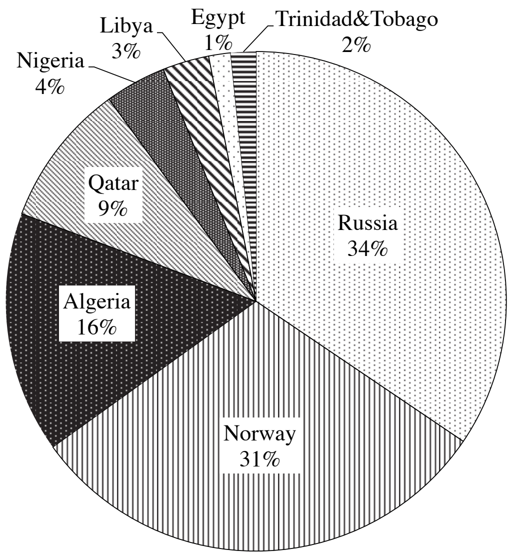

Figure 6 Source of EU gas imports in 2010[13]

A shift in the supply pattern from indigenous EU supplies to EU external supplies leads to an increase in the amount of transit gas and LNG supplies. Already a substantial share of gas consumed within EU borders transits one or more Member States. This for example concern the flow of Russian gas to Western Europe and the flow of Norwegian gas to Central and Southern Europe. With the decrease in EU gas production and a increase in gas imports, the amount of gas transit is likely to further increase. This implies a larger demand for new transmission pipeline investment across Europe.

2.3 EU gas market regulation

This section briefly describes the key regulation at the EU level in the domain of gas infrastructures. It provides a general background for the discussion of the regulatory framework applicable to individual gas infrastructure projects analysed in the case analyses in chapters 4 to 7. A summary of the relevant EU Directives and Regulations is provided below.

[13] Data obtained from the website of Eurostat:
http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database (last accessed 16-05-2012).

The 1998 Gas Directive

The objective of the first Gas Directive (EC, 1998) was to open up European gas markets by setting a set of mimum rules concerning the transmission, storage, distribution and supply of natural gas for all EU Member States. The focus was on realising third party access (TPA) to gas transmission and distribution pipeline networks, in order to effectively introduce competition on the wholesale market, and allowing consumers to freely choose for the gas supplier of their free choice. The Directive specified the gradual steps to be followed by Member States in opening up the market for the different categories of endusers over time. Member States were allowed to adopt regulated or negotiated TPA on its gas pipeline systems. Access to the gas system was only to be refused in cases of a lack of capacity, when access would prevent the owner of the system to carry out public service obligations, or when granting access would lead to serious economic and financial difficulties in relation with take-or-pay contracts. The latter exception required European Commission approval. Upstream gas pipelines were not subjected to TPA, but Member States had to ensure that "the objectives of fair an open access, achieving a competitive market in natural gas and avoiding any abuse of a dominant market position" were followed. Furthermore, gas supply undertakings were required to maintain separate accounts (accounting unbundling) for their different gas activities. The Directive also required Member States to designate competent authorities that would be capable of dealing with access disputes. Derogations of some of the requirements in the Directive could be obtained for the case of emerging gas markets or a large dependency on an external supplier.

The 2003 gas Directive

The 2003 gas Directive (EC, 2003a), also known as the 'acceleration' Directive, replaced the 1998 Gas Directive and contained a number of adaptations. Firstly, it required regulated TPA for gas transmission and distribution systems and LNG terminals. The regulatory regime applicable to gas storage facilities – allowing a choice for regulated or negotiated TPA by the Member State – remained unchanged. Secondly, the second Gas Directive required the appointment of system operators for the operation, maintenance and development of transmission, distribution, storage, and LNG facilities. In order to guarantee the non-discriminatory and transparent access, these system operators were required to be legally and functionally unbundled from other activities such as the production and supply of gas. Thirdly, the Directive required the implementation of minimum standards that ensured a protection of consumer interests. In addition, it allowed Member States to impose public service obligations that aimed at achieving public goals such as guaranteeing security of supply and protecting the environment. Fourthly, the Directive required Member States to appoint independent regulators and designate them the responsibility of monitoring compliance with non-discrimination principles and the level of transparency and competition. Separate from the Directive, the EC implemented Decision 2003/796/EC, which required the establishing the European Regulators Group for Electricity and Gas (ERGEG) (EC, 2003b), which brought together national regulators in order to ensure an coherent application of the Directive. Finally, the Directive allowed for an exemption from the requirement to subject gas infrastructure facilities to regulated (or negotiated) TPA. Article 22 of the 2003 Directive specified the particular circumstances under which major new gas infrastructure (whether concerning pipelines, LNG or gas storage facilities) may be exempted from default infrastructure regulation. Article 22 (1) of the second Gas Directive allows investors in new gas infrastructure facilities to apply for an exemption of, among other requirements, the requirement of regulated TPA, under the following conditions:

1. The investment must enhance competition in gas supply and enhance security of supply;
2. The level of risk attached to the investment is such that the investment would not take place unless an exemption was granted;
3. The infrastructure must be owned by a natural or legal person which is separate at least in terms of its legal form from the system operators in whose systems that infrastructure will be built;
4. Charges are levied on users of that infrastructure;
5. The exemption is not detrimental to competition or the effective functioning of the internal gas market, or the efficient functioning of the regulated system to which the infrastructure is connected.

As an effective and non-discriminatory third party access to gas transmission networks was considered a vital condition for the realisation of a well-functioning gas market, additional regulation was imposed to ensure a minimum level of harmonisation across

Member States. Regulation 1775/2005 (EC, 2005a) laid down the basic principles regarding service conditions for third-party network access, capacity mechanisms and balancing rules, criteria methodologies for setting network access tariffs, and transparency requirements.

The 2009 Gas Directive

The 2009 Gas Directive, repelaing the 2003 Gas Directive, came into effect in 2009 as part of the larger 'Third Energy Package' that encompassed – in additional to new electricity market legislation – separate regulation on conditions for access to gas transmission networks (EC, 2009a) and the establishing of an Agency for the Cooperation of Energy Regulators (ACER) (EC, 2009c). The sector inquiry into the gas and electricity market undertaken by DG Competition in 2007 (EC, 2007a) highlighted the inadequacy of the 2003 Gas Directive in realising an internal market for gas. The new Gas Directive contained the new rules that, according to the EC, are required. The three key new elements in the Directive are the following. Firstly, the Directive targets the more structural unbundling between gas transmission and gas production and supply activities. It does so by offering Member States a choice between three models: (1) ownership unbundling, (2) an independent system operator model, or (3) an independent transmission systen operator (ITO). This is expected to improve non-discriminatory access to networks and stimulate investment in infrastructure. Secondly, the Directive allocated stronger powers to national regulatory authorities and enforces their independence. Thirdly, the Directive creates a new insitutional set-up that aims to harmonize market and network operation rules at the pan-European level. This involves the creation of a European Network for Transmission System Operators for Gas (ENTSO-G), arranged in Regulation 715/2009 (EC, 2009b) and the earlier mentioned establishing of ACER (EC, 2009c). The goal for ENTSO-G was set to promote the completion and functioning of the internal market, promote cross-border trade and ensure optimal management, coordinated operation and a sound development of the European gas transmission network. ACER is set-up to have a key role in developing technical rules at the EU level (together with ENTSO-G and the EC) and in the monitoring and reporting on market functioning. In addition, ACER is may adopt decisions on cross-border issues. Regulation 715/2009 (EC, 2009b) further specifies rules for the conditions of access to gas transmission, gas storage and LNG terminals and repeals Regulation 1775/2005 (EC, 2005a). The previous regulation on access conditions led to guidelines on best practice agreed between stakeholders particpating in the 2002 and 2003 Madrid forms. However, as the implementation of these guidelines was not satisfactory, the EC decided to make these guidelines legally binding via this Regulation.

Regulation on guidelines for trans-European energy networks

In addition to the Gas Directive, the EC has implemented Regulation on guidelines for trans-European energy networks. The EC implemented Decision 1229/2003/EC (EC, 2003c) and Regulation 1364/2006 (EC, 2006) and recently adopted a new proposal (EC, 2011b). These guidelines aim to facilitate and speed up the completion of energy infrastructure across Europe, where the focus is explicitly on projects of European interest. Previous guidelines were based on the TEN-E programme, where TEN-E stands for Trans-European Energy Networks for Energy. TEN-E listed a number of so-called axes for priority projects, which may concern infrastructure corridors and gas market regions in Europe. Axes for priority projects for example included a new supply line from Russia through Northern Europe to the United Kingdom, a new supply line from the Caspian Seas countries via Turkey to the EU border, LNG terminals in Belgium, France, Spain, Portugal and Italy, and underground gas storage in South-eastern Europe and the Baltic States (EC, 2004). The selection of priority projects was based on the impact of the projects on the level of security of supply in the region or the whole EU. Priority projects were entitled to assistance from the EU, for example via the financing of feasibility studies. In addition, the projects could be eligible to other European Community instruments that could partly finance project investments. Furthermore, a so-called European coordinator could be involved in realising the project. The tasks of a coordinator include facilitating coordination between the various parties involved in implementing the cross-border section of a network and monitoring the progress of the project.

In October 2011 the EC adopted a proposal for updated regulation on guidelines for trans-European energy infrastructure (EC, 2011b), also known as ‘the infrastructure package’. Firstly, this Regulation identifies 12 strategic trans-European energy infrastructure corridors and areas for gas, electricity and CO_2 networks. Rules are laid down that should lead to the further identification of so-called projects of common interest (PCIs) that are considered key in realising adequate infrastructure capacity in the priority corridors and areas. Secondly, the proposal establishes a common regime for PCIs that entitles them to certain treatment by national and international authorities. It for example sets limits to the duration of permit granting processes and allows for national competent authorities to coordinate and oversee the permit granting process (i.e. a ‘one-stop-shop’ approach will be implemented). Thirdly, the proposal provides a methodology and a process for determining the costs and benefits associated with PCIs, and provides responsibilities to national regulatory authorities and ACER to allocate costs involved to Member States involved in proportion to the benefits received. Fourthly, the proposal specifies when PCIs may be eligible for financial support from the so-called Connecting Europe Facility.

3 Research approach

3.1 Introduction to the conceptual framework for analysis

The elements of the natural gas infrastructure that are the subject of this study – such as transmission pipelines, storage facilities, LNG terminals – are directly linked to the national transmission networks, but are not necessarily considered part of the TSO's domain. There can be economic and juridical reasons for placing these facilities in the competitive domain or under the TSO. In many cases, these facilities contribute to a country's security of supply and often also to the competitiveness of the wholesale market. This can be an argument for socializing (some of) the cost of these facilities. On the other hand there may be negative network externalities associated with these facilities, in the form of a need for deep network investments (in the transmission network). Socialisation of costs could therefore lead to the Averch-Johnson effect of overinvestment (Averch and Johnson, 1962).

All these facilities are asset-specific, meaning that they can only be used for their intended purpose and only in the location where they are built. This may cause particular risks for investors, which may, for instance, result in hold-up. The default form of regulation of, for instance, LNG terminals in the EU, is regulated TPA. This means that the entire investment risk is placed with the investor and that he is not allowed to sell long-term contracts to his facility before its construction in order to mitigate these risks. A prima facie, this model of merchant investment may well lead to a lower level of investment than would be socially desirable. This is caused by a combination of these particular investment risks (due to asset-specificity in combination with other factors) and the possible presence of positive externalities.

The merchant model (i.e. unregulated investment), which in some cases is the default form of regulation, may lead to underinvestment, while the classic reaction of including these facilities under the umbrella of the TSO may lead to overinvestment and perhaps also to other economic inefficiencies. However, a range of options exist in between these two extremes (Klein, 1996; Williamson 1998). Perfectly competitive markets and regulated natural monopolies may be considered 'extreme' points in a range of competition modalities: a range of other 'choices' can be identified that allow a role of competition in infrastructure expansion, with each option having different efficiency properties. In the past decades, deregulation efforts have challenged the notion of natural monopolies in a range of different sectors with network characteristics. Klein (1996) speaks of experiments that *"have tried to peel away competitive layers from regulated networks and lay bare the true remaining natural monopoly"*, with the scope for 'peeling off competitive layers' depending on the specific technical characteristics of the considered infrastructure or network industry.

In practice we see that different types of facilities are regulated differently and also that different countries apply different solutions. This study aims to explain why investment in different types of gas infrastructure is treated differently from a regulatory perspective. One explanation is that the facilities have different physical and economic characteristics. Another explanation is that regulators may make different trade-offs, for instance between the objective of economic efficiency and achieving an affordable gas supply system (which would suggest placing more of the risk on the investor) and achieving capacity adequacy and achieving security of supply (which could justify a larger degree of socialization of costs and risks).

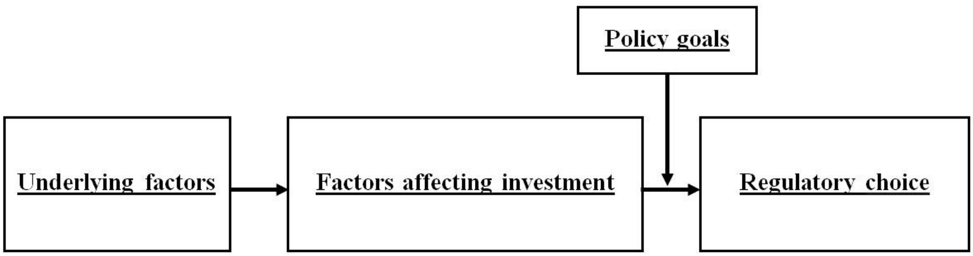

Figure 7 Conceptual framework for explaining the choice of regulatory model

Based on insights from both neoclassical and new institutional economics, this chapter develops a framework for understanding the relations between project characteristics, the private investor's perspective and regulatory choices concerning gas infrastructure investment. The starting point is the conceptual framework that is depicted in figure 7. It consists of three 'building blocks': factors affecting investment, policy goals and regulatory objectives, and the choice of regulatory model. As was stated in chapter 1, the term regulatory model is used to refer to a particular regulatory regime for gas infrastructure investment. It may also be described as 'competition modality' as each regulatory model represents a different role for competition or competitive investment.

The structure of this chapter is as follows. Section 3.2 reviews the different factors that may positively or negatively affect the investment case for infrastructure facilities (transmission pipelines, storage facilities, LNG import terminals). It covers the drivers for and barriers to gas infrastructure investment. Section 3.3 discusses the impact of public policy goals, regulatory objectives and the trade-offs that may need to be made in making regulatory choices. Section 3.4 reviews the range of possible regulatory models. Finally, section 3.5 presents the case study approach that will be used to confront theory with practice in the upcoming chapters (chapter 4 to 7).

3.2 Factors affecting investment

Economic literature identifies a range of factors that affect investment in infrastructure facilities. This section discusses these factors and illustrates their relevance in the context of the gas market. Underlying infrastructure-related and exogenous factors determine whether the particular factors affecting investment are relevant in particular circumstances. Some factors may prevail across a range of different types of gas infrastructure (pipelines, storage facilities, LNG terminals), whereas others are perhaps generic for one type of infrastructure or fully dependent on the context of an individual project. Regulatory authorities may, dependent on context specific conditions and regulatory objectives, need to deal with each of the factors discussed in this section when deciding on the appropriate regulatory framework. Using economic literature from both neoclassical and new institutional economics, four types of factors are identified that affect the level of investment. These factors can lead to underinvestment or overinvestment in infrastructure capacity from a public perspective.

Firstly, there may be project related investment barriers such as the asset-specific nature of gas infrastructure investments, uncertainty regarding the future value of new investment, and the credibility of regulatory authorities in setting and keeping committed to regulatory frameworks in the long term. If the regulatory model adopted by the authorities does not allow investors sufficient room to deal with these issues (for example by entering long-term contractual arrangements or vertically integrate), then investment in gas infrastructure may be threatened.

Secondly, the type and degree of competition in the provision of infrastructure services may be limited due to entry or exit barriers, which can result in monopoly power for the infrastructure owner. In addition, natural monopolists have an incentive to underinvest in new capacity from a public perspective as they incur scarcity rents. However, if there is some form of competition to which the infrastructure facility is subjected, then there may be less need for regulators to regulate access conditions or deal with the problem of underinvestment.

Thirdly, gas infrastructure expansion projects may need to be coordinated with infrastructure investments elsewhere in the infrastructure system. An example is the need for transmission pipeline investment due to the realisation of a new LNG import terminal. If no effective coordination mechanism is in place, then investment in the new facility may not go ahead.

Fourthly, investment in infrastructure facilities may involve external effects on the commodity market for gas. Investment in new facilities, such as for example a new cross-border pipeline interconnection, may enable market entry of new gas suppliers, which benefits the level of competition in the wholesale market. Moreover, a new cross-border pipeline interconnection may add to the number of gas supply sources to the market and increase the robustness of the system at times when security of supply is threatened. As these effects may not be taken into account in investment decision-making, there may be suboptimal investment from a public interest perspective.

The following four types of factors affecting investment are discussed in the remainder of this section:

- Private barriers to investment (section 3.2.1);
- The type and degree of competition to which the new facility is subjected (section 3.2.2);
- The need for coordination with other gas infrastructure investments (section 3.2.3);
- External effects on the commodity market for gas (section 3.2.4).

3.2.1 Private barriers to investment

Private barriers to investment, which may also be referred to as private investment risks, common barriers for investment in gas infrastructure are the high level of upfront investment costs, the share of capital costs in total cost of service provision (i.e. high capital intensity), and the lumpiness of investment (i.e. the indivisibility of assets). A high level of upfront investment costs poses challenges to the financing of investment ex ante (de Joode and van Oostvoorn, 2007). Moreover, the recovery of investment costs may be uncertain in cases where the pricing of infrastructure services is based on marginal cost pricing (Boiteux, 1960; Perez-Arriaga *et al.*, 1995). The recovery of investment costs requires that investors active in a liberalised market are capable of charging prices above marginal cost. Lumpiness of investment is caused by economies of scale in building gas infrastructure facilities (von Hirschhausen *et al.*, 2007; Brito and Rosellón, 2011). The presence of economies of scale may make it economically inefficient to invest in new facilities incrementally.

In addition to these widely documented barriers, new institutional economics points to ex post hazards involved in infrastructure investment when investment is asset-specific and the future value of investment is uncertain. In facilitating infrastructure transactions, investors need to devise institutional arrangements (such as long term contracts or vertical integration strategies) to mitigate ex post hazards. The exposure of infrastructure investors to ex post hazards depends on the characteristics of the transaction facilitated in combination with the key behavioural assumptions central in new institutional economics.

In contrast with neoclassical economics, new institutional economics assumes that actors intend to act rationally but only limitedly do so (i.e. bounded rationality), and that actors behave opportunistically in the sense that they deviate from earlier arranged deals or contracts when deviation suits there purposes ex post (i.e. opportunism). Examples of ex ante and ex post forms of opportunism are adverse selection and moral hazard, which both result from asymmetric distribution of information.[14] In the context of transactions or contracts, opportunism relates to distorted or selective information disclosure.

Williamson (1985; 1996; 1998) distinguishes three key transaction attributes that affect the need for institutional arrangements, of which two in particular, asset-specificity of investment and the uncertainty about the (future) market value of investment is, can lead to ex post hazards. The third transaction attribute, the frequency of transacting, affects the

[14] Adverse selection refers to the ex ante inability or unwillingness of economic actors to disclose their true risk position, while moral hazard refers to the ex post change in the behaviour of economic actors when faced with a redistribution of risk.

choice of institutional arrangements for the party investing, but does not increase or decrease exposure to ex post hazards and nor does it lead to additional barriers to investment. A description of the characteristics of asset-specificity and uncertainty, and their impact on infrastructure investment follows below.

Asset-specificity encompasses a variety of bilateral dependencies between transacting parties in an intertemporal context. Williamson (1985) provides the following definition: *"Asset-specificity refers to durable investments that are undertaken in support of particular transactions, the opportunity of which investments is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated, and the specific identity of the parties to a transaction plainly matters in these circumstances, which is to say that continuity of the relationship is valued, whence contractual and organizational safeguards arise in support of transactions of this kind, which safeguards are unneeded for transactions of the more familiar neo-classical (nonspecific) variety"*. Asset-specificity relates to the concept of sunk costs. Sunk costs refer to cost that already have been incurred and cannot be recovered. Asset-specificity creates an uneven bargaining position for parties seeking to engage in a transaction. It implies that one of the parties needs to incur investment costs ex ante of the transaction. Six types of asset-specificity can be distinguished (Williamson, 1999):

1. Physical asset-specificity (assets with specific purpose, as opposed to general purpose);
2. Human asset-specificity (knowledge that can only be acquired by doing);
3. Site specificity (location of assets and/or process in order to economize on transport and storage costs, relates to for example limited and very specific locational availability of production inputs or customer markets, is subject to asset immobility condition: the setup and/or relocation costs are very high);
4. Dedicated assets (investment in assets serving the transaction(s) with a particular buyer);
5. Temporal specificity (the value of the asset is critically dependent on the time period within which the product or service is delivered to the buyer);
6. Brand-name capital.

The transaction characteristic of uncertainty refers to the variance and nature of disturbances that influence the (value of the) transaction to either one of the parties. Uncertainty is an unavoidable transaction characteristic given the bounded rationality of economic actors, because if actors could foresee the different types of disturbances and their impact on the transaction, then they would be capable of folding back these developments into the contract that governs the transaction. In response, according to transaction cost economics, partners to the transaction search for a governance[15] mode that is, over time, able to effectively deal with any disturbances in a cost-efficient way. However, bounded rationality and opportunism of the transacting partners may further exacerbate the problem of finding a governance structure that economizes (i.e. matches cost-efficiently) on the impact of future uncertain events. Different definitions and categorizations are provided for the concept of uncertainty. Uncertainty may be interpreted as a frequency distribution of disturbances to the contract, signalling a mean frequency and a variance. In this definition, an increase in uncertainty can be interpreted as either an increase in overall frequency, or an increase in the impact of the disturbance for the contract. Williamson (1985) distinguishes between three different levels of disturbances based on the procedural impact of the disturbance on the contract, namely inconsequential disturbances, consequential disturbances and highly consequential disturbances. Inconsequential disturbances refer to variations in the contingent states that are too small to justify adaptation of the contract. In other words, the benefits of the adaptation that would accrue to the contract parties in this case do not exceed the costs of the adaptation process. The presence of consequential and highly consequential disturbances may require additional adaptation clauses to be added to the contract governing the transaction. These aim to reduce transaction costs that would be incurred if transacting partners would behave opportunistically when disturbances occur. The more frequent the disturbances, and the higher the impact of disturbances, the larger the need for contractual safeguards against opportunistic behaviour (resulting in adaptation costs). Koopmans (1957) distinguishes between primary and secondary uncertainty. Primary uncertainty here refers to state contingent kind of uncertainty related to random acts of nature of unpredictable changes in

[15] Williamson (1999) views governance as *"the means by which order is accomplished in a relation in which potential conflict threatens to undo or upset opportunities to realize mutual gains"*.

consumer preferences, whereas secondary uncertainty is related to information communication. Haase (2009) distinguishes between uncertainty in behaviour and uncertainty in the environment.

The combination of high asset-specificity and uncertainty gives rise to the hold-up problem. The level of asset-specificity in infrastructure investments in combination with uncertainty about either the behaviour of relevant actors (e.g. counterparts in transactions, regulatory authorities) or about the environment gives rise to ex post investment risks that prevent investment ex ante. This problem is commonly referred to as the hold-up problem (Klein *et al*. (1978); Williamson, 1975; Gans and King, 2003). If infrastructure assets have limited, if any, alternative use, this creates a quasi-rent. This is the difference between an investment's pay-off in its current use and in its highest alternative use. The limited alternative use, combined with high capital intensity and long lifetimes creates a long-term bilateral dependency that locks in the transacting parties. The long-term bilateral dependency may change over time and impact the appropriation of the quasi-rent. Prior to the investment, the one party– the producer/investor – may have a relatively strong bargaining position, as the other party– the consumer or its regulator – depends on him for undertaking the investment. After the investment is realised, however, the limited alternative use of the sunk investment ties the investor to the market for the foreseeable future, shifting the bargaining power to the regulator. This provides him with the incentives to adapt his policy in order to increase his own or society's rents at the expense of the investor's through appropriating the quasi-rent. The investment hold-up problem arises if these threats induce the investor to postpone or even cancel his investment.

The concepts of asset-specificity, uncertainty and hold-up have been studies before in literature on network industries and gas markets. According to Glachant (2002), four out of the six types of asset-specificity that are distinguished in literature apply to the case of network industries, including gas. Only brand-name capital and human asset-specificity are not considered relevant in the case of gas. Haase (2009) argues that human asset-specificity may be applicable to particular gas market transactions as infrastructure operations may require sector or asset-specific skills. Asset-specificity is not a feature that is necessarily constant over time: asset-specificity in energy markets can be lowered in some cases

(Glachant, 2002, Haase, 2009). Gas infrastructure assets may decrease in their level of asset-specificity for different reasons. Physical asset-specificity may be reduced as a consequence of technological developments that reduce the cost of adapting assets in order to deal with alternative gas (qualities). Market developments may, over time, reduce the level of dedicated assets of a pipeline investment for example, as the number of pipeline linkages in the gas system and the potential number of transaction partners may increase. This implies that (expected) gas system developments affect the level of asset-specificity and the need for particular institutional arrangements over time. Spanjer (2009) demonstrates how uncertainty enters transactions on the gas market. Transaction cost economics, in which asset-specificity is one of the key factors when analysing markets, has been successfully applied in analysing gas market developments and gas infrastructures. Nissen (2006) uses a transaction cost economic perspective to analyse changes observed in the institutional arrangements in the LNG value chain. He argues that the emergence of a competitive LNG market with independent LNG operators can be explained by the dynamics (i.e. growth) of the LNG business. Rüster (2010) studies vertical structures as a solution to the hold-up problem in the LNG business using transaction cost economics. Makholm (2006) analyses relation-specific investments in the US market and how regulation deals with them. By analysing the performance of long-term take-or-pay contracts in the case of gas trade between Brazil and Bolivia, Glachant and Hallack (2009) illustrate how the interests of contracting parties change over may time change over time. The introduction of exemptions from default access regulation for pipeline, storage and LNG terminal facilities in the second EU gas Directive can be interpreted as a measure aimed at solving the hold-up problem, as the imposition of strict third party access regulation led to a larger exposure for investors to ex post hazards, which held back investment in new infrastructure capacity. De Joode and Spanjer (2010) use transaction cost economics to analyse the hold-up problem in the case of a pipeline interconnection between the Netherlands and the United Kingdom.

3.2.2 Type and degree of competition

This section discusses the type and degree of competition and competitive behaviour that may apply to the case of gas infrastructure. Investment in new gas infrastructure can be sub-optimal due to a lack of competition. Infrastructure owners may refrain from realising the socially desirable amount of new capacity in situations where they gain from keeping infrastructure capacity scarce. According to contestable market theory, scarcity rents attract new market entrants, increase capacity and drive down rents. This is referred to as 'hit-and-run' strategies. neoclassical economics argues that via this process, scarcely available resources are allocated efficiently (Arrow, 1985). However, in the case of infrastructure markets entry and exit barriers may prevent this process from occuring, resulting in short-term market power and investment incentives that are suboptimal from a public perspective (Tirole, 1988).

The potential level of competition can be assessed by analysing potential entry and exit barriers. The presence of these barriers may give a first indication of the level of competition. Firstly, asset-specificity (also known as sunk costs) can be a barrier for market exit as the investor in specific assets cannot leave the market (as part of the earlier mentioned 'hit and run' strategy) without incurring losses. Whether this discourages the entry of new firms to the market ex ante depends on the level of asset-specificity and the magnitude of potential losses. Different types of asset-specificty were discussed above (section 3.2.1). Secondly, market entry may require investment in lumpy assets. Lumpy investment refers to investment that is relatively large and not marginally incremental and is also referred to as 'indivisible' investment. A high level indivisibility of infrastructure capacity limits the opportunities for other parties to enter the market (Gilbert and Harris, 1984). Lumpy investment may discourage market entry as it may not allow the investor to build exact the amount of capacity that is required to gain a profit and recover investment costs. Investments that are too large in size may lower market prices and increase the risk of the investor not recovering his investment costs. Fourthly, the size of the market determines the scope for market entry by (new) players. The market size may be limited to the degree that only one infrastructure facility is viable. Isolated island states, for example, may not be suitable for effective competition between infrastructure facilities. Finally, infrastructure investment may be characterised by high capital intensity and large upfront investment costs, which may hinder the entry of market parties if financing is difficult to arrange.

The presence of a barrier to entry (or exit) does not automatically imply that there is no potential for competition. Whether the barrier effectively removes the scope for competition is context dependent. Moreover, even in the presence of these barriers, infrastructure operators may behave competitively for various reasons.

Firstly, there may be effective competition between similar infrastructure facilities even though considered as natural monopolies from the outset because of their characteristics (lumpy assets, high capital intensity). An example is parallel pipelines serving the same market. There can only be full competition if the services provided are homogenous. As long as capacity constraints are not binding, service charges will reflect marginal cost of service provision. If the cheapest provider faces capacity constraints, prices for network services will equal the marginal cost of the more expensive (marginal) provider. In that case, the cheapest provider captures scarcity rents. If maximum capacity of parallel networks is constrained, then the price of network services needs to reflect the difference between consumer's willingness to pay and supplier's marginal cost for optimal rationing to be achieved. This form of competition may appear to be in contradiction with the previously discussed barriers that prevent market entry in the first place. After all, knowing that the degree of utilization of assets is unlikely to lead to the rents that are required in recovering investment costs, market entry will not occur ex ante. However this assumes a static market. An anticipated growth in demand for infrastructure services may be anticipated by new entrants, encouraging them to, despite entry barriers, investment in competing facilities. Moreover, apart from the size of the market, also the institutional context of existing infrastructure capacity may change over time, which is illustrated by the process of liberalization in a large number of infrastructure-bound markets around the world.

Secondly, infrastructure owners may, according to contestable market theory (Baumol, 1982), behave competitively due to the threat of competition. A requirement for this type of behaviour is that the threat is effective. This implies that entry and exit barriers are relatively low. Under the threat of competition infrastructure owners may voluntarily refrain from monopolistic pricing and rent capture as long as the expected rents are higher than in the situation where competitors enter the market.

Thirdly, some form of limited market contestability may apply when there is an effective threat of regulation (Glazer and McMillan, 1992). Self-regulation proponents argue that the mere threat of regulation will induce industry actors to limit socially non-desirable behaviour. In the case of natural monopolies for example, the industry actors that could behave as a monopolist (i.e. show rent-seeking behaviour) would refrain from capturing the full potential of rents because they expect this to trigger much fiercer regulation on their rent-seeking behaviour. The primary motivation for industries to impose some form of self-regulation is not related to public interests but is based on the mere threat of government imposed regulation. Although it is difficult to measure the credibility of a regulatory threat some basic conditions can be identified. These concern the presence of a regulatory authority, that is independent from other market actors and government, and has sufficient resources to enforce meaningful regulation within an acceptable timeframe. Conditions for an effective backstop procedure are: a transparent and accessible trigger to set off a possible backstop procedure, independent decision-making on the deployment of the backstop process, and a meaningful and relevant regulatory content.

In addition to the type and degree of competition (or competitive behaviour) discussed above, there may be competition for infrastructure services from outside the sector. A key concept in determining the actual level of competition in the case of gas infrastructure is the concept of the relevant market. The concept of the relevant market should be used to identify the boundaries of the competition between suppliers of a product or service. Several infrastructure or non-infrastructure based alternatives in the gas sector or outside the gas sector may effectively compete on the relevant market. The relevant market may encompass services provided by assets deployed in different sectors, and across borders.

Firstly, the market may be contestable because different network industries compete. An example is the competition between transport by rail and by waterways and the competition between petroleum product distribution systems and natural gas systems (Klein, 1996). The level of competition in the short and long-term depends on the possibilities for substitution (i.e. the cross-elasticity of demand). The price level of the relatively expensive network industry acts as a backstop for the relatively cheap network industry. This may allow companies in the latter industry to capture part of the rents but the effective competition puts downward pressure on market prices.

Secondly, although the market for a particular infrastructure-based service may be considered a natural monopoly, the service may be competing with alternative means of providing the service. For example, different means may be availabe for transporting a commodity to the final consumer. This challenges the perception that natural monopoly industries are per definition essential facilities. The product or service facilitated by a piece of infrastructure may be provided by other means.

There are several contributions in literature that discuss the level of competition in the market for energy infrastructure services. Brito and Rosellón (2011) argue that gas pipelines should to be considered very lumpy based on underlying technology: once the pressure limits on the pipelines are reached, only adding compressor stations or adding another pipeline can increase throughput. Von Hirschhausen *et al.* (2007) analyse the scope for competition between parallel gas pipelines in Germany and find that gas transportation via German transmission lines should be considered a natural monopoly. They cite a few cases of workable pipe-to-pipe competition in the US, where multiple pipeline connections between the Gulf of Mexico and the demand centres in the North-East and Mid-West compete with one another. In a report to the TSO of the Dutch gas transmission system (GasTransportServices, GTS), the Brattle Group (2007) assesses pipe-to-pipe competition distinguishing between three type of product markets: destination markets, origin markets, and transit markets (also referred to as parallel paths). For all three markets they conclude that no effective competition exists. Von Hirschausen (2008) analyses the scope for competition in gas infrastructures in the US (covering pipelines, storage and LNG facilities). He writes about the too narrow definition of the relevant geographic market as the reason why gas storage facilities were at some point more strictly regulated by US gas market regulator FERC than would have been necessary: they were not allowed to charge market-based rates. Alterations in the regulatory procedures led to a wider interpretation of relevant markets and a relatively lighter regulatory regime. Using a framework based on Williamson's four-layer model of institutions (Williamson, 1985), Correljé and de Vries (2010) illustrate how factors such as the size of the market and the stage of gas market development may have affected the restructuring of the electricity market differently across countries. Brunekreeft (2005) discusses the issue of market power in electricity interconnector investment and illustrates the scope for competitive investment in electricity transmission lines. Gas storage facilities compete with both infrastructure and non-infrastructure based alternatives in the market for flexibility services: gas storage facilities may effectively compete in the market for flexibility services with other flexibility sources such as flexible production, demand-side response, line-pack and LNG import facilities

(CIEP, 2006; de Joode and Ozdemir; 2009). Competition from other network industries for the provision of gas infrastructure services depends on the ability to substitute. The opportunities for endusers of gas are very limited. In power generation, some particularly power plants may have dual-firing capabilities and in the residential sector there may still be competition from other fuels, possible using competing value chains and networks, for heating purposes.

3.2.3 Need for coordination with other gas infrastructure investments

In infrastructure-bound industries, different elements in the value chain need to be coordinated in order to deliver the end-product to the final consumer. Services or products at intermediate stages in the value chain have limited or no value if the next element in the value chain is not properly functioning. In the context of gas infrastructures this may apply to an incorrect dimensioning of infrastructure assets elsewhere in the system.

The need for coordination between the realisation of different infrastructure assets may be assessed by the degree of interdependency. The degree of interdependency may be defined as the degree in which the (future) value of a new gas infrastructure facility depends on the successful realisation of investment in infrastructure assets elsewhere.

The notion of a network industry (such as the gas sector) implies the existence of externalities, positive or negative, between infrastructure users (Glachant, 2002). This also holds for potential users in the future, as previous investments may allow for new facility investment that may not require deep network investments. This depends on the configuration of the network, and the location of gas supply sources ('sources') and gas demand centres ('sinks') therein. The configuration of the network is the result of a build-up of assets in the past as the gas market proceeded through different stages of development. Therefore, the need for investment may be correlated with the stage of gas market development. The need for infrastructure investment elsewhere depends on the role of the proposed facility in the infrastructure system. From the perspective of an existing system, a new facility may be an extension or a substitution of existing assets and the existing gas infrastructure system. Glachant and Hallack (2010) study the economic properties of gas transportation networks and construct an analytical frame for the different possible types of gas networks. Gas networks consist of different individual components that can combined in different ways, giving rise to different economic properties. They argue that the variety of gas networks can be traced to three factors: the diversity of components (primary and secondary) that make up the network, the variety of combinations of components (i.e. connections and flows paths), and the historical inclusion of components in the networks (i.e. path dependencies).

The need for coordination in facilitating transactions in industries characterised by relation-specific assets is a key issue in transaction cost economics (Williamson, 1985; Williamson, 1996; Joskow, 2005). Transaction cost economics identifies six different organizational modes (referred to as 'governance modes' in the terminology of transaction cost economics) that may, dependent on the actual transaction that needs to be facilitated, safeguard coordination. The six modes are characterised below.

The first three modes are in the private sphere (Williamson, 1985; 1996), whereas the last three modes are in the public sphere (Frant, 1991; Dixit, 1996; Frant, 1996; Williamson, 1999). The first mode is 'the market', which equals the neoclassical view of market transactions. This governance mode does not involve more than a 'spot market like' transaction where a supplier and consumer momentarily express their assent to an exchange of a good or service and perform the exchange of the good or service (Ruiter, 2005). This mode is not suitable for transactions involving asset-specific investments (Williamson, 1996). The second mode is commonly referred to as 'the firm', which basically represents a classical (vertically) integrated firm where a certain transaction is internalized. Within the firm, there is no longer a transaction taking place in the classical sense. Instead of expressing assent to a transaction, the supplier now contracts personnel and acquires the assets needed to produce a good or service in-house. The coordination of this 'transaction' is no longer based on the market, but is hierarchical: the owner of the firm uses his authority to deliver the in-house transaction. The third mode is referred to as 'hybrids'. A typical example of a hybrid arrangement is a long-term contract, but the term hybrids may cover a range of forms such as long term contracting, reciprocal trading, and franchising (Williamson, 1996).[16] The fourth mode is 'regulation'. This mode may be characterised by government-specified rules and procedures on how private parties should coordinate investments. The fifth mode is referred to as 'public' bureau, which involves direct control

[16] Ménard (2004) discusses a large range of hybrid governance modes.

of the government in the provision and coordination of infrastructure services. The sixth and final mode is 'private bureau', which again allows a large for government control but this time via an outsourcing of tasks to a third party.

According to transaction cost economics, the mode of governance economizes the transaction cost involved in facilitating the transaction at hand. As the need for coordination is considered as one of the four types of factors affecting gas infrastructure investment, it is important for the regulatory decision-maker to implement a regulatory model that allows for market parties to economize on the transaction costs that are associated with coordination. However, the choice for a regulatory model may imply that specific modes for coordination are not available to market parties. For example, as was mentioned in chapter 2, the EU gas Directive requires some form of unbundling. This implies that coordination through vertical or horizontal integration may not be possible and an alternative coordination mechanism needs to be adopted.

Several literature contributions study the coordination between investments in the value chain, in particular the LNG infrastructure elements (Nissen, 2006; Hirschhausen and Neumann, 2008; Rüster, 2010). The coordination between investments in consecutive elements in the gas value chain is extensively studied from a new institutional economics perspective. Similar coordination problems as observed in the gas market occur in the electricity and coal industry. Joskow illustrates the bilateral dependency of a coal producer with an electricity power plant and a transmission line (Joskow, 1985; 1987). Several contributions assess the bilateral dependency between investment in gas production assets, gas transport pipelines and gas consumers and the role of long-term contracts (Crocker and Masten, 1988, Doane and Spulber, 1994).

The types of gas infrastructure assets covered in this study are part of a larger liberalized gas system that is characterised by decentralized decision-making regarding gas injections and withdrawals. In such a gas system there are a large number of transactions and an increasing need for coordination to reduce the potential for negative or positive network externalities (Lyon and Hackett, 1993; Glachant, 2002).

The coordination between gas infrastructure and wholesale and retail market activities has been subject of debate in the context of the ownership unbundling requirement imposed in the Gas Directive. Pollitt (2008) reviews the pros and cons of ownership unbundling and concludes, based on case study evidence, that ownership unbundling of transmission in the electricity sector is a key part of energy market reform in the most successful reform jurisdictions. Bréton and Kharbach (2008) model the welfare effects of unbundling gas storage and distribution and find that vertical integration enhances social welfare. Cremer *et al*. (2007) provide a theoretical welfare analysis of different types of unbundling and its impact on the incentive to invest and conclude that ownership unbundling is more detrimental to welfare than legal unbundling.

3.2.4 External effects on the commodity market for gas

Infrastructure investment can also give rise to external effects on the commodity market for gas, which may be referred to as investment externalities. Investment externalities may be positive or negative. A positive (negative) investment externality can be defined as a positive (negative) impact of investment on the welfare of third parties not involved in the investment project that is not taken into account by the parties involved in the investment. Positive externalities give rise to underinvestment from a social welfare perspective, whereas negative externalities give rise to overinvestment from the same perspective. The focus in this section is on investment externalities rather than the production or consumption externalities that are generally discussed in the context of gas markets (CPB, 2006), as the focus of this study is on investment. Investment in gas infrastructure facilities may have positive and negative external effects on the level of competition and the level of security of supply on the commodity market for gas.

The external effect of gas infrastructure investment on the level of competition on the commodity market for gas is positive or negative as will be demonstrated below. Investment in new gas infrastructure facilities has a positive external effect when it effectively enables the entry of new gas suppliers to the commodity market. A larger number of potential gas market suppliers on the market increase the level of competition on that market. However, whether the new gas infrastructure facility effectively increases the level of competition depends on how infrastructure capacity is allocated to the market, the current market share of the gas suppliers that are successful in acquiring capacity rights, and the effectiveness of secondary markets for capacity rights and use-it-or-lose-it or use-it-or-sell-it rules.[17] For example, investment in a first LNG import terminal in market enables the supply of gas from LNG producing markets that previously could not supply the destination market. Investment may therefore have a positive effect on the level of competition on the destination market. However, in order to facilitate the investment, the LNG terminal capacity may have been sold to a limited number of gas importing companies on a long-term basis. The magnitude of the potential new supplies to the destination market on the level of competition now depends on whether those importing companies already had a dominant market share that effectively limited the level of competition. In theory, market concentration may worsen. However, such negative external effects may be mitigated by well-functioning secondary capacity markets and regulations enforcing so-called use-it-or-lose-it (UIOLI) or use-it-or-sell-it (UIOSI).

Security of supply is a difficult concept to define and there is a debate on whether market actors are in fact capable of internalizing perceived external effects on markets. Security of supply may be broadly defined as the availability of gas against affordable prices (de Joode *et al.*, 2004). This definition captures both the dimension of commodity availability and adequacy of capacity required to deliver it to final consumers.[18] Grossman and Stiglitz (1980) point out that there may be an information problem of missing markets as actors may not be aware of the full range of security of supply incidents to which their transactions are subjected and cannot determine the willingness to pay or willingness to accept the risks of these incidents occurring via the price mechanism. This would imply that there are external effects on the level of security of supply. This is discussed by Bohi and Toman (1996) in the case of oil market disruptions and by Vazquez *et al.* (2012) for the European gas market. Another way of framing external effects of infrastructure investment on security of supply is by referring to the current political preference for a secure supply of gas in terms of reducing import dependency, and improving the level of gas supply diversification. The external effect of new gas infrastructure investment on the (perceived)

[17] The primary aim of UIOLI or UIOSI is to ensure that available infrastructure is used efficiently and is based on the principle that all capacity that could be available to the market is indeed made available. When these principles are applied, capacity that is not used by its capacity holders may be re-offered or re-sold to the market on an interruptible or firm basis.

[18] Sovacool *et al.* (2011), Kruyt *et al.* (2009), Luciani (2004) discuss the concept of security of supply and how it may be measured.

level of security of supply may then be interpreted as the impact on import dependency and supply diversification. For example, a pipeline connection with a gas producing country that previously was not connected improves may not improve import dependency but may improve the level of supply diversification. The new pipeline connection may therefore have a positive external effect on the level of security of supply. Additional investment in gas infrastructure facilities may increase market integration and increase the flexibility of the market in dealing with (unexpected) interruptions in supply (Asche and Osmundsen, 2002).

The above discussion on the potential external effects of gas infrastructure investment on the commodity market for gas provides a number of factors that can assist in identifying its presence in the context of individual investment projects. Factors that determine the presence and magnitude of external effects are: the ‘additionality’ of the new facility in terms of enabling new gas supplies to the destination market, the size of the new facility, the method of allocation of capacity rights in the facility in combination with current market structure, and the ‘additionality’ of the new facility in terms of increasing the level of gas supply diversification

The presence of external effects on the commodity market for gas may lead to a regulatory response aimed at internalization of these effects in the behaviour of market actors. The external effects, whether positive or negative, can be internalized if affected users of the network can successfully enter long-term contracts with the parties that triggered the external effect. If this is possible without transaction cost, the obtained market outcome is socially efficient (Coase, 1960). In practice however, the transaction costs may be too high, giving rise to socially undesirable market outcomes. Some type of regulatory intervention, involving for example a re-allocation of property rights, could therefore be justified.

3.3 Trade-offs between regulatory objectives

The range of factors that were discussed in the previous section may cause over- or underinvestment in gas infrastructure facilities and influence the choice of regulation. However, the final choice of regulation also depends on the objectives of regulatory decision-makers. Regulatory objectives, which may be derived from overarching public policy goals, may differ from country to country and may be in conflict with one another when regulatory choices need to be made. This implies that trade-offs may need to be made when making regulatory choices regarding the regulation of gas infrastructure expansion. Energy policy is generally characterised by three key goals: competition (also referred to as affordability, the internal market or economics), security of supply and sustainability[19] (EC, 2007b; Helm 2002; Glachant *et al*., 2010).

Preferences for policy goals, both at the EU and the member state level, may change in response to changes in the balance of political power, the relative power of competing interest groups, in technology, in risks (of for example supply disruptions), in international competitive pressure, or in investment needs (Newberry, 2001). This implies that objectives and preferences may change over time.

In the context of gas infrastructure investment the public goals of achieving an affordable (economically efficient) and secure gas supply system are key. The public goal of achieving sustainable future energy systems seems less applicable to the case of gas infrastructure investment.[20] Bekaert *et al*. (2008) argue, for the case of electricity transmission investment, that all three primary policy goals may compete with oneanother. The competition between the public goals of economic efficiency and security of supply may be illustrated as follows. Before liberalization, the governance of the European gas infrastructure system was characterised by a strong, government backed, approach that involved a high degree of socialization of infrastructure costs and centrally coordinated planning of investments (Arentsen and Künneke, 2003). This system safeguarded a high level of system capacity adequacy. However, the level of economic effieciency of the system was a point of critique, and one of the arguments to adopt market liberalization. With the introduction of liberalized gas markets, the efficiency of infrastructure system operations has improved, and the utilization rates of gas infrastructre facilities have increased. At the same time, the reserve margins in the system have been reduced, which

[19] Knops (2009) refers to these pillars as public goals and refers to them as the triple A: affordability, availability and acceptability.

[20] Investment in gas infrastructure may, indirectly, contribute to a more sustainable energy system in the future as it potentially facilitates the increasing use of gas at the expense of relatively 'dirtier' fuels in the energy mix and the penetration of intermittent energy sources by providing flexible back-up capacity via gas-fired power plants and gas storage facilities.

make the infrastructure system more vulnerable to the negative impacts of possible security of supply incidents.

In this study on the choice of regulatory model in the context of the regulation of gas infrastructure expansion, the term regulatory objectives is used to reflect the objectives of the regulatory authority that takes the decision (i.e. the regulatory decision-maker). Regulatory objectives may be interpeted as being derived from public policy goals at both the EU and member state level. The concept of regulatory objectives is thus used to operationalize public policy goals in the contex of gas infrastructure expansion.

Regulation of gas infrastructure expansion may contribute to multiple, possibly competing, regulatory objectives. This can be illustrated by the following example (de Joode and van Oostvoorn, 2006). In order to achieve the regulatory objective of enhancing the level of competition on the commodity market for gas, strict infrastructure access regulation may be implemented to ensure easy market entry for (new) actors. However, the default requirement for infrastructure operators to provide access to any third party may negatively affect the incentive for investment in new capacity. This may, over time, threaten the objective of capacity adequacy and a secure supply of gas.[21]

Possible regulatory objectives at stake in regulating gas infrastructure expansion are depicted in table 1 (de Vries *et al.,* 2009). It lists the different objectives that may be derived from the primary public goals of affordability (economic efficiency) and security of supply. The objective of economic efficiency has two dimensions: short-term efficiency and long-term efficiency. Short term efficiency refers to the efficiency of current gas infrastructure operations and can for example be interpreted as the optimal use of available gas infrastructure capacity and cost-reflective pricing of infrastructure services. Long-term efficiency refers to the investment decision-making process of gas infrastructure investment and the outcome of this process in terms of optimal investment size of new gas infrastructure capacity. The objective of security of supply may be related to the facilitation of timely and sufficiently strong incentives for investment.

Regulatory decisions may be evaluated by assessing the market outcomes regarding the allocation of costs, benefits and risks. A different choice of regulatory model for gas

[21] De Vries *et al*. (2009) illustrate how regulatory objectives may compete in electricity transmission investment.

infrastructure expansion results in a different allocation of costs, benefits and risks over market parties involvd and endusers. The weighing of regulatory objectives when taking regulatory decisions may change over time and differ across Member States. Earlier mentioned factors such as the balance of political power, the relative power of competing interest groups, technology developments, security of supply incidents may play a role in changing regulatory objectives over time.

Public goal	**Possible regulatory objective**
Economic efficiency (in short term)	Ensure optimal use of available capacity Encourage cost-reflective pricing of infrastructure services Provide incentives for cost reduction Ensure efficient capacity allocation
Economic efficiency (in long term)	Improve market competition Ensure efficient incentives for investment
Capacity adequacy	Ensure sufficient coordination between investment projects Provide sufficient perspective for investment cost recovery

Table 1 Overview of possible regulatory objectives

The next section turns to a review of regulatory models that may be chosen by regulatory authorities in the case of gas infrastructure investment.

3.4 Regulatory models

This section presents the range of regulatory models for gas infrastructure expansion as found in literature. The order in which regulatory models are presented is based on the role for competition in gas infrastructure expansion: from large to small. However, the role for competition in each regulatory model is only indicative, as each model may consist of different variants that differ in this respect. Each section below describes a regulatory model (and its variants), including required conditions for successful implementation, and reviews literature on its application in practice.

The following four regulatory models for gas infrastructure investment are consecutively discussed in the remainder of this section:

- Contestable market expansion (section 3.4.1);
- Unregulated competitive expansion (section 3.4.2);
- Expansion via tendering (section 3.4.3);
- Regulated expansion (section 3.4.4).

3.4.1 Contestable market expansion

The regulatory model of contestable market expansion refers to (perfectly) competitive or contestable market in neoclassical economics and the governance mode of 'market' in transaction cost economics. This governance mode does not involve more than a 'spot market like' transaction where a supplier and consumer momentarily express their consent to an exchange of a good or service *and* perform the exchange of the good or service (Ruiter, 2005). According to neoclassical based welfare economics, the market mechanism may be able to efficiently allocate scarce resources under certain conditions (Arrow, 1985). Welfare economic theory provides clear normative prescriptions for the pricing of products, including infrastructure-based services. That is, equating prices to marginal costs gives rise to social welfare optimal market outcomes. The general welfare proposition on marginal cost pricing states that economic (productive) efficiency is achieved when every product is produced and priced at marginal cost. However, for this theorem to hold, markets need to be complete (i.e. consumers and producers have full information, information is costless, and prices are publicly available), market actors need to be price-takers and the demand and production of a product needs to be convex (Mas-Collel, *et al*., 1995). For infrastructure-based services, the second assumption of convex production technologies does not readily apply: non-convexities exist due to the presence of fixed costs and increasing returns to scale. For productive efficiency to be achieved these non-convexities push for a smaller number of firms and, in the limit, even for one single firm: the natural monopoly. The presence of natural monopolies in turn challenges the assumption of price-taking firms, since monopolistic producers striving for profit maximization will act as price-setters, and not as price takers. This implies that allocative efficiency is not achieved and that market outcomes are sub-optimal from a public perspective. Benefits realised by the network company, for example via reductions in operational costs, will not be transferred to the consumers.

Self-regulation[22] due to the threat of regulation (as mentioned in section 3.2.2 in discussing the type and degree of competition) may be considered a form of unregulated competitive expansion (Glazer and McMillan, 1992). A government specified, administered and enforced regulatory design may not be necessary when the industry itself can specify, administer and enforce certain desired behaviour or outcomes. This is what is referred to as self-regulation.[23] Although the term 'unregulated' may be referred to as 'without direct government intervention in defining access conditions for infrastructure capacity', it does not necessarily exclude a role for government in self-regulation. It may actually involve varying degrees of government involvement. The threat of regulation can for example take the form of an announced regulatory backstop process. A backstop may be described as a pre-specified regulatory intervention that comes effect into effect when when self-regulation is not effective in restraining market behaviour.

Although short-term or long-term behaviour is not likely to be fully competitive, the overall performance with respect to efficiency and affordability of self-regulation may be better than the overall performance of more complex regulatory schemes due to transaction costs and regulatory failure. In addition, standard principles or guidelines may be used to influence infrastructure operators' behaviour with respect to pricing and planning. In a regime based on self-regulation, standards or guidelines are commonly drafted by infrastructure operators themselves, possibly in cooperation with (representatives of) infrastructure users. Infrastructure companies have complete freedom in taking operational decisions (access conditions) and investment decisions. Infrastructure operators in this case choose the tariffication structure, planning method and contractual arrangements with respect to risk management to their own likening. However, market parties are still obliged to follow requirement following from competition law.

The role of the different actors (owners/operators, users and government) in a system of self-regulation may vary. If there are guidelines or standards with respect to investment

[22] There may be different motives for the imposition of self-regulation, of which the threat of 'external' regulation is but one. Ostrom (1990) studies the related concept of self-governance in the context of common pool resources.

[23] *"Self-regulation remains a rather vague and elusive concept."* (Baggott, 1989, p436).

decision-making, pricing principles or the like a representative organisation of the owners/operators can have the task of monitoring or enforcing the implementation thereof. Alternatively, a combination of government, user and owner/operators can be allocated the task of monitoring. Enforcement can be undertaken by government authority or by infrastructure users' organisations based on voluntary agreements signed with the infrastructure owners/operators. A system of self-regulation has the advantage of being relatively more flexible in comparison with formal regulation. Moreover, self-regulation avoids the cost of specifying, administering and enforcing government induced regulation. Possible disadvantage is its limited effectiveness in countering undesirable behaviour or outcomes since the private interest to impose certain regulation can differ from the public interest.

An example of a contestable market via a regulatory backstop is the US long distance gas transport market (CIEP 2009); The market may be considered contestable due to the large degree of competition between parallel pipelines running from indigenous gas reservoirs to the large US gas demand centres. The authority regulating the US long distance gas transport market is the Federal Energy Regulatory Commission (FERC). Backstop regulation is based on principles of fairness and reasonability. Gas infrastructure owners are free to set and determine operating and investment conditions as long as these principles are respected. So-called 'rate-cases' may be triggered by stakeholders that argue that these principles are violated. A rate-case implies a regulatory review of the rates that are charged by infrastructure owners. The review is undertaken by the regulatory authority and involves the testing of whether the costs underlying the rates are reasonable and prudent. Another example of self-regulation is the case of the German gas market in the period until 2009. In that year incentive-based regulation of gas transport in Germany came into effect. Before then, gas transport operations were governed by so-called Association Agreements (In German: "Verbändevereinbarungen"), which is a form of corporate self-regulation where infrastructure operators and large gas consumers agreed upon transport tariffs (Meran and Von Hirschhausen, 2008). The second gas Directive required EU Member States, including Germany, to implement regulation of access conditions. This implied that Germany had to replace its approach of self-regulation. Meran and Von Hirschhausen (2008), using a game theoretical approach, show that the regulated approach is to be preferred over a self-regulation approach from a social welfare perspective. An institutional analysis by Glachant *et al*. (2008) is milder on the self-regulation approach as observed in the German electricity sector. They observe that the implemented ‘club’ arrangement is less harmfull than one would initially expect. Factors that play a role in the success of this arrangement are the skills ans strengths of the large industrial consumers and business associations and the incomplete vertical integration of German electricity companies. Brunekreeft (2001) analyses regulatory threat in vertically related markets, and in particular the case of the German electricity market. Examples of regulatory threat in vertically related markets have been documented for the US oil industry (Erfle *et al*., 1990), the UK petrol industry (Driffield and Ioannides, 2000), UK airports (Starkie, 2000), and UK electricity generation (Acutt and Elliott, 2000). Rotger and Felder (2001) propose a regulatory backstop process in the case of competitive electricity markets not providing enough transmission capacity to maintain reliability. A backstop process for the case of electricity is also proposed in Hirst and Kirby (2002).

3.4.2 Unregulated competitive expansion

The regulatory model of unregulated competitive expansion does not imply that the company undertaking the investment is not regulated, but rather that the investment undertaken by the company is not regulated with respect to access conditions or tariffs or revenues. Klein (1996) identifies competitive expansion of a bottleneck facility as a regulatory model for infrastructure expansion. This may also be referred to as merchant investment. Merchant investment can be defined as investment in which investors recover their investment costs through the market value of their investment. Early literature contributions on merchant investment identified conditions under which optimal investment would be realised (Hogan, 1992; Bushnell and Stoft, 1997), with ‘optimal’ referring to the social optimal level of investment. However, Joskow and Tirole (2005) found that these conditions do not hold in cases of lumpiness of investment, stochastic demand and strategic behaviour. Merchant investment can be interpreted in a physical and a financial way (Léautier and Thelen, 2009). The physical interpretation is that the investor uses the investment to arbitrage between two markets, whereby revenues need to recover investment costs. The financial interpretation is that the investor receives financial transmission rights that entitle the investor to the congestion revenues of the realised investment project, which are, in a system of nodal pricing and financial transmission rights, equal to the difference between prices on the two nodes connected by the investment project. Whether the incentive for investment in a market design based on merchant investment is efficient depends on the price signals provided by the market. Market power and strategic behaviour on the wholesale market may distort prices and provide uncertain signals for potential investors. But also in the case of correct price signals, investment may not be optimal from a social perspective since private and public interests diverge. Whereas the private investor needs congestion or arbitrage revenues to recover investment costs, the public optimal level of investment would involve no congestion (or arbitrage potential) after realisation of the project. If the market for infrastructure expansion would be perfectly competitive, no congestion or price arbitraging potential would exist since the prospect of some degree of congestion or arbitrage potential would immediately trigger new market entry. The risk of not recovering investment costs is likely to induce merchant investment to secure total or partial cost recovery ex ante through long-term contracting of capacity realised in the merchant investment project.

A specific case of merchant investment is the so-called access holiday (Gans and Williams, 1999; Gans and King, 2003; Gans and King, 2004; Caillaud and Tirole, 2004). The rationale for this instrument is the 'chilling' effect that access regulation can have on infrastructure investment. This effect occurs when if access regulation reducers investors' profits when their investment is succesfull, but fully exposes investors to the losses in case of unsuccesful investment (Gans and King, 2003). This truncation of profits may either delay or prevent socially desirable investment from going ahead (the hold-up problem). The economic basis for this phenomenon resides in the asset-specificity (i.e. sunk-cost) involved in infrastructure investment. Temporarily allowing a holiday from access regulation may restore the incentive for investment. Truncation of profits does not need to appear: this depends on the type of access regulation that is imposed after the investment is realised. If this regulation allows for a reasonable return on investment (including investment risk), then negative impact on investment need to arise. However, following Gans and King (2003), such regulatory commitment is unlikely in practice due to legal, political, and practical constraints. This lack of regulatory commitment powers creates scope to introduce access holidays, which remove truncation by allowing an investor to be completely free from any access regulation for a specified, definite, period of time. The profits retained during the access holiday should compensate the investor for the loss of profits incurred after expiration of the holiday when default access regulation prevails.

Léautier and Thelen (2009) and Joskow and Tirole (2005) observe that merchant investment is not often applied in energy infrastructure expansion. There are two explanations. Firstly, there is only a limited pool of suitable investment projects for this type of expansion. The majority of investment in infrastructures concern upgrades of various kinds. Secondly, merchant investment is often not viable based on market revenues because *"the return required to compensate for the merchant risk is higher than the return required to compensate the risk on a regulated asset"* (Léautier and Thelen, 2009). Hogan (2003) emphasizes that regulated expansion tends to crowd out merchant investment and argues for a distinction to be made between privately profitable projects on the one hand, and privately unprofitable but socially desirable projects on the other. Only the latter type of projects should be subjected to a model of regulated expansion. The remainder of projects should be left to the market. Regulatory holidays have been implemented in both Australia (Littlechild, 2004) and the EU (EC, 2003a; EC, 2009a). In the EU, regulatory holidays are typically referred to as 'exemptions'. Two important differences between exemptions that are advocated by access holiday literature and those that may be observed in Europe must be recognized (de Joode and Spanjer, 2010). While an access holiday is one-dimensional in the sense that there is no access regulation at all during the 'holiday season', the EU exemption regime is multi-dimensional in the sense that it distinguishes between different regulatory provisions: an investment can be exempted from third party access, from tariff regulation, or both. In addition, access holiday literature assumes that operators of exempted infrastructures are able to act as a monopolist as long as the exemption lasts. In Europe, however, exempted infrastructures are still subjected to competition policy: anti-competitive behaviour, when proven, is penalized.

3.4.3 Expansion via tendering

The regulatory model of expansion via tendering in natural monopoly industries can be traced back to Demsetz (1968). Klein (1996) refers to this option as 'competition for the market'. Demsetz argued that markets characterised by high fixed costs and increasing returns to scale can achieve market outcomes that are optimal from a social welfare perspective by implementing so-called franchise bidding, i.e. auctioning of a franchise license.[24] Whereas Demsetz´ idea related to the allocation of (franchise) licenses to *operate* an existing infrastructure or service the remainder of this section will focus on the role of tendering in infrastructure *expansion*. Obviously, tendering a license that envisages a particular infrastructure expansion may also involve (temporary) operation of that infrastructure once realised. The competition for the market, i.e. the tendering process, involves a pre-specification of reward criteria that may relate to cost or tariff levels, construction time, capacity made available, quality of service, etc, and may be accompanied by additional criteria with respect to organizational structure of the organization wishing to participate in the tender. The tender may involve a license to operate a gas infrastructure facility for a definitive or indefinitive period of time. Williamson (1985) differentiates between three different types of franchise contracts: the once-and-for-all contract (with a possible re-negotiation or re-bidding clause), an incomplete long-term contract, and a recurrent short-term contract.

For efficient bidding outcomes to be achieved a number of conditions need to be fulfilled. These include an equal distribution of information and a sufficient number of bidders. Another functional requirement of the expansion alternative is that it needs to concern a well-defined expansion project with a limited period of operation. Furthermore, the use of this instrument is limited by the degree of coordination required in realising the full capacity of the new investment. In meshed networks, in particular in the case of electricity where loop flows occur, it is difficult to single out investment projects suitable for competitive tendering.

A different form of regulation that could be considered an alternative form of tendering is regulation by contract. It has different operational definitions. It may be defined as regulation without a regulator or a tariff-setting agreement administered by an independent regulator (Sidak and Spulber, 1997). It involves an explicit agreement that pre-specifies the regulatory treatment and including how tariffs are set over time. When entering a regulatory contract, a regulatory authority or government organisation explicitly limits its discretion over time. It therefore may seem to solve the problem of an inherent problem of regulatory

[24] A tender may be considered a process in which a certain product (such as a license) is awarded to the best-performing bidder. Franchise bidding is the allocation of an in particular a franchising license via an auction. In the remainder of this study the term tendering is adopted.

commitment. However, this form of regulation seems to assume that ex post hazards to the transaction that is facilitated can be pre-specified ex ante and put into a regulatory contract.

Although a large variety exists in the design of particular tenders, the starting point for the application of tendering in infrastructure expansion is the fact that the identification of a certain expansion project is determined before a license is rewarded via the tender. Application of the alternative of expansion via tendering always requires some degree of pre-specification, for example regarding its dimensioning. Design choices to be made when implementing the regulatory model of expansion via tendering are: how is the tendered investment project identified (i.e. on the basis of which information and criteria), and what will regulation after realisation of the investment look like.

Identification of the expansion project to be tendered can be market-based or regulatory based. Market-based identification can be done by long-term auctioning of existing infrastructure capacity (McDaniel and Neuhoff, 2004), via open-seasons organized by the owner and/or operator of the existing infrastructure, or via user-based expansion proposals. Pérez-Arriaga (Perez-Arriaga, 2005) also describes the two basic approaches in identification of expansion projects: a (T)SO may propose an investment plan, to be authorized by the regulator, and construction and ownership may be assigned by competitive auction, or, a coalition of network users may propose investment, to be authorized by the regulator, and construction and ownership may be assigned by competitive auction. In the Argentinean electricity transmission sector, a consortium of users may propose particular network expansion projects (Littlechild and Skerk, 2008). Only after the economic and technical feasibility of the proposed project is positively assessed by the system operator of the transmission network, is regulatory approval awarded for the organzation of a tendering procedure. Apart from market-based identification mechanisms as described above, there is also the option of government identified expansion projects. However, this seems a more theoretical option since a successful tendering and realisation of an expansion project should reflect (at least to some degree) market demand for this expansion, unless the tender contains a particular subsidy for realisation and consequent operation that makes expansion and operation viable.[25]

[25] For example, one could propose to tender expansion projects that are identified as ‘priority projects’ in the EC TEN-E strategy (EC, 2006).

Theoretically, market-based identification of expansion projects should be preferred over regulation-based identification since the market is able to identify required expansion projects based on the willingness to pay for such expansion in day-to-day market operations, whereas it is difficult for regulators to assess the true willinges to pay (Laffont and Tirole, 1993). However, when the project has strong external effects on the commodity market, the government, or a government bureau may be involved in optimally dimensioning of the project from a social welfare perspective.

Then there is the question how the infrastructure facility is treated after its realisation: what are the operating conditions to which it will be subjected? An open access regime is to be preferred from the perspective of short-term market access and competition. A case where there is some degree of competition in the service provided by the expansion project (for example parallel pipeline infrastructure) and a relatively high investment risk may favor an exemption of open access regulation. In cases where competition is lacking, some type of third party access is required in order to at least not hinder short term market competition. A regime of negotiated access tariffs can safely be applied in cases where there is some degree of competition. A regime of regulated access tariffs may be used in cases where the private optimal level of investment diverges from the public optimal investment level due to externalities. For example, building a new gas interconnection between two systems potentially influences the degree of competition in both markets. When the interconnection expansion is based on a non-regulated business case, the investment level is likely to be lower than socially optimal since the investor needs to recover its investment by price differences between both connected systems.

A competitive tender for infrastructure expansion was implemented in the Argentinean electricity transmission sector, where the approach seems successfull as tenders have been won by a variety of companies and the costs of transmission have been reduced over time (Littlechild and Skerk, 2008). The UK have been using a tender to award investment in and operation of electricity transmission linkages between offshore wind parks and the existing electricity transmission network (Pollitt, 2011). In this case, the expansion project was typically identified based on both economic feasibility studies of the different potential locations of offshore wind parks and an engineering analysis of the optimal connection with the existing network (i.e. the landing point). Competitive tenders have also been deployed in allocating renewable energy support, for example in France (IEA, 2009).

3.4.4 Regulated expansion

The regulatory model of regulated infrastructure expansion may be characterised as a continuous hierarchical relationship between regulatory authority and infrastructure company where the regulatory authority sets strict regulation that directly affects the conditions for infrastructure expansion and the access conditions that are to apply after expansion is realised. Infrastructure capacity realised under this regulatory model is subjected to third party access (TPA), which may als be referred to as competition on the infrastructure. Competition on the infrastructure, also known as open access or common carrier, acknowledges that in order to make one potentially competitive segment of the network industry work effectively, access to remaining natural monopoly-type bottlenecks is required (De Vany and Walls, 1994; Doane and Spulber, 1994; Klein 1996).

The rationale for the imposition of some form infrastructure regulation is based on the possible lack of competition in the short-term. Regulation of access conditions, such as tariffs or revenues, effectively prevents infrastructure companies from abusing their possible market power. Regulated expansion comes in a variety of models, where each model differs by the constraints put on access conditions in the short term, and the incentives for investment in the long term. In this study the focus is on the incentives for investment, which means that in particular the properties regarding the allocation of costs, benefits and risks (i.e. the degree of socialisation) are of interest. Investment in new infrastructure facilitities will not be undertaken if the regulatory framework does not allow the investor a reasonable perspective on recovering the cost of investment. Two categories of regulatory models may be dinstinguished: cost-of-service and performance-based models.

Firstly, there is cost-of-service regulation, also known as rate of return regulation (Baumol and Klevorick, 1970; Laffont and Tirole, 1993). This type of regulation may be characterised by its relatively low incentives for shor-term reductions in costs, and its relatively high incentives for investment. In this model, the infrastructure is basically allowed to pass-through all costs incurred in maintaining, operating and expanding the infrastructure. This implies that the infrastructure company has relatively low incentives to increase efficiency of infrastructure operations and, in addition, may have low incentives to investment efficiently. However, investment risks are relatively low as the degree of socialisation of costs and benefits in this model is high. This type of regulation therefore encourages investment, possibly even more than is socially optimal (Averch and Johnson, 1962). On average, though, this type of regulation does not contribute to economically efficient infrastructure operations or expansion, but does contribute to capacity adequacy.

Secondly, on the opposite side of the spectrum of types of regulation. there are so-called performance based regulatory regimes, also referred to as incentive regulation (Vogelsang, 2002; Vogelsang 2006; Joskow, 2008). Performance-based may be referred to as competition through regulation as performance-based regulation – to some degree – tries to provide the incentives that would normally result from market competition in a well-functioning market that is not characterised by large economies of scale and lumpiness. In general, this type of regulation has relatively strong incentives for infrastructure companies to improve short-term efficiency, but may have relatively weak investment incentives. Performance-based regulation can come in many forms, such as price cap regulation (Cabral and Riordan, 1989), revenue cap regulation, sliding scale regulation (Lyon, 1996), menu of contracts (Laffont and Tirole, 1993) and yardstick or benchmark regulation (Jamasb and Pollitt; 2000). In general, performance-based forms of regulation put more of the risk on the infrastructure investor and allow for a much lower degree of socialisation. This type of regulation generally subjects the infrastructure company to strong incentives for improving short-term efficiency and reducing costs. In contrast with cost of service regulation, all forms of performance-based regulation share the feature that the regulatory authority in some way tries to induce the regulated company to operate more efficiently. Price or revenue caps limit the passing-through of costs to infrastructure users. The height of the caps may be based on an assessment of the expected cost of providing infrastructure services in the future, including investments that are expected to be needed. Yardstick and benchmark regulation also involve caps on price or revenue but are based on a comparison of a regulated company's performance versus a set target ('yardstick') or versus an average performing or best performing peer in the industry. Menu of contract regulation may be based on any of the other performance-based regimes but leaves the choice of cap to the regulated company. In theory, regulated companies with different risk profiles will choose a different cap 'from the menu'. Sliding scale regulation is simular to price or revenue cap regulation but contains explicit parameters that affect the allocation of costs and benefits over the infrastructure company and its users.

There are a number of parameters in the different types of regulation that determine the level of risk for the regulated infrastructure company investing in new gas infrastructure facilities, and thereby affect the incentive to investment. Firstly, performance-based regulation may target cost reductions in operational expenditures, captial expenditures, or both (total expenditures). The investment risk may be lower if capital expenditures are outside the performance-based regime (Helm, 2009). Secondly, the weighted average cost of captial, which co-determines the allowed rate of return on investment, as specified in regulation may deviate from the actual cost of capital incurred by the infrastructure company. Overestimation (underestimation) of the actual cost of capital may positively (negatively) affect the level of investment (Helm, 2009). Thirdly, regulation may distinguish between different sets of regulated rates of return based on the age of infrastructure assets. Investments may for example be allowed a higher regulated rate of return than older assets, which may reduce the risk of investment. Fourthly, regulation may differ with respect to the degree of freedom allowed to regulated companies in setting tariffs for particular infrastructure companies (KEMA, 2009). A larger degree of freedom may reduce the overall risk of investment as companies themselves can decide where required efficiency improvements can be realised most efficiently. Fifthly, regulation impose different variants of the ‘used and usefull’ principle. The used and useful test can be used by regulatory authorities to evaluate the necessity of particular investments. When new assets invested in are considered to be not used, or used but not useful, the regulatory authority may decide to disallow socialization of costs (i.e. the pass-through of these costs to users of the regulated infrastructure). This type of rule induces more efficient investment but also discourages investment in general due to an increased risk of insufficient cost recovery.

As required in EU Directives, regulated expansion is the standard in EU gas transmission and distribution networks (EC, 2009). Compared with the electricity sector[26], there is only little literature that describes and evaluates different types of cost-of-serivce or performance-based regulation in gas transmission, gas storageor LNG import terminals.

[26] For the electricity sector, Jamasb and Pollitt (2000; 2003) review the experience with benchmarking regulation in European electricity transmission and distribution. Joskow (2011) discusses the application of incentive regulation in practice.

Crew and Kleindorfer (1996) compare incentive regulation as implemented in the case of UK and US gas transmission, but predominantly focus on short-term efficiency aspects. Cavaliere (2007) describes how gas transmission pipelines, gas storage and gas distribution networks are regulated in Italy. Klop (2009) analyses the differences in performance-based regulation as adopted in UK and Dutch gas transmission, but does not evaluate its performance. Carrington *et al.* (2002) analyse the use of benchmarking regulation in the case of Australian gas distribution networks and provide suggestions for improving the Australian system of regulation. Esnault (2003) argues why TPA on storage is vital for the level of competition on the French gas market, but does not address the specific type of regulated TPA that would be appropriate. Gas Infrastructure Europe (GIE) publishes data on existing and planned capacity for different types of infrastructure facilities. The data published include the regulatory status of facilities. According to this source, regulated expansion is adopted for gas storage in Belgium, Bulgaria, Croatia, Italy, Poland and Spain, and for LNG import terminals in Belgium, France, Italy, Greece, and Spain.

3.5 Case study approach

This section illustrates how theory on the regulation of infrastructure expansion, and in particular the theoretical framework that results from the previous sections in this chapter, is going to be confronted with practice. Section 3.5.1 presents the theoretical framework that has been developed based on sections 3.2 to 3.4. This framework provides the basis for the case study approach adopted in this study and applied to four case study investment projects in chapters 4 to 7. Section 3.5.2 continues to discuss why a case study approach is a suitable approach to test the theoretical framework empirically. Section 3.5.3 turns to discuss the different elements of the case study framework, including the unit of case study analysis, the selection of case studies, the criteria for the performance evaluation of regulatory models, the case study questions and the structure of the case study chapters.

3.5.1 Theoretical framework

Sections 3.2 and 3.3 have contributed to a refinement of the conceptual framework that was introduced in chapter 1 (see figure 8).

The identified types of factors affecting investment are:

- Private barriers to investment;
- The type and degree of competition to which the new facility is subjected;
- The need for coordination with other gas infrastructure investments;
- External effects on the commodity market for gas.

The relevance of these factors in specific circumstances of gas infrastructure investment can be explained by a large set of underlying infrastructure-, project-, and context dependent factors that have been described in sections 3.2.1 to 3.2.4. In addition, section 3.3 elaborated on the trade-offs between regulatory objectives that may emerge when a regulatory model is chosen by the regulatory authorities. For the application to the case of gas infrastructure investment the following regulatory models have been identified:

- Contestable market expansion;
- Unregulated competitive expansion;
- Expansion via tendering;
- Regulated expansion.

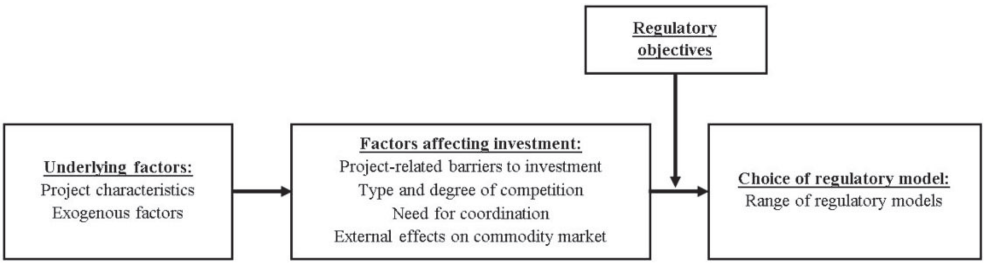

Figure 8 Framework for explaining the choice of regulatory model

3.5.2 Why a case study approach?

The case study approach is a particular research method in social sciences. Other research methods in social sciences include experiments, survey, archival analysis, and historical analysis. Yin (2003) provides two definitions of a case study analysis: "[a] *case study is an inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*", and "[t]*he case study inquiry copes with the technically distinctive situation in* *which there will be many more variables of interest than data points, and as one result, relies on multiple sources of evidence, with data needed to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection analysis"* (Yin, 2003).

According to Yin (2003) three conditions distinguish the research strategies of case study, experiment, survey, archival analysis and history analysis. These are: (1) the type of research question posed, (2) the extent of control a researcher has over actual behavioural events, and (3) the degree of focus on contemporary as opposed to historical events.

Although the distinguished research strategies have their distinctive features, they may overlap in scope and in the type of research questions to be addressed. Table 2 shows under which conditions a particular research method is appropriate.

Research method	**Type of research question**	**Requires behavioural control of events**	**Focuses on contemporary events?**
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how	No	Yes
Archival analysis	Who, what, where, how many, how	No	Yes / No
History	How, why?	No	No
Case study	How, why?	No	Yes

Table 2 Instruction on when to apply which social research method (Yin, 2003)

The research question addressed in this study is of the 'how' form: how can regulation of investment in gas infrastructure be explained and improved? This suggests that conducting experiments, historical analysis and case study analysis are all viable research strategies. However, experiments require a large degree of control in events subjected to analysis. However, in this study the researcher has no control over the events analysed. The performance of the gas market with respect to the public objectives of affordability and availability results from a large number of related factors over which no control is possible.

This observation suggests the use of historical or case study analysis. However, these research strategies vary in the scope of events, with case study analysis being explicitly suitable for analysis of contemporary events. The research in this study by definition analyses contemporary events since it aims to improve current regulation on investment in gas infrastructure. This leaves the conclusion that case study analysis is a suitable research method for this study. Yin (2003) distinguishes between five different types of case studies research (explanatory, descriptive, illustrative, exploratory and meta-evaluation case studies). The case study research envisaged in this study may be characterised as being both explanatory and descriptive in nature.

3.5.3 Case study framework

Unit of analysis

The unit of analysis in each case study is an individual gas infrastructure expansion project and the socio-economic context in which this expansion was initiated, realised and operated. The different aspects that are deemed to be part of the socio-economic context, and thus of the unit of analysis: the relevant market, the policy and regulatory framework, and relevant exogenous infrastructure related factors. Market aspects include the drivers for expansion, the actors involved in expansion, the prevailing policy and regulation with respect to the expansion, the regulatory process, and the impact of expansion on the system. In addressing policy and regulation a distinction needs to be made between policy and regulation on different jurisdictional levels (i.e. EU vs. national policy and regulation). As argued in chapter 1, the EU level regulatory choices are taken as a given in the case study analysis of regulatory choices.

Selection criteria for case study analyses

The following criteria were used for selecting the cases:

1. The case concerns a single investment project of a single type of gas infrastructure.

   The case study object should concern a well-defined, specific single investment project. Because the objective of this study is to explain differences in regulatory treatment of different types of infrastructure, the distinctions between the cases should be as clear as possible. A European, national or regional investment programme does not qualify because it may concern a larger variety of expansion projects in different geographic regions and different types of gas infrastructure assets (i.e. storage facilities, pipelines, etc.) at the same time. Section 1.5 in chapter 1 defined the scope of gas infrastructure in this study.

2. <u>The case study object is realised or being realised within EU borders.</u>
   This choice of scope means that all the cases have the same EU insitutional context, which facilitates their comparison.

3. <u>The final investment decision for the realisation of the case study object has already been taken.</u>
   The case study object should concern an investment project for which the financial investment decision already has been taken. The reason for this selection criterion is that it ensures that the basic dimensions of the expansion project as well as the regulatory framework that existed in the period before the final investment decision are known.

4. <u>Documentation about the regulatory framework, the regulatory choices and the investment decision should be available in the public domain in either the English or Dutch language.</u>
   This criterion reflects the practical limitations of this research project.

Based on these four criteria the following case study projects have been selected:

1. The gas transmisson pipeline connection between the Netherlands and the UK, also known as the BBL (covered in chapter 4);
2. The gas transmission pipeline connecting the LNG import terminals near Milford Haven (UK) with the national UK gas transport network (covered in chapter 5);
3. The (seasonal) gas storage facility which is currently being developed near Bergermeer in the Netherlands (covered in chapter 6);
4. The GATE LNG import terminal realised in the Rotterdam area in the Netherlands (covered in chapter 6).

Case study questions

This section identifies which questions need to be addressed in the case study research in order to empirically test the developed framework (see figure 8) and illustrates *how* these questions may be tackled in the context of the case study research. The case study questions are categorized according to the 'building blocks' of the theoretical framework.

Factors affecting investment

The first question to be addressed is: Which factors affected the gas infrastructure investment in the case study? In order to answer this question the following questions need to be addressed:

1. What are the private barriers to investment?
   This question can be answered by discussing the level of asset-specificity, uncertainty, degree of competition, regulatory risk.

2. What is the degree of competition in infrastructure development?
   This question can be assessed by referring to the concept of the relevant market (i.e. relevant product market and relevant geographic market).

3. Is there a need for coordination with other infrastructure investments from the perspective of the private investor?
   This question requires a reflection on the presence of network externalities related to the gas infrastructure investment.

4. Does the infrastructure investment project have external effects on the commodity market for gas?
   There are two possible external effects that may be associated with the investment: external effects on the level of competition in the market and external effects on the level of security of supply in the market. The concept of the relevant market is applied to delineate the relevant external effects in the case study.

Underlying factors

The second main question is: What are the underlying factors determining the relevance of particular factors of investment? In order to uncover the causal relations between the individual presence of factors affecting investment and the underlying infrastructure-, project, and context dependent characteristics in the case of the gas infrastructure investment, the following questions need to be addressed:

5. What were the underlying factors affecting the relevance of the factor of private barriers to investment?

   Addressing this question requires checking for the presence of the underlying factors mentioned in Section 3.2.1.

6. What were the underlying factors affecting the relevance of the need for coordination with other infrastructure investment?

   Addressing this question requires checking for the presence of the underlying factors mentioned in Section 3.2.3.

7. What were the underlying factors affecting the relevance of the factor of external effects on the commodity market for gas?

   Addressing this question requires checking for the presence of the underlying factors mentioned in Section 3.2.4.

Choice of regulatory models

The third main question is: Which regulatory choices were made and how were they motivated? This requires addressing the following sub-questions:

8. How can the regulatory choices be classified in terms of the theoretical framework? In particular, which regulatory model is chosen?

   The implemented regulatory choice can be derived by checking the range of regulatory models defines in Section 3.4.

9. To what extent did the regulatory choices address the concerns of the investor in the infrastructure facility and to what extent were the regulatory objectives reached? What were the regulatory objectives of the regulatory authorities involved in the gas infrastructure investment? And: How did the implemented regulatory model addressed concerns of the private investor and achieved regulatory objectives?

   A list of concerns for the private investor can be derived from the answers to questions (1) and (2) listed above. General economic efficiency criteria are used to evaluate the performance with respect to the regulatory objective of efficiency (i.e. efficient investment and efficient infrastructure operations), whereas the performance regarding capacity availability (i.e. capacity adequacy / sufficient provision of investment incentives) is evaluated by looking at the degree to which private investor concerns have been dealt with.

10. <u>What are alternative regulatory models that could have been implemented and could have led to an improvement of performance with respect to at least one of the regulatory objectives?</u>

Possible alternative regulatory models that could have been implemented and lead to a better performance can be identified by assessing the answer to question (9) above and identify on which aspect performance could have been improved.

Criteria for evaluation of performance

The case study analyses require an evaluation of both the regulatory model implemented and possible regulatory models that could have been implemented, and possibly lead to an improvement of economic performance. Regulatory models will be evaluated by using the following set of indicators for economic efficiency. Static efficiency is a measure of economic performance at a given point in time and consists of allocative and productive efficiency. Allocative efficiency is achieved when consumer's willingness to pay equals the marginal costs of the inputs to the production process (i.e. price equals marginal cost). Productive efficiency refers to the costs of providing a product and is achieved when maximum production is reached with minimum resources. Dynamic efficiency is concerned with productive efficiency over time and measures the degree in which production cost are reduced over time. Social efficiency refers to the allocative efficiency from a social point of view, whereby positive and negative externalities of production and consumption are accounted for. Social efficiency is achieved when social marginal benefit equals social marginal cost.

Structure of case study chapters

The chapters 4 to 7 share a common section structure. The first section of each chapter provides an introduction to the project. The second section elaborates on the technical characteristics of the project, the motivation for investment, and the actors involved in the realisation of the project. The third section assesses the regulatory framework applicable to the considered infrastructure expansion project. This section describes the regulatory choices that were made regarding the type of gas infrastructure expansion in general (i.e. gas pipelines, gas storage, LNG terminal), and the particular regulatory process to which the investment project was subjected in particular. The fourth section analyses the choice of regulatory model using the theoretical framework developed in this chapter. This section contains a description of the factors affecting investment, an analysis of the regulatory model adopted, and an analysis of alternative regulatory models. Finally, the fifth section draws the case study conclusions.

4 Case 1: The Netherlands-United Kingdom pipeline interconnection

4.1 *Introduction*[27]

This chapter reports on a case study research of the investment in the pipeline interconnection between the Netherlands and the UK. This pipeline is also known as the Balgzand-Bacton Line: BBL. This project concerns a large investment in a pipeline that connects two previously unconnected gas markets. Although gas pipelines in the EU are generally considered to be part of a natural monopoly, and treated as such in regulation, this pipeline has been built under a merchant investment approach. The Dutch and UK transmission systems that are connected by this private investment are operated by a national, regulated monopoly: Gas Transport Services and National Grid respectively. The private investor behind the BBL needed to coordinate project realisation with two regulated entities. Another fact that makes this BBL pipeline interesting from the perspective of this study is its status on an EU level. The BBL project was considered to be part of a vital gas corridor in North-western Europe, mainly for reasons of security of gas supply. It is interesting to see how regulatory authorities involved in making the key regulatory choices on this project balanced the private interests of the investor and the public interests for society.

The overall objective of this chapter is to explain why the BBL project was regulated the way it was: why were particular regulatory choices adopted and what were the underlying factors that led to them? Section 4.4 described the methodology that is used in tackling this question. This involves an analysis of the public and private perspective on BBL pipeline investment. Key questions addressed are: what are the regulatory objectives of the regulatory authorities involved when deciding upon the regulatory framework and making the key regulatory choices regarding this project? And: what are the investment risks for the investor, and which factors cause this risk? Answering these questions requires an analysis of the implemented regulatory choices. Such an assessment needs to illustrates,

[27] Parts of this section are based on de Joode (2006) and de Joode and Spanjer (2010).

if, and to what extent, particular regulatory objectives were attained and private investment risks mitigated. This assessment then provides a starting point for an analysis of alternative regulatory choices: how would different regulatory choices affect 'performance' in terms of attaining regulatory objectives and addressing private investor's investment risks? The answers to aforementioned questions will provide input for the synthesis analysis in chapter 8.

Throughout this chapter the following terms related to the economic regulation of gas infrastructure are used. The term regulatory framework will be used to reflect the overall set of rules and regulations to which a company is subjected. It may relate to both rules and regulations at the EU level and the EU Member State level. The term regulatory choices is used to refer to single regulatory decisions made at the Member State level. In the context of this study this term is generally used to refer to regulatory choices that affect the expansion of gas infrastructure. Finally, the term regulatory model is used to refer to a set of regulatory choices that affect gas infrastructure expansion.

This chapter is organized as follows. Section 4.2 introduces the BBL project by describing its technical features, the motivation for the investment and the actors involved. Thereafter, section 4.3 presents the relevant regulatory framework for investment and the manner in which the framework was applied in the case of BBL. Section 4.4 contains the analysis and addresses the key research questions mentioned above. Finally, section 4.5 summarizes the case study findings.

4.2 Description of the project

4.2.1 Technical features of the project[28]

The construction of the pipeline took about 2 years and it started operations in December 2006. The pipeline has a diameter of 90 centimetre (36 inches), with a design pressure of 137 bars. The project is designed for a life cycle of 50 years. The gas flow in the pipeline is from the Netherlands to the UK. A physical reverse flow may become possible in the future but this would require additional technical facilities. The pipeline encompasses

[28] The main source of information on the BBL project is the BBL Company website: www.bblcompany.com (last accessed 21-05-2012).

a total of 235 kilometres, consisting of a 230 kilometres offshore section, a 4 kilometres onshore section between a compressor station (containing three compressors) in Anna Paulowna and the connection with the offshore pipeline in Julianadorp, and a 1 kilometre onshore section connecting the offshore pipeline with the gas terminal in Bacton. This point is also the landing point of the gas pipeline connecting Belgium (Zeebrugge) and the UK, and an offshore pipeline bringing in gas from small fields in the UK North Sea. The initial pipeline capacity was about 16 BCM per year. In autumn 2010, the pipeline's capacity was increased with an additional 3.2 BCM per year by placing a fourth compressor at the Anna Paulowna compressor station. The initial BBL project was estimated to cost about €500 million.

The gas pipeline network in North-West Europe is quite dense with a large amount of production pipelines landing in the UK, the Netherlands, Germany and Norway, and with strongly developed transmission networks in especially the Netherlands and Germany that enable further transit of gas to Central and Southern Europe. The gas supply in this region was, at the time of the project development, mainly pipeline-based. During construction of BBL and within years of the realisation of BBL, a large number of LNG terminals have been commissioned in Northwestern Europe: Isle of Grain LNG (in 2005), Teeside LNG (in 2007), South Hook LNG (in 2009) Dragon LNG (in 2009).

4.2.2 Motivation for the investment

The main driver for the pipeline investment was the UK need for more gas supply sources, as UK gas production was expected to decrease further. This implied that UK gas supply companies increasingly had to source gas from other countries. This led Centrica to sign a 10-year gas suply contract with GasTerra (formerly part of the vertically integrated gas company Gasunie) involving the delivery of a total of 80 BCM. Just as other new gas supply contracts with external suppliers in general increased the need for new gas import capacity, this particular deal would need to be facilitated by new transport capacity between the Netherlands and the UK.

Together with Norway, the Netherlands and the UK have been the traditional gas suppliers in northwest Europe, with exports reaching the south and central European regions. In fact, the Netherlands was the starting point for the roll-out of an international gas pipeline network following the discovery of the large Groningen field in 1959. But the

UK has increasingly needed to rely on natural gas imports over the past decade. According to data from IEA (2010), the UK was a net exporting country in 2000, but changed into a net importing country in the following 10 years, with net imports having a 29% share in total gas supply in 2009. The gas to be supplied via the BBL would have an important role in bridging the increasing gap between UK indigenous gas supplies and gas consumption. At the same time, a number of other important UK gas supply options were under consideration or under development. This included the Langeled pipeline from Norway to the UK, a number of LNG import terminals, and an upgrade of the capacity of the interconnection between Belgium and the UK. An overview of new UK gas import projects was provided by National Grid Transco in its 2004 Ten Year Statement (National Grid Transco, 2004). Table 3 presents the list of projects.

At the European level, the BBL may be considered as part of a new gas supply route from Russia via the Baltic Sea to the UK. The investment project covering the route from Russia (Vyborg) to the German border (near Greifswald) is referred to as the Nord Stream project.[29] The project entails two parallel pipelines. One of the twin pipelines was completed in June 2011 and began commercial operations in November 2011. The second pipeline is expected to become onstream at the end of 2012. At the time of the final investment decision for the BBL, the Nord Stream project was only in a preliminary stage. At the time that the BBL was under development, the Nord stream pipeline was planned to transport 55 BCM, with half of this capacity expected to be coming coming on stream in 2010. The latter objective has been realised in 2011.

At EU level, the trajectory targeted by the Nord Stream and BBL projects was identifed as a priority project of EU interest within the EC's TEN-E programme. This programme identified a number of electricity and gas infrastructure projects that were considered to be vital for the development of a well-functioning European energy market as well as for the future level of supply security in Europe.

[29] This project has also been referred to as the Northern European Gas Pipeline (NEGP) until October 2006. Since then, the formal name of the company developing the project is NordStream.

Import project	Location	Size[30]	Date	Status in 2006
- Bacton – Zeebrugge Interconnector compression (Phase I)	Zeebrugge to Bacton	+ 8 BCM	2005/2006	Under construction
- Bacton – Zeebrugge Interconnector compression (Phase II)	Zeebrugge to Bacton	+ 7 BCM	2006/2007	Under construction
- Langeled (Ormen Lange)	Sleipner to Easington	25 BCM	2006/2007	Under construction
- FLAGGS – Statfjord late life project	existing UKCS infrastructure	4 BCM	2006/2007	Connection project to be completed
- Dutch Interconnector (BBL)	Balgzand to Bacton	15 BCM	2006/2007	Under construction
- Isle of Grain	Isle of Grain	4.4 BCM	Q1 2005	Under construction
- Isle of Grain	Isle of Grain	+10.5–14 BCM	2008	Open season for capacity held
- Milford Haven (Dragon LNG)	Milford Haven	6 BCM	2007/2008	TPA exemption secured
- Milford Haven (Dragon LNG)	Milford Haven	6 BCM	By 2012	TPA exemption secured
- Milford Haven (South Hook)	Milford Haven	10.5 BCM	2007/2008	TPA exemption secured
- Milford Haven (South Hook)	Milford Haven	10.5 BCM	2009/2010	TPA exemption secured

Table 3 UK gas import projects at the end of 2004 (National Grid Transco, 2004)

4.2.3 Actors

The actors involved in the BBL investment project through either organization or administrative and regulatory procedures are quite diverse. The actors can be divided into four groups: (i) the gas transmission system operators, (ii) the gas shippers, (iii) regulatory

[30] A '+' indicates an expansion of an existing gas infrastructure facility.

authorities and (iv) the private investors of the BBL. The focus in the discussion in the remainder of this section is on the TSOs involved, shippers and private investors. The regulatory authorities involved are mentioned when discussed the regulation of the project in section 4.3.2.

The investors behind BBL company are Gasunie (60%), E.On Ruhrgas (20%) and Fluxys (20%). In the Netherlands, *Gasunie* used to be the national monopoly partly owned by Shell and ExxonMobil (each with a 25% share) and the Dutch State (50%). European legislation (EC, 2003a) required legal unbundling of trading and transmission activities. Ahead of implementation of this Directive, Gasunie's activities were legally unbundled in January 2002. Furthermore, the Dutch government went ahead of European rules by unbundling trade and transport at the ownership level. This led to the creation of a trading company, *Gasunie Trade & Supply* (which later changed into GasTerra) and a transmission company, *NV Nederlandse Gasunie* in 2005. The latter comprises two divisions, *Gas Transport Services (GTS)* and *Technology and Assets*. The State bought the shares held by Shell and ExxonMobil in the transmission company, turning it into a fully government-owned organization. It was the Dutch government's intention to fully privatize this company by selling its shares to fellow shareholders Shell and ExxonMobil. However, the privatisation was put on hold and further discussions on this issue have ceased since.

E.On Ruhrgas AG is one of the leading energy companies in Europe. Apart from some own gas production facilities it procures gas through long-term contracting and sells to distribution companies, industrial consumers and electricity producers throughout the EU. In addition, it owns one of the four gas transmission companies in Germany through its subsidiary *E.On Ruhrgas Transport*. This legal separation was required by German government following the acquisition of Ruhrgas by E.On, and consequently effectuated by January 2004. The German approach of adopting a regime of negtiated TPA for gas transmission companies, an unique choice at the time given the pre-dominant choice for regulated TPA elsewhere in the EU, implied that E.On Ruhrgas Transport was not subjected to incentive regulation of revenues or tariffs until 2009. The German energy regulatory authority published a blue-print for an incentive-based regulated TPA regime in 2006 (Bundesnetzagentur, 2006). Implementation of incentive based regulation was planned for 2008, but was delayed to 2009. Being an integrated gas and energy company, the interests of E.On Ruhrgas AG are diverse. On the gas transmission side the company has, among other participations, a 20 % share in the Nord Stream project.

Fluxys is the Belgian gas TSO. It is legally unbundled (since the end of 2001) from Distrigas, Belgium's largest gas supplier and trader. Fluxys also operates Belgian gas storage facilities and, through it subsidiary Huberator, the gas hub at Zeebrugge. The shares in Fluxys were owned by the Belgian State (1 Golden Share), energy company Suez (57.25% through its subsidiary Suez-Tractebel), Publigas – a group of Belgian public communities – (31.25%) and 11.50% by private shareholders on the Euronext stock exchange. The majority share of Suez should be noted, since Suez is the dominant party in the Belgian electricity market through its ownership of Electrabel.

The UK gas TSO *National Grid* (formerly Transco) is not a partner in the BBL. Its role in the project is limited to a Network Entry Agreement with BBL Company. This agreements sets out the responsibilities of each party in coordinating operations of the BBL and Transco network connection. UK gas supplier *Centrica* has an indirect role in the BBL project. In June 2002, Gasunie Trade & Supply signed a long-term gas supply contract with Centrica involving 80 BCM over ten years time (CIEP, 2003). At the time, plans for a UK – Netherlands interconnection were already present but not yet finalized.

The next section presents the regulatory framework applicable to the BBL investment project and discusses how it was applied in practice.

4.3 Description of the regulatory framework and regulatory choices

4.3.1 <u>Introduction</u>

Within the boundaries provided by the EU regulatory framework (which was described in section 2.3), national regulatory authorities designed a regulatory framework applicable to gas infrastructure investment projects within the national jurisdiction. Both the UK and Dutch regulatory framework reflect the requirements prescribed at the EU level. The default regime for gas transmission activities is third party access combined with performance-based revenue cap regulation. Regulatory codes allow for long-term contracts in allocation of capacity. Capacity allocation in the Netherlands is based on first-come first served, whereas the UK implemented an auctioning of entry capacity. Both the UK and the

Netherlands have unbundled gas transmission and gas production and trade activities on an ownership basis. Finally, Dutch and UK regulation include the option of merchant transmission investment through exemptions from rTPA. In the case of BBL, the investor was successful in applying for such an exemption. The next section describes regulatory decision-making in relation to the exemption awarded.

4.3.2 Application of EU exemption regulation to the BBL project

The BBL project succesfully applied for an exemption to the default regulatory regime of regulated expansion. The process of deciding about an exemption for the BBL was different from the standard procedure since the application occurred before the second Gas Directive was adopted and implementated in Dutch and UK legislation. A two-tier process of first informal and then formal applications with all relevant regulatory authorities in the UK and the Netherlands resulted. In the UK this implied a role for the the Department of Trade and Industry (DTI)[31] and the Office of Gas and Electricity Markets (Ofgem). In the Netherlands it involved the Ministry of Economic Affairs and the Office of Energy Regulation (DTe).[32] After the draft application of Gastransport Services (GTS, 2003), informal comfort on the eligibility of an exemption was provided by Ofgem and DTe in 2003 (Ofgem, 2003a; DTe, 2003). Following the formal BBL investment decision in May 2004, a formal exemption request was filed in December 2004 (BBL Company, 2004). Formal approval was provided in 2005 by both national regulatory authorities (DTe, 2005; Ofgem, 2005a) and the European Commission (EC, 2005). An integral part of the process was that stakeholders were allowed to express their views on granting an exemption to BBL.

[31] The former Department of Trade and Industry (DTI) was transformed into the Department for Business Enterprise and Regulatory Reform (BERR) on 28 June 2007.

[32] The Dutch regulatory authority in the field of energy is the Office of Energy Regulation, which is part of the Dutch Competition Authority (NMa). At the time of reviewing the appropriate regulatory framework for the BBL the Dutch Office of Energy Regulation was in Dutch referred to as ‘Dienst uitvoering en Toezicht Energie’ (DTe). Although formal tasks have not changed, the Office is nowadays in Dutch referred to as the ‘Energiekamer’ (EK). Particular references may still refer to the specific Dutch acronyms of DTe or EK.

The paragraphs below describe how the exemption criteria were assessed by the relevant authorities in the case of the BBL project. The focus is on the line of reasoning adopted by the authorities and the explicit or implicit role of different factors therein: i.e. what were the reasons for evaluating the exemption criteria as they did?

Impact on competition and security of supply

The first criterion deals with the project impact on competition and security of supply. These two aspects are seprately discussed below.

Competition on the commodity market

The impact of the BBL on market competition in the UK was analysed as part of a study by ADL (2004). The study concluded that competition in both the upstream and downstream UK markets was likely to increase when the BBL would be realised. In the worst case, concentration on both markets would at least not worsen compared with the existing situation. The focus of the analysis seems to be on the impact of the volume and capacity of the BBL on the UK market and not on potential competition threats due to intertwined interests that arise due to shared ownership (e.g. strategic behaviour). For example, in considering the concentration on the upstream gas market, Gasunie Trade & Supply is assumed to be a competitor for Shell and ExxonMobil, but both companies have a 25% stake in Gasunie Trade & Supply. However, Gasunie Trade & Supply signed a long-term gas supply contract with Centrica for the delivery of 80 BCM over a period of 10 years, which would limit the impact of Gasunie Trade & Supply's market entrance and impact on UK upstream competition. However, it seemed unlikely that competition would in fact worsen with BBL realisation since the concentration in especially the upstream UK market is quite low. This can be illustrated by the Herfindahl-Hirschmann Index (HHI). The value of the HHI, according to ADL (2004), would stay well below 1,000. A HHI of 1,000 is generally considered to still be quite a dispersed market.[33] In its initial views on the BBL exemption, Ofgem saw an issue in the partial ownership of ExxonMobil in both BBL Company and a proposed LNG terminal in the UK. However, with the then already announced restructuring of the Nederlandse Gasunie this issue would be resolved.

[33] For comparison, a monopoly market would see a HHI of 10,000, while a symmetric oligopoly of five companies would see a HHI of 2,000.

A comparable analysis of the impact of the BBL on competition in the Dutch upstream and downstream market as done by ADL (2004) for the UK was not performed. The reason for this is the fact that it was unlikely that the BBL would have any impact on the level of competition in the Dutch market given the proposed forward flow (towards the UK) of the pipeline. The open season procedure did not find any market interest for transmission capacity from the UK to the Netherlands. The price difference between te the UK (NBP) and Dutch gas exchanges (TTF) provided further support to the idea that a backward flow (towards the Netherlands) would not be economic: the UK market was the higher priced market. However, considering the economic lifetime of the BBL investment, it is a question whether this price differential will prevail in the next decade. Given the large number of UK investments in gas import capacity, there have been talks of an oversupply of the UK market. In such a situation, physical capacity from the UK to the Netherlands could be beneficial for the Dutch market. However, competition in the Dutch gas market could be expected to improve anyway, due to:

- An increase in available domestic conversion capacity, and;
- The possibility of contractual counter flows and swaps.

The first impact on availability of conversion capacity is related to the design of the Dutch gas market and infrastructure. There are two different gas qualities present in the Netherlands that use a different pipeline infrastructure and serve different consumers. The gas produced from small fields offshore and gas imported from Norway and Russia are generally of of H-gas quality. Consumers connected to the H-gas pipeline network are large industrial consumers and power generator. The Groningen reservoir produces gas of low-calorific quality and is referred to as G-gas. All Dutch small endusers receive G-gas and are connected to the G-gas pipeline system.

The BBL enables the export of H-gas. Currently there is only limited conversion capacity to convert imported H-gas or H-gas from the small gas fields in the North Sea into G-gas. With the export of H-gas to the UK, more conversion capacity might become available and thereby stimulating competition on the G-gas market. This is acknowledged in the final exemption approval document (Staatscourant, 2005). It was suggested that the Dutch market might benefit from contractual counter-flows and swaps of contracts with UK and Norwegian shippers. The significance of these options for wholesale competition in the

Netherlands is uncertain, since little is known on the use and relevance of gas swaps in Europe. In the exemption approval of DTe, the creation of a virtual gas exit point at the Dutch side of the BBL was a condition for the granting of the approval.

The regulatory authorities tried to enhance the impact of the BBL on competition in the UK market. Although not required by EU legislation or regulation, the respective authorities requested BBL Company to analyse the option of increasing total capacity as determined by open season with an additional capacity margin of 20 to 25% available for short term contracts (BBL, 2004). It was concluded that this capacity extension would raise transmission tariffs to uncompetitive levels. According to DTe (2005) a calculation on financial viability of the project under different project design parameters was prepared and sent to both authorities to support this argument. However, these financial documents are confidential and thus not in the public.

Security of supply

The positive impact of the BBL project on UK *security of supply* appeared evident. The realisation of a new link between the UK and continental Europe contributes to a further diversification of UK gas supply sources. In the past, the relevance of such an interconnection was recognized by both the Commission (EC, 2003c) and the UK competition authority DTI. The BBL increases total UK import capacity with about 16 BCM per year, which was equivalent to about 18% of UK gas consumption at the time (ADL, 2004). In addition, Ofgem (2004) notes that the realisation of the BBL could have a positive effect on the perspective of the Nord Stream project, and hence, increases both Dutch and UK security of supply.

The impact of the BBL on Dutch *security of supply* is difficult to quantify. In the absence of physical reverse-flow capacity, contractual reverse flows could theoretically contribute to Dutch security of supply. As explained above, the increasing availability of gas quality conversion capacity could attract additional gas supplies to the Netherlands. In addition, as was noted earlier in the UK case, the BBL could have a positive impact on the establishment of the Nord Stream and therefore improve security of supply for both the Netherlands and the UK. The development of the BBL can also be put in the perspective of the Dutch government strategy to develop a Northwest European gas hub in the Netherlands. The succesful development of an interconnection with the UK could be a stimulus for similar and other gas market related activities that may be considered part of the gas hub. In an advice to the Dutch Minister of Economic Affairs (Energieraad, 2005), the Energieraad points to excellent opportunities for the Netherlands to become a gas hub. Factors that play a role are the existence of gas reserves, a well-developed gas network, the presence of a large number of depleted gas field that could be transformed into gas storage facilities and the location at European gas transit routes from North to South (Norway to Southern Europe) and East to West (from Russia to the UK).

Proportionality of project risk and exemption

In the absence of an exemption from TPA, the risk of not recovering the investment would have been unacceptablly high. The high risk is caused by the large degree of competition on the relevant product market. Given that the relevant product is gas infrastructure capacity, the following competing infrastructures can be distinguished that are capable of delivering the same service:

- The interconnector between Belgium (Zeebrugge) and the UK (Bacton) (Interconnector UK);
- LNG import terminals in both continental Europe (Zeebrugge, Belgium) and the UK (Isle of Grain, Milford Haven), and;
- Supply pipelines from Norway (Vesterled and Langeled), Belgium (Zeepipe) and France (Franpipe) to the UK.

The three alternatives are capable of delivering basic transmission services but also contribute to the flexibility market. All three alternatives are theoretically capable of arbitraging between the UK gas market and the continental Northwest European market. Different scenarios for the potential realisation of competing gas infrastructure projects needed to be taken into account when evaluating the business case for BBL. Important projects in this respect are the expansion of the Belgium-UK Interconnector, the capacity of the Langeled pipeline from Norway to the UK, and LNG terminal plans for the Netherlands.

The high risk attached to the project was acknowledged in an advice by KPMG and the ABN AMRO Bank on the risk profile of the BBL. Based on the differences between gas exchange prices in the Netherlands (the TTF) and the UK (the NBP), the maximum viable transmission tariffs for BBL was computed and compared with the competing route through the interconnector between Belgium and the UK. This resulted in an indicative tariff of €65 per m^3 per hour per year, based on a 30 inches pipeline for a 15 year contract with fuel costs included, against which the investment would be profitable. This indicative tariff was used in the open season procedure that was used to solicit market interest for the interconnection.

According to the Dutch regulatory authority the (perceived) regulatory risk was the main investment barrier for the BBL project. A main cause of regulatory risk is the relevance of three different jurisdictions on BBL investment and operations. DTe (2005) acknowledged that the regulatory risk related to the BBL could be a sufficient reason for an exemption since the BBL will be confronted with additional risk premium demanded by external investors.

With regard to the proportionality principle, there was discussion about the specific type of exemption that was to be granted. DTe (2005) discusses the desirability of the length of the exemption period corresponding to the project's long-term contracts that were the result of the open season procedure. The total investment undertaken by BBL Company was backed by long-term contracts with Gasunie Trade & Supply, E.On Ruhrgas AG and Wingas AG. The capacity rights contracts had durations that vary from 10 to 15 years. The regulators involved thought that the investment risk associated with the project would perhaps be sufficiently covered by only a part of the long-term contracts, which would imply that reducing the exemption period would not immediately endanger the go-ahead of the project. Nevertheless, the decision was to let the exemption period correspond to the length of the contracts for two reasons. Firstly, the open season that led to the signing of a limited number of long-term contracts was considered to be a kind of third party access. Secondly, as previously cited studies demonstrated that the gas flows enabled with the realisation of BBL were unlikely increase to market concentration.

There was additional discussion regarding the inclusion of counter-flow capacity in the exemption. For practical reasons, the national regulatory authorities argued for an inclusion of counter-flow capacity in the exemption. They stated that it could prove too difficult in trying to regulate a service of counter flows that is dependent on unregulated forward flow services. Moreover, the project's configuration was such that physical counter flows were impossible. All in all, national regulatory authorities suggested that BBL company could be relied on to provide counterflow services against reasonable conditions even under an unregulated regime. In its final exemption decision (EC, 2005b), the EC indicated that it was not convinced by this line of argumentation. Firstly, the Comission points to the weak incentives for BBL company to provide counter flow services due to the terms related to the long-term contracts with shippers. Secondly, regarding the practical argument, the Commission notes that a regulated regime does not necessarily dictate the approval or specific tariffs, but may also concern the approval of a suitable methodology for the calculation of tariffs. Finally, the Comission decides that it may not be legally possible under the Directive to allow an exemption for transmission services that are not physcially possible. In the end, the Commision rules that reverse flow nominations should not be exempt from provisions as required by the Directive.

Unbundling

The BBL was to be fully owned by BBL Company BV, with shares being hold by three separate subsidiaries of respectively NV Nederlandse Gasunie, Fluxys NV en E.On Ruhrgas AG. The Gasunie via a subsidiary holds a 60% share in BBL company while the other two investors hold 20% shares.[34] It is noted that none of the owners has shares in the competing interconnector between Belgium and the UK.

Allocation of investment cost

The passing-through of the investment costs of the BBL to the shippers that have booked long term capacity rights for the BBL sufficiently meets the criterion on cost allocation. However, a more difficult issue arises for the investment costs that are incurred by Gas Transport Services for the upgrading of the domestic transmission system. In contrast to the BBL, these are regulated investments. In the final exemption approval document of the Dutch regulatory authority (DTe, 2005) it is stated that the costs of

[34] In 2006 Gasunie and Gazprom signed a Memorandum of Understanding that would: "…*serve as a basis towards reciprocal stakeholding in the North-European Gas Pipeline and the BBL, the new pipeline connecting the Netherlands to the UK*" (Gasunie, 2006). Gazprom would receive a 9% stake in BBL (at the expense of Gasunie), while Gasunie would acquire a 9% share in the Nord Stream (i.e. NEGP) project. Although Gasunie did acquire the share in Nord Stream, Gazprom left the option to acquire its share in BBL expire in 2009 (Gasunie, 2010).

domestic transmission system upgrading should not translate into higher transmission tariffs for Dutch end-consumers except for the part for which they benefit from these investments. Gas Transport Services stated that these investment costs will be recovered via long-term capacity contracts with BBL shippers.

At the same time, the Dutch regulatory authority DTe stated that BBL transit should not endanger security of supply of Dutch consumers through a crowding-out of gas flows at the entry point at the border with Germany by transit flow destined for the BBL.[35] In additional information regarding capacity planning, GTS ensured DTe that new capacity would be to counter any potential problems in this respect. On the UK side of the BBL, National Grid Company stated that no additional investments in the domestic infrastructure were needed except for the actual connection with the BBL, which was included in the BBL project investment. Although it seemed that the condition that investment costs need to be passed-through to the infrastructure projects' users seemed to be met, there was a co-ordination issue between de TSO of the domestic network and the operator of the proposed project. In this specific case, the actors were part of the same company which creates problems related to conflicts of interests. This was discussed under criterion 3 on legal separation between the TSO and the operator of the proposed investment project.

Impact on market and regulated system functioning

Ofgem in both its initial and final view on the exemption application (Ofgem, 2003a; Ofgem 2005a`) did not see any reason for the BBL to hinder effective functioning of the market. It is only noted that gas quality issues should be sufficiently dealt with in connecting the BBL and the UK transmission system. In addition, it is acknowledged that BBL seems to apply standard rules with respect to capacity hoarding (the use-it-or-lose-it principle, UIOLI) and secondary market trading. DTe on the other hand again points to the possible negative impact of increased transit flows for Dutch security of supply, which was already mentioned in the discussion of the previous criterion. The earlier mentioned conflict of interest related to the fact that Gas Transport Services is both the regulated TSO of the Dutch transmission network, and, through Gasunie BBL BV, involved in the unregulated

[35] A potential problem of gas transit flows crowding out gas flows destined for domestic gas consumers is discussed in Lise *et al*. (2005), Jepma (2005) and addressed in de Joode *et al*. (2006).

BBL project is relevant under this header as well. Strategic decision-making by Gas Transport Services in either operational or investment decisions could very well hinder effective functioning of the available gas infrastructure.

4.3.3 Summary of regulatory choices

The regulatory choices in the case of the BBL pipeline project can be summarized as follows. The regulatory authorities have allowed the BBL to be realised as a privately operated merchant project by allowing an exemption from regulated third party access. The exemption enabled the pipeline investors to enter long-term contracts with shippers. An open season was organized to identify market interest for the project and determine the optimal dimensioning of the project. The private consortium of companies investing in the pipeline involves legally unbundled subsidiaries of two transmission companies (which are fully or largely publicly owned) and one gas trading company. One of the transmission companies organisationally involved in the BBL (Dutch gas infrastructure company Gasunie) is also owner of Dutch TSO Gas Transport Services.

4.4 Analysis of the case study project

4.4.1 Introduction

Investment in the BBL pipeline only materializes when the investor considers all investment risks sufficiently mitigated and a viable business case emerges. Whereas the facilitation of cross-border interconnections such as the BBL pipeline may be explicitly targeted at the EU level within the TEN-E programme, national regulatory authorities had other policy objectives to consider as well. Considering that regulatory objectives conflict, trade-offs need to be made in regulatory decision-making. The implementation of a certain regulatory framework may fulfil some objectives, but lead to sub-optimal outcomes on others. A choice for a different regulatory model leads to a different performance with respect to regulatory objectives. This section analyses the regulatory choices implemented in the case of the BBL pipeline.

The following structure is adopted. Section 4.4.2 describes the project’s characteristics from a private and public perspective. Section 4.4.3 analyses the regulatory choice implemented by highlighting the trade-offs in regulatory objectives in the case of regulating

BBL, identifying the factors that led to the implemented choice, and discuss the outcome of the regulatory choice. Section 4.4.4 analyses whether alternative regulatory choices could have contributed to an improved safeguarding of regulatory objectives.

4.4.2 Description of investment project characteristics

This section describes the characteristics of the project using the concepts of asset-specificity, uncertainty, complexity of transactions and external effects. The inherent project's characteristics in combination with the project's environment determine the investments involved for the investor. In addition, the same combination of factors may give rise to external effects that may need to be dealt with from a public perspective. Investment risks need to be sufficiently dealt with within the regulatory model in order for the project to go ahead. Not taking into account external effects in designing the regulatory model may lead to regulatory objectives not being achieved.

Asset-specificity

The BBL can be characterised as a highly asset-specific investment due to site and physical asset-specificity, but its assets are not dedicated to single buyers or sellers.

The BBL pipeline is highly site specific as its location economizes the costs of building and operating a pipeline connection between the Netherlands and the UK. The attractiveness of the particular location is a combination of a minimization of distance and suitable position of Bacton: an existing important entry point of the UK gas transmission system. Deep-sea pipelines such as the BBL are very costly to relocate, making the involved assets immobile.

The BBL pipeline is physically specific as the assets are designed to deal with natural gas of particular quality. The pipeline may be used by other types of gases but only after incurring unknown costs for refurbishing (part of) the assets. Only if pipeline assets are technically capable of transporting other gases, and when the transport is economically viable, then the BBL pipeline investment could be considered an investment with limited physical asset-specificity. This would imply that the project is relatively less vulnerable to ex post hazards. However, since this is currently not the case the BBL pipeline at this point should be considered a physical specific asset (i.e. a specific technology asset).

Although the assets realised in the BBL pipeline projects are site and technology specific, it does not concern dedicated assets. The pipeline connects two gas transmission systems to large numbers of buyers and sellers. These are all shippers with potential interest in using BBL pipeline capacity now or in the future. The pipeline is not dedicated to one particular buyer or seller on either side of the pipeline interconnection.

Assessment of the level of asset-specificity thus leads to the conclusion that the BBL pipeline is to be considered highly asset specific. In combination with uncertainty about future market outcomes and opportunistic behaviour of trading partners, it makes the investment project prone to ex post hazards.

Uncertainty

The payback time for the recovery of investment cost associated with the BBL pipeline spans about 15 to 20 years. The pay-off to the investment in the future depends on the uncertain future need for the service facilitated by the pipeline. The project's investor is exposed to different levels of uncertainty.

Firstly, although the BBL pipeline contributes to a widely acknowledged UK problem there is some uncertainty regarding the persistence and timing of the problem. A robust trend for the UK gas supply market seems to be that there is an increasing need for gas imports, which is in turn based on two parallel developments: the declining indigenous gas production capacity and the continuing high level of gas demand. The actual future need for new gas imports, and thus new gas import infrastructure, is uncertain. Climate policy may affect the medium term interest for gas and UK depletion policy may affect the steepness of decline in UK gas production. Additionally, the BBL pipeline is one of several alternatives for new gas supply imports, and the actual future materialisation of these competing alternatives affects the value of the services provided by BBL, and, hence, the required return on investment.

Secondly, besides the uncertainty in actual future developments related to trends that are considered robust, the BBL pipeline is also exposed to more fundamental, deep uncertainty. An example could be the major breakthrough in a competing energy technology that effectively makes natural gas highly redundant in the (UK) energy mix. Another example is the large-scale discovery of new UK gas resources turns the UK into a gas exporting country (again).[36] Both developments are now perhaps deemed to be unlikely, but the experience of the US shale gas revolution illustrates that unexpected developments can be a game changer that is difficult to foresee ex ante.

Need for coordination

The service facilitated by the BBL pipeline connection does not constitute an end-product that is intrinsically value by final consumers: it concerns only an intermediate service that is part of the larger gas value chain. As such, it needs to be well-coordinated with the transactions preceding and following-up on the transportation of gas though the BBL. Coordination can concern the coordination of flows and the coordination of infrastructure expansion. More concrete, a potential BBL investor needs to coordinate operational and capacity expansion issues with the regulated TSOs National Grid and Gas Transport Services at both sides of the pipeline in the UK and the Netherlands respectively. Whereas coordination between two transmission systems can already lead to the considered transaction to be referred to as complex, complexity is further increased by the fact that both regulated TSOs are regulated by different regulatory authorities. The transaction facilitated by BBL is thus multi-jurisdictional. It should also be noted that the TSOs at both ends of the pipeline have not entered in any kind of formal arrangement involving a common operation of gas systems. They are for example not part of the same holding company that is involved in both UK and Dutch gas transmission activities. The issues in coordinating with two different regulated gas pipeline systems and the involvement of two independent jurisdictions ensures that the interconnection between the Netherlands and the UK is a highly complex investment project.

Barriers to investment

Given the presence of asset-specificity, the uncertainties regarding the future demand for infrastructure services by the pipeline, and the complexity of transactions, opportunistic behaviour of actors involved give rise to ex post hazards. If not sufficiently dealt with in

[36] On first sight, the latter example would be less destructive for the BBL pipeline investment since it offers opportunities for a reversed gas flow from the UK to mainland Europe. The BBL connection is it currently is designed is forward flow towards the UK but with some additional investment reverse flows could be facilitated.

contracts between the different actors (which may include private and regulatory contracts), ex post hazards could prevent investment in the pipeline ex ante. The issues for an investor in the BBL pipeline are:

1. Risk of underutilization of the pipeline (i.e. volume and price risk of investment)

   The presence of competing infrastructures that each target similar gas market services (i.e. the supply of gas to the UK market, arbitrage between the UK and continental Europe gas markets) exposes the investor in the pipeline to both price and volume risks. Potential users may refrain from using the BBL pipeline to the extent that would lead to a recovery of investment costs by the investor. The risk exposure depends on the availability of competing alternatives and uncertain future changes in the gas demand and supply balance. The BBL investment cost may exceed the actual market value of BBL assets.

2. Risk of insufficient capacity availability for shippers

   For shippers specifically interested in gas transportation services from the Netherlands to the UK there is a risk related to pipeline access and entry conditions. At particular moment in the time there may insufficient pipeline capacity available to facilitate all desired transactions, which encourages the pipeline operator to charge tariffs that partly expropriate rents with the shippers.

3. Risk of insufficient coordination with the backbone infrastructure

   For the investor in the single BBL pipeline it is vital that forward and backward capacity in the system is sufficient to accommodate the maximum designated BBL transport capacity. If this remains unsecured there is the risk that part of BBL capacity permanently remains idle. This translates into risks for either the pipeline investor or shippers. The availability of only part of technical transport capacity may threaten the recovery of investments costs for the investor, since there is less capacity that can be sold to the market. On the other hand, the increased scarcity of pipeline capacity can increase the price of capacity rights. Timely realisation of capacity upgrades down or upstream of the BBL and sufficient gas flow coordination with the pipeline systems to which BBL is connected are key for the go ahead of the investment project ex ante.

4. Regulatory risk

   Finally, the fact that the pipeline investment affects markets in different jurisdictions with authorities with possible competing regulatory objectives increases the risk of uncertain future changes in the regulatory framework applicable to the project and in regulatory choices within the framework.

External effects of the project

The BBL project has two particular external effects. Firstly, the pipeline connects the previously unconnected UK and Dutch gas markets and therefore affects the level of competition in both markets. The ADL (2004) study took into account the allocation of long-term capacity rights and concluded that the level competition would not be harmed and was likely to increase. Secondly, the pipeline has a positive external effect on the level of security of supply in North-western Europe in general, and in the UK in particular. The pipeline increases the number of UK supply options and creates a more robust infrastructure system that may be capable of dealing with different types of unexpected events, such gas supply interruptions. Factors underlying both external effects are the previously limited connectivity between the two markets (only indirectly via the Belgian market) and the size of the investment project compared to the UK market.

The next section proceeds by analysing the regulatory choices in practice. For investment to go ahead, the identified issues for the BBL investor need to be sufficiently mitigated within the regulatory model implemented by the regulators. At the same time, the regulatory choices may, dependent on regulatory objectives, seek to mitigate the market failures present in the BBL case.

4.4.3 Analysis of the regulatory model

The objective of this section is to analyse the implemented regulatory model in the case of BBL. Firstly, a description of the regulatory objectives at stake in the BBL project is provided. Secondly, an analysis is provided of the factors that have led to the regulatory choices implemented. Thirdly, the performance of the implemented regulatory model is evaluated. The evaluation explicitly refers to the issues faced by the investor (i.e. the private perspective), and the regulatory objectives and external effects relevant for the regulatory authorities (i.e. the public perspective).

Description of regulatory objectives

The BBL pipeline investment project involves multiple jurisdictions with objectives of different regulatory authorities at stake. Objectives at the EU level have been addressed in Chapter 3. From an EC perspective, the realisation of a new interconnection between the UK and continental Europe is a priority since it is facilitates the realisation of a new gas supply corridor from Russia to North-western Europe. UK and Dutch regulatory authorities may have had alternative objectives at stake in BBL investment. For the UK authorities the expansion of gas supply infrastructure to the UK was the key priority. The BBL project would bring a first direct connection with the Dutch market and could in the medium-term connect the UK to Russian gas supplies via Nord Stream. Next to new pipeline supplies from Norway and LNG supplies from countries outside Europe a connection with the Netherlands would improve the level of supply diversification. Apart from security of supply objectives, the UK regulatory authority was also concerned with the level of competition on the UK gas market. Depending on capacity access arrangements and development of market shares in the UK market the BBL pipeline can worsen or improve UK competition. For Dutch regulatory authorities security of supply was not the key objective. A new gas transit pipeline could enhance the Dutch gas hub position and stimulate economic activity. In addition, there was concern over the impact of the BBL on the Dutch gas system and its users: BBL investment should not lead to an increase in tariffs for national system users, unless they profit from the BBL proportionately.

There are conflicts between different regulatory objectives of the authorities involved in the project. At the EU level gas market legislation mainly promoted gas market competition by reducing market entry barriers, while a separate infrastructure programme promoted the realisation of key gas infrastructure corridors. The focus on facilitating competition for example suggests the implementation of third party access to all infrastructure assets in the value chain, whereas the asset-specificity and upfront investment risks associated with infrastructure investment imply that third party access weakens investment incentives. A similar trade-off prevailed for the UK authorities where the market needed investment in the development of new gas import infrastructure but regulatory authorities were keen to enforce competition on the wholesale and retail markets by keeping market entry barriers at the minimum level. The Dutch regulator enforces efficiency of national gas infrastructure operations and investments through performance-based TPA regulation. It thereby aims for a reduction of transmission tariffs. However, the realisation of the BBL pipeline required capacity upgrades in the national system and would lead to a different gas flow pattern within the system.

The next paragraph analyses the choice of regulation and the factors that were considered. Factors concern project specific characteristics, exogenous factors and external effects.

Analysis of regulatory choices

Regulatory decision-making in the case of the BBL pipeline investment project is done at the level of the involved EU Member States but cannot be seen separated from general decision-making on gas market design at the EU level. The EU regulatory framework was described in chapter 3. Both the Netherlands and the UK regulatory authorities implemented a performance-based regulated third party access regime for gas transmission where shippers were allowed to enter long-term contracts, and allowed for the option of merchant investment based on an assessment of prescribed exemption criteria. Neither the UK nor Dutch regulatory authorities pre-specified particular investment projects that could be considered suitable for merchant investment by default. This implies that in the case of BBL only the assessment of formal exemption criteria allowed for considerations of particular issues or factors in deciding about the specific regulatory model to apply. The assessment led to the BBL being awarded an exemption, which implies that the BBL project is considered a (temporary) private, competitive infrastructure that is allowed to contract capacity to shippers on a long-term basis. Particular market failures and factors that feature in the assessment of exemption criteria are the following:

- The likely impact of the BBL project on market competition in the UK was analysed in a qualitative scenario study. Key variables in the assessment included the size of the project compared to the size of the market served (i.e. the UK market), and the UK market structure (i.e. market shares given existing long-term supply contracts).
- Estimation of project benefits included the position of the BBL in the overall gas supply portfolio of the UK gas market.
- In parallel, the inventory of future supply options for the UK showed that BBL was one option out of several. With multiple of those options in development the BBL

was in fact in competition. This led to a rejection of the assumption that BBL can resort to uncompetitive behaviour.

- The presence of effective competition led authorities to indeed consider the BBL owners to be exposed to particular investment risks.
- The risk of long-term contracts having a negative impact on (wholesale) market efficiency due to limited access to BBL pipeline capacity (even in the presence of secondary capacity markets that may not work in practice) has been weighed against the features of the open season procedure adopted ex ante of the investment and used to determine optimal investment size and market interest. The latter was considered a form of TPA ex ante of the project, as opposed to standard TPA imposed after project realisation.
- The coordination with the Dutch gas transmission system was a key issue in deciding whether the exemption would not have negatively influence other gas value chain activities: especially the timing of required investments and the allocation of the costs of investment across users. It seems that a statement of the Dutch gas TSO Gas Transport Services that investment requirements could be facilitated in a timely manner and system users other than the BBL shippers would only benefit from national pipeline system investments to the degree that benefits are obtained.

The legal unbundling requirement for BBL activities and interests in activities on the gas transmission system to which the BBL is connected was checked, but it did not lead to an assessment of the role of this type of vertical integration in facilitating the investment. Coordination between the competitive and regulated infrastructure as such was not included in the regulatory assessment. The same holds for the required legal unbundling of gas production or trade activities on the one hand, and gas infrastructure activities on the other. Legal unbundling was primarily assessed from the level playing field perspective of removing market entry barriers and avoiding possible cross-subsidisation between regulated and market-based activities, and not from the perspective of coordinating gas market activities.

Finally, the ex post hazard of uncertain future regulation for the multi-jurisdiction BBL pipeline was explicitly acknowledged by regulatory authorities as a factor that increases the regulatory risk and threatens investment ex ante. It specifically affected decision-making regarding the scope of the exemption rewarded: a full capacity exemption for at least the period of long-term contracts with shippers.

The next paragraph evaluates how the implemented regulatory model performed from a private and public perspective. The performance from a private perspective is evaluated using the list of issues of concern to the investor. The performance from a public perspective is evaluated using the performance criteria defined in the case study framework described in chapter 4, and the regulatory objectives and external effects identified earlier in this section.

Performance of the regulatory model

This section reflects on how the implemented choice of regulation deals with the ex post hazards that are important for private investor decision-making, considers the external effects associated with BBL investment, and the degree to which regulatory objectives are met. Key is the allocation of costs, benefits and risks across actors involved in the project.

Performance from a private perspective

In order for a private investor to go ahead with investment in the BBL pipeline, his investment concerns need to be sufficiently addressed within the implemented regulatory model. The different investment risks identified previously on the basis of project and transaction characteristics are consecutively discussed below.

- The volume and price risk for the investor in the BBL pipeline was transferred to its future users via long-term contracts. Since not all pipeline capacity available within the exemption period is sold long-term, there remains a risk for the investor. Given these long-term arrangements BBL investor has a reasonable prospect of recovering upfront investment costs (including a reasonable rate of return) and can commit to the investment project ex ante. Although the BBL investment is undertaken by a private company there may be some risk for society as some shareholders in the BBL Company include Dutch gas company Gasunie, which is fully government owned. Although investment risks are partly mitigated by the mentioned long-term contract arrangements, there seems to be a risk, although perhaps small, that Gasunie shareholders may experience negative financial consequences of unfavourable gas market conditions.

- The BBL operator is subjected to the risk of actual operational costs exceeding the expected operational costs that underlie the long-term contracts with shippers. If BBL operations can be performed at lower cost than expected ex ante and transposed in the contracts, then the efficiency gains are for the investor. This is the upward price risk for the investor, but downward price risk equally applies. This encourages the operator to perform as efficiently as possible, and any gains accrue to the operating company.
- The fact that BBL shippers have committed to buy BBL pipeline capacity via long-term contracts indicates that their risk of not being able to secure Dutch transmission system capacity against acceptable tariffs is sufficiently dealt, but it does not imply that the risk is fully mitigated. The regime of performance-based regulation of the national transmission system on a TPA basis may be characterised by capacity contracts that are limited in scope (in terms of number of years) and include uncertain tariff revisions that follow from periodic regulatory benchmarking exercises. BBL shippers can bid for long-term entry capacity in the UK system for up to 17 years ahead.

Performance from a public perspective

The performance of the regulatory model from a public perspective is evaluated using the performance criteria defined in the case study framework, and the regulatory objectives and external effects identified earlier in this section. An evaluation is provided below.

- The dimensioning of the project was based on an open season procedure. When organized properly, for example according to guidelines prepared by CEER, this method leads to the identification of the optimal size of investment from a private perspective. This implies that, assuming that the adopted open season was implemented correctly, the investment project has a high level of allocative efficiency.
- Both static (productive) efficiency and dynamic efficiency of the BBL project is high, since the project is privately operated without regulation and in competition with alternative supply projects. The operator has a clear incentive to reduce costs of operation over time. However, benefits are not passed-through to the users of the BBL pipeline, implying that optimal allocative efficiency is not achieved.

- Because capacity of the BBL is sold long-term against prices negotiated with shippers ex ante, allocative efficiency on the wholesale market is not necessarily attained. Whether allocative efficiency on the wholesale market is attained depends on the effectiveness of use-it-or-lose-it mechanisms and the functioning of the secondary capacity and interruptible capacity market. Market concentration and strategic behaviour may affect efficiency in practice as well.
- Social efficiency does not seem to be attained because the external effect of deep network investments in the Dutch transmission system is unlikely to be fully internalised. For users of the Dutch national pipeline system there is the risk of them paying part of the costs of the expansion of system capacity in order to facilitate BBL gas transit flows. The entry and exit tariff system adopted does not allow for discrimination between national and international users. An uncertain level of cross-subsidisation hams social efficiency. There was no comparable issue in achieving sufficient upstream transmission capacity in the UK transmission system as the capacity at the entry point at Bacton was adequate for accommodating BBL inflows.
- The strength of investment incentives provided by the regulatory model is assessed by looking at the degree to which the private investor's concerns are tackled in the regulatory model. This was illustrated in the previous paragraph, which described how investments risks mitigated.

Consistency with theory

From a theoretical perspective the question is whether the choice of regulatory model is consistent with theory, and whether the chosen regulatory model has been implemented as prescribed by theory. Finally, the implemented modes of governance can be reflected on from a transaction cost economics perspective.

The physical properties of the investment project would justify the adoption of a merchant investment approach (decentralised investment decision-making) (Klein, 1996, Brunekreeft, 2004). The pipeline is not part of a backbone infrastructure and seemed to have very limited external effects on the regulated (backbone) transmission systems to which it connects. Furthermore, the environment provided clear market-based signals for investment in this new cross-border interconnection. In addition, the project cannot be considered a natural monopoly because there it is in competition with alternatives (i.e. the relevant product and geographic market is competitive). Because EU regulation does not allow for merchant investment by default, but only via exemption regulation that is inspired by regulatory holiday literature (Gans and Williams, 1999; Gans and King, 2003, 2004; Caillaud and Tirole, 2004).

It is therefore appropriate to assess whether the application of regulatory holiday in the case of the BBL satisfies the principles described in literature. De Joode and Spanjer (2010) conclude that practice as demonstrated by the BBL project fails to incorporate the lessons provided by access holiday as well as transaction cost economics literature on three accounts. Firstly, in the BBL case the exemption instrument was considered an adaptation of default regulation aimed at improving project profitability rather than seen as device to mitigate various types of regulatory risks (i.e. ex post hazards). Especially regulatory uncertainty and opportunism have not been adequately addressed. There was no room for regulatory opportunism to justify leniency regarding the granting of BBL's exemption. Secondly, the BBL application process did not contain a scrutinisation of the assumption that regulated third party access indeed makes the BBL project privately unprofitable. Moreover, a sound analysis of the social desirability of the project was not included in the application process. Thirdly, the proportionality principle seems to have been applied insufficiently: little attention has been given to alternative project specifications (e.g. with respect to the amount of capacity contracted long-term and the amount of free capacity) and its social benefits, and the EC in the end decided that the length of the exemption period should correspond with the length of long-term contracts and should not cover additional capacity not sold in long-term contracts.

In addition, the application of a legal unbundling requirement can be criticised from both a neoclassical economic perspective as well as a transaction cost perspective. From a neoclassical perspective, horizontal integration of an unregulated and a regulated company can give rise to conflicting interests and perverse incentives for operational and investment behaviour (de Joode and Spanjer, 2010). Although the legal unbundling requirement aims to reduce the risk of undesirable behaviour, it is unclear whether it is sufficient in realising its objective. From a transaction cost perspective, horizontal integration may be favoured due to economies of scale in operating the connected infrastructure assets and effectively deals with the risk that investment in infrastructure is coordinated. It is uncertain whether legal unbundling is capable of capturing these benefits. BBL does not seem to be a representative test case in this respect since the external effect of BBL on neighbouring infrastructure seemed to be limited.

4.4.4 Analysis of alternative regulatory models

The previous section analysed the regulatory choices implemented in the case of the BBL project and discussed how the these affected market performance by pointing to the allocation of costs, benefits and risks. The key issues for the private investor are taken as a starting point for considering alternative regulatory choices. The key issues were the mitigation of ex post hazards, and the coordination with neighbouring gas transmission systems. Alternative regulatory models that deal with these issues differently than the one implemented are:

- Regulated investment jointly undertaken by the two TSOs (i.e. vertical integration);
- Tender for investment project.

These alternative regulatory choices and their implications are consecutively discussed below.

Regulated investment jointly undertaken by the two TSOs

An alternative regulatory approach for realisation of the BBL pipeline project is a joint investment by the two TSOs on either side of the pipeline. From a transaction cost economics perspective this amounts to a form of horizontal integration. The pipeline's tariffs would be regulated corresponding to the performance-based regime that applies to the national transmission systems in the UK and the Netherlands. This alternative corresponds with a large number of other interconnection projects on cross-border points throughout Europe. The need for investment is identified by an open season procedure for which either the Dutch or UK TSO can take the initiative.

This alternative involves a socialisation of risks involved in the investment: price and volume risks are carried by the two TSOs. In turn, TSOs may pass the costs that arise from these risks via its regulated tariffs to consumers connected to the system. The incentive for the TSO to perform efficiently depends on the type of performance-based regulation that applies, which can provide strong or weak incentives depending on different parameters and benchmarking methods adopted. Dynamic efficiency depends on the manner in which the project is defined. This is similar to the implemented regulatory model in the BBL case, except that the initiative for the organisation of the open season was with the private company BBL. This alternative requires a different type of cooperation between the TSOs, and the regulatory authorities. In the implemented regulatory model, the TSOs each had to agree upon connection agreements with BBL company bilaterally, whereas this alternative approach requires cooperation on a larger number of issues, such as on the operational control over the pipeline and on the share of investment in the pipeline. The regulatory authorities would need to decide which part of the investment can be justified to be undertaken by the respective national TSO. The benefits of realising the investment may not be divided equally among both countries and may lead to uneven participation of the two TSOs in the project. The allocation of investment costs may be an issue given the required investments in the Dutch gas transmission system. Some form of compensation by those actually benefiting from the BBL project may be demanded and may complicate investment decision-making ex ante. The participation of both TSOs (whether on a 50/50 basis or not) may facilitate coordination between the BBL investment and investment 'upstream' in the Dutch gas transmission network: the Dutch TSO is vertically integrated with the BBL pipeline. In reality, some form of internal coordination between the two investments was facilitated by the Dutch gas infrastructure holding company Gasunie since it has owns both the BBL pipeline (partly, within a consortium) and the Dutch transmission system (via subsidiary Gas Transport Services).

Discussion thus far assumes an inherent interest with both regulators to realize BBL investment. But this assumption may be violated in practice if the distribution of costs and benefits of project realisation (whether real or perceived) is skewed to such degree that the investment project does not go ahead. European, UK and Dutch interest may not be aligned. This is acknowledged to be a key problem in realising required gas infrastructure across the EU and is one of the reasons that led to the adoption of the recent energy infrastructure package. Both regulatory authorities involved in the project seem to have been very much interested in realising the project, but difficulties in realising the BBL under this alternative approach due to conflicting interests cannot be ruled out.

The adoption of this alternative regulatory model leads to a different performance on efficiency. Market demand for a pipeline interconnection could still be tested using an open season, implying that the investment project can still be considered efficient. If the dimensioning of the project is based on non-market based considerations, this will increase the likelihood of wasteful investment reducing efficiency. Dynamic efficiency of operating the pipeline depends on the strength of regulated incentives. In designing efficient incentives the regulator has to deal with information asymmetry problems versus the regulated firm. It is unlikely that the regulator is successful in providing incentives that achieve dynamic efficiency. In addition, regulation entails costs for regulatory oversight. Finally, the allocation of costs involved in realising and operating the pipeline between both regulated TSOs is unlikely to reflect the real allocation of benefits generated by the pipeline. This leads to cross-subsidization and decreases social efficiency.

Tender for investment project

A second alternative to the implemented regulatory model concerns a tendering of the identified investment project. The need for the pipeline project would be identified using an open season, similar to the one organized by BBL company in practice, but then initiated by one of the involved TSOs. The result of the open season, again similar to what's actually done in practice, would entail a set of long-term capacity contracts with interested shippers. Using the outcomes of the open season as a basis, a competitive tender for the realisation of a pipeline connection would lead to the awarding of the project to the (consortium of) bidder(s) with the 'best' offer. The different offers would need to be evaluated based on a number of pre-established criteria of which cost-efficiency and capacity availability conditions can be part. The winner of the tender would obtain the exclusive right to the project for the duration of the long-term contracts, after which the operation of the pipeline is transferred to the neighbouring regulated system operators. Ownership of the assets may reside with the winning consortium. I.e. after the unregulated period system, operations and transmission ownership is unbundled. Alternatively, the tender-winning company may continue to operate as a TSO.

In case of a lack of interest in private development of the pipeline, the regulatory model may oblige the involved TSOs to jointly realize the project under performance-based regulation (see the previously discussed alternative). In other words regulated TSO investment can be used as a default option. This alternative does not explicitly deal with any possible coordination problems between the pipeline interconnection and the regulated systems which it connects. If coordination problems occur, it depends on the default regulatory model applicable to the regulated systems whether coordination is sufficiently dealt with.

Implementation of this alternative regulatory model would imply efficiency improvements when compared with the alternative of regulated investment by the TSOs, but not compared with the merchant investment model that was implemented in practice.

4.5 Conclusions

This section provides the conclusions following from the analysis of this case study by addressing four questions:

- What were the key regulatory objectives at stake in realising the project and which were the key concerns for the investor?
- What was the response of regulatory decision-makers in terms of regulation implemented?
- Which considerations (factors) led to this choice?
- Would an alternative response have been (more) appropriate, and if so, why was this not implemented?

The key regulatory objective for the regulatory authorities involved in the BBL project was to encourage investment at the minimal expense of short-term market functioning and the level of competition. The project was the first to demonstrate the new exemption regulation, which was aimed to be applied only in exceptional cases. This implies that there was a very clear trade-off present in regulatory decision-making regarding the scope of exemption. The key issue for the investor was to mitigate investment risks that were present. This included the risk caused by asset-specificity of investment amidst a competitive, uncertain environment on the one hand, and a regulatory risk as a consequence of multiple regulatory authorities involved in realising the project.

The regulatory model that was implemented as response is the regulatory holiday model for merchant investment. Choices for the national regulators were limited to either granting an exemption or implementing regulated expansion. For an exemption to be granted, formal exemption criteria need to be fulfilled. Although criteria were developed from the perspective that exempted projects should have absolute minimum negative impact on markets and include positive external effects, the assessment of criteria did bring forward the key factors that according to theory should directly lead to the choice of merchant investment.

The factors considered were the level of competition to which the project would be subjected, the high risk due to the combination of competition, asset-specific investment and multiple jurisdictions involved, and the physical characteristics of the project: a single pipeline that is not part of a backbone infrastructure and has limited external effect on neighbouring infrastructure systems. External effects of the project on security of supply and level of wholesale market competition in the region were only assessed because required according to criteria, and not with the aim of internalizing these within the project's applicable regulatory model.

In the end, the decision to allow for merchant investment in the BBL project is consistent with theory. However, the 'regulatory route' taken had a different focus and led to substantial regulatory costs that may have been saved when a more direct choice for a particular role of competition in expansion was embraced at the EU level. An alternative regulatory model such as regulated TSO investment would have led to inferior performance on efficiency. However, in case of insufficient interest for private investment (for example due to problems in coordination with transmission pipeline systems upstream or downstream, or due to very large external effects on security of supply) regulated investment by joint TSOs can be considered a default option.

5 Case 2: The Milford Haven pipeline

5.1 Introduction

Central in this chapter is the investment in the Milford Haven pipeline in the UK. The objective of this chapter is to explain why the Milford Haven pipeline project was regulated the way it was: why were particular regulatory choices adopted and what were the underlying factors that led to them? This involves an analysis of the perspective of both the regulator and the investor in this project. Key questions addressed are: what are the regulatory objectives of the regulator when deciding upon the regulatory model and making the key regulatory choices regarding this project? In order to understand this question the investor's perspective needs to be analysed: what are the investment risks for the investor, and which factors cause this risk? Answering these questions requires an analysis of the implemented regulatory model. Such an assessment needs to illustrate, if, and to what extent, particular regulatory objectives were attained and private investment risks mitigated. This provides a starting point for an analysis of alternative regulatory models (i.e. counterfactuals): how would different regulatory models affect 'performance' in terms of attaining regulatory objectives and addressing private investor's investment risks? The answers to aforementioned questions will provide input for the synthesis analysis in chapter 8.

Throughout this chapter the following terms related to the economic regulation of gas infrastructure are used. The term regulatory framework will be used to reflect the overall set of rules and regulations to which a company is subjected. It may relate to both rules and regulations at the EU level and the EU Member State level. The term regulatory choices is used to refer to single regulatory decisions made at the Member State level. In the context of this study this term is generally used to refer to regulatory choices that affect the expansion of gas infrastructure. Finally, the term regulatory model is used to refer to a set of regulatory choices that affect gas infrastructure expansion.

This chapter is organized as follows. Section 5.2 introduces the case study investment project to the reader by describing its technical features, the actors involved and the motivation for the expansion. Thereafter, section 5.3 presents the relevant regulatory framework for the transmission pipeline investment in general and describes how it has been applied to the case of the Milford Haven pipeline in particular. Section 5.4 provides an analysis of case study observations and addresses the key research questions mentioned in previous paragraph. Finally, section 5.5 summarizes the case study findings.

5.2 Description of the project

This section presents the main project characteristics and describes the main drivers behind the project and the involved actors.

5.2.1 Technical features of the project

The project concerns an extension of the existing UK national pipeline network in the Southwest of Wales near Milford Haven. The UK national pipeline network is generally referred to as the National Transmission System: NTS. The project that is central to this chapter is also referred to as the Milford Haven pipeline, Milford Haven Gas Connection Projects, or the South Wales Gas Pipeline. In the remainder of this study the project will be referred to as the Milford Haven pipeline.

The project was triggered by the development of two LNG terminals in the direct surroundings of Milford Haven: the South Hook LNG import terminal and the Dragon LNG import terminal. Starting operations in 2009, the two terminals by the end of 2010 had a combined nominal annual capacity of about 27 BCM.[37] Four different shippers have acquired long-term capacity rights in the two respective terminals. BG and Petronas have acquired capacity rights for the delivery of 3 BCM per year each via the Dragon LNG terminal, whereas ExxonMobil and Qatargas have acquired about 7 and 3 BCM per year of initial total capacity of 10.5 BCM available at South Hook LNG terminal.

In order to accommodate the additional inflow of gas into these terminals, a new pipeline connection had to be built between Milford Haven and the existing NTS network. The map below shows that the connection project involved two pipeline sections. The first pipeline section runs from Milford Haven to Aberdulais, near Neath, while the second

[37] This figure is based on data provided by Gas Transmission Europe (GTE), which is available via http://www.gie.eu/maps_data/lng.asp (last accessed 24-07-2011).

pipeline section runs from Felindre (near Swansea) to Tirley in Gloucestershire. The pipelines have a diameter of 1220 mm and span a total length of 316 kilometer.

The new pipeline connection between the two LNG terminals at Milford Haven and the existing UK gas network implies an increase of peak import capacity of 27.5 BCM per year by 2008/2009 (National Grid 2006). This amounts to about 28% of current total UK gas demand and increases current total import capacity with about 36%.[38] Total deliverability of the combined LNG terminals would contribute to about 19% of peak demand.

At the beginning of 2012, the pipeline was not yet operating at maximum capacity due to a significant delay in the realisation of a pressure reduction installation near Tirley. This is caused by permitting issues as a consequence of local concerns related to safety, security and visual 'pollution' of the landscape. Final permission was granted in December 2010 and construction works commenced in March 2011. National Grid expects to commision the installation in late summer 2012. The project was estimated to cost about € 700 million but this figure has risen to about € 1,080 million.[39]

5.2.2 Motivation for the investment

Faced with a depletion of domestic gas reserves, the UK needs to develop new gas supply facilities. The LNG terminals near Milford Haven are an important part of this development. With the realisation of LNG import capacity in Milford Haven in 2009, the UK saw its gas import capacity increase. Although more LNG import terminals have been built throughout the UK, the particular siting in Southwest Wales is attractive given its proximity to the Atlantic Basin and its particular local geologic features. The realisation of various new gas supply options, including the pipeline connection with the Netherlands and the upstream pipeline connection with Norwegian gas production fields, significantly changes the UK gas supply portfolio and resulting gas flows in the UK gas system. A new pipeline is required between Southwest Wales and the large UK gas demand centres in the Midlands and the south of the UK to enable gas inflows into the system from the Milford Haven LNG terminals. Because of the relatively large size of the new import facilities that

[38] Other planned import projects at the time are not included in this figure.

[39] According to a news article posted by Hydrocarbons Technology: http://www.hydrocarbons-technology.com/projects/southwalesgas/ (last accessed: 21-05-2012).

needed to be accommodated, the Milford Haven pipeline project was considered of particular importance for the security of supply of the UK gas system.

5.2.3 Actors

The organisation responsible for the project is the designated owner and operator of the UK NTS. The formal name of the organisation has been changing several times in recent years but it is currently known as National Grid Gas (NGG). When the pipeline project was initially launched the designated owner and operator went by the name Transco. In 2005 the company Transco was renamed into NGG. NGG is part of the international gas and electricity company National Grid, which has activities in the UK and the US. National Grid is an investor-owned company with stock listings on the LSE and NYSE. National Grid owns the high voltage electricity transmission network in England and Wales and operates the electricity transmission system across Great Britain. National Grid, via the business unit NGG, owns and operates the gas NTS and owns and operates some gas distribution networks. In the remainder of this chapter the name NGG will be used in reference to Milford Haven project, although in citing of formal documents the name Transco will appear now and then.

The relevant regulatory authority in the case of the pipeline investment is Ofgem. Ofgem is the regulator of the onshore gas industry through the Gas Act and the operation of the Public Gas Transporter (PGT), Gas Shipper's and Gas Suppliers' licenses. The regulatory framework for the offshore gas industry is currently provided by the Department for Business, Innovation and Skills (BIS). This task was formerly allocated to the Department of Trade and Industry (DTI, until 2007), and the Department for Business, Enterprise and Regulatory Reform (BERR, from 2007 to 2009). These changes are related to a restructuring of government administration.

5.3 Description of the regulatory framework and regulatory choices

The relevant regulatory framework for the Milford Haven pipeline connection project is EU and UK legislation. The broad EU regulatory framework was described in section 2.3. It prescribes a regime of regulated third party access for gas transmission systems, but allows for private, unregulated investment in extraordinary cases. This section is organized as follows. After an introduction to the general regulatory framework for UK gas transmission networks in section 5.3.1, section 5.3.2 describes the application of this framework in the case of the Milford Haven pipeline connection and the regulatory process that resulted from this application. Section 5.3.3 describes the main regulatory approaches adopted in the case of the Milford Haven pipeline connection.

5.3.1 Gas transmission regulation in the UK

Before liberalization of the UK gas sector, gas transmission and distribution assets were under control of one vertically integrated gas company: British Gas (BG). In 1997 Centrica was demerged as a supplier from BG, with the BG continuing as BG plc and later BG Group plc. A further demerger came into effect in 2000 when Lattice Group and BG Group separated and Lattice Group took control over property and network assets and BG Group remained in control of upstream gas production assets. The Lattice Group bussines unit in control of gas transmission assets became Transco. In October 2002 Lattice Group merged with National Grid Group and the new organisation named itself National Grid Transco plc. In 2005 National Grid Transco was renamed into National Grid, with the electricity network business operating under National Grid Electricity Transmission and the gas network business operating under National Grid Gas.

The UK Gas Act stipulates that licenses need to be obtained for different activities throughout the gas value chain, including the transport of gas. According to the Gas Act, a gas transport license holder is required to operate and expand the gas network in an efficient manner. The main objective of the regulatory authority is: *"to protect the interest of current and future consumers in relation to gas wherever appropriate by promoting effective competition between those engaged in the shipping, transportation and supply of gas, with regard of the need to secure that, so far as it is economical to meet them, all reasonable demands in Great Britain for gas conveyed through pipes are met, and the need to secure that license holders are able to finance the carrying out of activities which they are authorised or required to do so"*[40].

Due to the natural monopoly character, the transmission and distribution of gas is subjected to so-called price controls and incentive arrangements. Price controls limit the revenues from transmission network activities and are designed to stimulate efficient

[40] Source: website Ofgem (www.ofgem.gov.uk (last accessed: 20-05-2012).

operations and investment. Every five years a systematic assessment of the company's expenditures and performance gives rise to new controls (i.e. allowed revenue) for the new regulatory period, which companies are allowed to receive from customers via infrastructure charges. Besides the price controls for gas transmission owners (TOs), the regulatory framework foresees separate incentive arrangements for system operators (SOs). Although this distinction between TO and SO activities is made within the regulatory framework, there is no particular requirement regarding the integration of both activities within one company. In the case of gas transmission, ownership and operations of the NTS for gas are both designated to NGG.

The relevant price controls and incentive arrangements for NGG at the time at which the final investment decision on the Milford Haven pipeline link was taken are described in Ofgem (2001b, 2002a). The resulting modifications in the license for NGG (then Transco) are presented in Ofgem (2002b). The price controls and incentive arrangements in the period 2002-2007 incorporate a significant reform of the price controls and incentive arrangements in the previous regulatory period. Main elements of reform concern the separate price regulation of the owner of the transmission assets (NTS TO), the system operator (NTS SO), the Local Distribution Zones (LDZ), and the metering responsibilities on the one hand, and strengthening of SO incentives with respect to the efficient and timely investment in the NTS on the other.

Capacity allocation

Tariffs for transmission capacity in the UK are based on the entry-exit model. In this tariff charging system each separate entry and exit point has ain individual tariff. The 2002-2007 price controls for the transmission operator NGG specify that revenues originate for 50% from entry charges and for 50% from exit charges, with entry charges being set through the short and long-term entry capacity auctions. Under the price control, NGG (then Transco) is allocated with NTS TO baseline capacity outputs, which basically refers to maximum technical capacity, that are consistent with the revenue allowed under the NTS TO price control. Under the SO incentive arrangements, NGG (then Transco) was obliged to provide at least 90% of TO baseline capacity. SO incentive arrangements state that 80% of SO baseline capacity needs to be offered to the market at least one year ahead, and that the remaining 20% must be held back for sale within a year ahead. In its explanation to the final license modifications, Ofgem states that the 20% requirement for short term sales may be dropped once a liquid secondary market for entry capacity has developed. As a SO, NGG may decide to offer capacity above the SO baseline capacity, but related revenues are treated differently under the SO incentive scheme. The differential treatment intends to provide NTS SO with a strong incentive to provide capacity to the maximum extend.

Investment signals via auctions

The 2002-2007 price controls and incentive arrangements also meant to improve upon the investment process and the incentives for new capacity provision through capacity expansion. Since 1999, auctions had been used to sell NTS entry capacity (Ofgas, 1999).[41] The introduction of auctioning was part of the New Gas Trading Arrangements (NGTA) that came into effect on October 1st 1999 and contained revised arrangements on capacity and balancing issues in particular. In a 2000 review of investment incentives Ofgem stated that the new arrangements may be considered an important step towards the longer term aim of *"identifying the efficient amount of new capacity that NGG (then Transco) should provide, and ensuring that Transco carries out the necessary timely investment to make this new capacity available"* (Ofgem, 2000a). This was taken up in the 2002 published price controls (Ofgem, 2002b) which facilitated allocation of entry capacity via long-term auctioning of not only capacity within the TO baseline, but also incremental entry capacity to be delivered through expansion. Under the new price controls and incentive arrangements, NGG was required to make available up to 150% of SO baseline capacity in quarterly auctions. If total bids for capacity exceed 100% additional investment in capacity is required. This allows shippers to signal the need for additional capacity. The maximum duration of long-term capacity contracts is 15 years, with a start date 2 years from the moment of auctioning. This implies that capacity can be contracted a maximum of 17 years ahead.

[41] The Office for Gas supply (Ofgas) merged with the Office for Electricity supply (Offer) in 1999 to become Ofgem.

NPV test for investment

When a need for additional capacity is signalled in the capacity auctions, the NPV test as described in the National Grid Gas NTSs Incremental Entry Capacity Release (IECR) Methodology Statement needs to be applied. The proposed NPV test dictates that the aggregated value of bids over a period of 8 years equals at least half the assumed project value. The project value in turn is an estimate of the costs of providing incremental entry capacity, which is calculated by multiplying the volume of incremental entry capacity being considered for release with an approximation of the long-term cost for providing additional capacity at that entry point (in the UK regulatory context referred to as a Unit Cost Allowance (UCA) (Ofgem, 2001a).[42] Before each regulatory period, the regulator sets UCAs for each entry point. These UCAs at the same time act as a reserve price in the long-term capacity auctions: i.e. the UCA provides a minimum price for long-term contracts. In short, the aggregated bids for the first 8 years need to exceed 50% of the cost of realising the investment. If the NPV test is met, NGG needs to seek approval to release a permanent increase in entry capacity, after which NGG can proceed to invest in the additional network capacity. With the introduction of the 2002-2007 price controls and incentive arrangements NGG started, selling entry capacity contracts for the capacity years starting 2 to 17 years from the date of the auction. The rate of return allowed on investment in new capacity is subjected to a cap (12.25%) and collar (5.25%). The actual rate of return depends on the competition for new capacity in the auctions.

5.3.2 Application of regulation to the Milford Haven pipeline

This section chronologically discusses how the Milford Haven pipeline was treated against the background of the general applicable framework described previously.

Regulatory gap regarding new entry points

During 2002, NGG (then Transco) received requests from gas market parties concerning the creation of three new entry points for the NTS. The entry points were related to project

[42] The UCAs are ex-ante agreed estimates of the per unit costs of providing incremental entry capacity at an entry point and are the basis for determining the range of revenues Transco is allowed for taking on an obligation to release incremental entry capacity rights (Ofgem, 2001a).

initiatives for a new gas storage terminal and two LNG terminals, including the Milford Haven LNG terminal. Although the price controls and incentive arrangements explicitly allowed for the expression of long-term investment signals through long-term auctions, it did so only for *existing* entry points and did not explicitly address the option of *new* entry points. By the end of 2002, Ofgem communicated that new entry points would be treated with a similar entry capacity incentive scheme as agreed for existing entry points (Ofgem, 2002c). This implied that the capacity realised as part of a new entry point would not be part of the TO baseline capacity and that Transco would be allowed to acquire a relatively higher rate of return on investment compared with the standard rate of return allowed for existing assets.

Regulatory framework is further specified

Early 2003, NGG (then Transco) published a proposal on how to proceed in offering capacity at new NTS entry points. The proposal contained indicative UCAs and price schedules for a limited number of new entry points for which market interest was observed (Ofgem, 2003a). In doing so, Transco adopted an approach similar to the price controls and incentive arrangements for existing entry points.

Ofgem's views on Transco's proposals were published in a consultation document dated June of 2003, along with the gas transport license modifications needed to facilitate the new entry points (Ofgem, 2003a). In this document, Ofgem specified how the UCA for new entry points in general, and the Milford Haven entry point in particular, would need to be determined. Ofgem recognized the fundamental uncertainty with respect to the likely demand for new capacity at the new Milford Haven entry point. For one LNG terminal it was estimated that it could be operating from 2006 onwards, with a possible second LNG terminal becoming operational at a later point in time. Ofgem accommodated this uncertainty in a rather tailor-made approach for the to be realised Milford Haven entry point in two ways:

- Extension of long-term capacity allocation procedure with an open season;
- Specification of a methodology to set unit cost allowances (UCAs) (which equal reserve prices in long-term capacity auctions) for new system entry points.

Both steps are described below.

Extension of long-term capacity allocation with an open season

Firstly, Ofgem proposed to extend the allocation method for long-term capacity at the Milford Haven entry point with an open season, which requires an adaptation of Transco's long-term auction arrangements. The open season would allow Transco to keep open the options of accommodating the demand for entry capacity from either one or two LNG import terminals to the extent that parties requesting the open season are prepared to pay for the costs which this imposes on Transco. The open season would involve a series of auctions for Milford Haven entry capacity, with bidders confronted with the same reserve prices (UCAs) as published by Transco. These auctions are additional to the regularly organized 'standard' auctions in order to optimally facilitate investment in the Milford Haven pipeline. After the performance of the standard NPV test and formal approval of Ofgem, bidders would then be awarded capacity rights in accordance with their bids. At the end of the opern season (i.e. series of entry capacity auctions), Transco could aggregate all submitted bids and determine common clearing prices payable by all parties that (successfully) participated in the open season. After the open season, Ofgem would determine the final UCA value (i.e. reserve price in future auctions) for entry capacity expansion in later years, in line with the determination of UCAs for other NTS entry points. The benefit of this proposed approach was that it simultaneously allowed all parties to purchase Milford Haven NTS entry capacity with certainty as to the maximum price, and allowed for Transco's investment decision deadlines to be extended in order to allow other potential bidders to signal demand in time to be accommodated by Transco (Ofgem, 2003a). The proposed open season approach required Transco to quickly modify its uniform network code and get Ofgem's approval for this modification. Ofgem approved the required network code modification 0638, 'Extended LTSEC Auctions at New Entry Points', on August 4, 2003 (Ofgem, 2003b).

Methodology for new entry points

Secondly, Ofgem needed to specify a methodology for estimating UCAs for new entry points. The initial general gas transport license of NGG involved a list of UCAs for existing entry points to the NTS that were based on an expansion of daily capacity by 6 million m^3. According to Ofgem, the application of this standard 6 million m^3 per day increment set for existing entry points may have undesirable consequences when applied to new entry points. Ofgem (2003b) considers three possible negative effects:

- Excessive short-term returns to Transco under its SO incentives;
- A high assumed project value under Transco's NPV test (which determines the value of bids which would automatically trigger the release of permanent obligated incremental entry capacity), and;
- Possible undesirable distribution effects between shippers.

Ofgem was of the opinion that the UCA for the new entry point should be based on the best estimate of per unit cost of providing capacity at the new entry terminal, in association with a proper judgement about the likely level of demand for capacity at that particular entry terminal. Considering the economies of scale in new entry capacity at this point, Ofgem proposed to identify two different UCAs for the Milford Haven entry point for two different demand levels, with the demand levels being related to the realisation of respectively one and two LNG terminals at the Milford Haven entry point over time. This finally resulted in an allowed UCA of £0.257 to £ 0.343 per kWh, depending on the total amount of entry capacity per day (Ofgem, 2003c).

Investment signals, planning and realisation of new entry capacity

National Grid Transco is obliged to publish a Transportation Ten Year Statement on an annual basis. Based on data received in its annual consultation process (which goes under the name of 'Transport Britain's Energy (TBE), publicly available commercial data, and, where possible, data through the Long Term System Entry Capacity (LTSEC) auctions, National Grid Transco publishes gas demand and supply forecasts and assesses the implications for its gas network operations and investment. In its Transportation Ten Year Statement of 2003 (National Grid Transco, 2003), Transco mentions investigations from Petroplus/BG Group and Qatar Petroleum / Exxon Mobil into LNG opportunities at Milford Haven and mentions a possible inflow of LNG gas into the UK of about 10 to 30 BCM per year in 2007.[43] The Statement mentions that for two LNG terminals near Milford Haven,

[43] Whereas its previous Ten Year Statement it was only anticipating about 5 to 10 BCM of LNG supply at Milford Haven by 2006/2007 (National Grid Transco, 2002).

several planning permissions had been granted but that no firm investment signal was obtained through long term capacity auctions yet. It notes that the absence of such a signal may give rise to some concern given the fact there is no existing NTS entry point and the relatively less accessible terrain in the area. Both factors can lead to delayed commissioning of new pipeline capacity. A timely investment signal is very important for the realisation of new entry capacity on such a short time horizon, which requires a short lead-time of investment of about 3 years. In the 2004 Transportation Ten Year Statement, National Grid Transco confirms that the Long Term System Entry Capacity (LTSEC) auctions at the end of 2004 provided firm investment signals for new NTS entry capacity at Milford Haven (National Grid Transco, 2004). In the long-term auctions at the end of 2004, NNG SO sold NTS entry capacity at the Milford Haven entry point from October 2007 onwards: 452 GWh/day for the quarter beginning October 2007, 650 GWh/ day for the quarter beginning October 2008 and up to 950 GWh/day for the quarter beginning January 2009 (Ofgem, 2006a).

In order to realize the project, a number of planning and environmental permissions were required. Planning permission for a new compressor installation at Felindre near Swansea was granted in November 2006. Consent to construct the pipeline was only granted in February 2007. Due to local opposition and difficulties in obtaining all relevant permits, concerns were raised as to whether the project could be realised on time. Opposition related to:

- The fact that the pipeline was planned to cross a National Park;
- The planned pipeline would be operating under higher pressure than seen in the UK thus far, and;
- Part of the pipeline crosses an area where some seismic activity is observed (sparking concerns over possible leakage);
- Dissent with local municipalities regarding the way in which pipeline and planning decisions were taken.[44]

[44] According to: http://www.hydrocarbons-technology.com/projects/southwalesgas/ (last accessed 24-07-2011).

In the course of 2006 Ofgem realised that timely delivery of the pipeline was under threat. In an April 2006 consultation document, Ofgem (2006a) takes action by reviewing current incentive arrangements for entry capacity investment and proposing an alternative incentive scheme. Although it seemed that about 240 GWh/day of capacity would be realised, it was signalled that additional capacity might not be completed until 2008.

In case NGG would not be able to timely deliver the additional capacity that was sold in long-term auctions, it would be subjected to buy-back liabilities as specified in the existing regulatory framework. The then existent incentive arrangements for NGG included a cap on exposure to such liabilities at £12.5 million per year, with the cost due to additional buyback liabilities to be recovered across all shippers and consumers. Although it was originally envisaged that these particular reinforcement incentives were reviewed during the price controls and incentive arrangements to be put in place from April 2007 onwards (i.e. the next 5 year regulatory period), Ofgem deemed it appropriate to further strengthen timely reinforcement incentives in the case of Milford Haven. It did so in a decision document dated July 2006 (Ofgem, 2006b). Ofgem decided to impose a buy-back incentive on NGG NTS with a total value of £36 million, with a profiling covering period of October 2007 to September 2008. This buy-back incentive limited NGG's liability. The strengthened buy-back incentive contained some provisions for deferral, which could be triggered in case *"the event of delays in delivery of capacity can be attributed to DTI taking longer than three months to provide environmental consents"* or in case of *"delays caused by force majeure events"* (Ofgem, 2006b).

Although some controversy remained regarding the building of an additional above ground facility near Tirley, the Milford Haven pipeline was officially commissioned on November 27th 2007 (National Grid, 2007). The state of the project at the end of 2009 has allowed NGG to respect its sold long term capacity rights, but some facilities were not yet commissoned (National Grid, 2009). The permission to build the final pressure reduction facility considered part of the pipeline project was received in December 2010. Construction of this facility started in March 2011 and is expected to be completed late summer 2012.

5.3.3 Description of regulatory choices

This section summarizes the key characteristics of the regulatory model adopted in the case of the Milford Haven pipeline investment.

The competition modality of competition implemented by the regulatory authorities is *competition on the infrastructure* (third party access). In the UK, National Grid is the designated owner and operator of the gas transmission pipeline system. This company is a regulated, privately owned monopoly. Regulation is implemented via a license-based system with separate licenses for system operation and system ownership. There is no role for other companies in the operation and investment in national gas transmission pipelines. Private involvement is only allowed in upstream pipelines in the North Sea basin and in pipeline interconnections with neighbouring countries (of which BBL is an example).

Regulation is performance-based with separated incentives for system operation and ownership. National Grid carries the sole responsibility for expanding the existing pipeline system. Given the regulatory objective of facilitating free entry to, and competition on the wholesale market, and the choice for competition on the infrastructure, a regime of ownership unbundling is implemented when it comes to production and trade activities on the one hand and infrastructure activities on the other. Pipeline capacity is allocated via auctions and both long and short term contracts are sold.

Horizontal integration of different gas infrastructure activities is allowed, if organized through legally separate business units of National Grid (i.e. horizontal integration based on legal unbundling). The capacity of National Grid transmission pipelines (including the Milford Haven pipeline) is allocated via short and long-term auctions. Competition for this infrastructure capacity is further encouraged through the facilitation of secondary markets. In the case of the realisation of the Milford Haven pipeline connection it is thus relevant to observe that within the UK:

- System ownership and operation are integrated in one company;
- System ownership and operations are fully ownership unbundled from gas supply activities, and;
- System ownership and operations are legally unbundled from unregulated LNG infrastructure activities (for example related to the Isle of Grain LNG facility).

5.4 Analysis

5.4.1 Introduction

This section aims to analyse the regulatory model adopted in the Milford Haven pipeline project from both a private and public perspective using the framework described in chapter 4. From a private perspective it is important that the implemented regulatory model allows the investor to sufficiently deal with investment risks associated with the project. From a public perspective the regulatory model should contribute to the achievement of regulatory objectives. Trade-offs need to be made in deciding upon the regulatory model to be applied. This section makes an effort to uncover the trade-off made in the context of the Milford Haven project.

The structure of this chapter is as follows. Section 5.4.2 describes the characteristics of the Milford Haven pipeline from a private and public perspective. Section 5.4.3 analyses the regulatory model implemented by describing the regulatory objectives at stake, analysing the choice of regulation and its underlying considerations, and evaluate its performance. Section 5.4.4 analyses whether alternative regulatory models could have been implemented that would lead to improved performance from either private or public perspective.

5.4.2 Description of investment project characteristics

Inherent project characteristics influence the choice of regulation on two aspects. Firstly, project characteristics, including transaction characteristics, determine the type and level of investments risks to which the investor is exposed. For the investment project to go ahead, an implemented regulatory model should take into account private investor's concerns and allow the investor sufficient instruments to mitigate investment risks. Secondly, the project in combination with its environment (i.e. the context of project investment) may give rise to positive or negative external effects. Depending on its objectives a regulator may want or need to take the external effects into account when making regulatory choices. This section discusses the key characteristics of the Milford Haven project by referring to the concepts of asset-specificity, uncertainty, transaction complexity and external effects.

Asset-specificity

The Milford Haven pipeline is highly asset-specific because the investment is site-specific and concerns a dedicated asset. The pipeline facilitates particular transactions by shippers that own LNG terminal capacity at the entry point of the pipeline. The degree to which the pipeline is a dedicated asset (i.e. customer specific) depends on the degree to which LNG import capacity is freely available in the short term and the tradability of capacity rights for the LNG import terminal in the long term. In addition, the pipeline is physically asset-specific: the pipeline can only be used to transport natural gas of specific quality from the LNG terminal to the UK's main gas transmission network. Although designed to transport natural gas of a particular gas quality, the pipeline could be made suitable for the transport of gas of other quality, or of alternative gases such as CO_2 and hydrogen in the future after uncertain adaptation investments are undertaken. This could potentially reduce physical asset-specificity.[45] The high level of asset-specificity of the pipeline implies that the investment becomes a sunk cost after realisation, which makes it prone to ex post hazards of the hold-up problem type.

Uncertainty

For the investor in the pipeline, the future demand for the infrastructure services that are provided by the new Milford Haven pipeline over the 20 years or so (in which he needs to recover the investment costs) is uncertain. However, uncertainty for the investor in the particular pipeline case of the Milford Haven is especially large because it is a dedicated asset that enables a new gas supply route to the UK market at large. The Milford Haven pipeline is a single supply line, of which the utilization is uncertain and fully dependent on the gas supply position of the LNG terminal that injects gas at the one end of the pipeline.

Experience in recent years with the shale gas boom in the US gas market and its implications for world LNG flows illustrates the deep uncertainty regarding the economic value and usage of LNG terminal capacity around the world and in particular in the northwest European region. This uncertainty translates into both a price and volume risk for

[45] Whether this is an alternative within the period in which the pipeline investment needs to be recovered depends on fundamentally uncertain developments in the markets for these respective gases but it appears unlikely that this actually materialises (Neele *et al.*, 2011).

an investor in the Milford Haven pipeline. In addition, uncertainty about the future realisation of gas demand and supply locations close to the pipeline affects the value of the pipeline. In the future, the possible connection of the pipeline with nearby newly discovered (non-conventional) gas production fields or new large clients would change the type of transactions that can be facilitated by the pipeline and affect the value of the pipeline. However, currently available information shows little potential for shale gas in the area around the pipeline (DECC, 2011).

Need for coordination

Since the transactions that are facilitated by the pipeline are part of a larger chain of transactions, the transport of gas through the pipeline depends on other activities in the gas value chain. Consequently, the project raises coordination issues for the investor. The value of the pipeline diminishes if insufficient coordination exists with the owner and operator of the LNG import terminals on the one hand or with the owner and operator of the remainder of the UK transmission pipeline system on the other. Coordination is needed with respect to both the operation of the infrastructure (gas flows) and investment in infrastructure capacity. Especially the timing of investment is important: at the time that the LNG terminals are completed, the users of the terminals need to have access to sufficient capacity in the national transmission system and in the pipeline connection. This is a matter of sufficient physical capacity as well as contractual availability.

Barriers to investment

The presence of a combination of asset-specificity, (deep) uncertainty and the complex chain of transactions gives rise to a set of issues that need to be dealt with by the investor for the project to go ahead. The issues for an investor in the Milford Haven pipeline are the following:

1. <u>Risk of underutilization of the pipeline (i.e. volume risk of investment)</u>
   The volume risk due to underutilization of the pipeline arises from the asset-specificity of the investment in combination with uncertainty. The transaction facilitated by the investment requires one party to the transaction to incur costs ex ante. A lower than expected demand for the Milford Haven pipeline will lead to a loss for the pipeline investor. Less demand for the pipeline can be caused by less

intense use of the terminals (due to lower gas demand in the market), a delay in the realisation of the terminals, or a cancellation of LNG terminal investment altogether.

2. <u>Risk that the cost of the pipeline exceeds its market value (i.e. price risk of investment)</u>
   The upfront investment costs could exceed the total value of the investment over its economic lifetime. The value of the investment depends on the tariffs that can be charged for pipeline services. Investment costs may not be recovered.

3. <u>Risk of insufficient coordination with the LNG terminal and its shippers</u>
   There is a risk that the pipeline is realised after the LNG terminals are completed, as a consequence of which the terminals cannot be used right away: insufficient coordination with the LNG terminal increases the volume and price risk of the pipeline investment. Being a dedicated asset, the risk of tardy realisation of (full) LNG terminal capacity negatively affects the degree of volume and price risk for the pipeline investor.

4. <u>Risk of insufficient coordination with the backbone infrastructure</u>
   Both the pipeline and LNG terminal investor and shippers risk an underutilization of infrastructure as a consequence of insufficient capacity being available in the backbone infrastructure (the transmission system operated by National Grid). Required backbone investments may be realised too little or too late or required capacity may be already sold out.

5. <u>Risk of opportunistic behaviour of actors involved</u>
   High asset-specificity and potentially opportunistic behaviour of either the owners of the pipeline, the LNG terminals or the meshed backbone infrastructure give rise to the hold-up problem. They may be tempted to capture quasi-rents upstream or downstream ex ante of investment. When not sufficiently dealt with in the in contracts or the regulatory model, it can prevent investment in the pipeline, the LNG terminals or the backbone infrastructure ex ante. The operator of the LNG terminal is dependent on the pipeline operator, regardless of the economic value of LNG supplies to the UK market. This dependency may encourage the pipeline operator to claim part of the rents acquired by the LNG operator in the upstream business by

charging higher capacity tariffs. This creates significant price risk for shippers with capacity rights for the LNG terminal. This constitutes an upside risk for the pipeline investor. The operator of the national pipeline system to which the Milford Haven pipeline links can expropriate rents acquired in the Milford Haven LNG and pipeline activities by charging high system access tariffs.

6. Regulatory risk

   Regulation exposes the pipeline investor to two types of regulatory risk: regulatory risk due to general and to behavioural uncertainty. Changes in the market or economy (reflecting general uncertainty over future developments) may affect regulatory objectives of the authority over time and lead to an unexpected, unilateral change in the 'regulatory contract'. Behavioural uncertainty concerns uncertainty about future regulatory actions regarding pre-specified parameters in the regulatory contract. Both types of risks can affect the future value of investment and lead to the hold-up problem ex ante.

External effects of the project

Physical characteristics and the context of the investment project give rise to two external effects. Firstly, the project indirectly affects market competition since the investment indirectly allows gas suppliers an additional option to enter the UK gas market. Whether the external effect on the level of competition on that market in a positive way depends on which gas market supplier acquires capacity rights, the incumbent or new market parties. Secondly, the investment indirectly allows for an increased diversification of UK gas supplies. If the pipeline does not go ahead, it frustrates efforts to import additional gas to the UK market via two LNG terminals with a combined import capacity of 27.5 BCM.

Section 5.4.3 continues by analysing the implemented regulatory model from both a private and public perspective. Therein, both the list of concerns for the investor and the external effects play an important role. For the investment to be realised, the regulatory model should be capable of addressing the investor's concerns, whereas the regulator may want to take into account the external effects in the context of achieving regulatory objectives.

5.4.3 Analysis of the regulatory model

This section analyses the implemented regulatory model from both a private and public perspective. It starts by describing the regulatory objectives at stake and the trade-offs involved. Thereafter, an analysis of the key regulatory choices and their underlying considerations (e.g. project characteristics, exogenous factors) is performed. Then the performance of the regulatory model in terms of investor's concerns being addressed and regulatory objectives being attained is evaluated according to the case study framework presented in chapter 4. Finally, the consistency of implemented choices with theory is discussed.

Description of regulatory objectives

To the degree that the Milford Haven investment is considered as desirable from a public perspective, the regulatory authority may be concerned in contributing to solving (some) of the issues for the private investor. The regulator should then implement a regulatory model and make regulatory choices that allow private actors to sufficiently deal with the issues related to the investment. However, the regulator may have additional objectives serving the public interest that may conflict with each other and with the interests of the investor.

Formally, the regulatory authority in the Milford Haven case, Ofgem, has two objectives: protecting consumers and helping to secure Britain's energy supplies. Ofgem is obliged to do so by promoting competition and regulating monopoly companies and markets where appropriate, so that there is adequate investment. Realising these objectives in the case of the Milford Haven pipeline investment, does not only require that the risks of the investor are taken into account (i.e. does the market in combination with the regulatory model allow for a sufficiently strong investment incentive), but may also require market failures such as a lack of competition and external effects to be dealt with. In the event that the Milford Haven pipeline investment does not go ahead, it reduces the potential number of gas supply options to the UK. Since new gas supplies need to compensate for the decline in domestic gas production, security of supply would decrease.

The two key regulatory objectives of protecting consumers and increasing security of supply are conflicting in the case of the Milford Haven investment. The objective of providing strong incentives for pipeline investment conflicts with the objective of maximizing short-term efficiency of pipeline operations. In order to achieve second-best social welfare optima in the short run, regulatory authorities need to induce market parties to maximize productive and allocative efficiency. Optimal efficiency is obtained when prices and tariffs equal the level of long term marginal costs. However, since the provision of pipeline services requires large upfront investment costs that need to be recovered via capacity charges, charges actually need to exceed marginal cost. If the pipeline investor is not allowed an additional margin to cover capital costs, investment will not take place. The trade-off can be illustrated as follows. Long-term capacity contracts allow the investor to mitigate long-term risk of investments (and thus increase the investment incentive), but may reduce the availability of pipeline capacity for short-term trading (and thus reduce the short-term level of competition). The regulatory authority needs to take this general trade-off into account in regulatory decision-making.

The next paragraph analyses the revealed choice of regulation and the factors that were considered. Factors concern project specific characteristics, exogenous factors and external effects.

Analysis of regulatory choices

What have been the key regulatory choices in the case of Milford Haven and what were the arguments and factors underlying these choices?

The UK regulator implemented a regulated third party access regime for the Milford Haven pipeline; i.e. competition on the infrastructure. It accounted the regulated monopolist National Grid Gas responsible for providing the connection between the backbone infrastructure and the LNG terminals. UK regulatory authorities did not consider in great deal the role that more competitive regulatory models could play in realising this investment. The dense UK transmission pipeline system with large number of entry and exit points was expected to make it difficult to coordinate between different private investments in gas transmission assets and properly allocate costs and revenues of transmission services (Ofgem, 2000a).

Allocation of pipeline capacity in the system in general, including the particular case of the Milford Haven pipeline, is based on auctions. A minimum share of capacity is auctioned short-term, whereas the majority of capacity is offered in long-term auctions (up to 17 years ahead). The long-term commitments from market parties reduce the risk of wasteful investment being undertaken by the TSO, whereas short-term capacity markets and secondary capacity markets facilitate efficient capacity re-allocation, short-term market entry and competition on the UK market.

Incentive regulation for the TSO investing in the Milford Haven pipeline distinguishes separate system operator and transmission owner incentives, and contains financial incentives for timely and efficiently realising new capacity. Considerable liabilities are involved if investment is tardy. Finally, new investments are allowed a higher regulated rate of return compared to the standard rate of return applicable to other TSO assets.

The next paragraph discusses if, and to what degree, these regulatory choices solved (some of) the issues for the pipeline investor, took into account external effects of the project, and attained regulatory objectives.

Performance of the regulatory model

Performance from a private perspective

In order for a private investor to go ahead with investment in the Milford Haven pipeline, his investment concerns need to be sufficiently addressed within the implemented regulatory model. The performance of the regulatory model with respect to the investment risks identified previously on the basis of project and transaction characteristics are consecutively discussed below.

- The risk of underutilization of the Milford Haven pipeline is transferred from the investor to the users of the pipeline (i.e. the shippers that hold long-term contracts in the LNG terminal) via long-term capacity contracts. If the LNG terminal is not used to the extent foreseen in the business case, then the volume risk of investment in both the LNG terminal and the pipeline connection are for the shippers. There is an upside and downside risk for shippers. The value of capacity rights may or may not exceed the price paid according to the long-term contract.

- Operational costs are socialized, but regulation aims to provide incentives to the TSO to reduce these costs. Benefits are periodically passed through to final consumers via price controls that are periodically revised. Profits or losses due to this risk are socialized among all users of the UK national transmission system (NTS). However, risks in practice may be limited since the long-term marginal cost of building new capacity has been used a reserve price (i.e. minimum price) in the long-term capacity auctions. The reserve price is the outcome of a review in which both the TSO and regulator are involved.
- Within the adopted regulatory model, insufficient coordination between the LNG terminal and the pipeline connection due to a delayed commissioning of the LNG terminals translates into a risk for the holders of the long-term capacity rights. Although costs for transmission capacity rights are incurred, they are worthless when there is no LNG import capacity.
- Underutilization of LNG terminals and the Milford Haven pipeline due to insufficient coordination with the NTS exposes the TSO to large liabilities when shippers have already booked capacity long-term. If National Grid cannot deliver services to which it itself committed to in long-term capacity rights, it is required to buy back sold capacity rights. However, the holders of long-term capacity rights are also exposed to upside and downside risk in case the price of capacity agreed upon in long-term contracts deviates from the real market value of delivering LNG to the UK market at the time. Shippers profit if the long-term capacity tariff exceeds actual market value and lose if market value exceeds the long-term capacity tariff. The risk of delayed investment in the pipeline was increased by the failure of regulation to develop a procedure for allocating future capacity at new entry points. The defined method for allocating long-term entry capacity to the national transmission network and the signalling of investment requirements – the capacity auctions – only applied to existing system entry points and did not cover new system entry points. This omission had to be ‘fixed’ ad hoc. In addition, realisation of full pipeline capacity was delayed due to problems in the permitting process. The liabilities for the pipeline investor that resulted were mitigated by a new financial incentive scheme that replaced the standard scheme.

- The regulatory model deals with potential opportunistic, rent-seeking behaviour from the part of the TSO National Grid towards the LNG terminal owner by regulating access and revenues. The regime is particularly targeted at preventing National Grid to earn monopoly rents. In doing so, the regulatory authority needs to overcome information asymmetry problems regarding actual performance.
- The regulatory risk associated with investment in the Milford Haven pipeline is translated in a relatively higher allowed rate of return for its investor National Grid. Regulation specifies a normal rate of return of sunk assets and a higher rate of return for investments in new assets: the higher allowed rate of return is thus not location or pipeline specific. Whether the allowed rate of return is regarded as sufficient to mitigate regulatory risk depends on the view of financers. Their view may depend on the type of financing used by the investor. Project financing generally leads financers to demand a higher risk premium compared to equity-based financing. This implies that identical risk situations may be perceived differently by different organizations.

Performance from a public perspective

The performance of the regulatory model from a public perspective is evaluated using the performance criteria defined in the case study framework, and the regulatory objectives and external effects identified earlier in this section. An evaluation is provided below.

- The investment project scores high on allocative efficiency from a private perspective since the need for investment is based on actual willingness to pay for capacity expansion by future shippers in the long-term capacity auction. This requires that conditions required for efficient outcomes are met: all market parties have the same information, there is no market power and a sufficient number of bidding parties participate (De Joode *et al.*, 2006). However, the implemented regulatory model may have negative impact on allocative efficiency of the pipeline capacity market. For optimal allocative efficiency to be attained in the case of a part of new pipeline capacity being allocated on a long-term basis, secondary markets and use-it-or-lose-it mechanisms need to function efficiently and effectively. This assumption may be violated in practice. Then there is a risk of allocative efficiency on the Milford Haven pipeline capacity market being negatively affected. In view of the fact that secondary markets may not work effectively and efficiently in practice, the separate allocation of LNG terminal capacity and Milford Haven pipeline entry capacity risks further negative impacts on allocative efficiency.

- Productive efficiency in realising the investment project depends on the incentives provided by performance-based regulation of the owner and operator of the Milford Haven pipeline. Costs associated with regulatory oversight need to be included in this measure and negatively affect productive efficiency performance. The strength of performance incentives in future price control periods determines the level of productive efficiency.
- Dynamic efficiency of the regulatory model depends on the strength of regulatory incentives to reduce the costs of providing transportation services with the Milford Haven pipeline over time. In the regulatory model, the owner and operator of the pipeline are also owning and operating the national transmission system and are subjected to incentives applied to the system as a whole. This implies that the regulated company (National Grid) is in the position to internally re-allocate costs (and cost reductions). The price controls cannot target a single pipeline independently.
- The two external effects at stake in the pipeline investment (increased diversification of UK gas supplies, positive or negative impact on market concentration and the level of competition) were taken into account in the choice of regulatory model for the pipeline investment. The impact on market competition was, however, an issue in the regulation of LNG terminal investment.
- The strength of investment incentives provided by the regulatory model is assessed by looking at the degree to which the private investor's concerns are tackled in the regulatory model. The previous paragraph illustrated how investments risks were allocated and mitigated by long term contractual arrangements between pipeline investor and shippers and the choice of regulatory model (i.e. regulated TSO investment).

Consistency with theory

The regulatory model adopted for Milford Haven pipeline investment is competition *on* the infrastructure (Klein, 1996), i.e. open access. Klein shows that although technical characteristics may appear to make a particular infrastructure a natural monopoly, it does not need to be: "*The natural monopoly argument does not imply that complete systems need to be owned and managed by a single firm.*" (Klein, 1996). Applying the principle of introducing competition in network industries where possible, conditional upon private investment risks being mitigated by an appropriate governance mode, at least two options would appear to be suitable for implementation in the case of Milford Haven: competition for the market, also known as franchise bidding or competitive tender (Demsetz, 1968), and private, decentralized investment (Klein, 1996). The key factor that allows for implementation of these options is the topology of the backbone infrastructure and the role of the proposed Milford Haven pipeline therein.

However, implemented regulatory choices, such as an increased allowed rate of return for Milford Haven pipeline investment and the large role for long-term contracts, show that the regulator has been concerned with the issues faced by the investor. The fact that possibly better alternative regulatory models have not been considered may be explained by concerns over the perceived costs associated with the coordination of multiple gas transmission companies or system operators and properly allocating costs and benefits of gas transmission activities (Ofgem, 2000b). However, such costs have not been estimated and confronted with the benefits of introducing more competition in investment in new pipelines. Remarkably, the option of tendering of investment has been implemented by Ofgem for the (future) realisation of electricity transmission line connections to offshore wind parks with the existing electricity transmission network (Pollitt, 2011). Although involving different technology, both are concerned with a dedicated extension of backbone infrastructure, which makes them equal suitable for more competitive investment models. This raises the question why the regulator chose to implement regulated investment in the case of Milford Haven.

5.4.4 Analysis of alternative regulatory models

The previous section illustrated how the regulatory choices dealt with the concerns of private investors and to which extent they led to regulatory objectives being met. The Milford Haven pipeline is characterised by high asset-specificity in the form of a dedicated asset. This is caused by the position of the Milford Haven pipeline in the configuration of the UK gas transmission system: the pipeline is not a backbone pipeline but a feeder to the backbone infrastructure in the form of a single, forward-flow supply line. This provides opportunities for a larger role for competition in the realisation of this pipeline. There are two alternatives, each with different variants:

- Vertical integration of pipeline and LNG terminals;
- Tender-based regulated pipeline investment.

Vertical integration of pipeline and LNG terminals

The first alternative regulatory model is vertical integration of the Milford Haven pipeline with LNG terminal operations. *From the perspective of Klein (1996) range of competition modalities for natural monopoly types of infrastructure, this is a form of decentralised investment decision-making*. The LNG terminal project was exempted from regulated third party access, and the combined terminal and pipeline as an integrated project could be exempted from rTPA as well. Being a dedicated pipeline, the Milford Haven connection to the backbone NTS infrastructure could be interpreted as being part of the LNG terminal investment. Two variants may be adopted for the organisation of activities. The infrastructure company could integrate system operations and LNG and transmission assets ownership within one company, or could unbundle system operations. In the latter case, system operations may be performed by the SO of the NTS – which would correspond to the independent system operator model. The integrated owner of the terminals and pipeline transfers the volume and price risk to the shippers via a combined allocation of LNG terminal and pipeline capacity rights. Long-term allocation of capacity would be undertaken by an open season that precedes final investment decision for the integral project.

The risk of not recovering costs of investment in LNG terminal and pipeline capacity combined is fully allocated to shippers using long-term contracts. Long-term contracts with shippers are the result of an open season. Coordination between LNG terminal and pipeline investment is solved by vertical integration. Similar to the implemented model, opportunistic behaviour of the operator of the backbone infrastructure aimed at capturing rents upstream is countered with performance-based regulation imposed by Ofgem. The investment in the pipeline is no longer subjected to the risk of the regulator reneging on earlier committed performance-based regulatory contracts, for example related to allowed rates of return (this refers to behavioural uncertainty). After all, an exemption from TPA and regulation of access conditions is awarded. However, there may (nevertheless) be regulatory risk associated with unexpected interventions in operations due to fundamental changes in the context of the project (i.e. combination of uncertainty and opportunism). Compared with the implemented regulatory model, there is less socialisation of possible risks and losses associated with pipeline activities.

Allocative efficiency of the investment would be attained via the organisation of an open season. If functioning efficiently and effectively, an open season can lead to similar market outcomes as an auction. Allocative efficiency on the capacity market (LNG terminal and pipeline) could reduce compared with the implemented model (in which part of capacity is reserved for short-term allocation) dependent on the functioning of the secondary market and the effectiveness of the adopted use-it-or-lose-it mechanism applicable to both pipeline and LNG import terminal capacity. Regulation prescribes the implementation of these conditions when granting an exemption from regulated TPA. In this regulatory model, productive efficiency of the investment is encouraged through competition with other gas supply options to the UK market. There is competition for investment in new gas supply infrastructure to the UK, and, once realised, there is competition from other supply lines. This give rise to high static and dynamic productive efficiency. Compared with the implemented model, regulated incentives are replaced by market-based incentives. External effects related to the impact of new LNG supplies on market competition and diversification of gas supplies are accounted for when assessing the exemption conditions. In the implemented model this was applied for LNG terminal investment, whereas in this model it applies to the combined infrastructure: hence social efficiency does not increase or decrease.

Tender-based regulated investment

Another alternative regulatory model could involve a tender of the pipeline investment project. After signalling the need for investment in the Milford Haven pipeline in its capacity auctions, the TSO could (be required to) tender the investment. The company with the best bid would be awarded the exclusive right to build and own the infrastructure assets, while system operation could be transferred to National Grid. The bid should include a tariff structure and tariff levels for the period in which the cost of investment of the infrastructure would need to be recovered. Thereafter, the pipeline's tariffs could be regulated by the regulatory authority.

Competition in the bidding phase could lead to enhanced productive efficiency and lower tariffs in the initial period of recovering investment. In the event of limited or no private interest in building the project, the fall-back option would be to let National Grid undertake the investment under the standard regulatory model (which is the existing model). For this model to be a viable alternative in practice, the possible benefits should exceed its costs. Costs may include the cost of coordinating the tendering procedure and coordinating operations between different transmission owners and the system operator after the pipeline becomes commercial.

This regulatory model was briefly considered in an Ofgem review document considering reforms to the transmission investment framework: there *" ...may be considerable scope for competition in the building and maintaining of assets comprising the NTS under a common system operator"* (Ofgem, 2000b). Arguments against further exploring and implementing this option were the density of the network and the difficulties that may arise when needing to identify revenue streams for different transmission owners. However, this regulatory model has later been implemented in the case of realising electricity transmission lines for offshore wind project.

5.5 Conclusions

This section provides the conclusions following from the analysis of this case study by addressing four questions:

- What were the key regulatory objectives at stake in realising the project and which were the key concerns for the investor?
- What was the response of regulatory decision-makers in terms of regulation implemented?
- Which considerations (factors) led to this choice?
- Would an alternative response have been (more) appropriate, and if so, why was this not implemented?

The key regulatory objective in the case of the Milford Haven project is the facilitation of new investments in infrastructure that enables increasing gas imports to the UK gas market while protecting customers and improving the level of competition in the market where possible. For a private investor the key issues are the investment risks that are due to a combination of dedicated assets, environmental uncertainty and potential opportunistic behaviour with trading partners, and the required coordination with both the LNG terminals on the one hand, and the backbone infrastructure on the other.

The regulatory response to these objectives and concerns was the to let the regulated TSO undertake the investment under the default rTPA regime that allowed for substantially long long-term contracts (up until 17 years) to be sold (auctioned) and to partially socialize risks. The perceived transaction and regulatory costs associated with multiple companies investing in the national transmission network seem to have played a role in the choice of regulatory model for pipeline investments in the UK in general (Ofgem, 200a).

The physical characteristics of the pipeline project do not justify an rTPA approach. Because it concerns a dedicated forward flow pipeline that is not part of a backbone infrastructure (but rather a single extension of it) and has very limited external impact on the backbone infrastructure to which it is connected. The regulator did not perform an assessment on the scope of competition in realising new transmission pipelines in general or in the case of the Milford Haven pipeline in particular. Especially the aspect of dedicated assets would justify a competitive investment by the actors also involved in the LNG terminals that triggered the pipeline investment. A vertically integrated company investing and operating the LNG terminals and the pipeline would be considered to be subjected to competition from other gas supply projects to the UK.

Adoption of an alternative regulatory model that acknowledges the potential for private actor involvement in realising this project would lead to improved performance from both a private and public perspective, without compromising the positive external effects of the project on UK security of supply and the level of competition. Alternative regulatory models involving a larger role for unregulated, competitive expansion have not been seriously assessed and considered because the costs of coordinating different pipeline companies within one system were perceived to be too high.

6 Case 3: The Bergermeer gas storage facility

6.1 Introduction

This chapter presents the third case study: the Bergermeer gas storage project in the Netherlands. This project makes an interesting case study because of its key features. Firstly, large-scale gas storage as envisaged in the Bergermeer project has particular characteristics (economies of scale, high upfront investment costs) that may lead policy-makers to have the perception that it concerns a monopoly activity. Secondly, gas storage in general is associated with different regulatory objectives: it may for example enhance security of supply in a region, and has a role to play in efficiently delivering gas to final consumers (i.e. matching of demand and supply). Thirdly, the project, and especially the regulatory process that it was subjected to, has been relatively well-documented and accessible.

The objective of this chapter is to explain why this specific gas storage project was regulated the way it was: why were particular regulatory choices adopted and what were the underlying factors that led to them? In order to address this question the case study framework described in chapter 3 is applied. This involves an analysis of the perspective of both the regulator and the investor in this project. Key questions addressed are: what are the regulatory objectives of the regulator when deciding upon the regulatory model and making the key regulatory choices regarding this project? And: what are the investment risks for the investor, and which factors cause this risk? Answering these questions requires an assessment of the implemented regulatory choices. Such an assessment needs to illustrates, if, and to what extent, particular regulatory objectives were attained and private investment risks mitigated. This assessment then provides a starting point for an analysis of alternative regulatory choices: how would different regulatory choices affect ‘performance’ in terms of attaining regulatory objectives and addressing private investor’s investment risks? The answers to aforementioned questions will provide input for the synthesis analysis in Chapter 8.

Throughout this chapter the following terms related to the economic regulation of gas infrastructure are used. The term regulatory framework will be used to reflect the overall set of rules and regulations to which a company is subjected. It may relate to both rules and regulations at the EU level and the EU Member State level. The term regulatory choices is used to refer to single regulatory decisions made at the Member State level. In the context of this study this term is generally used to refer to regulatory choices that affect the expansion of gas infrastructure. Finally, the term regulatory model is used to refer to a set of regulatory choices that affect gas infrastructure expansion.

This chapter is organized as follows. Section 6.2 introduces the case study investment project to the reader by describing its technical features, the actors involved and the motivation for the expansion. Thereafter, section 6.3 discusses the regulatory framework applicable to this gas storage investment project, and describes how it was applied in practice. Section 6.4 contains the analysis part of this case study and addresses the key research questions mentioned in previous paragraph. Finally, section 6.5 summarizes the case study findings.

6.2 Description of the project

This section provides a description of the investment project analysed in this chapter. It consecutively deals with the technical features of the project, including aspect such as location and technical specifications (section 6.2.1), the motivation for investment (section 6.2.2), and the actors involved in its realisation and envisaged operations (section 6.2.3).

6.2.1 Technical features of the project

Since the end of 2010 preparations, are underway to develop a large-scale gas storage facility in the vicinity of the Dutch city of Alkmaar. This project is generally referred to as the Bergermeer storage project. The Bergermeer storage project is located in the Northwest of the Netherlands, close to the interconnection point of the Balgzand – Baction pipeline between the Netherlands with the UK.

The project comprises 14 new wells near the community of Bergermeer (west of the city of Alkmaar), and a 35 kilometre long underground pipeline from the wells to a gas treatment facility south of Alkmaar. The gas treatment facility is connected to an existing pipeline between a LNG peak shaving facility – already owned and operated by TAQA – at the south end of Alkmaar with the national gas transmission network. The gas storage facility is developed in a nearly depleted gas field and has a designed working gas capacity of about 4.1 BCM (TAQA, 2011).

The maximum send out rate of the facility would be about 57 million m^3 per day. This figure reflects the maximum amount of gas that can be extracted from the storage facility. The maximum injection rate is 42 million m^3 per day, which is the maximum volume of gas that can be put into the gas storage facility.

With its design capacity, the facility would, when realised, be one of the largest gas storage facilities in Northwest Europe. The investment costs associated with the project were projected to be around €800 million (TAQA, 2011), excluding the cost of acquiring cushion gas. The €800 million covers the adaptation of existing wells and the drilling of 14 new wells, the laying of pipelines between the wells and the gas treatment installation and the cost of the treatment installation itself (where gas is pressurized and made suitable for grid injection). The designed working gas capacity requires an amount of cushion gas of about 4.3 BCM to be permanently present in the facility (TAQA, 2011). The lifespan of the Bergermeer facility is 30 to 40 years. The investment cost associated with the cushion gas, which is required to maintain pressure in the reservoir during operations, is estimated at around €2 billion.

The final investment decision for the Bergermeer storage project was taken in October 2009 (TAQA, 2009). First construction works were initally planned for mid-2010, first drillings for 2011, and commercial operations in 2013 at the earliest. TAQA recived the final approvals and permits to constuct and operate the storage facility in May 2011. However, a formal procedure with the Dutch Council of State has been launched that appeals the granting of approvals and permits. The Dutch Council of State is the highest adminsitrative court in the Netherlands. This appeal procedure is the last phase in the permitting procedure. The appeals have delayed intialt planning though. First operations are now expected to commence in April 2014, involving only part of planned capacity, whereas full commercial operations are scheduled for April 2015. On December 19th, 2011, it was reported that TAQA secured its first three long-term contracts for storage capacity involving a total of 0.9 BCM (Argus, 2011). Customers include Statoil and Vattenfall; the third customer is unknown.

The next section turns to discuss the economic rationale behind the gas storage project.

6.2.2 Motivation for the investment

The main driver for the Bergermeer gas storage project is the need for storage capacity that can accommodate seasonal swings in gas demand in Northwest Europe. Demand for gas varies over time, creating daily, weekly and seasonal patterns. The seasonal variation across different demand sectors varies. Whereas gas demand in industry is relatively flat across the year, the gas demand in the residential sector especially is relatively large due to its use for heating purposes. In Northwest Europe the demand for gas in the residential sector can be about three times as high in a winter month as in a summer month.[46]

There are different ways in which the gas market can accommodate these swings in gas demand across seasons. For a given geographical market such as the Northwest European gas market, seasonal swing can be provided by:[47]

- Flexibility in local gas production;
- Flexibility in in pipeline imports (i.e. variation in gas production of exporting countries);
- Flexibility in LNG imports (i.e. variation in gas production of exporting countries);
- Gas storage facilities.

Traditionally the largest source of seasonal flexibility in Europe is indigenous gas production, mainly based in the Netherlands and the United Kingdom. With the depletion of indigenous sources, the market increasingly needs to rely on other sources of seasonal flexibility, such as imports and gas storage facilities. This trend is analysed by De Joode and Özdemir (2009). Using data on imports, production and the use of storage, they calculate the contribution of each source in bridging the 'summer'and 'winter' difference. The need for seasonal flexibility differs from one year to the other, mainly, due to changes in gas demand for heating purposes in winter months. De Joode and Özdemir (2009, 2010) assess the future need for seasonal gas storage and conclude that there is a substantial need for investment in new gas storage facilities in the period until 2020 in specifically the

[46] The difference between summer and winter demand is much larger when considered on a daily basis. The figure cited here is based on IEA monthly gas demand data.

[47] For flexibility on a daily basis, a number of additional sources may be considered (De Joode and Özdemir 2009).

Northwest European region.[48] They conclude that compared to the amount of storage capacity present in 2009, an additional 17 and 20 BCM (cummulative) of gas storage working gas capacity needs to be added by 2015 and 2030 respectively in a scenario with only relatively little growth in gas demand. Their assessment confirms that a relatively larger share of seasonal flexibility will need to be provided by gas storage facilities. The investors behind the Bergermeer project cite the future spread between summer and winter gas prices as being the main intrinsic value driver. This spread reflects the demand for seasonal flexibility (TAQA, 2011).

6.2.3 Actors

The initiator behind the Bergermeer project is TAQA Energy BV, a full subsidiary of the Abu Dhabi National Energy Company based in Qatar. The project was initially developed by a consortium consisting of TAQA, Energie Beheer Nederland (EBN), Dyas BV and Sunco, but both Dyas and Suncor sold their shares in the project to TAQA by August 2010 (TAQA 2010). Since the sale, TAQA and EBN hold a share of 60% and 40% respectively. EBN is a Dutch gas company of which all shares are owned by the Dutch State[49] and is responsible for a number of public tasks as specified in the Dutch Mining Act. Their public tasks include the participation in gas and oil exploration and production, participation in production-related activities such as the offshore transport of gas and oil and carrying out tasks related to the functioning of the Dutch public private partnership regarding the exploitation of natural gas.[50]

The storage facility will be operated by TAQA. Gazprom Export, the Gazprom subsidiary responsible for its exports, is a third partner in the project as it delivers the

[48] In the study of De Joode and Özdemir (2009, 2010), the Northwest European region refers to the countries of Belgium, Denmark, France, Germany, Luxembourg, Ireland, the Netherlands, and the UK.

[49] The Minister of Economic Affairs, Agriculture and Innovation (formerly the Minister of Economic Affairs) is the formal representative of the State for EBN.

[50] EBN holds a 40% share in Dutch gas company GasTerra. Other shareholders of GasTerra include Shell (25%), Exxon Mobil (25%) and the Dutch State (10%).

cushion gas. In return, it receives working gas capacity[51] and a participating interest in the technical operator of the field (TAQA, 2009). The remainder of capacity rights will be allocated to the market via auctions.

6.3 Description of the regulatory framework and regulatory choices[52]

This section presents the regulatory framework that applies to the Bergermeer gas storage project and presents how the framework was applied in the case of this project. This includes a summary of regulation on both the EU and member state level. The section is organized as follows. Section 6.3.1 and section 6.3.2 respectively describe the relevant key regulatory choices on the EU and member state level (i.e. the Netherlands). Section 6.3.3 describes how regulatory authorities applied the EU and national regulatory framework in the case of the Bergermeer project. Section 6.3.4 summarizes the key regulatory choices pertaining to the Bergermeer investment project.

6.3.1 Gas storage regulation in the EU

According to the second Gas Directive (EC, 2003a), gas storage activities needed to be functionally and administratively unbundled from other gas market activities on a functional and administrative basis. The third Gas Directive (EC, 2009a) went one step further and imposed legal unbundling: according to EU legislation, gas storage activities need to be legally unbundled from competitive gas market activities (production, trade, retail). EU legislation requires TPA regulation of gas infrastructures, including gas storage facilities, but Member States are allowed to choose between negotiated and regulated TPA.[53] As in the case of pipeline expansion, EU legislation provides the option of

[51] No formal communication about the actual share of Gazprom Export in total work gas capacity has been released, but a share of about 50% is mentioned in a news article published by Platts (2011).

[52] It should be noted that at the time of publication of this study, the Bergermeer project was not yet realised. This implies that possible further actions from the part of the project initiators or the involved regulatory authorities cannot be ruled out. Any further adaptations made to the regulatory choices as described and assessed in this chapter are thus not covered.

[53] Under regulated TPA the access conditions are regulated: gas storage users pay a regulated tariff for gas storage services acquired. Under negotiated TPA access conditions are under the

exempting gas storage expansion from TPA requirements. The envisaged impact of an exemption is a stronger incentive for investments in all types of gas infrastructure projects, including (seasonal) gas storage facilities. Until 2011, the EC had not awarded any exemptions to gas storage investment projects, but only to LNG and pipeline investment projects. However, in June 2011an exemption was granted to a low capacity, high deliverability storage facility in the Czech Republic (EC, 2011a).[54]

6.3.2 Gas storage regulation in the Netherlands

EU legislation on gas storage (i.e. the Gas Directive) is transposed in the Dutch Gas Act[55]. The basic regime for gas storage investment and operations involves negotiated third party access (nTPA) regime (as defined in Article 18 of the Gas Act), with a further distinction between a ‘strong’ (Article 18a-18f) and ‘light’ regime (Article 18g), and the possibility for the relevant government authority to award an exemption from overall nTPA regime (Article 18h). In addition, an exceptional status is awarded to gas storage facilities that wholly or partly function as so-called ‘additional production facilities’. The scope for acquiring this exceptional status is given in Article 1f of the Gas Act and more elaborately described in DTe (2002). A description of the for this study relevant elements in Dutch gas storage legislation is provided below.

Negotiated third party access

Where EU legislation allows for a choice between regulated and negotiated TPA, Dutch legislation adopts negotiated TPA with a ‘light-handed’ and ‘heavy-handed’ variant. The regulatory authority argues that gas storage companies may have a strong economic position in the market but that gas storage is not to be considered a natural monopoly (DTe, 2002). In its most recent and still valid gas Storage Code (DTe, 2002), the regulatory

supervision of regulatory authorities but tariffs for the provision of gas storage services are negotiated between the storage operator and the customer.

[54] For a list of exemptions granted to gas infrastructure expansion projects we refer to the website of the Directorate-General for Energy: http://ec.europa.eu/energy/infrastructure/exemptions/exemptions_en.htm (last accessed: 20-05-2012).

[55] The most recent version of the Dutch Gas Act is available at: http://wetten.overheid.nl/BWBR0011440/ (last accessed: 20-05-2012)

authority notes that although the number of suppliers of gas storage services in the Netherlands is small there are at least two reasons why the market should not be considered a natural monopoly. Firstly, there are opportunities for new entrants to enter the market in the medium and long-term. Secondly, there are other instruments for delivering the type of services offered by gas storage facilities effectively compete with gas storage services. These instruments include, according to the regulatory authority, flexible gas supply contracts, storage services acquired abroad and line pack (i.e. short-term storage in pipelines). This leads to the view that gas storage facilities are not considered to be natural monopolies per se, but may have some degree of market power in the short term (DTe, 2002).[56]

Based on this line of argumentation, the Gas Act distinguishes between gas storage companies with a strong economic position in the market and gas storage companies without a strong economic position (i.e. operating in a competitive market). The former are reflected in Articles 18a-18f of the Gas Act, the latter in Article 18g.[57]

In the Dutch regulation, the nTPA regime implies that the regulatory authority determines the starting conditions for negotiations by approving indicative tarrifs and conditons for access (DTe, 2002). Thereafter, negiations between users and storage service providers determine the actual gas storage contracts. The Gas Storage Code also specifies the general of provisions of the Gas Act. The most recent Gas Storage Code was published in August 2002 (DTe, 2002) and remains applicable until a new Gas Storage Code is adopted.

The Dutch Gas Storage Code[58]

The main purpose of the Gas Storage Code (DTe, 2002) is to mitigate the possible asymmetry in bargaining power between the gas storage company and its customers when negotiating access conditions. The Code contains provisions concerning the process and the contents of negotiations. These are discussed below.

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[56] In Dutch: "*De gasopslagbedrijven worden [...] beschouwd als economische machtspositie en niet als natuurlijk monopolie*" (DTe, 2002).

[57] A heavy nTPA regime is also applicable in cases where gas storage companies have a special license under the Mining Act.

[58] In Dutch: 'Richtlijnen gasopslag'.

Regarding the process, storage companies are obliged to publish indicative tariffs and conditions for the next calendar year ultimately by the 1st of July of the preceding year. In setting the indicative tariffs and conditions, gas storage companies are required to consult representative organisations (of market parties). Gas storage companies may invite other parties or stakeholders in this consultation process as well. In both the consultation and the publication of indicative tariffs and conditions, all elements that are mentioned in the Gas Storage Code need to be covered. Market parties that consider the published indicative tariffs and conditions to be insufficient or incomplete, given the provisions contained in the prevailing Gas Storage Code, can request the regulatory authority to provide a binding recommendation to the storage company in question. The regulatory authority can also autonomously test whether Gas Storage Code have been sufficiently implemented.

Dutch gas storage regulation requires gas storage owners and operators to sell gas storage services on a non-discriminatory basis with negotiated access conditions. Storage companies are allowed to sell so-called standard service contracts or tailor-made service contracts. Regarding the type of contracts sold, gas storage companies are required to sell short-term gas storage services involving at least capacity contracts for one and 12 months. Other types of short-term service contracts such as day, week or quarterly contracts are allowed but not required. Regarding long-term gas storage services, gas storage companies are required to offer bundles of 12 month contracts, with a maximum contract duration of 60 months (i.e. 5 years). The Gas Storage Code does not dictate the use of fixed shares of available storage capacity in different type for contracts (i.e. short vs. long-term) because this could unnecessarily restrain the market: it could become a barrier tor new market entrants and thus to competition at a later point in time. The Gas Storage Code explicates a number of gas storage service contract clauses that are prohibited, for example clauses that violate the non-discriminatory access to available capacity. In addition, provisions are included that aim to facilitate the trading of storage services on a secondary market. The Gas Storage Code does not specify the use of a specific capacity allocation method: this is free for market parties to decide. The regulatory authority periodically monitors the development of competition and market liquidity.

Special regime for 'additional production facilities'

Although all Dutch gas storage facilities essentially need to provide nTPA to all customers for full capacity there is an important derogation defined in the Gas Act and the Gas Storage Directives regarding three gas storage facilities (Norg, Grijpskerk, and Alkmaar) which are operated by NAM and TAQA. The Gas Act specifies that TPA is required only for the part of capacity that is not used for so-called 'production activities' (Article 1, sub f). The term production activities is not defined in the Gas Act, but has been interpreted by the regulatory authority as referring to the activities needed to secure the supply of gas to 'protected consumers' (which basically refers to the consumers in the residential sector) and to optimally accommodate gas supplies from the Dutch small fields. Based on Büro für Energiewirtshaft und Technische Planung (2002) the Dutch regulatory authority decided that initially only a third of capacity in aforementioned storage facilities would need to be made available for third parties. This 'reservation' related to a particualr public service obligation for gas supplier Gasunie (the trade and supply division that, since ownership unbundling of Gasunie in July 2005, have been operated by GasTerra). According to this obligation, Gasunie is the supplier of last resort for protected consumers. However, irrespective of the legal position, the services provided by the additional production facilities are, from a technical and economic perspective, similar to the storage services delivered by other facilities such as the proposed Bergermeer storage facility.

Exemption regime for gas storage facilities

Article 18h of Dutch Gas Act specifies the conditions under which a new gas infrastructure can be exempted from the tariff and access regulatory provisions in Articles 12-20. The scope of this article includes gas storage facilities. The specified conditions are directly transferred from relevant EU Gas Directive Article (EC, 2009a).

6.3.3 Application of regulation to Bergermeer

This section continues by assessing how the legal and regulatory framework has been applied to the Bergermeer project.

Request for informal opinion on regulatory status

Being the first seasonal gas storage project to be developed in the Netherlands since the start of the liberalization process, it was important for the inititators of the Bergermeer project to gain insight in the interpretation of the prevailing legal and regulatory framework in the Netherlands for the Bergermeer context. In a letter to the Dutch regulatory authority DTe, TAQA inquired what DTe's informal position was on the future regulatory regime applicable to Bergermeer. The central question, as interpreted by DTe, was: would the realisation of the Bergermeer facility give TAQA a dominant economic position in the (relevant) market? Having a dominant economic position in the market is the single most important determinant for the choice between a light-handed and a heavy-handed[59] nTPA regime. In its informal view on this issue, DTe (2007a) argued that Bergermeer would be subjected to the light nTPA regime. A heavy handed nTPA regime would not be applicable since the gas company does not seem to have a dominant economic position in the relevant market.[60]

A more technical exposition underlies this general, informal view (DTe, 2007a). In judging whether TAQA onshore BV, or its holding company TAQA Energy BV, have a dominant economic position in the (relevant) market, the regulatory authority included in its informal opinion paper the existing gas storage facility operated by TAQA Piek Gas BV in Alkmaar. Via the holding company TAQA Energy BV, the initiating company behind the Bergermeer storage facility, TAQA Onshore BV is organizationally related to TAQA Piek Gas BV. TAQA Piek Gas BV has a special license under the Mining Act and is thus considered a gas storage company with a dominant economic position. The Alkmaar gas storage facility is therefore subjected to the heavy-handed nTPA regime. Given this context TAQA requested the regulatory authority to address two particular questions concerning the regulatory regime for the Bergermeer storage facility:

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[59] The light-handed and heavy-handed regulated nTPA regimes were earlier defined in Section 6.3.2.

[60] Nor does it hold a special license under the Mining Act, which would be the other situation where a heavy-handed nTPA regime would be applicable.

1. Do the activities of TAQA Piek Gas BV, which has a dominant economic position in its respective market, affect the activities of TAQA Onshore BV?
2. Does TAQA Onshore BV have a dominant economic position with the Bergermeer gas storage facility?

Ad 1:TAQA Piek Gas BV activities do not affect TAQA Onshore BV activities

If the Bergermeer storage facility would aim to serve the same market as Alkmaar storage facility, then the same heavy-handed nTPA regime would automatically apply to the Bergermeer storage facility. Based on information submitted by TAQA, the Dutch regulatory authority concluded that the Bergermeer and Alkmaar storage facilities would not be part of the same (relevant) product market. The Alkmaar storage facility is a *peak-shaving* facility for *low* calorific gas (L-gas), whereas the Bergermeer storage facility is a *seasonal gas storage* facility for *high* calorific gas (H-gas). The regulatory authority takes the position that the market for low calorific gas storage services is different from the market for high calorific gas storage facilities and that the function of the Alkmaar facility, being a peak-shaving unit, is different from the seasonal flexibility providing function of the Bergermeer facility. This implies that the Bergermeer facility is not automatically subject to the same regime as the Alkmaar facility.

Ad 2: TAQA Onshore BV is not expected to obtain a dominant economic position

The conslusion drawn above still leaves the question whether TAQA Onshore BV would have a dominant economic position in the relevant market (i.e. the market for seasonal gas storage services). The regulatory authority observed that at the moment of the request, it was unlikely for the Bergermeer storage facility to have a market share that could lead to a dominant economic position in the relevant market. This would hold if the relevant geographical market were narrowly defined (including only physical storage capacity in the Netherlands and Germany) and the availability of import capacity was assumed to be limited.

Would Bergermeer qualify for an exemption from TPA?

Neither TAQA, in its request for a informal opinion on the regulatory status for Bergermeer, nor the regulatory authority, in its response, mention the possibility of an exemption from nTPA. In a press release accompanying the publication of its informal opinion, the regulatory authority observes that TAQA and its Bergermeer investment project prove that investments without exemptions from relevant Gas Act provisions are indeed possible (DTe, 2007b). Judging from the criteria provided by the Gas Act, it can not be stated ex ante that the project would not qualify for an exemption from TPA. If the project could indeed be eligible, the question is: why has this option not been pursued?

Request for informal opinion on cooperation agreement

Apart from the concerns regarding the regulator's view on the economic position of the proposed facility, TAQA also had concerns about how the regulatory authority would interpret a specific cooperation agreement with Gazprom Export BV. According to the Dutch regulatory authority, TAQA, in a letter dated April 29, 2009, requested the Dutch regulatory authority to give its opinion regarding three questions related to a cooperation agreement considered by TAQA and Gazprom Export BV in the context of the Bergermeer project (DTe, 2009). The considered cooperation agreement includes the development and operation of the proposed gas storage facility. The basic agreement entails a trade of storage capacity rights in return for the supply of cushion gas. The three questions posed by TAQA were:

1. Is it correct that Gazprom Export in the context of the proposed cooperation agreement will not be considered a gas storage company as defined in the Gas Act?
2. Is it correct that Gazprom Export consequently cannot be obliged to provide third parties access to the gas storage capacity, acquired in return for the supplied cushion gas, under Article 18a-g of the Gas Act?
3. Assuming that gas storage facility Bergermeer has no dominant economic position in the relevant market, is it then correct to state that the process as described in TAQA's request for informal opinion, sufficiently deals with the requirements from Article 18g of the Gas Act, and in particular Article 18g(3)? [61]

The response of the regulatory authority to these questions is briefly summarized below.

[61] Article 18g(3) refers to the use of objective, transparent and non-discriminatory tariffs and conditions for gas storage access.

Ad 1:Whether Gazprom Export will be considered a storage company depends on actual behaviour

Regarding the first question, the regulatory authority notes that the Gas Act defines a gas storage company as any entity that operates a gas storage installation. The relevant question is thus whether Gazprom Export manages the Bergermeer facility. The Gas Act requires the registration of the managing entity with the relevant government authority (in 2009 this was the Ministry of Economic Affairs). According to TAQA the operation of the facility will be done by TAQA Onshore BV. The regulatory authority states, however, that it is not the formal registration that determines whether a gas company is indeed considered to be managing the facility, but rather the actual behaviour. This leads the regulatory authority to observe that in order for Gazprom Export not to be considered gas storage company under the Gas Act, it must refrain from actual behaviour that could be interpreted as operating the gas storage facility. Although the regulatory authority has no ground to expect that Gazprom Export could and would do so in the future, it does comment on the arrangement proposed by TAQA in which Gazprom Export receives a participating interest in what TAQA defines as, the technical operator of the facility. This participating interest gives Gazprom Export, via a so-called 'operating committee' influence in a gas storage decision-making body. Although the regulatory authority shows understanding for the rationale of the particular construction (i.e. the high operating costs which Gazprom Export partly incurs and the large committed cushion gas volume), it stresses that the organizational structure to be adopted for the Bergermeer facility must be such that there is no reason to believe that based on actual behaviour Gazprom Export can in the future be considered a gas storage company as defined in the Gas Act.

Ad 2: No TPA obligation on Gazprom Export is imposed as long as it is not considered to be a storage company (see Ad 1)

Regarding the second question, the regulatory authority points to the earlier published informal opinion of 2007 regarding the regulatory regime applicable to the Bergermeer storage facility (DTe, 2007a). Therein the regulatory authority stated that it considered it unlikely for Bergermeer to have a dominant economic position in the relevant market. This means that Article 18g describing the 'light' nTPA regime would be applicable and not the heavy-handed nTPA regime of Article 18a-18f. Treatment under the latter heavy-handed regime can only be triggered if gas storage capacity rights holder Gazprom Export indeed is involved in operation of the storage facility.

Ad 3:Thus far DTe has no reasons to believe that Article 18g requirements are not sufficiently dealt with

The regulatory authority assumes that in its third question TAQA refers to the process that led to the trading agreement with Gazprom Export concerning the gas storage capacity rights and the cushion gas delivery. The regulatory authority underlines that it is not in a position to judge over adopted methods in an informal opinion and that an informal opinion can only clarify the relevant legal framework. Article 18g requires gas storage companies to negotiate access with third parties (Article 18g(1)), resulting in objective, transparent and non-discriminatory tariffs and conditions related to access to the gas storage facility. In the case of Bergermeer, this has apparently led to a contract that allocates a considerable share of storage capacity to Gazprom Export. It is up to the operators of the storage facility to decide whether this serves the commercial interest of the gas storage company. The regulatory authority does point to the important requirement of imposing a use it or lose it mechanism to capacity that was allocated to the market in an earlier stage but remains unused. The regulatory authority observes that such a mechanism is indeed proposed by TAQA, but also notes that it needs to be expanded in more detail. Furthermore, the regulatory authority points out that future European (and thus national) legislation may involve stronger requirements regarding the use of available gas storage capacity. It concludes that based on the information submitted by TAQA it does not have reasons to believe that the capacity negotiation process and resulting tariffs and conditions are not conform relevant Gas Act provisions.

Application of the Planning Act in the case of the Bergermeer project

The complexity of multiple planning and permitting procedures is considered an important barrier for the timely realisation of large large infrastructure projects in the energy sector (EC, 2010a). For example, projects often require multiple permits from different government authorities. The Dutch government argued that the negative impact of such processes, in terms of costs and time, needs to be mitigated in cases where there is a national interest at stake. This resulted in the adoption of a regulation on the coordination of large energy infrastructure projects of national interest (*'Rijkscoördinatieregeling'* in Dutch), which came into effect in March 2009. This regulation, which is part of the Spatial Planning Act, required an adaptation of the Gas, Electricity and Mining Act. It allows a simultaneous, coordinated process for all planning and permitting procedures related to a particular energy infrastructure project. If the project is considered to be of national interest, this process is led by the Ministry of Economic Affairs, Agriculture and Innovation (and formerly with the Ministry of Economic Affairs). This regulation has been applied to the Bergermeer gas storage project.[62] Its application is somewhat controversial since one of the local communities opposes realisation of the project but is effectively bypassed with the application of this *'Rijkscoördinatieregeling'*.

Final investment decision

The final investment decision for the Bergermeer gas storage project was announced on October 21st, 2009. In its press release (TAQA, 2009), TAQA states the expectation that commercial operations of the storage facility will commence in 2013. It also confirms the earlier mentioned deal with Gazprom Export: Gazprom Export delivers cushion gas in return for gas storage capacity and a participation in the 'technical operator of the facility'.

The next section describes the regulatory decisions that were explicitly or implicitly made in the case of the Bergermeer storage facility.

6.3.4 Description of regulatory choices

This section briefly describes the key regulatory choices for the investment project of Bergermeer. It summarizes the regulatory framework at large, and its application in the case of Bergermeer contained in the previous sections. This section does not aim to explain these implemented choices but rather provides a starting point for the analysis of choices that is provided in the next section (section 6.4). This section is organized according to the key regulatory choices as defined in the case study framework. These were the type and degree

[62] All information and documents related to the application of the Planning Act in case of Bergermeer are available at: http://www.senternovem.nl/Bureau_Energieprojecten/Opslagprojecten/Gasopslag_Bergermeer/vergunningenmatrix.asp (last accessed 20-05-2012).

of competition, the type and degree of vertical integration between gas storage activities and other activities in the gas value chain, and the role for long-term arrangements.

Type and degree of competition

The Dutch approach to gas storage expansion in the case of the Bergermeer storage facility can be characterised as a competitive market approach. It is a light-handed regulatory approach with the market to determine necessary capacity, and the regulatory authority only safeguarding a level playing field on the gas storage market. All market parties are allowed to invest in gas storage (conditional on respecting the unbundling requirements). There is no central coordination of the volume of gas storage capacity in the long-term. The Dutch regulatory framework for gas reflects the idea that the market can deliver the required amount of gas storage investment and that competition can deliver these investments in a timely and efficient manner. The Dutch regulatory framework contains provisions that may further strengthen investment incentives, notably via an exemption from TPA. The main rationale behind the implemented regulatory provisions is to mitigate the possible negative impact that the uneven negotiating positions between gas storage companies and gas storage customers may have on tariff and access conditions.

Type and degree of vertical integration between gas storage and other activities

Being developed by a joint venture of EBN and TAQA, the Bergermeer storage can be viewed as a public private partnership, since EBN is fully government owned. The energy company TAQA is a global energy player with interests in exploration, production and storage. In the Netherlands, TAQA Energy BV has gas and oil production assets (which were acquired from BP in 2007), and owns and operates the gas peak-shaving facility near Alkmaar. The Bergermeer storage facility will be operated by separate business unit TAQA Onshore BV. This implies a legal unbundling of trande and production activities from storage activities.

Gazprom Export is a wholly owned subsidiary of Gazprom and acquired a substantial, but unknown, share in storage capacity once the facility is realised, in return for a ‘participating interest’ in technical operations. This raises the issue of a possible conflict of interest. Theoretically, Gazprom may use its influence in technical operations to reduce storage capacity availability for its competitors. This possible issue of conflict of interest was also raised by the Dutch regulatory authority in its informal opinion on the cooperation agreement between TAQA Onshore BV and Gazprom Export. The actual organizational and decision-making structure of the Bergermeer storage facility is still unknown at the beginning of 2012. It therefore remains unclear how the parties will manage the possible conflict of interest between the legal requirement for TAQA to be an independent gas storage company and Gazprom's need to have some sort of control as a reward for its substantial investment in the provision of cushion gas. Another issue is the degree of integration between the different functions related to the facility. These roughly concern the ownership, technical operation, and the commercial operation of the facility. The possible conflict of interest in the role of Gazprom could possibly be resolved by letting Gazprom Export participate in the ownership but not in the technical and commercial operation of the facility and legally unbundle ownership and (technical / commercial) operation. However, this may trigger problems with respect to the EU's reciprocity ruling that included in the third Gas Directive. This ruling extends the unbundling requirements for infrastructure and trading / production activities to EU external companies, such as Gazprom. In order for subsidiary Gazprom Export to have a participation in gas storage ownership it would need to be unbundled from its parent company Gazprom according to EU unbundling requirements. The reciprocity ruling is controversial and has not been tested in practice yet.

Scope of long-term arrangements

In the case of the Bergermeer project, the driver for investment is the spread in summer and winter gas prices in Northwest Europe in general, and the Netherlands in particular (TAQA, 2011). The investment is to be recovered from the revenues generated from selling available storage capacity.

It is more difficult to legally interpret the proposed cooperation agreement between TAQA and Gazprom Export. The cooperation agreement can be seen as a risk mitigation instrument for TAQA. In return for the long-term sale of storage capacity, TAQA does not need to purchase cushion gas, which is very costly for large-scale storage facilities. The remainder of the storage capacity can now be used to cover the cost of the facility itself, without the cost of cushion gas. Gazprom Export on the other hand uses the Bergermeer gas storage project to increase its gas supply position in Northwest Europe. The long-term capacity rights in the facility help it to optimize its portfolio of delivery contracts in this region of Europe, especially in winter.

Summary of key regulatory choices

The regulatory choices in the case of the gas storage facility Bergermeer can be summarized as follows:

- Gas storage is subject to negotiated third party access (nTPA) and an exemption from nTPA may be awarded if exemption criteria are met;
- The Bergermeer project did not apply for an exemption and is thus subject to nTPA;
- Legal unbundling of storage and other gas market activities is required;
- The Bergermeer project is developed by a consortium of one private and one public company;
- There is no organisational link between the consortium members and the owner or operator of the pipeline network to which the Bergermeer storage facility is connected;
- Long-term storage capacity contracts are allowed if allocated on a non-discriminatory basis;
- Capacity will be allocated to the market via short and long-term auctions;
- Cushion gas investment is secured via a long-term arrangement with Gazprom export: cushion gas is delivered in return for a share of long-term capacity rights.

The next section provides an analysis of the regulatory choices implemented in the Bergermeer case using the case study framework described in Chapter 4.

6.4 Analysis

6.4.1 Introduction

This section aims to analyse the regulatory model adopted in the case of the Bergermeer gas storage facility from both a private and public perspective using the framework described in Chapter 4. From a private perspective it is important that the implemented regulatory model allows the investor to sufficiently deal with investment risks associated with the project. From a public perspective the regulatory model should contribute to the achievement of regulatory objectives. Trade-offs need to be made in deciding upon the regulatory model to be applied. This section makes an effort to uncover the trade-off made in the context of the storage facility Bergermeer.

The structure of this chapter is as follows. Section 6.4.2 describes the characteristics of the project from a private and public perspective. Section 6.4.3 analyses the regulatory model implemented by describing the regulatory objectives at stake, analysing the choice or regulation and its underlying considerations, and evaluate its performance. Section 6.4.4 analyses whether alternative regulatory models could have been implemented that would lead to improved performance from either private or public perspective.

6.4.2 Description of investment project characteristics

Inherent characteristics of the Bergermeer facility influence the choice of regulation on two aspects. Firstly, project characteristics, including transaction characteristics, determine the type and level of investments risks to which the investor is exposed. For the project to go ahead, an implemented regulatory model should take into account private investor's concerns and allow the investor sufficient instruments to mitigate investment risks. Secondly, the project in combination with its environment (i.e. the context of project investment) may give rise to positive or negative external effects. Depending on its objectives, a regulator may want or need to take these into account when making regulatory choices. This section discusses the key characteristics of the Bergermeer storage project by referring to the concepts of asset-specificity, uncertainty, transaction complexity and external effects.

Asset-specificity

Investment in gas storage facility Bergermeer is highly asset-specific: the gas storage assets are physically and site specific, and may be temporal specific. This is illustrated below.

Gas storage assets are physically asset-specific as assets deployed in gas storage are made suitable to deal with only a narrow range of gas qualities. A broader range of gas qualities can be accommodated after investment in adaptation of assets. Existing gas storage facilities may in the future be capable of storing alternative gases such as hydrogen or CO_2, which would again require unknown adaptation costs.

Gas storage assets are highly site specific. Site characteristics above and underground to large degree affect the cost of investment and influence the choice of location. Once realised, the cost of recovering and relocating assets is prohibitively high, implying high immobility of assets deployed.

In addition, gas storage facilities show some properties of temporal specificity. Assets are temporal specific when their value is dependent on the timeframe within which the transaction needs to be provided. In the case of gas storage, assets are in particular of value when there is a need for the storage facility to be deployed, for example for price arbitration. Non-timely use of the gas storage assets may considerably reduce the value of assets. This also applies to the Bergermeer facility that aims to accommodate (and profit from) seasonal variations in gas demand. The gas storage facility Bergermeer does not involve dedicated assets used in accommodating a transaction between a specific buyer and seller. The storage facility is of interest to a wide range of gas market actors (gas producers, gas traders, large-consumers).

Uncertainty

The economic lifetime of the Bergermeer seasonal gas storage project is 30 to 40 years – and technical lifetime may be larger. The investor needs to recover upfront investment costs in specific assets during this period. The value of the overall investment depends on a variety of uncertain developments. The key uncertainties in assessing the future value of deployed of gas storage assets are the demand for gas in the energy system, and the need for flexibility in accommodating gas demand. The future role of gas in the energy system is uncertain, with uncertainty increasing over a longer time horizon. The position of gas-based technologies versus competing end-user technologies may increasingly be challenged in sectors as the electricity generation sector and the residential sector. Seasonal gas storage facilities such as Bergermeer compete on a larger market for flexibility services, implying uncertainty about the actual demand for its gas storage services. On the relevant geographical market for seasonal gas storage services, the Bergermeer facility competes with numerous other facilities in the Netherlands and neighbouring countries. The higher level of competition for a given volume of flexibility, ceteris paribus, decreases the value of

Bergermeer storage assets. An upside risk for the investor is the frequency and severity of failures in the delivery of gas to the market. This temporarily increases demand for the type of flexibility that can be delivered by the storage facility and provides additional rents for the owner of the facility (or its capacity right holders). Finally, the gas storage market may be subjected to uncertain and unexpected changes in applicable regulation. This may negatively (or positively) affect the market value of Bergermeer gas storage assets.

Need for coordination

The market value that Bergermeer gas storage assets have in the gas market, depends on the availability of sufficient pipeline capacity to accommodate storage inflows from gas supply sources (at times of little need for gas / low gas prices), and on the availability of sufficient pipeline capacity to accommodate storage outflows to regions and customers in need for additional gas (at times of high gas demand / high gas prices). Availability of sufficient infrastructure capacity concerns a direct pipeline connection from the Bergermeer facility to the national transmission network and possible deep network investment elsewhere in the system. The latter type of investment can be located in the Netherlands or on cross-border connections with neighbouring countries. An optimal integration of gas storage Bergermeer requires a coordination in capacity expansion and coordination in making capacity commercially available to the market.

Barriers to investment

The characteristics of the Bergermeer project (high asset-specificity, fundamental uncertainty over future market value, need for coordination of transactions) give rise to a specific set of investment risks for the investor. These are described below.

1. <u>Risk of not recovering investment costs (i.e. price and volume risk of investment)</u>
   Underutilization of the storage facility due to lower than expected demand or larger than expected degree of competition may result in upfront costs not being recovered. The risk exists that the cost of the storage facility exceeds its market value.
2. <u>Risk of insufficient coordination with the national transmission infrastructure</u>
   There are three types of coordination issues. Firstly, there is the risk that the direct pipeline connection is realised after completion of the storage facility, resulting in

underutilization of the facility. Secondly, there is the risk that required deep network investments are realised after completion of the storage facility, resulting in underutilization of the facility or lower market value of the facility. Thirdly, there is the risk of insufficient access to network capacity or unavailability of capacity rights (contractual congestion) for the users of the storage facility.

3. Risk of opportunistic behaviour of actors involved

   The dependency on sufficient capacity availability in the backbone infrastructure to which the storage facility is connected may lead to opportunistic behaviour from the owner of the backbone infrastructure that can result in a capture of rents acquired with gas storage operations.

4. Regulatory risk

   The project is subjected to regulatory risk. Unanticipated behaviour or intervention in the gas market may negatively affect the market value of the gas storage investment.

External effects of the project

Physical characteristics and the context of the investment project give rise to two external effects in the area of gas market competition and security of supply. Firstly, realisation of the Bergermeer gas storage facility increases the level of competition on the flexibility market. Secondly, it increases the availability of storage capacity for (new) market participants, and thereby facilitates competition on the wholesale and retail markets.

Furthermore, the Bergermeer storage facility has a positive external effect on the level of security of supply in North-western Europe, and in particular in the Netherlands. The project would increase the amount of storage capacity with 78% and increases peak supply capacity by an additional 57 million m^3 per day. The project therefore contributes to a more robust gas infrastructure system that is capable of effectively dealing with a range of potential security of supply incidents.

The next section (section 6.4.3) will analyse the regulatory model implemented in the case of Bergermeer. The analysis includes an evaluation of the performance of the regulatory model from both a private and public perspective. The list of issues for the investor will be used to evaluate the performance from a private perspective whereas the external effects may be taken into account by the regulatory authority when it comes to achieving regulatory objectives.

6.4.3 Analysis of the regulatory model

This section analyses the implemented regulatory model from both a private and public perspective. It starts by describing the regulatory objectives at stake and the trade-offs involved. Thereafter, an analysis of the key regulatory choices and their underlying considerations (e.g. project characteristics, exogenous factors) is performed. Then the performance of the regulatory model in terms of investor's concerns being addressed and regulatory objectives being attained is evaluated according to the case study framework presented in chapter 4. Finally, the consistency of implemented choices with theory is discussed.

Description of regulatory objectives

Dutch gas market policy is characterised by three public objectives, namely achieving an affordable gas supply system, a high level of gas security of supply, and a strong contribution of gas sector activities to the Dutch economy. The objective of achieving an affordable gas supply system is translated into a regulatory objective of facilitating and improving the level of competition in the market where possible, and stimulate efficient market behaviour in segments where inherent market incentives to do so are low (such as in network operations). Security of supply may be translated into a capacity adequacy objective for the infrastructure system as whole. Finally, the Dutch government aims to strengthen the position of the Dutch gas sector in order to maximize resulting economic benefits (Ministerie van Economische Zaken, Landbouw en Innovatie, 2011; The Brattle Group, 2010).

In the case of Bergermeer, the key decision on the type and degree of competition in the market for gas storage is reflected in the Dutch Gas Act and regulation of gas storage activities were further specified in the Dutch gas storage code prepared by the regulator. The explicit objectives of Storage Code were to improve the functioning of the market for storage and flexibility and to improve the investment climate. In preparing this regulation the regulator had to respect the overall objectives of facilitating competition on the gas market and encouraging efficient market behaviour of gas infrastructure companies and users.

In practice, when assessing the regulatory framework for Bergermeer investment and the regulatory procedure followed, it seems that initially, encouraging gas market competition and efficient market behaviour have been the key regulatory objectives. Only when the project encountered delays due to permitting issues as a consequence of a lack of local acceptance did the Ministry express concerns related to capacity adequacy and importance of storage realisation for gas hub development. This led to the implementation of a government instrument to ease realisation of projects of national interest.

The regulatory process did not clearly show conflicts between particular regulatory objectives. The presumption was that investment in new storage capacity can be realised in a competitive market. This supposes that there is no trade-off between strengthening long-term investment incentives on the one hand and encouraging short-term access to capacity and competition in the market on the other.

Analysis of regulatory choices

What have been the key regulatory choices in the case of the Bergermeer storage project and what were the arguments and factors underlying these choices?

Case specific, national regulatory decision-making needs be conform the overall EU framework for gas storage, which allows for three options: rTPA, nTPA and merchant investment (through exemption of regulation). The Dutch regulatory authority adopted a negotiated third party access regime for storage, but with two variants: a light-handed and heavy-handed nTPA regime. The argument for implementing a default regime of negotiated TPA is that the market is in principle competitive. There is competition from other gas storage facilities both within the Netherlands and across the border, and there is competition from other instruments that are capable of delivering gas market flexibility. Therefore, gas storage is not a natural monopoly activity in the Netherlands. However, because particular sub-markets of the market for storage (compare for example short-term high deliverability services with medium-term low deliverability services) may have little competition, there is still the risk of abuse of market power under particular conditions. By specifying a light-handed and heavy-handed regime in Dutch gas storage regulation, the regulator creates the opportunity to implement a tailor-made choice for individual gas storage facilities. A heavy-handed nTPA regime is included to prevent market concentration issues and storage operators charging non-competitive prices. In the case of Bergermeer the regulator argued that the proposed project would operate on a competitive part of the flexibility market: it was considered unlikely that the facility would acquire a dominant market position. Therefore, application of a light-handed nTPA approach was therefore considered appropriate.

The Dutch gas storage code prescribes the use of non-discriminatory access and transparent capacity allocation procedures. The operator of the Bergermeer facility has announced to use long and short term capacity auctions (open seasons). Since the regulatory framework allows the use of long-term contracts, Bergermeer owners offer long-term capacity bundles for 4 to 10 years. Also short-term contracts of 1 year are offered.

The regulatory framework as applied to Bergermeer thus far has allowed the owners of the storage facility to enter into a specific long-term arrangement with Gazprom Export (in which cushion gas is delivered by Gazprom Export in return for a (unknown) share of long-term capacity and influence in technical operations).

Since the project is not yet commissioned, or may even be further delayed (or even cancelled) due to rulings of the Dutch Council of State, further adaptations to the regulatory framework of the Bergermeer facility cannot be ruled out. This may for example relate to the long-term arrangement between Gazprom Export and the Bergermeer owners. Depending on the operationalization of the agreement to let Gazprom Export to influence technical operations of the facility, legislation requiring legal unbundling of gas storage and gas trading activities may be violated.

The next paragraph discusses if, and to what degree, the regulatory model allowed the investor to mitigate investment risks, and achieved regulatory objectives.

Performance of the regulatory model

This paragraph evaluates the performance of the regulatory model from a private and public perspective using the list of investment risks identified in section 6.4.3 and the regulatory objectives described above.

Performance from a private perspective

An evaluation of how regulation allowed the investor to deal with the investment risks associated with the project is performed below.

- The risk of underutilization was not fully mitigated but significantly reduced by the bilateral long-term arrangement made with Gazprom Export. As part of this agreement Gazprom Export holds about half of storage capacity (2.9 BCM) (ICISHeren, 2011). At the time of the final investment decision, the Bergermeer investors carried risk for remainder of capacity. In due time, the largest part of the remainder of capacity will be sold via long-term contracts of maximally 10 years. The remaining risk for the investor depends on the amount of capacity that is sold long-term. The uncertainty related to the owner being successful in selling a mix of long-term and short-term contracts of variable length over time implies a substantial price and volume risk for the investor.
- The pipeline connection between the gas storage facility and the existing Dutch transmission network operated by Gas Transport Services is realised by the Bergermeer initiators. This is an example of vertical integration. The risk of the pipeline connection not being realised on time thus fully resides with the Bergermeer investors.
- The risk of not having enough entry capacity available at the connection point with the transmission network of Gas Transport Services (GTS) is mitigated by Bergermeer Gas Storage by already contracting entry and exit capacity for the first 10 years of operations. This did not lead to upgrade investments in the GTS network as existing capacity apparently was sufficient. By contracting GTS transport capacity long-term, Bergermeer Gas Storage can offer bundled capacity packages to its customers (i.e. delivery on TTF, the virtual trading point on the GTS network). Customer will then not be subjected to the risk of not having sufficient transport capacity near the storage facility to accommodate desired gas in and outflows.[63]

[63] However, customers will still need to ensure that sufficient capacity is available at entry points where gas destined for the storage facility is injected, and at exit points where gas originating from the storage facility is taken out of the GTS network. These for example may concern entry or exit points at the border.

- The investment by Bergermeer Gas Storage in both the storage facility and the pipeline connection prevents possible hold-up problems due to bilateral dependencies. The risk of the TSO GTS behaving opportunistically and capturing rents of storage activities may be considered minimal given the strict performance-based regulated TPA regime to which it is subjected.
- Future operations of the gas storage facility are subject to possible changes in applicable regulation: it is impossible for the regulatory authority to credibly commit to the initial ‘regulatory contract’ of a light nTPA regime.

Performance from a public perspective

The performance of the regulatory model from a public perspective is evaluated using the performance criteria defined in the case study framework, and the regulatory objectives and external effects identified earlier in this section. An evaluation is provided below.

- The project as a whole is considered allocatively efficient because the market for storage and flexibility is competitive, and the Bergermeer project is a merchant project that has fully based its investment decision on market signals (i.e. expected summer-winter price spreads). For optimal efficiency to be achieved the observed prices should not be distorted due to market concentration.
- Productive efficiency of realising the investment is high as it involves a private for-profit investor investing under competitive market circumstances.
- From a social perspective it is difficult to assess whether the investment is efficient. Economic theory points to a possible underinvestment from social perspective in the case of lumpy investment. This could lead to investors investment projects that are smaller than socially desirable in order to obtain sufficient rents to recover upfront investment costs. Given that the type of flexibility provided by the storage facility can also be delivered by other, more modular and capital intensive sources and no immediate shortage is expected, it could be concluded that the Bergermeer investment is likely to be efficient from a social perspective.
- Dynamic efficiency if high because of competition from other storage and flexibility sources in the market, the future operator of the storage facility is subjected to strong incentives for reducing operational costs involved in delivering gas storage services over time (high dynamic efficiency). The level of competition in the relevant market

should be capable of ensuring that at least part of efficiency gains are transferred to customers.

- In addition, nTPA regulations contain specific clauses that contribute to a reduction in information asymmetry and improve bargaining positions of customers in case of market power.
- Allocative efficiency of the storage capacity market is high because a market-based allocation mechanism is adopted: open seasons for long-term capacity contracts, and auctions for short-term contracts. This allows for non-discriminatory third party access and does not lead to short-term barriers for gas market trading. The project hereby stimulates efficient storage capacity trading.
- The private choice of Bergermeer Gas Storage to invest in a pipeline connection internally can be interpreted as a transaction cost efficient solution. It prevents the costs associated with for example drafting and monitoring contracts with the operator of the pipeline, and it avoids possible hazards due to opportunism and uncertainty.
- By allowing a large role for long-term contracts in allocating capacity to the market, the nTPA based regulatory model effectively encourages gas storage investments.
- The strength of investment incentives provided by the regulatory model is assessed by looking at the degree to which the private investor's concerns are tackled in the regulatory model. This was illustrated in the previous paragraph, which described how investments risks mitigated.
- The external effect of Bergermeer storage investment on either the level of security of supply or economic activities under the gas hub strategy has not been accounted for in specific regulatory decisions. This can be explained by the presumption that the market would be capable of delivering investments without specific regulatory intervention.

The next paragraph discusses whether regulatory choices observed in the case of Bergermeer were consistent with theory.

Consistency with theory

In assessing whether the actual mode of competition adopted in the case of Bergermeer is consistent with theory one needs to take into account that the EU framework provided for three possible choices: rTPA, nTPA and an exemption from TPA, of which the latter option should be applied for by the project initiator. The default regime of nTPA adopted by the Dutch regulatory authority is consistent with theory. However, from the perspective of the project developer, a successful application for an exemption would have been consistent with theory. This is elaborated below.

According to theory, the fact that gas storage services compete with a range of infrastructure and non-infrastructure based alternatives implies that the gas storage facility is not a natural monopoly, and should not be treated as such. In terms of Klein (1996), the market is contestable via competition among infrastructures and via competition with non-infrastructure-based instruments. The Dutch regulator correctly assessed the properties of the relevant product and geographic market and decided for the TPA regime that allows market parties to negotiate storage transactions: nTPA. However, the regulator rightfully states that there is not one market for storage and flexibility services but that several sub-markets may exist. Due to the complexity of determining the actual level of competition for each of the sub-markets it decides to what can be dubbed a regulatory backstop: in case a storage operator does have economic power on the relevant (sub) market, a stricter (heavy-handed) nTPA regime applies that aims to reduce its negative effects. This choice for a light-handed and heavy-handed nTPA regime may be explained by two factors: the focus on the regulatory objective of improving functioning of the gas storage and flexibility market on the one hand, and the difficultly and regulatory cost involved in specifying regulation for each specific type of gas storage project on the other. The implemented regulatory model provides for a balance: it allows for the application of a tailor-made solution for the regulatory problem in each specific gas storage activity the regulator is confronted with, both not at the expense of systematically detailing out different possible regimes ex ante. After all, the expected number of projects to be dealt with in practice is low. In transaction cost terms: the frequency of the regulatory transaction is too low to justify defining very specific regulatory contracts ex ante.

From a theoretical perspective, the Bergermeer project developer could have been expected to apply for an exemption from TPA. Since the project did not apply for such an exemption, the regulator could not consider awarding one. The exemption regulation is designed based on regulatory holiday literature (Gans and Williams, 1999; Gans and King, 2003, 2004; Caillaud and Tirole, 2004). The factors that in theory point to appropriateness of awarding an exemption are present in the case of Bergermeer: the project concerns a very large, lumpy, upfront investment in very specific assets and is realised against the background of uncertainties in the future demand for gas storage services. Considering the exemption criteria defined in regulation, the project may actually have been successful in acquiring an exemption if applied for. The value of acquiring an exemption from TPA may have been relatively small since it concerns negotiated TPA, which already allows for long-term contracts at market-based rates. Could an exemption have raised (expected) profitability of the investment? The explanation for not applying for an exemption may be that the investor estimated the costs of applying for an exemption to exceed the potential benefits of possibly obtaining one.

Transaction cost economics explains the governance mode of long-term contracts to be a response to the presence of asset-specificity: transactions characterised by asset-specificity are generally not suitable for spot market exchange. Although being a highly asset-specific investment, the Bergermeer project apparently did not need to secure long-term contracts for full capacity in order to proceed with investment. The less than expected need to mitigate risks due to asset-specificity may be explained by the environmental factor of stage of market development. In a study of 311 long-term supply contracts Von Hirschhausen and Neumann (2008) find evidence that long-term agreements are mainly relevant during the early stages of industrial development when large-scale investments have to be realised and the number of potential trading partners is limited. In the case of Bergermeer, the gas market is highly developed and contains a high number of possible transaction partners.

The Bergermeer case study observations seem to contradict the UK analysis of Codognet and Glachant (2006). Although the UK and the Netherlands are quite similar in terms of gas market characteristics and dynamics, there are apparently sufficiently strong incentives for seasonal gas storage investment in the Netherlands, whereas there is not, according to Codognet and Glachant, in the case of the UK.

Finally, the strategy of Bergermeer gas storage to implement the governance mode of vertical integration in realising the pipeline connection between storage facility and existing transmission network may be interpreted as being the result of economising on transaction costs. Apparently, the costs involved in outsourcing the pipeline connection to a third party and specifying the necessary (incomplete) contracts, exceeded the costs of realising the investment internally and carry the risks associated with it. The third party in case could have been the regulated TSO Gasunie, in which case outsourcing would imply exposure to additional regulatory risk inherent in the performance-based regulatory framework in the Netherlands.

6.4.4 Analysis of alternative regulatory models

The previous section illustrated how the implemented regulatory model is expected to perform in practice. The analysis of the performance of the regulatory choices contained two starting points for the identification of alternative regulatory models.

Firstly, it was concluded that the project might have been eligible for an exemption from nTPA. Since the Bergermeer investors did not apply for an exemption, it is interesting to analyse how an exemption would have led to a different performance from private or public perspective.

Secondly, external effects of storage investment on security of supply in the Netherlands appeared not to be a key issue in the case of Bergermeer, or at least did not seem to affect regulatory decision-making in practice. Under a regulated TPA regime – an option contained in EU legislation but not implemented in Dutch regulation – the regulatory authority would have had instruments to improve investment incentives to such degree that a level of investment internalised positive external effects on security of supply. For example by setting sufficiently large allowed rates of return and by socialising investment costs.

These two alternative regulatory models are discussed below:

- An exemption from nTPA;
- A regulated TPA based investment.

Exemption from nTPA

Under the regulatory model of merchant investment with an exemption from default nTPA, the Bergermeer project could, for example, have been awarded an exemption for full storage capacity for a period of 15 years.

How would such an exemption influence the risk position of the investor and the degree in which regulatory objectives were met? Since the same long-term arrangements as implemented in practice may be assumed, the degree of volume and price risk is not affected. Furthermore, it was shown that coordination issues were mitigated by vertical integration (into the pipeline connection) and long-term contracts (concerning entry and exit capacity to the GTS system). An exemption would not lead to different solutions or performance in that respect. The risk of the owner of the transmission network behaving opportunistically was mitigated with rTPA. However, an exemption could be of value to the Bergermeer investor as mitigation instrument against regulatory risks. An exemption could prevent a regulator to opportunistically change nTPA conditions when, for example, large rents are received by Bergermeer Gas Storage, which may trigger the regulator to seek that these rents are passed-through to gas storage users. The other side of the coin is that by awarding an exemption, the regulator commits to not intervening in an unknown future situation in which it would otherwise actually be tempted to intervene, for the sake of public interest. This implies that there is an uncertain cost for society attached to the regulator awarding an exemption. For the remainder, efficiency performance of the project would be identical to the performance described previously in section 6.4.3.

Why did Bergermeer Gas Storage not apply for an exemption? There are two possible explanations:

1. The (expected) costs of acquiring an exemption outweighed the expected benefits of obtaining one;
2. An application would fail to meet one or multiple exemption criteria.

Ad 1. Although the application procedure as such will entail transaction costs for the investor, it is more likely that the lack of evident expected benefits of obtaining an exemption played a role. Note that Bergermeer was only subjected to a light nTPA regime, which in practice does not deviate too much from a free market approach. If the default regime would have been an rTPA, then the expected benefits of obtaining an exemption would be larger. In addition, the default regime already allowed Bergermeer to enter negotiated long-term contracts. If the regulatory authority would have limited the scope of long-term contracts in regulation, then there would be a clear incentive to seek an exemption.

Ad 2. An application for an exemption could have failed to meet (only) one out of the five exemption criteria, and may have discouraged Bergermeer Gas Storage to seek one. Given that the Bergermeer project in practice was able to secure the final investment decision without an exemption being awarded and given that none of the other exemption criteria posed a problem[64], then the need for applying for an exemption may hinge on criterion 2: *"The level of risk attached to the investment is such that the investment would not take place unless an exemption was granted"* (EC, 2009). Factors relevant in evaluating this criteria are the general price and volume risks associated with investment, the level of competition when operational, and the integral cost of providing the storage service vs. that of competing alternatives (including the cost of financing). The level of risk attached to the project may not be as high as perceived. Firstly, the project is financed with equity, which is generally less costly than project-based financing. Secondly, although there are competing alternatives for gas storage, the Bergermeer storage may have a relatively lower cost structure in comparison. This would imply that when overall demand for gas storage or flexibility is low, demand for Bergermeer storage remains relatively high due to lower marginal costs. A comparatively favourable cost structure thus reduces volume risk. Finally, the investment risk attached to the gas storage facility may be limited, since it provides in a very fundamental need for seasonal gas demand in Northwestern Europe in a very large gas market with a large number of possible trading partners.

To conclude, the option for Bergermeer storage to undertake investment under an exemption regime may not be attractive for the investor because: (1) the additional benefits of an exemption are uncertain and likely to be small given the small differences with a

[64] The Bergermeer has an external effect on both security of supply and the level of competition in the gas market, which implies that criterion 1 is met. The owners and operators are not organisationally linked with the owner and operator of the transmission network to which the storage facility is connected: criterion 3 is thus fulfilled. In order for the Bergermeer project to be profitable, the costs of the infrastructure are fully reflected in the storage tariffs to be charged to future users. This means that criterion 4 is fulfilled. Finally, given the transparency and capacity allocation methods used, and the limited impact on downstream network operations, the Bergermeer facility is unlikely to have a damaging impact on competition, internal gas market functioning or infrastructure operations: criterion 5 is fulfilled.

nTPA regime, and (2) it may be difficult (or even uncessary) to obtain an exemption based on the appropriate risk criterion.

Regulated investment

Implementation of a regulated TPA regime implies that trading partners are not allowed to negotiate on access conditions but that access conditions, including allowed tariffs or allowed total revenues, are fully determined by the regulator. Different types of regulated TPA regimes can be implemented, varying from cost-plus based mechanisms to performance-based mechanisms. Organisationally, the rTPA operated storage facility could be operated by either a private business active in gas production or trade, or a regulated business involved in gas transmission. A brief characterisation on how these regimes deal with investment risks and attain regulatory objectives follows below.

Under cost-plus based rTPA full investment risks are socialized among the users of the storage facility, whereas performance-based rTPA leaves some risk for the operator. If the dimensioning of the project is based on market demand (open season), the project is likely to be efficient. There is some regulatory risk involved for the investor in the performance-based regime because future allowed tariffs are uncertain (due to the benchmark exercise), and investments may not be considered prudent ex post (preventing the investor to pass-through full cost of investment). Static efficiency of the storage facility is likely to be lower compared with market-based investment, as it is difficult for the regulator to set efficient incentives (as a consequence of information asymmetry, which causes additional regulatory cost). Productive efficiency is higher in a performance-based regime than a cost-plus-based regime.

6.5 Conclusions

This section provides the conclusions following from the analysis of this case study by addressing four questions:

- What were the key regulatory objectives at stake in realising the project and which were the key concerns for the investor?
- What was the response of regulatory decision-makers in terms of regulation implemented?
- Which considerations (factors) led to this choice?

- Would an alternative response have been (more) appropriate, and if so, why was this not implemented?

The priority for the regulator in the case of Bergermeer investment was to encourage competition and improve market functioning where possible. Although adequate gas infrastructure capacity is considered important for the provision of sufficient investment, the level of investment incentives was never an issue for particular gas storage facilities. For the gas storage investor, the key concerns were the regulatory risk related to the uncertain interpretation of existing regulation in relation to specifically the Bergermeer investment, and the long-term investment risk associated with the investment given asset-specificity and uncertain future demand for gas storage services.

The regulator implemented a default nTPA regime for gas storage, with a further distinction between a light-handed and heavy-handed nTPA regime. In addition, like all types of gas infrastructure and as required by the EC, an exemption clause was introduced which would allow merchant investment (i.e. no nTPA obligation). The key factor considered in implementing nTPA was the economic position of the gas storage facility and operator in the market, and its bargaining position versus trading partners when negotiating access to the facility. Since the investor did not apply for an exemption from nTPA, it remains uncertain how the regulator would have evaluated the exemption criteria in the case of Bergermeer.

The Bergermeer case shows that a competitive storage market can deliver necessary investment without full capacity contracted long-term ex ante of investment, even though large storage facilities have physical properties (asset-specificity, lumpy investment, uncertainty) that theoretically should give rise to large risks for the investor. The explanation may lie in the market environment and expected market developments. North-western Europe contains a very large, liberalized gas market with significant spot markets with a large number of suppliers and sellers (i.e. Netherlands, Germany, and UK), has a large number of interconnections, and is experiencing a continuous decline in indigenous gas production – which raises the need for market flexibility instruments. The Bergermeer case illustrates that under these circumstances there is unlikely to be a problem of underinvestment from a public perspective.

Merchant investment without full capacity sold in long-term contracts is a model that is very unlikely to emerge in a market that does not share the aforementioned characteristics but involves relatively smaller gas markets, with high market concentration, limited number of gas suppliers / consumers, limited interconnectivity, etc. Under these circumstances investment risks would, as consistent with theory, need to be mitigated either by socialization (i.e. regulated TPA) or via long-term contracts under an exemption regime. In those cases, there would be a possible problem of underinvestment that needs to be addressed by the regulator. The choice between rTPA and an exemption may depend on the level of competition in the market (i.e. the negative impact that an exemption may have on it). In addition, the factor of import dependency may affect regulatory choices. Countries with large gas import dependency such as Romania, Poland, Spain, Italy and Hungary implemented rTPA on storage facilities.

7 Case 4: The GATE LNG import terminal

7.1 Introduction

This chapter presents the fourth case study: the GATE LNG import terminal in the Netherlands. The GATE project provides an interesting case study since it includes all issues that are central in the context of this study. Firstly, the project and the transaction facilitated by the project have particular characteristics that give rise to considerable risks for a potential investor. The project requires large upfront investment costs and is exposed to fundamental uncertainty regarding the future demand for its services. This combination gives rise to strong ex post hazards that may prevent project investment ex ante. Furthermore, a successful realisation of the project requires sufficient coordination with the neighbouring pipeline system. The value of the LNG project depends on the availability of sufficient downstream pipeline capacity against reasonable prices. Secondly, from the perspective of a regulatory authority, a range of market failures may be related to the investment in, and operation of LNG infrastructure. These market failures can lead to particular regulatory objectives that in turn guide regulatory decision-making. Market failures that are referred to in the case of LNG terminals (but may not necessarily be present in all situations) are a lack of competition for the operator and owners (perhaps even a natural monopoly), and external effects on security of supply (increasing diversity of gas supply).

The objective of this chapter is to explain why the GATE LNG terminal project was regulated the way it was: why were particular regulatory choices adopted and what were the underlying factors that led to them? This requires an analysis of the perspective of both the regulator and the investor in this project. Key questions addressed are: what are the regulatory objectives of the regulator when deciding upon the regulatory model and making the key regulatory choices regarding this project? And: what are the investment risks for the investor, and which factors cause this risk? Answering these questions requires an analysis of the implemented regulatory choices. Such an assessment needs to illustrate, if, and to what extent, particular regulatory objectives were attained and private investment risks mitigated. This assessment then provides a starting point for an analysis of alternative regulatory choices: how would different regulatory choices affect 'performance' in terms of attaining regulatory objectives and addressing private investor's investment risks? The answers to aforementioned questions will provide input for the synthesis analysis in chapter 8.

Throughout this chapter the following terms related to the economic regulation of gas infrastructure are used. The term regulatory framework will be used to reflect the overall set of rules and regulations to which a company is subjected. It may relate to both rules and regulations at the EU level and the EU Member State level. The term regulatory choices is used to refer to single regulatory decisions made at the Member State level. In the context of this study this term is generally used to refer to regulatory choices that affect the expansion of gas infrastructure. Finally, the term regulatory model is used to refer to a set of regulatory choices that affect gas infrastructure expansion.

This chapter is organized as follows. Section 7.2 introduces the case study investment project to the reader by describing its technical features, the actors involved and the motivation for the investment. Thereafter, section 7.3 presents the relevant regulatory framework for LNG terminal investments in general and describes how it has been applied to the case of GATE in particular. Section 7.4 contains the analysis part of this case study and addresses the key research questions mentioned in previous paragraph. Finally, section 7.5 summarizes the case study findings.

7.2 Description of the project

This section provides a description of the investment project analysed in this chapter. It consecutively deals with the technical features of the project, including aspects such as location and technical specifications (section 7.2.1), the motivation for investment (section 7.2.2), and the actors involved in its realisation and envisaged operations (section 7.2.3).

7.2.1 Technical features of the project

The companies Gasunie and Vopak developed a LNG import terminal at the 'Maasvlakte' near Rotterdam in the Netherlands.[65] The terminal project is generally referred to as GATE, which stands for 'Gas Access To Europe'. The main function of the

[65] More detailed information on the project is available at www.gate.nl.

facility is to receive LNG supplies arriving by LNG tanker, re-gasify the LNG and, with the additional help of a buffering facility, continuously inject gas into the Dutch gas transport network. The GATE LNG terminal project was built on a newly reclaimed site at the Rotterdam port entrance to the North Sea. The terminal was projected to consist of three storage tanks, of 180,000 m^3 each, and two jetties. This allows for an initial throughput capacity of 12 BCM per year, with the opportunity to increase capacity to 16 BCM per year in the future. The project was expected to cost about €800 million and became commercial in the second half of 2011. Given that first feasibility study was launched in August 2005, the first permit procedures were started in November of that same year, the actual construction started only in the first half of 2008, and its opening was at the end of 2011, the lead time of investment for this project was about 6 years.

The development of the LNG terminal triggered investment in a short pipeline connection to the existing transmission network and capacity expansion of the network further downstream. This particular deep investment was necessary to accomodate the expected gas flows originating from the LNG terminal.

7.2.2 Motivation for the investment

There has been considerable investment in LNG import terminals in Europe the past decade and still nummerous LNG import facilities are planned. This trend can be explained by two particular drivers: an increasingly large EU gas supply gap, and a stronger need for diversification of EU gas supplies.

In order to address the potential future gas supply gap for specifically the Northwest European region due to the decrease in especially UK and Dutch gas production, a number of competing pipeline and LNG projects have been proposed and developed in the period until 2010. In the coming decades, the demand for natural gas is expected to further increase, especially demand from the power sector. Given the declining gas reserves in Europe there is an increasing need to import gas from outside the EU. Whereas part of this gap will be filled by the pipelines that traditionally supply EU external gas, LNG is expected to play an increasingly large part. The fact that the cost of supplying gas via a LNG chain has considerably decreased in the past decades has further stimulated this development.

At the same time, the increasing import gap raised concerns of high dependence on a limited number of gas suppliers such as Russia, Norway and Algeria. This import dependence is perceived to make the EU gas system vulnerable to supply interuptions. In order to reduce this vulnerability, energy companies explore alternatives that can diversify their gas supply portfolio. LNG import terminals enable the sourcing of gas from different gas producing countries further away from Northwest Europe.

The initiators behind GATE, Gasunie and Vopak, aim to expand their respective bussinessess of gas infrastructure and energy storage operations by facilitating new LNG import terminal capacity, whereby the market value of the project depends on the need of energy companies to source new gas supplies and diversify existing gas supply portfolios.

In the Netherlands, two additional LNG terminals were planned besides the GATE terminal. Gasunie and Vopak, together with Essent, cooperated in another Dutch LNG initiative that would involve the realisation of an LNG terminal in the north of the Netherlands, near Eemshaven. The consortium, however, cancelled its LNG investment plans in September 2010 due to an insufficient financial basis (Essent, 2010). The decision was based on a feasibility study from 2007. A development that had a negative impact on the business perspective for this LNG project was the rate at which new LNG terminals and new supply pipelines were constructed in (Northwest) Europe. A third proposed LNG import terminal project to be developed by 4Gas, also in Rotterdam and known as the LionGas LNG terminal, had already been cancelled in March 2010. The reasons for the cancellation were again the changing market circumstances that made it increasingly difficult to realize a financially viable LNG project. Consecuently, at the end of 2010, the GATE terminal was expected to be the only Dutch LNG terminal in the near future. In Northwest Europe new LNG capacity has been realised recently in Belgium (expansion of Zeebrugge LNG in 2008), the UK (Isle of Grain LNG in 2005, South Hook and Dragon LNG in 2009) and France (Fos Cavaou in 2010), and additional LNG import projects have been proposed in again the UK, France and Germany.

7.2.3 Actors

In 2005 the companies Gasunie and Vopak took the initiative to assess the possibilities of developing an LNG terminal in the Rotterdam port area. Gasunie is a gas infrastructure company with both unregulated and regulated gas infrastructure activities. Via its wholly owned subsidiary Gas Transport Services it owns and operates the Dutch gas transmission system and via a German subsidiary it owns and operates part of the German gas transmission system. It is the designated TSO in the Netherlands and one of the designated TSOs in Germany. Gasunie participates in the BBL pipeline and the Zuidwending storage project. Vopak is an independent company specialising in the storage and handling of gaseous chemical and oil products. Vopak LNG develops, owns and operates LNG re-gasification terminals. Besides its participation in GATE, Vopak is also involved in the development of LNG terminals in France (Fos Faster LNG terminal near Marseilles) and Germany (Rostock LNG terminal).

LNG terminal's import capacity has been allocated to five different customers via long-term contracts. The energy companies Dong Energy, EconGas OMV International, RWE Trading International[66], E.On Ruhrgas and Eneco together acquired capacity rights for the throughput of 12 BCM per year, which equalls total initial throughput capacity. The length of the contracts is assumed to be in the order of 20 years (Dong, 2010). In addition, four of the long-term customers (Dong, EconGas OMV, RWE and E.On Ruhrgas) acquired a 5% stake in the LNG terminal and act as minority shareholders next to Gasunie and Vopak, who together own the remaining 80% of shares. In communicating their respective roles in the GATE project, each of the energy companies points to the need to source new gas sources and diverify the existing gas supply portfolio.

Dong is a Danish energy company with activities in both the gas (exploration and production) and electricity (power generation). Regarding its GATE arrangements, it comments that this adds to the strategy of complementing pipeline-based gas supplies from among others Germany, Russia and Russia, in order to develop a more flexible gas supply portfolio (Dong, 2010). EconGas is a large gas supplier for distribution companies and large business clients in Central Europe. By acquiring capacity rights in GATE EconGas aims to link its customers with the largest trading hubs in the EU and improve security of their gas supplies (EconGas, 2007). With its GATE participation, RWE is progressing in realising its strategy of further strenghtening its upstream gas position and in setting up more and more own LNG activities (RWE, 2006). E.On Ruhrgas is a major energy player

[66] Original contracts were signed with Essent, which became part of the RWE group in September 2009.

in Europe with large interests in the upstream gas sector. Further expanding LNG activities is considered part of the strategy to increase security of gas supply. Also Eneco (2010) points to its increased ability to secure supplies to its customers when talking about its acquisition of GATE capacity rights.

Each of the GATE customers needs to source the gas that is to be imported via the GATE terminal themselves. For example, in March 2010 Dong signed a contract with Spanish energy company Iberdrola for the delivery of 1 BCM of LNG per year for the period 2011-2021 at the GATE terminal. Sources of these specific LNG supplies are said to be Nigeria, Norway and Algeria (Dong, 2010).

The next section presents the regulatory framework applicable to the GATE investment project and discusses how it was applied in practice.

7.3 Description of the regulatory framework and regulatory choices

This section presents the regulatory framework that applies to the GATE project and presents how the framework was applied in the case of this project. This includes a summary of regulation on both the EU and member state level. The section is organized as follows. Section 7.3.1 and section 7.3.2 respectively describe the relevant key regulatory choices on the EU and member state level (i.e. the Netherlands). Section 7.3.3 describes how regulatory authorities applied the EU and national regulatory framework in the case of the GATE project. Section 7.3.4 summarizes the key regulatory choices pertaining to the project.

7.3.1 <u>LNG import terminal regulation in the EU</u>

The second EU Gas Directive (EC, 2003a) provides the legal framework for the GATE terminal project. Although repealed by the third Gas Directive in 2009 (EC, 2009a), the second Directive provides the applicable framework for the final investment decision of the GATE LNG terminal project since its permitting procedures were initiated late in 2005 and final investment decision was taken at the end of 2007. With the implementation of the third Directive in 2009, GATE LNG project had to meet requirements therein. The Directive articles regarding the role of competition and the degree of vertical integration (i.e. unbundling) are summarized below.

Regarding access conditions, Article 18 of the second Gas Directive (2003a) stated:

"Member States shall ensure the implementation of a system of third party access to the transmission and distribution system, and LNG facilities based on published tariffs, applicable to all eligible customers, including supply undertakings, and applied objectively and without discrimination between system users. Member States shall ensure that these tariffs, or the methodologies underlying their calculation shall be approved prior to their entry into force by a regulatory authority referred to in Article 25(1) and that these tariffs — and the methodologies, where only methodologies are approved — are published prior to their entry into force."

This requirement corresponds with a regime of regulated third party access. In this respect, LNG infrastructure is treated identical to gas transmission and gas distribution infrastructure. However, not necessarily the same methodology needs to apply to the different types of gas infrastructure. The implementation of regulated TPA should, however, not prevent the conclusion of long-term contracts insofar as they comply with competition rules (EC, 2003a, Article 18 (3)).

Article 22 (1) of the second Gas Directive allows investors in new LNG terminals to apply for an exemption of, among other requirements, the requirement of regulated TPA, under the following conditions (EC, 2003a, Article 22):

(a) The investment must enhance competition in gas supply and enhance security of supply;
(b) The level of risk attached to the investment is such that the investment would not take place unless an exemption was granted;
(c) The infrastructure must be owned by a natural or legal person which is separate at least in terms of its legal form from the system operators in whose systems that infrastructure will be built;
(d) Charges are levied on users of that infrastructure;
(e) The exemption is not detrimental to competition or the effective functioning of the internal gas market, or the efficient functioning of the regulated system to which the infrastructure is connected.

Article 22 (2) adds that exemptions shall only be considered for *"...significant increases of capacity in existing infrastuctures and to modifications of such infrastructures which enable the development of new sources of gas supply"*. Furthermore, Article 22 (3) contains additional considerations for relevant regulatory authorities that consider an exemption. Exemptions need to be assessed on a case-by-case basis, may cover all or parts of new infrastructure capacity, and may include conditions regarding the duration of the exemption and non-discriminatory access. In addition, when imposing conditions to an exemption, the regulatory authority shall take into account the duration of contracts, additional capacity to be built or the modification of existing capacity, the time horizon of the project and national circumstances. Finally, the regulatory authority may decide upon the rules and mechanisms for management and allocation of capacity to the degree that it does not interfere with the implementation of long-term contracts.

Regarding unbundling, the second Directive requires gas companies to unbundle accounts of different gas market activities, including LNG operations. Article 17 (3) contains this requirement and explains its rationale:

"Natural gas undertakings shall, in their internal accounting, keep separate accounts for each of their transmission, distribution, LNG and storage activities as they would be required to do if the activities in question were carried out by separate undertakings, with a view to avoiding discrimination, cross-subsidisation and distortion of competition."

A new legislative energy package was adopted in 2009. This somewhat changed the legal framework for LNG terminal projects. Firstly, a new (third) Directive (EC 2009a) was adopted that repealed the second Directive. Secondly, Regulation 1775 (EC, 2005a) that was concerned with conditions for access to natural gas transmission networks was repealed by Regulation 715 (EC 2009b). Regulation 715 (2009b) had a wider scope than EC 1775 (2005a), since it includes provisions related to LNG terminal access conditions. The key changes put forward in these pieces of legislation are mentioned below.

Article 32 (1) of the new Directive restates the obligation for Member States to adopt regulated TPA for gas transmission and distribution systems as well as LNG facilities (corresponding with Article 18 in the second Directive).

A new provision relevant for new LNG terminal projects is reflected in Article 23 (EC, 2009a). This article requires the TSO to establish and publish transparent and efficient procedures and tariffs for non-discriminatory connection of storage facilities, LNG regasification facilities and industrial customers to the transmission system. In addition, the TSO is not allowed to refuse the connection on the grounds of possible future limitations to available network capacities or additional costs linked with necessary capacity increase: sufficient entry and exit capacity shalle be ensured for the new connection.

The option of granting exemptions from TPA provisions for new infrastructure projects, including LNG terminals, was maintained in the third Gas Directive, Article 36 (EC, 2009a). Exemption regulation as described in this Article was amended on primarily two aspects. Firstly, Article 36 (4) allows for a role of the newly created Agency for Cooperation of Energy Regulators (ACER) in exemption decisions involving cross-border infrastructure investments. Since LNG terminals are generally built within country borders this provision does not affect LNG operations. Secondly, Article 36 (6) now contains more specific requirements regarding the rules and mechanisms for management and allocation of capacity. It requires that all potential users are invited to indicate interest in new infrastructure capacity before actual capacity allocation takes place. It also requires the implementation of congestion management rules that include the obligation to offer unused capacity in the market, and the right for infrastructure users to trade contracted capacity on the secondary market.

Article 31 upholds the requirements for natural gas undertakings to have separated accounts for different gas market activities, including LNG facility operations (corresponding with Article 17 in the second Directive). LNG facilities are not subjected to stricter unbundling on either legal or ownership basis.

Regulation 715 (2009) amended Regulation 1775 (2005) regarding access conditions for gas storage facilities and LNG terminals. Access conditions in practice were considered insufficient. Article 17 of the Regulation lists the principles of capacity allocation mechanisms and congestion management procedures concerning storage and LNG facilities. Article 19 contains requirements regarding transparency of storage and LNG facilities. Finally, Article 22 requires operators of transmission, storage and LNG systems to take all reasonable steps that allow for capacity rights to be freely tradable on a secondary capacity market.

The next section turns to discuss the regulatory framework in the Netherlands.

7.3.2 LNG import terminal regulation in the Netherlands

Regulation of LNG in the Gas Act

The regulation of LNG terminals in the Netherlands is based on paragraphs 2.2 through 2.5 of the Gas Act, which govern the access to gas infrastructure in general and the describe the competences of the regulatory authorities to adopt access tariffs and conditions. EU exemption regulation is transposed in Arcticle 18h, including the required exemption conditions. The competent authority for access arrangements at the time of the submission of the exemption application of GATE was the Dutch Office of Energy Regulation (‘Energiekamer (EK)’ in Dutch), which is part of the Dutch competition authority. Dutch gas infrastructure legislation and specifically exemption provisions were described in section 6.3.2. The implemented regime for LNG facilities can be characterised as a regulated TPA-based regime. How this rTPA regime is operationalised in additional legislation (a ‘Ministeriële Regeling’ (MR)) that is briefly discussed in the next paragrpahs. The procedure for exemption applications is basically as follows. For each exemption application the regulatory authority assesses whether the conditions for obtaining an exemption are fulfilled and prepares and advice to the relevant competent authority[67], who takes the final exemption decision and informs the EC in case an exemption is granted. The EC is then allowed to veto the exemption decision taken by the national competent authorities or demand an alteration of the conditions of the exemption (i.e. duration, scope, etc.).

Consultation concerning LNG regulation

In February 2006, the Dutch regulatory authority and the Ministry of Economic Affairs jointly launched a consultation on the TPA and exemption regulation concerning LNG terminals (NMa/EZ, 2006). The purpose of this consultation was to provide input for a further specification of the relevant Gas Act Articles on these aspects via a MR. The MR came into effect after GATE applied for an exemption; it was published in November 2007 (Staatscourant, 2007).

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[67] This currently is the Ministry of Economic Affairs, Agriculture and Innovation, and formerly was the Ministry of Economic Affairs.

In the first part of the consultation the regulatory authority and Ministry set out their view on the possible role of LNG in the Dutch gas market. It is envisaged that the development of Dutch LNG import capacity could enhance Dutch security of supply since additional LNG supplies on the Dutch market could reduce the demand for indigenously produced gas. In other words, Dutch gas reserves could be conserved. In the view of the consultation document, the realisation of LNG import capacity would enhance security of gas supply diversification. The consultation document observes that not all imported LNG may necessarily have to serve Dutch gas demand: LNG supplies may be re-exported to neighboring countries. In the consultation document, the regulatory authority and Ministry also hypothesize that the realisation of Dutch LNG import capacity could induce a changing gas flow pattern within the Dutch gas transport system, with LNG import capacity in presumably the western part of the Netherlands relieving the need for an upgrade of the North-South transport corridor that appeared necessary due to increased gas demand in the south. Additional LNG imports in the south of the Netherlands, destined for Belgium and France, could reduce the throughput of Norwegian gas through the Netherlands to these countries. However, the consultation document also acknowledges that LNG supplies in that part of the country could induce a stronger west-east gas flow when LNG is destined for the German market. The regulatory authority and the Ministry also anticipate a possible impact on market liquidity and flexibility in the market.

The second part of the consultation document discusses the Dutch physical potential for the realisation of LNG import terminals. It identifies four suitable locations, with an associated import capacity of about 60 BCM per year, located near Rotterdam (three locations) and in Groningen (one location). Other potential locations are disregarded on the basis of nearby waterway conditions (i.e. depth), waterway traffic density and population density. It is also noted that offshore LNG landing facilities appear to be economically less attractive.

After a brief overview of LNG regulation in other EU countries, the consultation moves on to a description of a proposed regulatory regime for LNG access conditions and for the application of exemption regulation, including particular consultation questions regarding its different elements. Each of the exemption criteria are carefully discussed, including a specification of possible quantitative and qualitative indicators for each of the criteria. The document mentions several reasons why rather ligh-handed regulatory regime is proposed for the Netherlands: there is competition on the gas market, the Dutch market is not expected to become dependent on LNG imports, and LNG terminal development would contribute to the realisation of the Dutch gas hub strategy.

Result of the consultation: final regulatory decisions

All market responses to the consultation were published on the website of the regulatory authority by March 16 2006.[68] A MR on access to LNG terminals was adopted on 26th October 2007 (Staatscourant, 2007). It specifies the default regime of regulated TPA as follows. The objective of this regulation is to provide a system of fair, non-discriminatory access to LNG terminal capacity, characterised by an efficient use of available and to-be-built capacity, and, in combination with exemption regulation, provide an optimal investment climate for the realisation of new LNG terminals.

The regulatory authorities chose to specify the rTPA requirements as flexibible as possible. This means that LNG terminal operators are allowed to propose a methodology for setting tarrifs based on either cost-based or market-based principles. The regulator needs to annually approve tariffs to be charged by the operators. This type of rTPA may be referred to as a light-handed approach.

The arguments provided for this choice are the following. Since the Netherlands had at the moment no LNG terminal capacity, the regulatory authority considered it important regulate only to the degree necessary. Given that all LNG terminal initiatives at the time applied for exemption from default rTPA and were likely to obtain one, the default regime described in this regulation would only apply to new facilities after the exemption period would end, which would be in about 2027. In arguing for a very light-handed approach, the regulatory authority acknowledges the need for coordination between the different elements in the LNG value chain, and the impact thereof on investment risk: regulation on the access to import terminal capacity affects investments higher up the chain. The regulation also mentions the desirability of LNG terminal investments in the Netherlands as a new source

68 The responses to the consultation were published on the regulator's website: http://www.nma.nl/documenten_en_publicaties/archiefpagina_documenten_en_publicaties/consultatiedocumenten/nma_publiceert_reacties_op_informatie_en_consultatiedocument_regulering_en_ontheffing_lng.aspx (last accessed: 20-05-2012).

of gas supply that contributes to a further diversification of Dutch gas supply as a reason to specify a default rTPA regime that is light-handed.

Seperately, the Dutch competition authority published two documents concerning the particular exemption procedure. NMa (2006a) describes the informational requirements for the party seeking an exemption from default access regulation from the authority and NMa (2006b) describes the structure and content of the advice that the authority would give towards the competent authority (i.e. the Minister of Economic Affairs) whether to award an exemption (NMa, 2006b). Together these documents provide transparency regarding the manner in which Dutch regulatory authorities will evaluate future exemption applications.

The next section deals with the exemption application process and evaluation in the case of the GATE LNG terminal project.

7.3.3 Application of regulation to GATE[69]

On 27th of March 2006, GATE Terminal B.V. formally applied for an exemption under Article 18h of the Gas Act with the Ministry of Economic Affairs. The formal application did not mention firm volumes of import capacity but mentioned the expectation of an initial import capacity level of 8 to 12 BCM per year, with the possibility of further expanding to 16 BCM per year later on. GATE applied for an exemption from default access conditions for a period of 25 years. The formal exemption application was supported by a number of additional documents in order to meet information requirements[70] (Staatscourant, 2006). On request of the Ministry, additional documents were provided by GATE on July 4, 2006

[69] The official publication in the *'Staatscourant'* (in Dutch) of November 13th 2006 (Staatscourant, 2006) announces the granting of the exemption and describes the basic application procedure and assessment. This document is the basic source of information used in this section.

[70] Submitted documents included: an area map, project planning schedule, a report by The Brattle Group, a report by BNP Paribas, documentation on the open season procedure, an overview of contracts in the LNG industry, a description of the basic LNG market characteristics, and a response to the consultation document published by the regulatory authority and the Ministry of Economic Affairs (NMa/EZ, 2006).

(Staatscourant, 2006).[71] The regulatory authority submitted its advice to the Ministry on August 30th 2006. In short, the evaluation of the five exemption criteria (Article 18h of the Gas Act) was as follows:

1. The new infrastructure improves both competition in the supply of gas and the security of supply;
2. The risk associated with the investment is such that the investment will not go ahead without an exemption;
3. Ownership of the new infrastructure resides with a legal entity that is at least legally separated from the legal entity that owns the infrastructure to which the new infrastructure is connected;
4. The users of the new infrastructure are charged for the use of the infrastructure;
5. The exemption does not hinder effective competition or reduce efficiency of the internal market or the network to which the new infrastructure is connected.

Ad 1: GATE improves competition and secturity of supply

Competition in the Dutch market is considered to be enhanced due to the increased opportunities for gas suppliers to enter the Dutch market, to the benefit of the gas consumers. The LNG terminal facilitates diversification of supply sources since it opens the Dutch market to LNG imports. This positive impact is strengthened by the fact that GATE has adopted and proposed efforts that ensure non-discriminatory access to LNG import capacity. An open season procedure was adopted and strict use-it-or-lose-it provisions apply to long-term capacity contracts. In addition, GATE facilitates a secondary market for capacity rights. The actual impact on competition was analysed in a quantitative scenario

[71] Additional requested and submitted documents included: the press release of Gate terminal (9-6-2006), an overview of Gate terminal clients and contacts (by 26-6-2006), a description of the process towards the Memorandum of Understanding (MoU), a description of the process towards the Heads of Agreement (HoA), a Gate terminal brochure, a comparison of Gate tariffs with competitors, a customer tariff calculation sheet, an international comparison of LNG activities, an abstract from registration with the Chamber of Commerce, an outline of Gate terminal CV equity structure, a CD-ROM containing the environmental impact assessment and permit applications, SHE-policy statement Vopak, a statement on safety from Gasunie, an application for connection from Gate terminal to GTS, and a GTS response to the connection application.

study by The Brattle Group[72]. The report concludes that, unless the market party with the largest share of the Dutch gas market contracts over 50% of the expected minimum LNG terminal capacity of 8 BCM per year, the realisation of the terminal indeed improves the level of competition. Information contained in additional documents submitted by GATE sufficiently assured the authorities that none of the LNG terminal customers has the desire to contract more than 4 BCM of import capacity and that the main scenario study conditions would hold. The competent authorities considered the first condition to be fulfilled.

Ad 2:An exemption is vital for the project to go ahead

In the assessment there is a role for the supply and demand balance at the time of the application. In the exemption decision, the Minister of Economic Affairs mentions that global LNG import capacity is about four times as high as global LNG export capacity, which implies strong competition for LNG supplies. Given the more limited regulation of LNG import terminals in some other parts of the world, notably the US, the Ministry agrees with the applicant that stricter regulation could make it less likely that the GATE LNG terminal would be able to recover its investment cost. If the project would be subjected to a TPA regime, its financers would demand an additional premium in order to compensate for the increased risk of intervention in access and tariff conditions – and thus project payback conditions – by the regulatory authority. Passing through the additional cost of financing to its customers would worsen the competitive position of the LNG terminal vis-à-vis its large number of competitors in Northwest Europe. This view was supported by additional (confidential) financial assessments of two large banks. The Minister accepted the general line of reasoning brought forward by GATE and assessed by the regulatory authority and concluded that the second criteria was fulfilled.

Ad 3:GATE is legally unbundled from organisations operating the infrastructure to which it will be connected

Although there is an organizational link between one of the initiators of the GATE project and the owner and operator of the gas transmission system to which the GATE terminal will be directly connected, the Minister acknowledged that the third exemption

[72] The Brattle Group study is quoted in Staatscourant (2006), but not publicly available and could thus not be closer evaluated.

criteria was fulfilled since the different business activities are legally unbundled from the Gasunie holding (i.e. N.V. Nederlandse Gasunie).

Ad 4: GATE clients are charged for the use of the terminal

Being an individual LNG company with no activities other than the activities related to the proposed LNG terminal it needs to charge full costs of operations to its customers. For the viability of the terminal project, it is necessary for GATE to acquire customers that are willing to pay market-reflective tariffs for future LNG services. The open season procedure adopted to derive market interest for the LNG terminal was the instrument through which this could be achieved. At the time of the exemption application, the open season did not yet resulted in the signing of firm contracts. In the application for exemption, GATE indicated that the signing of so-called throughput agreements was scheduled for the winter of 2006 and spring of 2007. Documents and (earlier) agreements submitted by GATE to the Ministry and the regulatory authority gave sufficient comfort that the fourth criterion was met.

Ad 5: GATE does not hinder effective internal EU market competition or efficient operation of the network to which it is connected

Regarding this last criterion, reference was made to the extensive argumentation under the first criterion regarding the impact of the realisation of the LNG terminal on market competition. That also made clear that market functioning would not be hindered. A remaining issue to be cleared under the fifth criterion was the impact of the LNG terminal on efficient functioning of the gas transport system. Based on a letter received from Gas Transport Services (GTS, the owner and operator of the national transmission system), the authorities concluded that the realisation of the terminal would not affect the efficiency of the system to which the terminal would need to be connected, i.e. the national transmission system. The letter provided comfort regarding the following issue. Although the terminal would trigger investment in both a new connection pipeline between the LNG terminal and the existing network, and a required upgrade of existing capacity in the national transmission system, GTS was confident that it could realize necessary investments before the expected commercial starting date of the terminal, without any (harmful) impact on existing obligations towards gas shippers and market parties connected to the system.

Scope of exemption

Following the conclusions that all legal criteria for acquiring an exemption were met, the scope of the exemption with respect to duration and capacity mainly still needed to be defined.

The authorities considered that the application for a 25 year exemption too generous, given the expected financial break-even point for the project based on the (confidential) submitted financial figures. The exemption decision makes reference to a confidential contract duration that should be considered a minimum for LNG capacity contracts. From responses to the consultation document in 2006 it could be inferred that the minimum contract duration could be in the order of about 15 years. All in all, the authorities opted for an exemption period of 20 years. Regarding the scope of exemption in relation to capacity it was argued that an exemption for less than 100% of capacity would again raise the earlier mentioned issue of raising tariffs to be charged to capacity users (because of increased risk of not recovering investment cost). Since the actual capacity of the proposed LNG terminal in both the short and medium to long-term was not firm yet, there was the issue of whether to grant an exemption only for an initial indicated capacity of 8 to 12 BCM per year or for the maximum long-term capacity of 16 BCM that can be developed at the designated site. The Minister followed the regulatory authority's advice and decided for an exemption for the long-term maximum site capacity of 16 BCM per year. The Minister notes that, theoretically, this decision could have a negative impact on investment in new LNG import capacity in the future when the owner and operator of the GATE LNG terminal does not have the desire to expand existing capacity but other market parties are willing to invest in new capacity on the site of the GATE LNG terminal. Greenfield investment elsewhere can expected to be relatively mose costly due to economies of scale. Building a new LNG terminal instead of expanding an existing LNG terminal may be inefficient from a public perspective. According to the Minister there was little chance of this occurring due to the fact that LNG terminals generally involve 'one port[73] with a number of tanks' (Staatscourant, 2006). In order to ensure that future capacity additions would be undertaken in a fair non-discriminatory way, an additional condition would be attached to the final

[73] This is interpreted as being the actual location of receiving berths where LNG tankers can offload their gas.

exemption decision that dictates that a similar open season procedure should be adopted when further capacity additions are considered in the future.

Exemption decision vs. exemption advice

In granting the specific exemption to GATE for the development of an LNG terminal the Ministry largely followed the advice of the regulatory authority. However, it did not take over some specific conditions that the regulatory authority recommended to the exemption. One particular condition that was advised but not transposed in the final exemption decision was related to the possible negative impact on gas market competition when a large share of LNG import terminal capacity is allocated to a party with an already dominant position. The regulatory authority advised to include a condition in the exemption decision that would have put an obligation on the GATE terminal operator to ensure that the allocation of re-gasification capacity would not negatively affect competition in the market. This could be achieved by letting the regulator identify market parties that would not be allowed to obtain re-gasification capacity, unless they obtained permission from the regulator. The Ministry acknowledged the importance of not allowing already dominant market parties to acquire even stronger market positions through participation in new infrastructure projects but took a different position than the regulatory authority. It estimated that the risk of such occurring could not be sufficiently mitigated via the GATE exemption decision. Instead it argued that (the existing) Article 66a of the Gas Act was a more appropriate and effective instrument in this case. Article 66a of the Gas Act allows for the competent authorities to draft new regulatory measures (in Dutch: *'Algemene Maatregel van Bestuur'*) regarding the manner in which, among others, LNG operators offer capacity to the market.

The final exemption decision by the Ministry of Economic Affairs was published on 13th of November 2006. A notification of this exemption decision from the Ministry was received by the EC on the 23rd of November. The EC approved the Dutch exemption decision in April 2007. When the exemption period comes to an end, the default regulatory regime as described in the Gas Act in general, and the MR (Staatscourant, 2007) on acces to LNG terminals in particular, will apply to the GATE terminal.

7.3.4 Description of regulatory choices

Type and degree of competition

The implemented methods for regulating LNG infrastructure expansion as identified in EU legislation are the regulated expansion mode and the merchant-based expansion mode. The first method is considered the default method, whereas the latter is considered the exceptional expansion mode. The EU legislative position towards LNG terminal investments originates from its position towards gas pipelines expansion. The infrastructure has some properties that may point to natural monopoly or essential facility type of problems. EU legislation allows EU Member States to adopt a more tailor-made approach in defining the regulatory framework for LNG operations and LNG terminal investments, in which local market and geographical conditions can be accounted for. On the one side of the spectrum is the option of strictly regulating third party access with a large role for regulatory authorities to set and influence LNG access tariffs and conditions, whereas on the other side of the spectrum there is a more market-based approach that foresees a more market facilitating role for the competent regulatory authorities and more freedom for LNG operators and customers to bilaterally agree upon access tariffs and conditions.

On a national member state level there is substantial discretion for governments to adopt a specific method within the EU spectrum. This has de facto led to a different default regime for LNG infrastructure expansion in various countries. Traditional LNG import country Spain has adopted a regulated expansion method. The UK and the Netherlands have developed what appears to be a default regime of merchant-based expansion. This means that although respective UK and Dutch legislation fully transposes EU legislation in this field, the application of this legislation in practice comes down to merchant-based approach as the default. Italy and France have adopted a hybrid system with both regulated and merchant-based expansion. In France, one LNG facility is realised using a regulatory expansion method whereas (at least) one other LNG project has now acquired an exemption and thus applies a merchant-based expansion approach. In Italy, the hybrid system is reflected on a individual LNG project bases since numerous LNG projects have now acquired an exemption for 80% of designed capacity while the remainder of capacity is regulated. Since the implementation of the exemption Article 22 in the second Gas

Directive (EC, 2003a), a total of 11 LNG terminal projects have been granted an exemption, including the GATE terminal project.

Type and degree of vertical integration between LNG and other activities

The EU does not require more than accounting unbundling of LNG and other gas market activities, but EU Member States are allowed to adopt stricter unbundling requirements. In practice this means that LNG projects across the EU have different characteristics concerning the relation between the owner or operator of the LNG terminal on the one hand, and other, non-LNG related, gas market activities on the other hand.

In the case of the GATE terminal, several forms of horizontal and vertical integration of activities can be identified. There is horizontal integration between gas transmission and LNG activities within the Gasunie holding, one of the major shareholders in the project. This horizontal integration applies to both infrastructure ownership and system operation, and the four different customers of the LNG terminal vertically integrate gas trading with their partial ownership of the LNG terminal (each customer has a 5% share of GATE terminal ownership rights).

Scope of long-term arrangements

EU legislation indicates that long-term contracts may be concluded insofar competition rules are met. In addition, in allocating long-term contracts to the market, the LNG terminal operator needs to abide to principles of non-discriminatory access and transparent capacity allocation procedures. Whereas the EU legal framework initially did not contain binding regulations on congestion management and capacity allocation procedures, 2009 changes in the framework has led to more specific and binding requirements in this area. This concerns the facilitation of secondary capacity markets and the implementation of anti-capacity hoarding measures.

GATE adopted an open season procedure to assess market participant's interest in re-gasification capacity before concluding long-term contracts with four customers. Required conditions for secondary market trading and must-offer provisions have been implemented.

Summary of key regulatory choices

The regulatory choices in the case of the GATE LNG terminal project can be summarized as follows:

- EU legislation provides two possibilities for the role of competition in the case of LNG facilities: competition on the LNG facility via regulated third party access or merchant-based competition based on temporary exemptions from regulated third party access. Both possibilities are reflected in Dutch legislation;
- The Dutch regulatory authorities have chosen to allow GATE an exemption from rTPA;
- Owners of the GATE terminal are unbundled from other gas market activities based on accounts, whereas legal unbundling is adopted (as required under exemption criteria) between LNG terminal operations and operations of the neighbouring transmission network.
- An open season has been organized to assess market interest. This has resulted in long-term capacity contracts with four customers for duration of about 15 to 20 years.

7.4 Analysis

7.4.1 Introduction

This section aims to analyse the regulatory model adopted in the case of the GATE LNG terminal project from both a private and public perspective using the framework described in Chapter 4. From a private perspective it is important that the implemented regulatory model allows the investor to sufficiently deal with investment risks associated with the project. From a public perspective the regulatory model should contribute to the achievement of regulatory objectives. Trade-offs need to be made in deciding upon the regulatory model to be applied. This section makes an effort to uncover the trade-off made regarding GATE LNG terminal investment.

The structure of this chapter is as follows. Section 7.4.2 describes the characteristics of the LNG germinal project from a private and public perspective. Section 7.4.3 analyses the regulatory model implemented by describing the regulatory objectives at stake, analysing the choice or regulation and its underlying considerations, and evaluate its performance.

Section 7.4.4 analyses whether alternative regulatory models could have been implemented that would lead to improved performance from either private or public perspective.

7.4.2 Description of investment project characteristics

Inherent project characteristics influence the choice of regulation on two aspects. Firstly, project characteristics, including transaction characteristics, determine the type and level of investments risks to which the investor is exposed. For a socially desirable investment project to go ahead, an implemented regulatory model should take into account private investor's concerns and allow the investor sufficient instruments to mitigate investment risks. Secondly, the project in combination with its environment (i.e. the context of project investment) may give rise to positive or negative external effects. Depending on its objectives a regulator may want or need to take the external effects into account when making regulatory choices. This section discusses the key characteristics of the GATE LNG terminal project by referring to the concepts of asset-specificity, uncertainty, transaction complexity and external effects.

Asset-specificity

Facilitating the import of LNG requires investment in specific assets. The GATE LNG terminal is characterised by both site and physically specific assets. The 'hardware' assets are designed for the purpose of importing LNG, regasification and injecting the resulting natural gas in the nearby transmission network. Notwithstanding general physical-specificity of LNG terminal assets, there are, to limited extent, some properties that indicate a multi-purpose use. Firstly, there are distinct technical functions performed within the boundaries of the LNG terminal that allow for the temporary facilitation of transactions other than the base load processing of LNG into natural gas. For example, the LNG facility has the capability, albeit limited, to temporarily store gas and thereby provide flexibility services to the system. Secondly, some LNG *import* terminal assets may be of use when converted into a LNG *export* terminal. Therefore, part of LNG import terminal assets has an alternative economic value.

Because of high ex ante set-up costs and ex post re-location costs of the assets required for LNG import activities, the GATE LNG terminal is also site-specific. This would for example not be the case when it would concern an offshore LNG terminal. Offshore LNG terminals are generally more expensive to realize but are relatively easier to redeploy elsewhere. The GATE LNG terminal, however, is built onshore. The relatively more costly alternative of building LNG importing facilities offshore is generally favoured in areas with less suitable onshore physical and geological conditions.

In contrast with some other types of gas infrastructure investments in other contexts, the GATE LNG import terminal is not to be considered a dedicated asset. There is no particular lock in situation with one or a limited set of buyers and sellers. The terminal users can buy on the liquid world LNG market and sell to all gas users connected to the European gas transmission system. This does not mean to say that LNG terminal are never to be considered a dedicated asset: examples of the contrary are LNG import terminals that are only able to supply to one particular consumer and LNG export terminals that depend on one (nearby) gas producer for its business case.

Considering the features and context of the GATE LNG import terminal project, the conclusion must be that investment in this project is to be considered asset-specific of the physical and site-kind. In combination with (deep) uncertainty regarding the future use and value of LNG import services there may be considerable ex post hazards to be dealt with by the actors involved in the project.

Uncertainty

The value in providing LNG import services resides in two activities: the base load import of gas as a means to meet base load gas consumption, or the time-dependent import of gas in times when security of supply is threatened or local or regional system flexibility is required. Both value drivers are exposed to demand uncertainties.

The need for new LNG-based gas imports in North-western Europe (which includes the Netherlands) is based on continuing trends in gas demand and gas production. Indigenous gas production is in decline whereas demand for gas is expected to remain high. The increasing gap between demand and supply needs to be accommodated by new gas supplies. The development of LNG terminals in general, and the GATE LNG terminal in particular, is one option to bring in new supplies. On a project level, the GATE LNG terminal competes with other LNG facilities in the region and with new pipeline projects. Uncertainty about the actual demand developments, the actual decline of indigenous production and the number and timing of new supply projects affects the future economic value of GATE LNG terminal services and gives rise to the risk for the investor that upfront investment costs may not be recovered.

The need for flexibility services suffers from the same type of uncertainties. Alternative means of providing different types of flexibility services, ranging from seasonal to peak hour services, may or may not be developed, and demand for these services may change as a result of a different role of gas in the overall energy system. For example, the increasing penetration of intermittent electricity sources (such as wind) in the North-western European energy system may increase the need for flexibly operating gas-based power plants and for flexible gas assets in the value chain (such as storage facilities).

The types of uncertainties described above may to limited extent be accounted for in risk-based / scenario-based analyses. However, there is a different type of more fundamental uncertainty that is difficult to take into account in drawing up a business case for gas infrastructure investment. An example of deep uncertainty is for example the unexpected development of a new renewable-based energy technology that effectively makes gas obsolete as an energy carrier in particular end-user sectors. Other examples are revolutions in gas producing technologies that unexpectedly and fundamentally change the gas demand and supply balance in a region, instantly making gas import projects obsolete. The most compelling example of the latter is the recent shale gas boom in the US. It has been reported that at least one project LNG import terminal has been redesigned into an LNG export terminal.

Need for coordination

The transactions facilitated by the GATE LNG import terminal can be referred to as complex in the sense that they need to be simultaneously accompanied by transactions on the gas transmission system to which the LNG terminal is connected and transactions on the LNG market. The LNG terminal is only valuable if LNG supplies can be sourced in the market and can be transferred to final consumers via the transmission network. This requires coordination with LNG activities upstream and with gas transmission network activities downstream: there needs to be sufficient LNG liquefaction capacity, LNG transport capacity, and gas transmission capacity.

Barriers to investment

The presence of a combination of asset-specificity, (deep) uncertainty and the complex chain of transactions gives rise to a set of issues that need to be dealt with by the investor for the project to go ahead. The issues for an investor in the GATE LNG terminal are the following:

1. <u>Risk of underutilization or undervaluation of the LNG import capacity (i.e. volume and price risk of investment).</u>

   The key risk for the terminal investor not recovering upfront investments costs within the economic lifetime of the project due to lower than expected interest in use of the terminal or lower than expected tariffs for use of the terminal. As explained above, the future demand for gas and LNG terminal services is inherently uncertain, which makes asset specific investment the more risky. The cost of the terminal may exceed its market value.

2. <u>Risk of insufficient coordination with upstream and downstream assets and activities.</u>

   The complexity of the transaction facilitated by the LNG terminal infrastructure increases the risk for the investor, as the demand for LNG terminal services depends on the availability of both upstream LNG production capacity and downstream pipeline capacity against affordable prices. This requires a coordination between the LNG terminal and the neighbouring infrastructure system on operational as well as investment aspects. Whether coordination in transmission network investment is important depends on the position of the LNG terminal within the pipeline system to which it is connected. Although the GATE LNG terminal is located close to a large gas demand centre in the Netherlands and may actually reduce the flow of gas sourced elsewhere (for example the Dutch Groningen reservoir), the users of the terminal did trigger new investments in the neighbouring pipeline system. The reason behind this is that holders of LNG terminal capacity had the intention to re-export part of LNG imports further downstream to Germany.

3. <u>Risk of opportunistic behaviour of actors involved.</u>

   Dependency on transactions upstream and downstream of the LNG terminal in combination with asset specific investment causes a risk of trading partners behaving opportunistically over time in order to capture rents elsewhere in the value chain. In the case of GATE, this could hold for actors responsible for upstream liquefaction and shipping and downstream transmission.

4. Regulatory risk.
   Regulation (or the threat of regulation) exposes the GATE terminal investor to two types of regulatory risk: regulatory risk due to general and to behavioural uncertainty. Changes in the market or economy (reflecting general uncertainty over future developments) may affect regulatory objectives of the authority over time and lead to an unexpected, unilateral change in the 'regulatory contract'. Behavioural uncertainty concerns uncertainty about future regulatory actions regarding pre-specified parameters in the regulatory contract. Both types of risks can affect the future value of investment and lead to the hold-up problem ex ante.

External effects of the project

Physical characteristics and the context of the investment project give rise to two external effects.

With the realisation of a LNG import terminal the Netherlands can tap into the world LNG market and increase its diversification of gas supplies. The Netherlands have always relied on both indigenous gas reserves and pipeline gas from Russia and Norway (via Germany). GATE LNG terminal investment would thus have a positive external effect on the security of supply position of the Netherlands. In addition, the additional LNG import capacity could allow for an increase in the level of competition in the market, dependent on which company succeeds in acquiring LNG and LNG terminal capacity rights.

In the next section, the regulatory model implemented in the case of GATE is analysed. This includes an evaluation of the performance of the regulatory model from a private and public perspective. This includes an evaluation of the degree to which investor's risks and external effects have been taken into account.

7.4.3 Analysis of the regulatory model

This section analyses the implemented regulatory model from both a private and public perspective. It starts by describing the regulatory objectives at stake and the trade-offs involved. Thereafter, an analysis of the key regulatory choices and their underlying considerations (e.g. project characteristics, exogenous factors) is performed. Then the performance of the regulatory model in terms of investor's concerns being addressed and regulatory objectives being attained is evaluated according to the case study framework presented in chapter 4. Finally, the consistency of implemented choices with theory is discussed.

Description of regulatory objectives

At the EU level there is the concern of policy-makers that the decrease in indigenous gas production in combination with a continuing demand for gas will expose a large import gap. This gap needs to be bridged by new gas supplies from outside Europe, and preferably not expose Europe to large dependency on few external suppliers. The latter is perceived to worsen the level of security of gas supply. Since LNG terminals are inherently more flexible in sourcing gas from far away sources than pipelines the EU supports LNG terminal investments. This serves both a security of supply and 'geo-political' competition interest. This translates into a clear objective to facilitate further LNG terminal investments. On the other hand, the EU believes that only a competitive and properly integrated European gas market is able to trigger the required investments in for example LNG import terminals. Encouraging gas market competition by reducing market entry barriers to the maximum extent possible is a priority objective.

At the member state level, Dutch authorities have three distinct objectives in gas policy related to LNG terminals (NMa/EZ, 2006). Firstly, well-functioning markets characterised by a high level of competition on the wholesale and retail markets are an important objective. This implies strong efforts to improve on market entry conditions to all markets. Secondly, security of supply is becoming increasingly important as North-western Europe, including the Netherlands, experiences a continuous decline in gas production that is expected to continue in the future. With gas demand expected to remain at a high level it is important that the increasing gap between indigenous supply and demand is met by new supply infrastructure, including LNG terminals. Since the Netherlands at the time did not have LNG import terminal capacity, the realisation of the GATE terminal would be a welcome contribution to security of supply. Finally, based on the current important role of the gas sector in the Dutch economy and the opportunities to further develop gas sector activities, the Dutch government adheres to the so-called gas hub policy which envisages a future where the gas sector continues to play a large role in the Dutch economy and a large role within the (North-western) European gas market. In the perspective of Dutch gas hub policy, the realisation of new gas supply routes can be seen as both a result of the excellent, well-positioned Dutch gas market, as well as a trigger for further gas hub developments. Although the realisation of one or more LNG terminals in the Netherlands would obviously improve the security of gas supply in the Netherlands, there is no explicit regulatory objective in this respect.

The overarching policy objectives translate into regulatory objectives that are at odds with one another. The objective of increasing market competition by minimising, or fully removing, market entry barriers would be supported by strong requirements regarding third party access conditions. Any deviation from such strict access regime for the purpose of enticing investors to build new infrastructure would conflict with this objective. But completely neglecting private actor's concerns regarding the long-term recovery of investment costs would, on the other hand, led to underinvestment and increase the risk of security of supply failures in the system. However, with the facilitation of new investments in gas infrastructure, by for example less strict access conditions and freedom to set tariffs, there is a risk that any lack of competition in the relevant infrastructure service market gives rise to market power for the investor. Infrastructure owners that charge non-competitive tariffs due to a lack of competition damage gas market efficiency.

The next paragraph analyses the choice of regulation and the factors that were considered. Factors concern project specific characteristics, exogenous factors and external effects.

Analysis of regulatory choices

What have been the key regulatory choices in the case of the GATE project and what were the arguments and factors underlying these choices?

It is important to note that The Netherlands did not have LNG import terminal facilities until the GATE terminal materialised in 2011. In 2006, when confronted with the first LNG initiatives in the Netherlands, the Dutch regulatory authority organized a market consultation on regulation of LNG terminals in the Netherlands in order to decide on the future regulatory model. The choices and underlying factors can be summarized as follows.

A light-handed rTPA was implemented that implied that the regulator needs to approve tariff methodology (market-based or cost-based) and resulting tariffs that are proposed by LNG operators. The choice for a light-handed approach is based on several factors and considerations:

- LNG investments in the Netherlands were considered desirable (because of gas supply diversification and its impact gas hub development) and in order to attract investment it was reasoned that only strictly necessary regulation needs to be implemented;
- The Netherlands is not dependent on LNG supplies, and will not be in the foreseeable future: very strict regulation is therefore not necessary;
- The Dutch gas market is mature and competitive: an LNG operator is not likely to have a dominant market position that would distort market functioning.

While drafting regulation on LNG terminal access, three LNG terminal exemption application procedures were in process. Although not explicitly mentioned the regulation does seem to assume that for new investments exemption regulation would de facto be the standard approach. In describing rTPA regulation, the regulatory authority mentions the specific features of the LNG value chain, being characterised by a range of investments in specific assets that need to be coordinated in order to reduce investment risks, including the investment risk for LNG import terminal investors.

GATE terminal successfully applied for an exemption from rTPA. In assessing the formal exemption criteria an additional number of considerations and factors were addressed.

- GATE is subjected to a large degree of competition on the world LNG market (there are by far more import than export terminals): a default rTPA regime would not allow GATE to effectively compete on that market. A default rTPA regime would give rise to large financial risk due to the fact that future terminal tariffs uncertain and influenced by the regulator. This increases the cost of operations and damages the position of GATE in the market to the degree that investment is not opportune.

- Horizontal integration between actors in the gas value chain is assessed on its possible distorting impacts (i.e. conflicts of interests and cross-subsidisation).
- External effect on the gas wholesale market: the impact of terminal realisation on the level of competition is assessed in different scenarios.
- External effect on the backbone infrastructure: the impact on operations and investment requirements on pipeline network to which the LNG terminal is connected is assessed.
- External effect on security of supply: the impact of LNG terminal investment on security of supply diversification is assessed.

In the end, the most important consideration in allowing the GATE terminal project an exemption is the negative impact that yearly tariff reviews would have on the (financing) costs of the investment, and the competitive position of the terminal in the LNG market. Given that investment was desirable from a number of perspectives (including security of supply, competition in the market, and contribution to gas hub development), an exemption was considered justified.

Performance of the regulatory model

In this paragraph, the performance of the regulatory model adopted is evaluated from a private and public perspective using the list of issues for the private investor and the operationalized objectives of the regulator.

Performance from a private perspective

In order for a private investor to go ahead with investment in LNG import terminal capacity, his investment concerns need to be sufficiently addressed within the implemented regulatory model. The different investment risks identified previously on the basis of project and transaction characteristics are consecutively discussed below.

- The exemption from regulated TPA awarded to the LNG terminal investor for a period of 20 years allowed him to sign long-term ship-or-pay contracts with customers. This effectively transfers price and volume risk to terminal customers.

This implies that the risk of not being able to source enough LNG in the market is also borne by the customers.

- The coordination with investment in the pipeline system, to which the LNG terminal is connected, was apparently not an issue threatening the go-ahead of the LNG terminal investment. This does at least not come forward from assessing regulatory documents. Therefore it may be assumed that the standard approach to TSO network expansion was sufficient in accommodating future gas flows origination from the proposed GATE LNG terminal.[74]
- The risk of opportunistic behaviour of the owner and operator of the backbone infrastructure aimed at capturing rents acquired in LNG activities is mitigated by the performance-based regulation (rTPA) imposed by the regulatory authority. Any hazards related to the behaviour of gas market actors upstream are transferred to the uses of the LNG terminal via the long-term ship-or-pay contracts.
- Regulatory uncertainty may exist regarding the specific regime that will be approved after the exemption period for the terminal has ended. However, since the investment is expected recovered within the period of the exemption (see exemption decision), this does not longer threaten investment.

Performance from a public perspective

The performance of the regulatory model from a public perspective is evaluated using the performance criteria defined in the case study framework, and the regulatory objectives and external effects identified earlier in this section. An evaluation is provided below.

- The LNG terminal investment was based on a transparent open season, reported on by the investor to the regulatory authorities. As willingness to pay for new capacity by shippers on the one hand, and the long-term cost of providing this capacity on the

[74] The standard approach in facilitating network expansion is as follows. Based on signals from the market that indicate particular (future) scarcity of capacity the regulated TSO Gas Transport Services can organize an open season. The open season then tests market interest for network expansion. In the open season interested shippers can take up long term commitments (typically exceeding 10 year) for new network capacity.

other, are the key determinants in the dimensioning of the project, it can be assumed to be efficient.

- The exemption decision allows GATE to operate as an unregulated private company in a very competitive environment. This provides strong incentives for static and dynamic efficiency.
- The long-term contracting of LNG terminal capacity does not need to be hindering short-term capacity trading and effective market competition if implemented measures such as secondary markets and use-it-or-lose-it mechanisms are properly implemented. If this condition is met in practice is monitored by the regulatory authority. What could ease secondary market facilitation is combining capacity rights for the terminal with entry capacity rights to the backbone infrastructure. This does not seem to be the case.
- External effects are not internalised within the regulatory model but rather provide a rationale to deviate from the default model of rTPA.
- The strength of investment incentives provided by the regulatory model is assessed by looking at the degree to which the private investor's concerns are tackled in the regulatory model. This was illustrated in the previous paragraph, which described how investments risks mitigated.

Consistency with theory

From a theoretical perspective the question is whether the choice of regulatory model is consistent with theory, and whether it has been implemented as prescribed by theory. Finally, the implemented mode of governance can be reflected upon from a transaction cost economics perspective.

The GATE case study suggests that the Dutch regulatory authority would have been likely to implement a negotiated TPA regime if this was allowed for in EU legislation, because the factors considered are illustrative for an nTPA or merchant approach (i.e. decentralised investment decision-making (Klein 1996, Brunekreeft, 1995). In the end, GATE was awarded a merchant status, but only after following an exemption procedure. Factors considered included the level of competition in the relevant market, the stage of gas market development, and the need for coordination of LNG chain activities via long-term contracts. The level of competition is illustrated by two other LNG terminal initiatives that were developed (but cancelled) in parallel to GATE. In North-western Europe, gas supplies via GATE compete with a large number of alternative supply sources. The regulatory authority explicitly mentioned the trade-off between providing sufficient investment incentives via light-handed regulation on the one hand, and the need to ensure short term access to import capacity on the other. It argued that given the need for gas supply diversification, the likely positive impact on market competition and the stimulus it could provide to gas hub development, priority should be given to facilitating investment, and safeguard non-desirable impacts on market functioning insofar possible.

The GATE LNG terminal project was successful in applying for an exemption from default TPA regulation. In assessing whether the exemption process as adopted is consistent with access holiday and transaction cost economic theory, the four key questions as derived by de Joode and Spanjer (2010) can be used. The questions that should be addressed in considering the appropriate regulatory choices are: (1) are there ex post hazards for the investor? (2), do the ex post hazards warrant mitigation?, (3) is the exemption instrument the least-cost mitigation option for the ex post hazards?, and (4) what type of exemption is considered proportional given the ex post hazards?

- The ex post hazard for the investor concerns the risk that future regulated tariffs are insufficient for recovering upfront investment costs. This translates into an additional financial risk that could indeed make the investment uncompetitive. The regulatory risk involved may be considered high also because LNG imports are a new phenomenon for the Netherlands. The regulatory authority stated that it currently only provides the basic framework conditions for regulated TPA conditions whereas separate elements may need to be specified later in time. This beholds a clear risk for the investor.
- The main source of the hazard is the choice to implement regulated TPA at the EU level. If EU legislation would have allowed for nTPA, then ex post hazards would have been substantially (and perhaps sufficiently) reduced since it would allow the investor to transfer risk to customers in long-term ship-or-pay contracts that are not exposed to price regulation.
- The default regime of regulated TPA reduces the profitability of the project and financial risk analyses supposedly confirmed that without an exemption the project

is unprofitable. This cannot be verified since information is not provided for reasons of confidentiality.

- Social benefits of realising a terminal in were mentioned, but no full analysis of the social desirability of the project was performed, which makes it difficult to assess whether the exemption in the case of GATE turns a socially desirable unprofitable investment into a privately profitable investment.
- Concluding, implementation of negotiated TPA (if allowed under EU legislation) would probably have removed the need for an exemption. Given that regulated TPA was the default regime, an exemption being awarded to GATE is probably justified, even though private and social profitability positions have not been fully explored. An argument for giving an exemption although doubts may be raised is the fact that the costs and benefits of providing an exemption as asymmetric. In the case of GATE, it is likely that the benefits of realising investment by awarding an exemption (although perhaps not justified) are by far larger than the costs of not rewarding an exemption (while it in fact would be justified). The benefits relate to the external effects on wholesale market competition, diversification of gas supply and contribution to gas hub development.

From a transaction cost perspective, different alternative governance modes could have been implemented in order to mitigate the risk for the investor. Instead of securing recovery of investment via long-term contracts, the owner could have decided to vertically integrate with upstream liquefaction assets to secure a sufficient supply of gas. The customers can secure LNG supplies by either entering long-term supply contracts upstream or vertically integrate with LNG suppliers. The risk of insufficient coordination with investment in the backbone infrastructure is supposedly mitigated with the standard expansion procedure of the regulated operator Gas Transport Services (GTS). The question whether the organizational link between GATE and Gasunie, the holding company of GTS contributed to this coordination cannot be answered. In theory, horizontal integration of LNG and gas transport activities can solve coordination issues. The case of GATE raises the question if the expansion and coordination process would have been just as smooth in the case of Gasunie not being involved in the LNG terminal investment.

7.4.4 Analysis of alternative regulatory models

The previous section illustrated how the implemented regulatory choice dealt with the concerns with private investors and to which extent it led to regulatory objectives being attained. This resulted in a particular allocation of costs, benefits and risks. This allocation is reflected in a regulatory choice regarding the role of competition. The key issues for the investor are the investment risk associated with the project and the coordination with the backbone infrastructure. Relevant objectives for the regulatory authorities involved were the sufficient provision of investment incentives (in order to safeguard security of supply), minimal distortion of market functioning and competition in providing these incentives, and possibly contribute to the development of the Dutch gas hub. EU legislation provided only two possible regulatory models, of which one, exemption from rTPA, was implemented. In this section two alternative regulatory models are evaluated. The first alternative is investment under regulated TPA. The second alternative involves a partial exemption from rTPA, which may be referred to as a hybrid model. These alternative regulatory choices and their implications are consecutively discussed below.

Investment under a regulated TPA regime

While LNG terminal investment in the UK, the Netherlands and Italy is largely based on exemptions, regulated LNG terminal investment is common in Belgium, France and Spain. Regulated investment needs to involve a stable cost-based remuneration regime that sufficiently compensates for (financial) risks: if performance-based regulation would apply, investment would not take place due the large regulatory risks involved. When remuneration formulas as applied by the regulatory authority are indeed robust and cost-based, rTPA is a very effective model to encourage LNG terminal investments. This comes at the expense of efficiency though. With costs of LNG investment and operations being socialized, static and dynamic efficiency worsen because there is no incentive for operators to increase efficiency. Dimensioning of the LNG project could be market-based, via open seasons for example, or could be based on central planning. The latter is the approach adopted in Spain for example. When a particular investment is deemed necessary from a public point of view, the desired LNG investment project could be tendered off to the market. When investments are based on central planning criteria it is relatively easy to internalise external benefits of LNG terminal investment in the market. A positive aspect of the rTPA model is that full terminal capacity is available to the market, making it easier for new market entrants to enter the market and improving market functioning. A reason for considering such an rTPA based investment model is a strong (LNG) import dependency. Spain for example almost completely relies on LNG supplies, and in addition, resorts to LNG terminals to provide market flexibility (in the absence of ample opportunities for underground gas storage).

Hybrid investment: combination of rTPA and partial exemption

In discussing the performance of the regulatory model adopted in the case of GATE, it was highlighted that the final exemption decision prioritised the realisation of new LNG terminals over possible concerns over short-term access to LNG terminal capacity for other market entrants than those who secured long-term contracts. A different prioritisation that would seek to keep possible negative repercussions on short term access to a minimum level could lead to the adoption of a hybrid model that involves an exemption of only part of the LNG terminal capacity. This hybrid model is for example implemented in Italy, where 80% of capacity is exempted, and 20% is regulated and destined for short-term trading. The performance of this regulatory model from a private and public perspective is in-between the earlier discussed models of full exemption investment (as awarded to GATE) and regulated TPA investment (see previous paragraph).

7.5 Conclusions

This section provides the conclusions following from the analysis of this case study by addressing four questions:

- What were the key regulatory objectives at stake in realising the project and which were the key concerns for the investor?
- What was the response of regulatory decision-makers in terms of regulation implemented?
- Which considerations (factors) led to this choice?
- Would an alternative response have been (more) appropriate, and if so, why was this not implemented?

The key objective for the regulator in considering default regulation for LNG terminal access conditions was to implement a regime with a minimum level of regulation of access conditions, without violating the EU requirement of imposing regulated third party access. The actual access conditions to existing terminal capacity were of no concern since the Netherlands did not have any LNG terminal at the time when regulation was designed. The regulatory authorities were mainly occupied with capturing the possible external benefits that investment in an LNG terminal would have for the Dutch market: it would improve diversification of gas supplies, improve the level of competition, and would contribute to further development of the Dutch gas hub strategy. For investors in the terminal the key concern was with the competitive position of the terminal in the market under different possible regimes, and with the ability to sign long-term contracts with consumers to reduce investment risk.

By implementing light-handed rTPA regulation the regulatory authorities hoped to encourage future investment in LNG terminals. Before this regulation was implemented, the Dutch gas Act already, as required by the EC, contained the exemption clause under which LNG terminals could apply for an exemption from this rTPA regime. During the implementation of default LNG regulation, the regulatory authority was involved in three LNG terminal exemption applications. GATE was successful in acquiring an exemption for full terminal capacity for 20 years. The decision to do so was relatively easy since the regulator could point to the large external benefits in the market on the one hand, and argue that it does not come at the expense of competition or new dominant economic positions: the Dutch gas market, as part of the North-western European gas market, is a mature, large gas market with a substantial number of gas suppliers.

Alternative regulatory models could have been adopted, such as rTPA-based investment, or a hybrid model of partial exemption / partial regulated TPA investment. Regulated TPA could have led to key issues for the investor being addressed but at the expense of static and dynamic efficiency performance. This option would be more suitable under different market circumstances such as a large import dependence, small gas market, and limited interconnectivity. Compared to the implemented regulatory model, the hybrid model would give better performance regarding short-term market facilitation and would allow better opportunities for new market entrants. Whether this alternative is to be preferred depends on how the secondary markets and use-it-or-lose-it mechanisms implemented as part of the exemption function in practice.

8 Synthesis

8.1 Introduction

The objective of this chapter is to derive generalised observations from the individual case studies. The case studies were analysed using the theoretical framework that was developed in chapter 3 (see figure 9). Within each case study, different factors affecting investment and the chosen regulatory model were assessed. The four types of factors affecting investment are private barriers to investment, the type and degree of competition to gas infrastructure facility is subjected, the need for coordination with other gas infrastructure elements, and external effects on the commodity market. As was illustrated for individual projects in the case study analyses, the choice of regulatory model not only depends on the particular presence of these factors, but also on the public policy preferences (i.e. regulatory objectives). In the choice of regulatory model, regulatory decision-makers should first assess the factors affecting infrastructure investment, and then evaluate which regulatory models are suitable from the perspective of public objectives that need to be met or regulatory objectives that need to be attained.

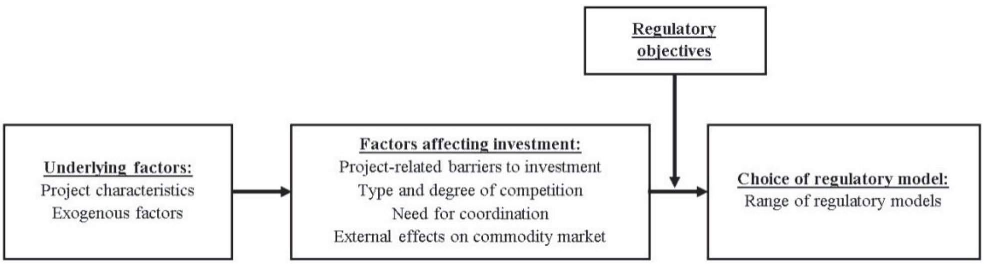

Figure 9 Framework for explaining the choice of regulatory model

The structure of this chapter is as follows. Firstly, section 8.2 discusses the relevance of the different factors affecting investment in different types of gas infrastructure. It draws conclusions regarding both similarities and differences in regulatory choices for different types of gas infrastructure. Then, section 8.3 continues by discussing why regulatory choices can vary from project to project and across countries within one particular type of gas infrastructure. Based on the drawn conclusions, section 8.5 reflects on the regulatory choices that were made by the EU and were taken as given in the case study analyses. Finally, section 8.4 argues which improvements in regulatory choices can be made given the current regulatory framework in the EU.

8.2 Analysis of different factors affecting investment

This section draws conclusions regarding the factors affecting investment in gas infrastructure. It consecutively deals with the private barriers to investment, the type and degree of competition, the need for coordination with other gas infrastructure elements, and external effects on the commodity market. For each factor, its relevance for different types of gas infrastructure is discussed. This allows for conclusions to be drawn regarding common and distinctive factors for different types of gas infrastructure.

8.2.1 Private barriers to investment

The assessed case study projects illustrated that gas infrastructure investors face a number of barriers to investment, some of which are common for different types of gas infrastructure. However, the combination of different characteristics may lead to different risk positions for the project and give rise to different regulatory models being adopted in practice. Below the specific barriers of asset-specificity, uncertainty, lumpiness of investment, upfront investment costs, and regulatory risk are discussed.

Asset-specificity

The higher the level of asset-specificity, the larger the investment risks. In combination with high upfront investment costs and uncertain future market circumstances, the presence of asset-specificity can give rise to the hold-up problem (de Joode and Spanjer, 2010) and prevent investment ex ante. The impact of asset-specificity on the level of risk for the investor depends on the type of asset-specificity. Does the problem of asset-specificity apply to all types of gas infrastructure? Some forms of asset-specificity, in particular physical and locational asset-specificity, apply to all types of gas infrastructure, but not all gas infrastructure projects involve dedicated assets.

Gas infrastructure assets are generally both physically and locational specific. They are physically specific because they are designed to deal with gas of specific quality and specifications, and location-specific as the costs of relocating pipeline, storage and LNG assets is prohibitively high. The case study projects are all characterised by high levels of physical and locational asset-specificity. All projects were designed to deal with gas of specific high calorific quality and a direct alternative use involving another type of gas was not considered realistic during the lifetime of the project. A possible exception to the general location specificity of gas infrastructure assets is re-deployable off-shore LNG terminals that may be relocated against certain cost.

Not every gas infrastructure necessarily involves dedicated assets. Whether dedicated assets are involved varies from project to project. If this is the case depends on the number of potential trading partners for the infrastructure owner: if the number is limited (to one trading partner in the extreme), then the assets can be considered dedicated. This deteriorates the bargaining position of the investor after assets are sunk, so it implies a large investment risk. Single pipelines are dedicated assets if they are not part of the backbone infrastructure and if they connect one infrastructure facility in particular (such as a LNG or storage facility). When a pipeline is part of a backbone infrastructure that connects a larger number of gas suppliers or consumers, then it is not a dedicated asset. The chances of a new pipeline being a dedicated asset relates with the stage of gas market development. In the early stages of gas industry development there are limited trading partners, implying a larger risk of investment involving dedicated assets. Similarly, gas storage and LNG import facilities can be dedicated to facilitate gas infrastructure services to a very limited number of gas consumers, but if connected to a larger gas infrastructure system with numerous buyers and sellers, the assets can no longer be regarded dedicated. However, dedicated assets were only observed in the case of the Milford Haven pipeline. The BBL pipeline did not involve dedicated assets as it facilitates a transportation service between two backbone infrastructure systems that may be of value for a large range of shippers. Also the GATE LNG terminal and the Bergermeer storage facility are positioned to deliver services that are of interest to a wide range of market players. Three out of the four case study projects were not transaction specific: the capacity in the BBL, Bergermeer and LNG Gate terminal projects were assessed to have a certain economic value for alternative users. However, the Milford Haven pipeline would be transaction-specific, and have an alternative value of zero if capacity rights in the LNG import terminal at the start of the pipeline would be nontransferrable / non-tradable or in the case of LNG imports not being economically viable at all due to changed market conditions.

Uncertainty

Uncertainty in combination with asset-specific investment, high upfront investment costs and long lifetime of investment may lead to high levels of investment risk that may become a barrier for investment in socially desirable infrastructure projects if the applicable regulatory model does not allow sufficient opportunities to mitigate risks. Large uncertainty could therefore lead to underinvestment in gas infrastructure capacity from a public perspective. In the case study projects, long-term contracts were closed in order to re-allocate investment risks to those parties that were best capable of bearing the risk. However, different types of long-term arrangements were made across the case study investment projects, regarding length and conditions. The explanation for these differences may partly lie in the differences in uncertainty regarding future demand for infrastructure services and thus the future value of infrastructure in different projects. A distinction can be made between general gas market uncertainty and uncertainty related to the specific investment project.

The key uncertainty affecting the business case of gas infrastructure investments is the uncertainty regarding the future role of gas in the energy system in general, but this is not different between the considered case studies as they are located in the same geographic market of Northwest Europe. General factors of influence are the stage of gas market development (i.e. what is the role of gas in the relevant market? What is the penetration rate of gas in the relevant market? What are the contemporary dynamics in gas demand and supply?). Although the future demand for and competition between infrastructure services provided by new infrastructure projects is inherently uncertain, robust market developments, as for example reflected in market signals such as prices and levels of congestion, may give some reasonable expectation that new investment is necessary to meet future demand. Gas demand and supply dynamics may be considered a function of the stage of gas market development and of local gas supply developments. The case studies show no diversity in this aspect. The North-western European market is a mature market with a relatively high penetration rate of gas in the energy mix. This does not lead to different valuations across the four case studies, since all are realised within the North-western European market. Relevant for all case studies is the fact that North-western European gas production is in decline. This leads to an increasing need for new gas import capacity from new gas supply sources (the LNG terminal case), new pipeline capacity required to enable additional imports (the BBL and Milford Haven pipeline connections), and requires replacement investments in new sources of seasonal flexibility (the gas storage case).

New gas infrastructure facilities are subjected to different levels of uncertainty regarding the specific demand for their services and the competition in their provision. Uncertainty more specific to the type of infrastructure concerns the future need for specifically the type of services that can be delivered. This depends on the overall trends in the use of gas within the energy system but also on the development of competing alternatives. This factor works out differently for the different types of infrastructure investment. The differences in specific environmental uncertainties can be illustrated with the projects assessed in the case study analyses.

- Both the BBL and the Milford Haven pipeline largely contribute to the solving of the problem of an increasing UK import gap that is widely accepted to increase in the future. Although the need for new gas supplies in the coming decades can be referred to as robust, there is competition between different infrastructure projects. The cost of each option in the UK supply curve determines if the investment risk is large compared with competing options. The BBL and Milford Haven pipeline (including LNG terminals) compete with Norwegian supply lines to the UK and with UK LNG terminals.
- For the Bergermeer storage facility, the declining capability of indigenous gas production to provide seasonal flexibility is the trend that underlies its business case. However, the future level of competition from other storage facilities in the region is uncertain as new storage facilities may be realised. Again, the cost structure of the storage service provision by Bergermeer compared with the cost of alternatives determines the actual risk for the investor. Lumpiness of gas storage investment may cause a first-mover advantage in the sense that new storage investments will be more likely to be costlier due to less favourable local conditions and therefore relatively more prone to volume and price risks.

- LNG import facilities such as the LNG GATE terminal compete with other gas supply sources such as indigenous gas production and long distance pipeline imports. The general demand for gas and the decline in local gas production determines the need for new gas supply sources. In meeting the gap between gas demand and indigenous gas production, the investor in a new LNG terminal is uncertain about the level of competition from other gas import facilities.

Lumpiness of investment

The different types of gas infrastructure that featured in the case studies vary in the degree of lumpiness, which gives rise to different risk profiles for the projects as some infrastructure facilities can follow demand developments over time more closely. The lumpiness of infrastructure investment has important implications for the risk position of the investor and thus the choice of regulatory model. Non-convexities in the long-run marginal cost curve for infrastructure capacity services give rise to lumpy investments. If infrastructure investment could be divided into smaller incremental steps it would be possible to 'track' market demand for capacity over time more closely, implying relatively less risk than for very lumpy investments. The degree of lumpiness may be expressed as the minimal amount of new capacity (for example in BCM per year) that is economically and technically feasible. In combination with investment risks due to asset-specificity and uncertainty, lumpiness of investment can exacerbate the potential problem of underinvestment in infrastructure capacity. In general, all types of gas infrastructure investments are lumpy, but the degree of lumpiness varies across the types of gas infrastructure. Gas storage investments are lumpy since the dimensioning of the storage facility is largely based on the local physical conditions. The expansion of an existing storage facility depends on the nearby presence of suitable caverns or depleted fields that may be connected to the existing facility in the future. LNG, although also constrained by its physical surroundings, is probably less lumpy as the capacity of the facility can be dimensioned in a modular way, with multiple LNG terminal receiving berths and LNG storage tanks. Pipeline capacity is also very lumpy due to its economies of scale (von Hirschhausen *et al.*, 2007). Existing pipeline capacity may be expanded by adding compression facilities, but only limitedly so. When capacity limits are reached, a new (parallel) pipeline may prove the only options. In the case of GATE, project investors were aware of the maximum technical capacity at the location of development (as determined by the availability of land) and choose to adopt a stage-by-stage investment procedure where capacity expansion follows demand for LNG services over time. BBL investment, involving offshore pipeline building is very lumpy: after realisation capacity could only to limited degree be expanded via additional investment in compression facilities, or by expensive investment in a second parallel pipeline. The Milford Haven pipeline was dimensioned on the specific capacity of LNG terminals to be realised at one end of the pipeline.

Upfront investment costs

The size of upfront investments costs both in absolute terms and in relation to operational costs varies across types of gas infrastructure and across projects. The larger the upfront investment and the larger the part of capital cost in total cost of service provision, the larger the barrier to investment. In the presence of uncertainty and asset-specificity, high upfront investment costs are a barrier for investment of gas infrastructure projects. Large investment costs incurred ex ante expose the investor to different types of risk (such as volume risk, price risk, and regulatory risk). The size of the upfront investment itself is influenced by physical and geological conditions: the more unfavourable the physical environment, the higher the upfront investment costs and the larger the exposure to investment risks. High upfront investment costs are a relevant factor for gas infrastructure in general, although capital intensity may vary across different types of gas infrastructure. Gas storage facilities show large variation in amount of capital costs in relation to size of the facility: large storage facilities with low deliverability have different investment cost properties than small storage facilities with high deliverability. Investment cost estimates for the four projects assessed in the case study analyses vary from €500 million to over €1 billion.

Regulatory risk

Regulatory risk covers a broad range of different issues that may be described as being the risk that future regulatory decisions or changes to regulatory decisions from the past affect the market value of the investment. Factors that influence the investor’s perception of regulatory risk are: a lack of independence of the regulator, which increases the risk of political influence in the case of politically sensitive projects, the involvement of multiple regulatory authorities in the regulation of infrastructure activities, and uncertain interpretation of regulation and undesirable changes in the regulatory model over time.

From the available documentation that was researched as part of the case study analyses the regulatory risk due to a lack of independence of the regulatory authority did not emerge as an issue. This may be explained by the common stage of gas market development and the high level of gas market liberalization across the case studies – in particular the number of years that the gas market has been liberalized and the experience in regulating the infrastructure parts has been gathered.

Multiple regulatory authorities involved in shaping the regulatory model to be applied to the specific infrastructure project increased the level of regulatory risk in the case studies on the BBL pipeline and the GATE LNG import terminal. The two projects were awarded an exemption from default EU regulation and thus had to deal with regulatory processes and decision-making on the EU and the member state level. In addition, the interconnector investment (BBL) was subjected to regulatory oversight of two national regulatory authorities in respectively the Netherlands and the UK. This led project financiers to demand higher risk premium for their financial contributions. The increased regulatory risk was one of the factors that led regulatory authorities to allow for an exemption from default regulation for BBL.

Three out of the four case study projects were exposed to the risk of a too low regulated rate of return on investment. This is a risk that is applicable to all cases where the default choice for regulation is based on regulation of tariffs or revenues. In the case of the BBL interconnector and the GATE LNG terminal investment projects this risk was removed by granting an exemption for default regulation. The projects will be subjected to regulated rates of return after the exemption period ends. However, since the companies aim to recover the cost of investment within the period of exemption, the risk of too low regulated rates of return did not affect final investment decision-making. In the case of the Milford Haven pipeline the regulatory authority allows for a temporary higher regulated rate of return for all investments in new pipelines, including the Milford Haven pipeline. Bergermeer was not subjected to similar risks since the default choice of regulation for gas storage was based on negotiated TPA.

Although the regulatory framework applicable to the case study projects was known, there was a risk for infrastructure investors concerning its interpretation and implementation in practice. All case study projects can be characterised as ‘being first’ in seeking regulatory comfort for the respective type of project.

- The BBL was the first project in the whole EU to apply for the exemption introduced in the second Gas Directive (EC, 2003a). As the Directive was not yet ratified, BBL investors sought comfort from regulatory authorities beforehand and basically undergoing two regulatory procedures (one informal and one formal application procedure). The risk of the outcomes of the two procedures being different was shouldered by the investors, and the only reassurance was provided by letters of comfort received from national regulatory authorities.
- The Bergermeer project was the first large storage project proposed in the Netherlands since the start of the liberalization process. This implied that the Bergermeer investors could not rely on precedents regarding the interpretation of new Gas Act articles to the case of gas storage, which creates regulatory uncertainty for the investment project. The investors have tried to mitigate this type of risk by explicitly putting forward questions to the Dutch regulatory authority on the validity of certain articles in the context of Bergermeer.
- Similarly, GATE was the first LNG terminal project proposed in the Netherlands. Until then, the regulatory authority had no experience in regulating LNG terminal activities in the Netherlands. In parallel to the exemption application of GATE, the Dutch regulatory authority organized a consultation on the regulation of Dutch LNG import activities. GATE investors took the final investment decision only when the exemption from default TPA regulation was granted. At the same time, the regulation of LNG terminals was published, which will apply to GATE terminal activities after the exemption period ends.
- The Milford Haven pipeline case provides an example of incomplete regulation. A framework for expansion of the NTS system was implemented that specified a procedure for expanding existing NTS entry point capacity, but it did not specify a procedure for expanding the NTS with new entry points. This increased the regulatory risk for the investor in the Milford Haven pipeline, TSO National Grid Gas. The regulatory authority Ofgem was successful in fixing this regulatory gap

under large time-pressure and in close consultation with stakeholders in the sector. During the time that a solution was not yet available the TSO was carrying large financial liabilities related to contractual obligations to Milford Haven pipeline capacity holders.

8.2.2 Type and degree of competition

Although none of the case study infrastructure projects operate in a fully contestable market (due to entry and exit barriers related to asset-specificity, lumpiness of investment and high upfront investments costs), all are subjected to some degree of competition. This has two important implications. Firstly, this challenges the view of gas infrastructures being natural monopolies. A larger degree of competition removes the need for very strict regulation of access conditions, and opens up possibilities to implement a regulatory model that is different from regulated investment. Secondly, competition in the provision of infrastructure services does increase the barrier to investment as it is uncertain what the actual demand for the new infrastructure facility will be in the future. The type and degree of competition to which the case study projects were subjected is summarized below.

- The BBL pipeline interconnection competed with other gas infrastructure facilities (both pipelines and LNG terminals) in the relevant destination and transit markets. The BBL competed with a parallel Belgium-UK pipeline in the market for transfer services to the UK and competed with a range of supply projects, such as UK LNG terminals and Norwegian pipeline supplies, on the relevant destination market (i.e. the UK). This increased the investment risk for the project and at the same time reduced the need for the regulation of tariffs or revenue.
- The Milford Haven pipeline considered in isolation was not subjected to competition from other infrastructure or non-infrastructure based instruments. However, as a dedicated pipeline for bringing LNG imports into the UK, the pipeline can be considered part of upstream LNG investments. The integral infrastructure project, LNG terminals and connection pipeline combined, are in effective competition with other supply projects for gas delivery to the relevant destination (i.e. the UK).
- The Bergermeer storage facility aims to provide flexibility services to the North-western European gas market. In doing so it competes with alternative flexibility sources such as flexible gas production and flexible gas imports via LNG import

terminals or pipeline deliveries. This decreases the need for strict regulation of storage tariffs but adds to the risk of investment.

- The GATE LNG terminal was proposed at a time where also other plans for Dutch LNG terminal projects were put forward. As the other proposed LNG projects have failed to materialize since the final investment decision for GATE, one can conclude that GATE was successful in the ‘investment race’ to become the first LNG terminal in the Netherlands. But also after realisation of the new LNG facility, it competes with other gas supply sources in delivering gas to the region of Northwest Europe.

8.2.3 Need for coordination with other infrastructure

The case study analyses pointed out the need for coordination with connecting infrastructure can be an issue for both the investor (as a lack of coordination increases the risk of investment) and the regulator (as it may lead to underinvestment in gas infrastructure in general). New gas infrastructure investments can trigger additional investment in capacity downstream or upstream of the project. From the perspective of the investor in a new piece of infrastructure, this may be an external effect. The need for coordination with investment in other parts of the gas infrastructure depends on the network externalities associated with the new gas infrastructure facility and its location in the existing infrastructure system. From the perspective of an existing gas infrastructure supply system, a new gas infrastructure facility can be considered a substitution of existing infrastructure or an extension of the existing infrastructure system: i.e. does the new facility gives rise to a new ‘role’ for existing infrastructure assets or is it replacing existing infrastructure assets. These are in fact two different cases with different types of externalities involved. Two factors determine the type of type of externality: the configuration of the infrastructure system to which new infra is connected and the size of the infrastructure investment. The character of the existing gas infrastructure system depends on the density of the network and the location of sources (i.e. production, LNG facilities) and sinks (i.e. demand centres). This type of characteristics compare with the study of Glachant and Hallack (2010), who analyse the economic properties of gas transport infrastructure.

The size of the infrastructure expansion compared to the overall size of the system to which it connects matters. The larger the new gas infrastructure facility compared with the relevant market, the larger the risk that substantial downstream infrastructure investments are required. The size of the system is likely to be related to the particular stages of gas market development. In a mature gas market such as the North-western European gas market, there is relatively less chance that one new gas infrastructure facility makes a difference when it comes to affecting existing infrastructure systems and triggering new investments.[75]

Among the case study projects, the Milford Haven pipeline and the Bergermeer storage facility did not require investment elsewhere in the system, whereas the BBL and the GATE LNG terminal required investment in neighbouring gas transmission pipelines. The Milford Haven pipeline project (combined with LNG terminal investment) implied a new gas supply route for the UK gas system and extended the existing pipeline system. The new supply infrastructure should be considered a substitute for declining production elsewhere in the system. The new pipeline was relatively conveniently located close to gas demand centres in the South-West of the UK. Similarly, the Bergermeer gas storage was conveniently located close to the BBL pipeline and close to Dutch gas demand centres in the west of the Netherlands. However, investment in the BBL and in GATE terminal triggered investment elsewhere and involved a larger need for coordination. From a Dutch perspective, the BBL is an additional export outlet requiring sufficient internal transmission capacity.[76] It required an upgrade of east-west transmission capacity in the Netherlands.[77] Although the location of the GATE LNG import terminal seems favourable given its close

[75] In contrast, in a less developed market, with a relatively small infrastructure system, it is more likely that any new gas infrastructure facility has substantial impact on the operation of existing gas infrastructure assets and stronger coordination between investments is required.

[76] Upgrades of BBL transport capacity in the future may require further east-west capacity additions to accommodate not only Dutch gas flows to the UK but also Russian gas flows (via the newly built Nord Stream) to the UK. Investment in the BBL would then need to be coordinated with investment in Dutch transmission capacity as well as cross-border Dutch-German transmission capacity.

[77] From a UK perspective the BBL pipeline can be considered a substitution for existing infrastructure (in both an economic and a technical sense): the BBL connects at the NTS entry point of Bacton, where gas produced on the UK continental shelf was previously delivered to the UK market. Therefore, no need for coordination with other investments was required.

proximity to large gas demand centres in the Southwest of the Netherlands an upgrade of the transmission pipelines running from the terminal to the German border was required since holders of long-term capacity rights indicated that part of the LNG was destined for Germany. This thus required a coordination of investment in the LNG terminal and downstream transmission pipelines.

8.2.4 External effects on the commodity market

New gas infrastructure facilities may have external effects on the commodity market, on the level of competition or the level of security of supply. New capacity potentially increases the level of competition in wholesale and retail markets (positive external effect) and may positively affect the level of security of supply of a gas system via the contribution of this new capacity to the diversification of gas supplies.

Factors that affect the presence of external effects on the commodity market are the role of gas in the market, size of the infrastructure project (compared to the market), the level of gas import dependence, the gas supply portfolio, and the market concentration on the commodity market.

External effect on the level of competition

The BBL pipeline and the Milford Haven pipeline expand total UK gas import capacity with respectively 16 and 27 BCM per year, which corresponds to 16% and 28% of total gas demand in the UK.[78] This is an indication of the large potential impact on the level of competition, depending on whether incumbent companies or new market entrants acquire capacity in these facilities. The Bergermeer storage facility will, upon realisation, compete with existing alternative sources for particularly seasonal flexibility: a market that currently has a fairly limited level of competition (Frontier Economics, 2008; The Brattle Group, 2011). The realisation of the first LNG import project in the Netherlands allows for a market entry of gas supplies not formerly (directly) delivering to the Dutch market, implying a positive effect on the level of competition as new gas producers are now able to supply gas to the Netherlands.

[78] Based on a total UK gas consumption of 98 BCM in 2010 (IEA, 2011c).

External effect on security of supply

All four assessed infrastructure projects contribute to a more secure gas supply system though an improved diversification of resources and a more robust gas supply system. The BBL improves the level of security of supply of the UK gas system as it improves interconnections with mainland Europe and allows for direct gas flows from Dutch gas producers. The Milford Haven pipeline indirectly enables a large increase in UK LNG import volumes. Given that the UK pre-dominantly relied on domestic and pipeline gas from Norway, this implies a substantial diversification of gas supplies, which again favourably affects the security of supply position of the UK. The Bergermeer gas storage facility adds 4.1 BCM per year to the 5.1 BCM per year of existing storage working capacity of the Netherlands which corresponds with an increase of about 80% (IEA, 2011c). Moreover, the project adds to the peak gas supply capacity of the Dutch gas system in dire times. Being the first LNG import project in the Netherlands, the GATE LNG terminal adds to the diversification of the Dutch gas supply portfolio: new LNG producing countries can now (directly) deliver to the Dutch gas supply system.

8.2.5 Conclusions

The investment risk associated with investment in a new gas infrastructure facility (i.e. the combination of private barriers to investment) depends on a number of factors. It is the interplay between these factors that determines whether a project is relatively risky in comparison with projects involving other types of gas infrastructure.

- All gas infrastructure projects are physically and locational specific, but not all gas infrastructure assets are necessarily dedicated to a particular transaction. Other types of asset-specificity were not found in the case studies.
- Uncertainty about the future value of new gas infrastructure facilities due to uncertain future demand for gas in general was not the main source of risk in the case study projects, as the North-western European gas market may be characterised by robust developments that involve a decline in gas production and continuing strong demand for gas. However, the risk of uncertain demand for specifically the infrastructure services provided by the new facilities is large because of the level of competition on the respective infrastructure markets.

- The different types of gas infrastructure that featured in the case studies vary in the degree of lumpiness, which gives rise to different risk profiles for the projects, as some infrastructure facilities can follow demand developments over time more closely. Notwithstanding differences that may be observed within a certain type of gas infrastructure, LNG terminals are on average more modular in expansion than gas pipelines or gas storage terminals.
- The size of upfront investments costs, both in absolute terms and in relation to operational costs, varies across types of gas infrastructure and across projects. The larger the upfront investment, and the larger the part of capital cost in total cost of service provision, the larger the barrier to investment.
- The level of regulatory risk was relatively high in the cases of the BBL and the GATE LNG terminal due to the involvement of multiple regulatory authorities and the too low regulated rate of return that would apply if the default regulatory approach was implemented. This risk was mitigated by granting exemptions in both cases. The other two cases were subjected to relatively less regulatory risk as the default regime allowed for higher returns on investment (in the case of Milford Haven via a higher regulated rate of return, in the case of Bergermeer via a relatively unregulated regime based on nTPA). All case study projects may be considered 'test cases' in the sense that they were the first of their specific type to be realised. This led to additional regulatory uncertainty for the investor during the regulatory process, but did not seem to affect the ultimate choice of regulatory model.

Regarding the type and degree of competition, the following conclusion can be drawn. All considered case study projects may effectively compete with other gas infrastructure facilities: both in the expansion phase, and thereafter. However, if security of supply is the dominant regulatory objective, a choice for regulated investment (e.g. by the TSO) may be made in order to ensure sufficient investment.

The need to coordinate the realisation of new gas infrastructure facilities with investments elsewhere in the system depends on the role of the new facility in the existing infrastructure system: it may concern an extension or substitution for existing infrastructure assets. Deep infrastructure investments are likely to be required in case the proposed facility extends the role of the infrastructure system. Examples are the BBL (which extends the role of existing Dutch infrastructure in providing transit services) and the GATE LNG terminal (which extends the role of existing Dutch infrastructure in providing gas exports to Germany from a new gas supply point). Deep infrastructure investments are unlikely to be required in case the proposed facility substitutes existing infrastructure. Examples are the investment in the Milford Haven pipeline and the Bergermeer storage facility.

Regarding external effects, the conclusion is that all analysed gas infrastructure projects positively contributed to both the level of competition and the level of security of supply on the relevant market. In fact, the conclusion may be that it is difficult for new gas infrastructure projects to not have a positive external effect on the competition and security of supply, except in the situation where an incumbent succeeds in increasing market share by acquiring capacity in any new facility. The size of the external effect depends on the additionality of the new facility where, larger facilities are more likely to be additional and have positive external effects. Examples of projects with a strong additional impact are the GATE LNG terminal (first LNG terminal in the Netherlands) and the Bergermeer storage (which increases Dutch storage capacity with 78%, see chapter 6). This principle of additionality can apply to all types of gas infrastructure, each within their own market.

The next section turns to explain regulatory choices between different projects involving the same type of gas infrastructure. Differences may exist within country borders, or between countries.

8.3 Analysis of regulatory models

The objective of this section is to draw conclusions regarding the choice of regulatory model for the expansion of different types of gas infrastructure. Whereas the previous section provided conclusions on how factors affecting infrastructure investment differ for different types of gas infrastructure, this section focuses on explaining differences between different projects of a specific type of infrastructure. This implies that gas transmission pipelines, gas storage facilities and LNG import terminal facilities are discussed in separate sections below. Each section argues how the choice of regulatory model from project to project depends on the context-specific factors affecting investment. The structure of the remainder of this section is as follows. Section 8.3.1 deals with the choice of regulatory models for investment in gas transmission pipelines. Section 8.3.2 shifts attention to the choice of regulatory models for gas storage facilities. Finally, section 8.3.3 focusses on the choice of regulatory models for LNG import terminal facilities. The structure of each of these sections is as follows. First, it is argued which factors affecting investment can be different from project to project. Second, the different project contexts are related to the choice of regulatory model. Section 8.3.4 analyses how a trade-off between economic efficiency and security of supply (capacity adequacy) may affect the choice of regulatory model for gas infrastructure expansion. Finally, section 8.3.5 provides the main conclusions from this section.

8.3.1 Regulatory models for gas transmission pipelines

This section on the choice of regulatory models for gas transmission pipeline investment first discusses the differences in factors affecting investment from project to project, and then turns to discuss the choice of regulatory model.

Differences in factors affecting investment

The choice of regulatory model may be explained by differences in the factors affecting investment from one project to the other. Factors that may differ between different gas transmission pipeline projects are the following:

- The type and degree of competition to which the pipeline service is subjected;
- The presence of dedicated assets in the new facility;
- The nature of regulatory risk involved;
- The need for coordination with other infrastructure assets (due to network externalities);
- External effects of the project on the commodity market for gas.

Firstly, the type and degree of competition differs from pipeline to pipeline project. This may be assessed for different relevant product markets such as destination, origin and transit markets. Von Hirschhausen *et al*. (2007) and The Brattle Group (2008) concluded that in the cases of the Netherlands and Germany that effective competition between different gas transmission pipelines does not exist. However, the BBL, and also the Milford Haven pipeline (when considered integrated with the LNG import terminals) are competing with alternatives. The difference in the type and degree of competition affects the level of risk attached to the investment and the need to regulate access conditions in order to prevent non-competitive behaviour.

Secondly, a different type and degree of asset-specificity may apply. Whereas all gas transmission pipeline projects are physically and locational specific, some pipelines may be specific for a particular transaction (i.e. the pipeline involves dedicated assets). This gives rise to different exposure to opportunistic behaviour of transacting partners and may increase the barrier for investment. For example, the Milford Haven pipeline involves dedicated infrastructure assets, whereas the BBL interconnector does not.

Thirdly, the nature of regulatory risk differs between cross-border interconnections and national transmission pipelines, and between national transmission pipelines in the one or other country. Investment in a new pipeline interconnection (such as the case of the BBL) involves additional investment risks as the investors needs to comply with two regulatory regimes that are likely to differ from one another (Haase, 2009; Klop, 2009). In addition, with two regulatory authorities involved it is more difficult to get regulatory commitment (Spanjer, 2009). Also the risk of investing in a transmission pipeline within country borders is different from country to country as different cost or performance-based regulation with different allocation of risks and costs may be applicable: the case of Milford Haven discussed the risks for its investor National Grid.

Fourthly, investment in a gas transmission pipeline may or may not give rise to required investment elsewhere in the gas infrastructure system. Coordination between the infrastructure investments is needed if the value of new transmission pipeline investment crucially depends on the upgrade investments elsewhere. The coordination may concern investment elsewhere in the infrastructure system within country boundaries, or may concern investment across country borders. In the case of the Milford Haven pipeline there was no particular need for investment elsewhere in the UK gas pipeline system. In the case of BBL, however, upgrades of transmission capacity in the Netherlands were required.

Finally, transmission pipeline investments may have positive external effects on the level of competition on the commodity market or the level of security of supply. The investment in the Milford Haven pipeline enabled the supply of gas to the UK from new gas supply sources, and thus had a positive external effect on both competition and security of supply. The same holds for the case of BBL interconnector investment. However, the presence of positive external effects was less clear in the case of the upgrade of the Dutch transmission pipeline that was required to facilitate gas flows through the BBL. Strong positive externalities associated with realisation of new gas transmission pipelines may lead regulatory decision-makers to make different choices for regulatory models then otherwise would have been made in the absence of any externalities. But this depends on how regulators deal with the trade-off between economic efficiency and security of supply.

Other factors that were discussed in section 8.2 but not listed above are assessed as not being different to the degree that they may lead a different choice of regulatory model. Examples are the lumpiness of investment and the (relative) size of upfront investment costs, which are comparable across transmission pipeline projects. The following paragraph proceeds by showing how different regulatory models may be implemented in the different contexts of gas transmission pipeline investment.

Regulatory models

Based on the two case study analyses on gas transmission pipeline investments (the BBL and the Milford Haven pipeline), and the previously discussed set of factors affecting investment that may differ from project to project, this paragraph analyses which regulatory models may be implemented in different contexts.

The type and degree of competition determines scope for unregulated or lightly regulated expansion

The level of competition on the relevant market determines whether regulation of third party access (TPA) conditions to new transmission pipeline capacity is strictly necessary or that expansion can be realised competitively, for example via merchant investment (using an exemption). This determines the basic scope for competitive expansion of transmission pipelines.

In the case of a limited competition or a dominant market position, regulators need to impose some form of access regulation. The less competitive the market, the stricter the form of access regulation may need to be. This condition was applied in the case of BBL since one of the design principles was that the exemption should not create a strong monopoly position for the investor. This was not the case in the BBL project as it competed with numerous gas supply alternatives. The Milford Haven pipeline was subjected to regulate TPA as it was realised within the domain of the TSO National Grid. However, the analyses of alternative regulatory models for this pipeline investment illustrated that the pipeline could have been treated as a competitive project, possibly as part of the LNG supply infrastructure, in which case TPA regulation would not have been required.[79]

Dedicated assets as indicator for private, competitive expansion

From a private actor and transaction cost perspective, the presence of dedicated assets (i.e. transaction specificity) could encourage private parties to enter institutional arrangements outside of the model of regulated expansion. This was illustrated by the case of Milford Haven pipeline. The investors behind the LNG terminals that triggered investment in the Milford Haven connection pipeline, could have contracted (long-term) a third infrastructure company to build and operate the pipeline connection, or could have built and operated the pipeline connection internally (i.e. horizontal integration of LNG and transmission pipeline activities). However, this may be difficult to realize in practice due to external network effects that cause for a need to coordinate with investment further downstream in the gas infrastructure system: this issue is discussed next.

Need for coordination reduces scope for competitive expansion

Whether a new transmission pipeline can be realised under an unregulated, merchant model depends on whether, when present, possible external network effects are mitigated. If there is no need for coordination with investments elsewhere in the system, because the current infrastructure system is capable of accommodating the new pipeline investment such as in the case of Milford Haven, then the pipeline project may be realised competitively. When there is a need for coordination, because the full market value of new transmission investment may not be captured without expansion of the infrastructure system elsewhere, then it depends on the available methods for coordination whether competitive expansion can still be realised.

[79] The facilitation of secondary markets and use-it-or-lose it or use-it-or-sell-it obligations can be required by regulatory authorities to further reduce the risk of negative impact on competition when in doubt about the competitive position of the transmission pipeline project.

Three possible solutions are available.

- Firstly, coordination between investments can for example take place through parallel open season procedures. Here it may nevertheless be difficult to achieve smooth coordination as it involves more actors and possibly different regulatory procedures that increase the risk of delays in investment.
- Secondly, coordination may be achieved via the participation (i.e. horizontal integration) of neighbouring transmission pipeline operators in the new pipeline project. An example is the participation of Dutch TSO Gasunie in the pipeline investment project BBL: this creates an internal interest in optimally accommodating future BBL gas flows.
- Thirdly, when coordination via other methods fails, regulatory authorities may decide to allocate all pipeline investments in the regulated domain of a single TSO. This is a regulatory model that is implemented in different European Member States. When making this choice, regulatory authorities forego on the benefits that may be achieved in realising pipeline investments competitively. These were described in the analysis of alternative regulatory models in the case of Milford Haven. A more competitive variant of this regulatory model is the independent system operator (ISO) model where one single actor coordinates network operation, and is thus involved in all new gas pipeline projects, but where independent actors (transmission owners) can competitively invest in new transmission assets.

External effects on the commodity market

Strong external effects commodity market may be a reason for regulatory decision-makers to socialize some of the costs and risks involved in building transmission pipelines. For example by being lenient with respect to the conditions for negotiated TPA and exemptions.

8.3.2 Regulatory models for gas storage facilities

This section on the choice of regulatory models for investment in gas storage facilities first discusses the potential differences in factors affecting investment from project to project, and then turns to discuss the choice of regulatory model.

Differences in factors affecting investment

The choice of regulatory model for gas storage investment may be explained by differences in the factors affecting investment from one project to the other. Factors that may differ between different gas storage projects are the following.

Firstly, the private barriers to investment in gas storage may differ as a gas storage project may be characterised by low or high entry and exit barriers. The (relative) size of upfront investments costs can be an important market entry barrier for specifically large-scale gas storage facilities which require large investments in cushion gas and of which the business model is based on the provision of seasonal or long-term flexibility services to the market. This may be less of an issue for small-scale gas storage facilities that have no or little cushion gas requirements and of which the business model is based on more frequent, short-term flexibility service provision. The cost of developing storage facilities, whether small or large scale, varies across countries according to geological characteristics, which may lead to different investment risk positions for gas storage projects across the EU. Furthermore, asset-specificity of the transaction specific type can negatively affect the risk position of a gas storage facility: it may create a barrier for market exit that prevents investment ex ante. Transaction-specificity (also referred to as dedicated assets) can apply to any size of gas storage facility.

Secondly, the type and degree of competition on the relevant market may justify a different choice of regulatory model in different gas storage projects. The relevant product market can be defined by the type of flexibility product provided. Gas storage facilities contribute to the balancing of gas demand and supply in time and in doing so competes with other flexibility sources. The alternatives for flexibility provision are different for different types of flexibility products and can be infrastructure or non-infrastructure based. Large-scale, low deliverability storage facilities delivering seasonal flexibility services generally compete with flexible gas production and flexible gas imports (either via pipeline or LNG), whereas small-scale, high deliverability storage facilities delivering short-term flexibility services (within an hour or day) also compete with line-pack (i.e. storage capacity in the pipeline network) and demand response measures. The relevant geographic market for gas storage depends on the reach of the gas storage facility. The reach of seasonal gas storage facilities is generally larger than the reach of small-scale, high deliverability storage facilities (CIEP, 2006) because of the respective product markets that they are part of (Ecorys, 2007).

Thirdly, depending on its location and size, gas storage investment gas storage expansion may trigger additional investment elsewhere in the system. The direct network connection needs to be dimensioned on the peak injection and off take capacity. Gas storage facilities can be built in geologically different locations such as depleted oil and gas fields, salt caverns and aquifers. When a gas storage facility is built in a depleted gas field, direct network connection costs may be limited due to the presence of old gas infrastructure previously used for production purposes. In the case of building gas storage facilities in salt caverns or aquifers, the nearby presence of gas pipelines to which it can be connected may reduce the direct network connection costs. As the value in providing storage services to the market depends on the timely delivery of these services to final-consumers, the economics of gas storage investment predict investors to choose locations close to the destination market. This would reduce the chance of substantial deep network investments being needed. However, deep network investments may be required if geological conditions at the location of the demand centres is limited and gas storage facilities are built further away from those centres. Also large differences in the costs and opportunities for gas storage investment between two countries may lead to the realisation of new gas storage facilities in the one country, and the need for (additional) interconnection capacity towards the other country.

Finally, new gas storage facilities may differ regarding the positive external effect on the commodity market for gas. This may concern positive externalities for the level of competition and the level of security of supply (capacity adequacy). Gas storage facilities may contribute to a well-functioning wholesale market by offering (new) market parties access to flexibility services that may be required in serving final consumers. Different flexibility services are of interest to different gas market actors. Seasonal flexibility services delivered by seasonal gas storage facilities in particular derive their value in the market for residential consumers, whereas short-term flexibility services are particularly of value for those parties that need to balance the gas system (network operators). Short-term flexibility provided by small high deliverability storage facilities can contribute to the provision of system flexibility on the electricity market, acting as a back-up for electricity generators with for example large number of wind-based electricity generation assets in their portfolio.

In addition, gas storage facilities may contribute to a higher level of security of supply on different accounts. Large-scale gas storage facilities, generally built by the market to provide for seasonal flexibility services provide relief as a strategic gas storage facility in the event of an interruption in supply for a longer period of time. Small-scale storage facilities can have an additional security of supply value in extreme, short-term demand situations, such as a very cold winter spell that occurs in one in fifty years.

Other factors, not mentioned above but discussed in section 8.2 are considered to be applicable to all types of gas storage facilities to more or less the same degree, and as such do not lead to a different choice of regulatory model between projects. The following paragraph proceeds by showing how different regulatory models may be implemented in the different contexts of gas storage facilities.

Regulatory models

This paragraph analyses the potential regulatory models for gas storage investment based on the case study findings from the project of Bergermeer, the analysis of factors affecting investment in gas storage, and the observations on regulatory choices across Europe in practice.

The type and degree of competition determines regulation of access conditions

In principle, the market for gas storage and for gas storage expansion can be competitive. The relevant market is the market for flexibility services and a range of potential sources may compete with gas storage facilities on this market. If the market is not concentrated (i.e. dominated by few companies) and there are ample opportunities for building new storage facilities, than the gas storage market may be considered competitive and regulation of third party access regulation is not strictly necessary. In case regulatory authorities doubt whether the users of gas storage are able to successfully negotiate on the access to gas storage then a negotiated TPA regime may be implemented, with stricter TPA regulation acting as a backstop. This is the regulatory model adopted by the Netherlands. The Dutch regulatory authority acknowledges the competitive nature of the market for gas storage services and implements only the minimum level of regulatory requirements as laid down in the EU Gas Directive, which is negotiated TPA. When there is no competitive market for flexibility services – for example due to limited market size or due to limited physical / geological options to develop flexibility sources in general and gas storage in particular – then the regulatory model of regulated TPA for existing storage capacity is more appropriate.

In practice, EU Member States have adopted negotiated TPA in cases where the market is competitive (such as the Netherlands, Germany and Austria), and regulated TPA when there are market concentration issues (such as Belgium, Spain, and Italy).[80] The regulatory choice regarding expansion corresponds with the regulatory choice on access to existing capacity: countries with abundant alternatives for developing storage facilities adopt negotiated TPA (with competitive open seasons to determine investment), whereas countries with little opportunities adopt a model of regulated TPA. The market for gas storage in the Czech Republic is concentrated and subjected to regulated TPA but for the investment in a new facility the EU has allowed an exemption from rTPA (EC, 2011a).

Regulated or competitive expansion for new gas storage facilities

Applying the regulation of access to gas storage capacity also to new gas storage facilities weakens the incentive to investment if the regulated rate of return is too low or if there is too large uncertainty regarding the future regulated revenue for storage services. Either cost-based or performance-based regulation of gas storage may therefore harm investment incentives and reduce adequacy of storage capacity in the long-term. Alternatively, if there are ample geological opportunities for the development of new gas storage facilities, regulatory decision-makers may opt for a default exemption for new gas storage facilities. Upon concerns that incumbent companies may increase their market share, additional conditions can be imposed that (temporary) prohibit or limit the share of the incumbent in capacity rights of any new facility. Under the looser regulatory model of negotiated TPA, exemptions may not be necessary, as is illustrated in the case of the Bergermeer gas storage facility.

Role of long-term institutional arrangements in securing investment in gas storage facilities

[80] See Ascari (2010), ERGEG (2006) and the website of Gas Infrastructure Europe (GIE) (http://www.gie.eu.com/, last accessed 20-05-2012) for country based information.

Although both small and large gas storage facilities can in principle be competitive, the market for small-gas storage facilities generally may be characterised as having lower entry barriers than the market for large-scale storage facilities since the upfront investment costs are significantly lower and the storage facility is used more frequently and intensively (in order to profit from price arbitrage opportunities in the short term). Large-scale gas storage facilities like Bergermeer are a relatively riskier investment and generally may require different risk mitigation strategies, such as long-term contracts or vertical integration of operations. For a competitive storage market to work, the role of long-term contracts needs to be acknowledged in the regulation of storage activities. However, in the case of Bergermeer, the final investment decision was taken without the long-term sale of full storage capacity, although it did involve a long-term deal that secured the delivery of cushion gas for the facility in return for part of capacity rights in the facility. As the provision of cushion gas normally concerns the majority of investment costs, this long-term arrangement apparently led to a sufficient mitigation of investment risks associated with the project.

Transaction specific investment in gas storage unlikely on North-western European market

Both small and large-scale storage facilities are characterised by high levels of asset-specificity of the physical and site/location kind. Whether the investment is specific for a particular transaction depends on the size of the market: in a large market a larger number of market parties may put value on particular gas storage services whereas in a small market with limited interested market parties the investment may be highly transaction specific. In Europe, the majority of gas storage facilities are developed by a range of gas market actors such as gas producers, gas trading companies and gas consumers. The case study of Bergermeer is not representative of this situation as this facility is developed by an independent energy company without direct linkages in the gas value chain in the Netherlands.

External effects on commodity market as driver for choice of regulatory model

Gas storage facilities accommodate changes in the balance of gas demand and supply by providing flexibility services. This may concern changes considered normal in daily and seasonal demand and supply patterns but also unexpected changes, such as interruptions in gas supply. Whether this should be considered an external effect of gas storage investment is debated (Bohi and Toman, 1996; Vazquez *et al*., 2012; Grossman and Stiglitz, 1980), but even as it is perceived as such by policy-makers it should be considered a factor of influence for the choice of regulatory model for gas storage expansion. Policymakers may take the perspective that (private) gas market actors are capable of assessing and responding to security of supply risks in general or may take the perspective that these actors do not (fully) take into account the low frequency, high impact security of supply incidents in their investment decisions. The external security of supply affect applies to both small-scale, high deliverability facilities and large-scale, low deliverability facilities. The former contribute to high demand peaks in severe winter seasons, whereas the latter contribute to strategic storage aimed at accommodating longer gas supply interruptions. For both type of investments a regulated or market based regulatory model may be adopted. In the Netherlands, the provision of infrastructure facilities needed to ensure extreme peak demand situations is regulated and its costs socialized. It takes the form of a public service obligation upon the TSO Gasunie. However, no such regulation exists for 'strategic storage'. In Italy, regulatory authorities oblige gas companies to hold gas in storage, with the amount to be held in storage related to their gas supply portfolio.

Limited need for coordination with investment elsewhere in the system

The investment in new gas storage infrastructure triggers investment in a direct pipeline connection with the existing gas infrastructure, and dependent on subsequent (shifts in) gas flows through the overall infrastructure system, may trigger investment elsewhere as well. Depending on national regulatory codes, direct connection costs may be incurred by the project developer, or, via the responsible TSO, by gas network users in general (i.e. socialization of shallow connection costs). Putting cost responsibility with the project developer promotes allocative efficiency, whereas a socialization of these costs may encourage gas storage development and thus contributes to security of supply. In the case of Northwest Europe it seems unlikely that new gas storage facilities trigger large investment requirements elsewhere in the system as its gas infrastructure system is vast and meshed. In such a system it would be difficult to allocate deep infrastructure costs to those who cause it, due to the difficulty of establishing the costs of a specific transaction. However, there is a need for coordination in the case of a gas market that is under development and involves a relatively small infrastructure system.

8.3.3 Regulatory models for LNG import facilities

This section on the choice of regulatory models for investment in LNG import facilities first discusses the differences in factors affecting investment from project to project, and then turns to discuss the choice of regulatory model.

Differences in factors affecting investment

Context-dependent factors affecting investment that may differ from LNG import terminal project to project are the following.

Firstly, the required amount of investment costs may vary substantially as the local circumstances may be more or less favourable for the development of LNG import facilities. Under unfavourable conditions, LNG terminals may need to be developed offshore instead of onshore. Offshore pipelines and offshore LNG receiving terminals generally require higher upfront investment costs than similar facilities onshore. Furthermore, the capital intensity may vary across different projects within a type of gas infrastructure. The capital cost of LNG terminals in general depends on the local physical / geological conditions.

Secondly, the LNG terminal may involve dedicated assets. This is the case when the number of potential users of the facility is limited. This holds in the case of small relevant markets, which for example is the case when an LNG terminal is connected to a large gas consumer but has no connections with other gas infrastructure systems or gas consumers. In Northwest Europe, with its large, dense infrastructure system, this situation does not occur.

Thirdly, the type and degree of competition can vary across regions. Competition in LNG terminal investment can be limited because there are limited suitable locations for the development of LNG terminals. Dependent on the availability of gas pipeline supplies in the region, the economics of LNG terminals may be unfavourable, making LNG terminal economically inefficient from a private investor perspective.

Fourthly, the realisation of a new LNG import facility may require investment in gas pipeline capacity in the infrastructure system to which it is connected. Coordination between LNG terminal and downstream pipeline investment may be required if the (future) value of LNG terminal assets is critically dependent on the timely realisation of pipeline capacity elsewhere in the system.

Fifthly, dependent on local circumstances LNG terminal investment may be associated with positive external effects in the market. This depends on factors such as the size of the project (relative to the size of the relevant market), the market structure, and the existing gas supply portfolio.

Other factors, not mentioned above but already discussed in section 8.2 and generally applicable to all LNG import facilities to the same degree, do not lead to a different choice of regulatory model between projects. The following paragraph proceeds by showing how different regulatory models may be implemented in the different contexts of LNG import facilities.

Regulatory models

This paragraph analyses the potential regulatory models for LNG import terminal investment based on the case study findings, the analysis of factors affecting investment in LNG terminals, and the observations on regulatory choices across Europe in practice.

Type and degree of competition determines scope for competitive expansion

In general the import of gas via LNG import terminals can be considered a competitive market since potential competition comes from indigenous gas production and pipeline imports. As such, LNG import activities are thus not suffering from a lack of competition and are not to be considered natural monopolies. In the case studies on the GATE LNG terminal and the Milford Haven pipeline, the featuring LNG terminal investments effectively competed with alternative gas supply sources. Therefore, the default regulatory model for LNG terminal investment may be based on competitive expansion based on exemptions from TPA. This corresponds with the regulatory model adopted in the UK and the Netherlands.

Large market concentration may threaten equal access conditions in practice and significantly reduce the level of effective competition. Existing LNG terminal capacity may be subjected to negotiated TPA in case of justified concerns over the conditions of access in an unregulated market. Market concentration on the wholesale market (which includes the supply of gas via LNG terminal imports) may be countered by strong competition policy that for example prescribes maximum shares in import capacity for incumbents. But even when political willingness to adopt and enforce such policy is lacking, competitive expansion can be viable if exemptions from TPA are allowed and additional criteria ensure that incumbent market power is at least not increased with new LNG terminal investment. Such conditions can be part of exemption regulation as required by the EU Gas Directive and implemented in individual Member States. Based on the requirement that exempted infrastructure should not have adverse effects on the level of competition, the proposed LNG projects that seek an exemption are tested on their possible impact on the level of competition by the competent authorities. The French and Dutch regulatory framework for LNG import infrastructure specifies a different regime for LNG operators depending on current market structure and the market power possibly exercised by the companies involved in new infrastructure investment.

Alternatively, regulatory authorities may choose to implement a similar regulatory regime of regulated TPA for both existing and new LNG facilities. Then the conditions for rTPA-based investment, in particularly the allowed rate of return on investment, should be such that investor's risks are sufficiently covered. Implementing a performance-based rTPA regime may be successful in encouraging efficiency of LNG operations and reducing tariffs, but may thus threaten the level of investment and lead to the risk of underinvestment. This impact may be mitigated by allowing a higher rate of return on investment for investment projects compared to the allowed rate of return on older assets.

External effect on other infrastructure and need for coordination

The choice for a regulatory model may be affected by the presence of network externalities and the need for coordination between LNG terminal investment and downstream gas transmission pipeline capacity. If the (future) value of LNG terminal investment crucially depends on the capacity investment downstream then coordination of the two investments is vital for the go-ahead of the LNG terminal project. Different mechanisms may be used for this coordination.

- Firstly, the operator of the transmission pipeline network may be required to invest in a new LNG facility. In this case, the responsibility for LNG terminal investment is put in the regulated domain of the TSO. This implies that (at least part of) total costs are socialized via regulated tariffs for the final consumers. This choice involves a horizontal integration of LNG and gas transmission activities. A variant on this model is the competitive tendering of LNG terminal investment where ownership of LNG terminal assets resides with a third party but operations are integrated with gas transmission operations. Strong network externalities could lead regulators to choose a regulatory model that involves regulated expansion using a centrally planned approach, such as in Spain (Suárez, 2010). Another variant involves the participation of the TSO in the private LNG investment project. This was the case in LNG terminal GATE where infrastructure Gasunie participated in GATE and is responsible for the neighbouring transmission pipeline network via its business unit Gas Transport Services (the TSO).

- Secondly, decentralized markets are used to signal investment needs for downstream capacity and the TSO is responsible for investment in transmission pipeline capacity. Investment in the LNG terminal remains in the private domain. This model was implemented in the case of Milford Haven. There, the required investment costs for pipeline connection to the national transmission system were partially socialized through regulated TSO investment. Investment in the LNG terminals at Milford Haven was private, based on an exemption from rTPA requirements.
- Thirdly, both LNG terminal and transmission pipeline investment could be undertaken in the unregulated, private domain. However, this is only a feasible option if pipeline investment concerns dedicated assets. If the required pipeline investments involve deep network investments in a meshed network it will be difficult to allocate costs to different users and particular transactions. This regulatory model was suggested and analysed in the case of Milford Haven pipeline. As the required pipeline investment only concerned a direct pipeline connection between the LNG import terminals and the existing transmission pipeline network it was concluded that implementation of this option would have led to improved market outcomes from a public perspective.

For all regulatory models the degree of socialization of transmission pipeline costs depends on the method of capacity allocation. In the UK and the Netherlands, capacity is allocated based on entry and exit tariffs where entry and exit tariffs are uniform for all users. In the Netherlands these tariffs are set ex ante and constant throughout a longer period of time (i.e. a year or for the duration of a regulatory review period). In the UK the price of entry capacity is determined in capacity auctions. In both cases, there is some degree of socialization. An example of a system with direct allocation of investment costs to users is the US (CIEP, 2009).

External effect on commodity market

LNG terminal investment may have positive external effects in the area of commodity market competition and security of supply that can affect the choice of regulatory model.

The impact on the level of competition was mentioned above in discussing the scope for competitive LNG terminal expansion. The external effect on the level of competition is generally only taken into account in the regulatory framework as a condition for competitive expansion (i.e. exemption regulation): i.e. the new facility should not damage market functioning but should increase the level of competition. This condition was met in the case of LNG terminal GATE (and also in the case of the LNG terminals near Milford Haven that triggered investment in the Milford Haven pipeline connection). Additional restrictions on the sale of LNG terminal capacity, such as a maximum share for an incumbent gas company, may be imposed as part of the exemption. This was not the case for GATE but has been implemented in for example France. Another instrument commonly used to counter potential negative implications of LNG terminal investment (generally based on long-term capacity contracts) on commodity market functioning is the requirement that LNG terminal operators facilitate secondary markets for LNG import capacity and implement use-it-or-lose-it or use-it-or-sell it mechanisms.

LNG terminal investment may contribute to diversification of gas supplies and a higher level of security of gas supply. About the degree to which this impact is fully internalized in private actor decision-making can be debated, but given that this feature can and is used by regulatory decision-makers to in particular encourage LNG terminal development, it should be included in an analysis of the choice of regulatory models for LNG terminal investment. In the case study on LNG terminal investment in the Netherlands, there was no specific regulation aimed at the realisation of LNG terminal capacity per se: its investment was considered a result of decentralized, private investment decision-making. However, GATE investors needed to demonstrate a positive impact on security of supply in its exemption application, as it is one of the exemption requirements in the EU Gas Directive. Spain adopts a different regulatory model that is based on regulated expansion. Being dependent on LNG for its gas supplies, Spanish regulatory decision-makers have chosen to coordinate the need for investment and tender to the market new LNG terminal licenses (Suárez, 2010).

8.3.4 Trade-off between economic efficiency and security of gas supply

The analysis of factors affecting investment and regulatory models above demonstrate that a range of regulatory models may be implemented in gas transmission pipeline investment. But even though there may be scope for competitive expansion, a model of regulated investment may be implemented in practice as a result of a trade-off faced by the regulatory authority. Implementation of the regulatory model of regulated investment leads to a larger degree of socialization of costs and risks associated with gas infrastructure investments. The different regulatory models that have been put forward involve different levels of socialization, which means that a trade-off needs to be made between economic efficiency and security of supply. Individual EU Member States may make different choices depending on what is considered socially desirable. Regulatory decision-makers may be faced with the following trade-offs between the public objectives of economic efficiency and security of supply (capacity adequacy).

Firstly, there may be concern over whether the actual level of competition in the market is sufficient to bring about competitive market outcomes. The level of competition may be assessed ex ante through market share and pivotal supplier analysis but it is likely that assumption will need to be made regarding the positions of the different (potential) competitors, for example regarding the cost of flexibility services' provision. Ex post, regulatory authorities may investigate whether abuse of market power or collusion has taken place. However, this may be difficult to prove in practice due to information asymmetries. In response to these difficulties, policymakers or regulatory decision-makers may want to assess the risks of choosing the wrong mode of regulation. Too strict regulation may harm incentives for investment and negatively affect capacity adequacy, whereas too lenient regulation may give too much room for uncompetitive behaviour resulting in economically inefficient market outcomes.

Secondly, regulatory authorities need to consider the impact of measures (such as allowing for long-term contracts) that aim to facilitate investment in new gas storage facilities on the level of competition in the market. Secondary capacity markets and use-it-or-lose-it mechanisms may in theory prevent any adverse effects of allocating capacity long-term to a limited number of market players, but practice may be different as gas markets may not meet ideal market conditions at all times. The impact of investments in new facilities needs to be weighed against the possible risk of a negative impact on market competition. National policy-makers make different decisions in this respect. Italy, for example, has implemented a regulatory approach for new LNG import facilities that combines regulated and unregulated investment: 80% of LNG terminal capacity may be exempted from TPA and contracted long-term whereas 20% is subjected to regulated TPA and thus available for short-term trading.

Thirdly, the implementation of specific measures aimed at realising peak gas supply facilities may negatively affect investment incentives in the market. For example, obliging gas suppliers to hold a certain amount of gas in storage directly encourages them to contract gas storage capacity or build new facilities. However, the required level of gas that must be held in storage may lead to total gas storage capacity that exceeds the level of capacity that is economically optimal from a public perspective. Similarly, regulatory decision-makers may prefer the realisation of new LNG terminal facilities under a cost-plus based regime (as part of a gas supply diversification strategy) over relatively cheaper (but perceived as more risky) pipeline supplies.

8.3.5 Conclusions

This section draws conclusions regarding the underlying factors that affect the choice of regulatory model within one type of infrastructure and which regulatory model should be implemented under which conditions. Below follow the conclusions for transmission pipelines, gas storage facilities and LNG import terminals.

Factors that can explain a different choice of regulatory model for different *gas transmission pipeline* projects are the type and degree of competition to which the pipeline service provided is subjected, the presence of dedicated assets in the new facility, the nature of regulatory risk, the need for coordination with other infrastructure due to network externalities, and external effects on the commodity market.

The key determinant in deciding about a regulatory model is the type and degree of competition: if the level of competition is too low a regime of regulated TPA should be implemented. If there is (some) competition, a light-handed regime of negotiated TPA should be implemented (in combination with an open season). If there is a high level of competition, TPA is not necessary and pipeline expansion can be done competitively. In the case the proposed pipeline is subjected to competition and involves dedicated assets, then the investment could be undertaken by private parties. However, private investment may become more difficult if there are strong network externalities and there is a consequential strong need for coordination with infrastructure investment elsewhere that cannot be facilitated smoothly with the prevailing coordination mechanism. Then a regulated regime should be adopted as it can more easily realize interdependent investments. Finally, if the gas infrastructure facility has strong external effects on the commodity market for gas, then the regulator may 'overrule' and decide to implement the model of regulated expansion may nevertheless be implemented.

Factors that can explain a different choice of regulatory model for different *gas storage facilities* are the level of investment risk (and then in particular the size of upfront investment costs required and the potential transaction-specificity of assets), the type and degree of competition, and the external effect of storage on the commodity market for gas. Another possible factor is the need for coordination with infrastructure investment elsewhere, although this is not confirmed in the cases analysed in this study due to the ample opportunities for gas storage close to the market.

The market for gas storage is in principle competitive, as it is part of a larger product market for flexibility services on which gas storage facilities compete with infrastructure and non-infrastructure based alternatives. In the absence of high levels of market concentration and ample opportunities for new facilities, light-handed negotiated TPA should be implemented. In situations of high market concentration and ample opportunities for investment in new facilities, regulation may be based on a default exemption for new facilities on the condition that the capacity share of dominant market companies is limited via exemption conditions. If the market is competitive but options to expand are limited, a competitive tender for the remaining storage location should be implemented. The size of the storage facility indicates in which particular flexibility market it competes, which explains why small and large-scale facilities may be subjected to different regulatory models. When the default regulatory regime for gas storage does not allow for long-term contracts as required to mitigate investment risks, then it becomes more and more important for investors to obtain an exemption, especially in competitive storage markets and for large-scale facilities that generally have much higher upfront investment costs. The need for coordination does not seem to be an important factor in the context of Northwest Europe as the regional gas infrastructure system is dense and contains a large number of potential gas storage sites close to demand centres. Irrespective of the potential to allow light-handed or unregulated investment for storage expansion, the positive external effect on the system's level of security of supply may prompt regulatory decision-makers to adopt the model or regulated expansion (rTPA) in order to ensure capacity adequacy.

Factors that can explain a different choice of regulatory model for different *LNG import terminals* are the type and degree of competition on the relevant market, the private barrier for investment (mainly the level of upfront investment costs that depends on local circumstances), the degree of network externalities caused and the consequential need for coordination between investments, and the positive external effects on the commodity market.

The market for LNG terminal services is in principle competitive due to its competition with other gas supply sources (indigenous production, pipeline imports and gas storage). This implies that the default expansion approach should be based on light-handed regulation such as negotiated TPA. As nTPA is not allowed under the EU framework, the default regulatory model for LNG terminal expansion then becomes merchant investment (via exemptions). If the market is concentrated, expansion can still be undertaken merchant-style if exemption conditions contain limitations for the role of incumbents in new facilities and if there are ample opportunities to develop other LNG terminals. If there are limited opportunities, then expansion can be tendered (in the case of low market concentration) or regulated (in case of high market concentration). LNG terminal investment may have network effects that call for investment elsewhere in the system. This depends on the additionality of the facility to the existing system. Regulated expansion may be implemented in cases where coordination between LNG terminal and downstream investment are problematic, i.e. if privately devised institutional arrangements fail or prove to be too costly. Finally, the effect of above factors on the choice of regulatory model may be overruled by regulatory-decision makers due to strong external effects on the commodity market (mainly in terms of security of supply): it may lead them to adopt the model of regulated expansion irrespective of the potential for competition in the LNG market.

Finally, irrespective of the scope for competitive expansion or expansion under light-handed regulation, regulatory decision-makers may decide to implement a regulated expansion model if the regulatory objective of security of supply is dominant over others such as economic efficiency.

8.4 Reflection on regulatory choices at the EU level

The case study analyses took EU regulation as a given, but the above analyses of factors affecting investment and the choice of regulatory models allow for a reflection on EU regulation. Based on the reflection in this section, the next section will provide recommendations for improving EU gas regulation. The following points of critique are provided:

- A strong EU focus on achieving competition on the commodity market at the start of liberalization seems to have come at the expense of a proper assessment of how to regulate gas infrastructure;
- In designing gas infrastructure regulation, the EU has insufficiently taken into account fundamental differences between different types of gas infrastructure;
- The design of exemption regulation has been unnecessarily restrictive when judged by its ability to use the inherent potential for unregulated or less-regulated investment;
- The current design of the EU regulatory framework carries the risk of a non-level playing field.

Firstly, a focus on short-term market functioning at the start of the liberalization process in 1998 seems to have diverted the attention of policy-makers from the question of how to optimally facilitate gas infrastructure investment. The general notion that gas infrastructures have natural monopoly properties led to the implementation of a default regime of (regulated or negotiated) TPA on all gas infrastructure, which did not contribute to an environment with strong investment incentives. Existing gas infrastructure was at the centre of the early EU liberalization strategy based on the essential facility argument, but efficient and effective expansion was out of the picture. The focus was mainly on reducing inefficiencies present in the old system of vertically integrated markets. The main instrument for this purpose was TPA and tariff or revenue regulation, which was not conducive for expansion of the existing system. At the EU level, the initial focus on the policy objective of market liberalization and increasing market competition came at the expense of the incentives for gas infrastructure investment in general – irrespective of which type – and of a proper assessment of a proper regulatory regime for investment for different types of infrastructure in particular.

Secondly, in designing gas infrastructure regulation, European policy did not recognize how investment in gas infrastructure is influenced by the various factors that were identified in this study.

The primary response for infrastructure-bound activities in the gas value chain was to implement a default regime of third party access with regulation of tariffs or revenues. Given the analysis of the factors affecting investment in different types of gas infrastructure in this study and the conclusions drawn based thereon, we now see that regulation can be improved. The choice for nTPA can be explained by the fact that gas market regulation, at least then, was based on neo-classical economics view of regulation. As has been demonstrated in the context of the gas market regulation in general by Spanjer (2009), and confirmed for gas infrastructure regulation in particular (this study), such a view is useful but incomplete.

The lists of projects that have been awarded the exemption status illustrate the shortcomings of this approach. For example, no exemption has been applied for by gas storage facilities, whereas LNG facilities have regularly applied with all applications to date being successful. This track record also does not seem to match with the expectations of the EC, which indicated at its introduction of the instrument that it would only be allowed in exceptional cases.

Thirdly, although the implementation of exemption regulation (i.e. regulatory holiday or access holiday) offered a welcome regulatory model for gas infrastructure investment in the EU, this instrument has been unnecessarily restrictive when evaluated on its ability to use the potential for unregulated or less-regulated investment.

In order to improve investment incentives, the EC implemented an exemption ruling that, in principle, allowed large new infrastructure projects to apply for an exemption from the default regulatory provisions as laid down in the Directive. The exemption ruling took the shape of a regulatory holiday, i.e. temporarily allowing the investor to enter exclusive long-term contracts with (future) customers, and was designed to cover all types of gas infrastructure (pipelines, LNG facilities, and storage facilities). It was thus not a 'positive' choice to use the full potential for the role of competition and market forces in gas infrastructure investment, but rather a 'negative' choice to somewhat repair the negative impact of the default approach of (regulated) TPA on investment. This was translated into a restrictively formulated exemption clause with explicit conditions that included aspects that not necessarily need to be included when discussing the role for unregulated or less-regulated investment in gas infrastructure. For example, merchant investment can contribute to public welfare even if it does not contribute significantly to an improved level of competition or security of supply, or is not a 'major' piece of infrastructure (EC, 2009a). De Joode and Spanjer (2010) criticized this approach as follows: *"[T]he exemption instrument is considered an adaptation of default regulation aimed at improving project profitability rather than seen as device to mitigate various types of regulatory risks (i.e. ex post hazards)."*

On the positive side, the range of conditions attached to the granting of exemptions encourage regulatory authorities to assess the different aspects involved in gas infrastructure investment (such as the level of risk involved and the external effects on existing infrastructure and commodity markets), and to use this information in deciding on the scope of exemption (i.e. length of exemption, share of capacity). However, the final decision is still a yes or no to unregulated merchant expansion and does not allow for regulatory models with other roles for regulation and market forces. Initially, the interpretation of exemption conditions and the type and level of assessment as performed by regulatory authorities could deviate from country to country and project to project. However, the way in which exemption regulation was implemented in practice can be expected to have converged over time with the sharing of experiences and with the publication of a guideline on exemptions prepared by CEER/ERGEG.

As a comment to the manner in which exemption regulation has been implemented, it should be noted that, again, no distinction has been made between different types of gas infrastructure. An analysis of the contribution of exemption regulation to the strengthening of investment incentives could then, for example, have revealed that gas infrastructures can differ regarding the potential for unregulated investment, and could perhaps have led to a different 'fix' of insufficient investment incentives for gas infrastructure. For example, LNG terminals in large parts of the EU markets are in fact competing with alternative supplies, a fact that could have been used to specify regulation that takes unregulated LNG terminal investment as the default approach, and specifying a limited set of conditions under which this approach may (temporarily) deviated from by regulatory decision-makers (i.e. 'competitive investment, unless' instead of 'regulated investment, unless').

Fourthly, although current EU regulation allows national policy-makers to adapt EU regulation to local circumstances (e.g. by choosing negotiated or regulated TPA for storage, by making different assessments of exemption applications), it also increases the risk of an uneven playing field emerging over time. The overall objective of achieving an integrated, competitive gas market can be threatened if unjustifiable differences in regulation between Member States continue to exist, thereby violating the principle of a level playing field for infrastructure investment throughout the EU. This may lead to suboptimal market outcomes. For example, differences in the regulatory approaches to LNG terminal investment in Spain, France and Italy may affect the locational choice of investors. Over time, the relevant market for gas infrastructure services may be expected to increase in size as markets are increasingly interconnected. This should be accounted for in regulatory choices across the EU. This is an issue that in the nearby future warrants attention from regulatory authorities and ACER.

8.5 Improving regulation of gas infrastructure expansion

The objective of this section is to provide conclusions on how the regulation of gas infrastructure expansion can be improved. Overall, the role for competition and competitive expansion in the EU and in individual Member States can be enhanced across the assessed types of gas infrastructure, with specific improvements for each type of infrastructure. Aspects that are important in further enhancing the scope for unregulated or less-regulated investment are the way in which coordination between infrastructure investments is achieved, and the strength of competition policy for the gas market in general. The following improvements are consecutively discussed:

1. Increase the role for competitive (and lightly regulated) gas transmission pipeline investment;
2. Adopt the regulatory design principle of ‘competitive expansion, unless’ instead of ‘regulated expansion, unless’ for LNG import terminals;
3. Adopt the regulatory design principle of ‘lightly regulated expansion, unless’ instead of ‘regulated expansion, unless’ for gas storage facilities;
4. Increase the scope for competitive expansion by improving the coordination with required gas transmission pipeline expansion elsewhere in the system;
5. Increase the scope for competitive expansion by improving the level of commodity market competition via strong competition policy.

Firstly, regulation can be improved by increasing the role for competitive investment in gas transmission pipelines. The current choice of regulatory models across Europe reflects less scope for competitive investment, or less strictly regulated investment, than would be possible. The current scope for competitive investment under EU regulation is limited to the projects that may be successful in obtaining an exemption from the default regulatory model of regulated TPA. This choice of regulatory model may be explained by the strong focus on opening wholesale and retail markets for competition and reduce entry barriers to the market to a minimum level. However, the case study analyses on the BBL interconnector (chapter 4) and the Milford Haven pipeline (chapter 5), and the synthesis of case study findings (section 8.2 and 8.3) have demonstrated that the role for competition in realising gas infrastructure expansion in potential can be much larger than currently reflected in regulation. The potential scope for infrastructure investment outside the domain of the TSO can be reflected in current regulation and its application on two levels: the member state and the EU level.

At the member state level, not all gas transmission pipelines should necessarily be treated as part of the regulated monopoly. For example, investment in the Milford Haven pipeline could have been realised outside the regulated domain of the TSO, as it involved a dedicated pipeline that had limited impact on transmission system requirements elsewhere in the UK. The pipeline could have been considered part of the private, unregulated LNG terminal investment that triggered the building of it. As an integral project, it would compete with numerous other gas supply facilities in the UK. This implies that regulation of access conditions would not be strictly necessary. The case study analysis demonstrated that economic efficiency should be higher when this regulatory model is adopted instead of the default of regulated expansion.[81]

Alternatively, national regulatory decision-makers may opt for a regulatory model based on a common system operator but with multiple private transmission pipeline owners. This regulatory model still allows for private investment in parts of the gas transmission pipeline system, but also relieves possible concerns over the potential costs of coordinating multiple transmission pipeline companies by designating a single system operator. In such a model, individual pipeline investments may be tendered to the market, and raise economic efficiency compared with the default approach of regulated investment (see section 5.4.4).

At the EU level, these alternative regulatory models for gas infrastructure expansion may not necessarily require a change of regulation as tenders for investment and merchant investment are already allowed. However, a change in the way exemption regulation is designed and applied may be required. As argued before (section 8.4), the conditions attached to the granting of exemptions may be unnecessarily strict just from the perspective of allowing a larger role for competition in investment. Not all transmission pipeline investments may strictly meet current exemption conditions, even though unregulated investment may be desirable from a public perspective. A question that will need to be answered by every national regulatory authority is how a larger role for gas transmission pipeline investment can be implemented in practice. It would therefore be recommended to prepare EU wide guidelines on how regulatory authorities across Member States can implement a regulatory model that allows for a larger role for investment outside the regulated domain. Although the scope may differ across countries, the guiding principles can be similar and based on this study.

[81] This regulatory model may be considered similar to the regulatory model applied to offshore gas production networks. In both the UK and the Netherlands, investments in those pipeline systems are undertaken free from strictly regulated access conditions.

Secondly, regulation can be improved by replacing the current default regulatory model for investment (regulated TPA) by competitive investment. As the relevant market for LNG supplies is competitive, and not a natural monopoly per se, it is recommended to implement a default regulatory model that is based on the principle that LNG expansion should be 'competitive, unless', instead of the currently applied principle that LNG expansion is 'regulated, unless'. Experiences across EU Member States – such as the Netherlands, the UK, and Italy – illustrate that new LNG terminals are always successful in obtaining an exemption from regulated TPA. Also the case of the US provides a good example of the role competitive LNG terminal investment can play in liberalized gas markets (von Hirschhausen, 2008).

However, it should be acknowledged that local conditions can in practice reduce the level of competition on the relevant market and make unregulated investment undesirable from a public perspective. Although over time a strong competition policy and increasing integration of national and regional markets may improve the level of competition, it would be a valid argument for (at least temporary) applying a stricter regulated approach. The following strategies should be applied for respectively existing and new LNG terminal capacity. The default regulatory regime for existing LNG terminal capacity should be based on negotiated TPA, with a backstop regime based on regulated TPA in the case of highly concentrated markets. For new LNG terminal capacity the default regulatory model should be based on unregulated investment. However, in case of high market concentration limits should be imposed on the maximum share of capacity in new facilities that may be allocated to incumbents. Regardless of the regulatory regime applied, requirements on allowing secondary capacity markets and use-it-or-lose-it mechanisms should apply to optimally facilitate commodity market competition.

The scope for competitive LNG markets may be enhanced by strong competition policy: this is expanded on later in this section.

Thirdly, similar to the case of LNG terminal investment, current regulation can be improved by choosing unregulated or light-handed regulation as the default regulatory approach. The market for flexibility services does not necessarily need to be considered a natural monopoly but can be a competitive market as numerous alternatives can coexist.

Again, the principle of 'competitive expansion, unless' should prevail over the currently applied principle of 'regulated expansion, unless'. Therefore, a light-handed regime of negotiated TPA should be considered the default for existing storage capacity, with a backstop regulation of regulated TPA in case of high market concentration. A default regulatory model for new gas storage facilities may be based on light-handed negotiated TPA. This regulatory model is implemented in a majority of large gas consuming countries such as Germany, the Netherlands, and the UK and has successfully led to the realisation of a large number of new facilities. The Bergermeer facility is going to be one of them. Given the success of this regulatory model in terms of investment projects realised, it seems unnecessary to argue for completely unregulated investment in gas storage as apparently the imposed TPA regime does not give rise to a problem of underinvestment. This can be explained by the fact that in practice negotiated TPA and unregulated investment can be quite similar if long-term contracts are allowed for under the former. From an investor's point of view it is important to mitigate risks associated with the project with for example long-term contractual arrangements.

Fourthly, as the successful realisation of (competitive) investment in new gas infrastructure may (critically) depend on investment in infrastructure elsewhere, improving coordination mechanisms can also further improve the scope for competitive investment. There was an issue of coordinating different investments in three out of the four case studies (all except for Bergermeer). Case study observations demonstrated two things. Firstly, it appeared as if the standard procedure for investment in new gas transmission pipelines proved sufficient in realising new capacity in a timely fashion. This involved the signalling of facility investment in long-term outlooks prepared by the national TSOs, and the commitment of interested shippers to long-term capacity contracts in the transmission system once the final investment decision was made. In the UK this was facilitated by long-term capacity auctions, whereas in the Netherlands it involves periodic open seasons. Secondly, in two out of those three cases, the operator and owner of the neighbouring transmission pipeline network was also involved in the realisation of the new gas infrastructure facility that triggered the required network investments. This organizational linkage can be described as horizontal integration between two gas infrastructure activities. Whether this form of vertical integration has affected the coordination process, and was perhaps decisive in this respect, remains to the question. From a transaction cost perspective the organizational integration can be interpreted as an efficient, transaction cost economizing mode in solving the coordination problem. However, this does not need to imply that under different institutional arrangements, the coordination between investments would have failed. Further research in this area, involving assessments of investment projects that have failed to materialize are recommended.

However, an important aspect in safeguarding coordination between different infrastructure investments is whether it concerns investments within national boundaries or on different sides of the border. The case studies assessed in this study all involved coordination of investments within national borders. However, the lack of coordination between investments across borders is an important current research topic (EC, 2011b; Ascari and Glachant, 2011; CIEP, 2011; Glachant, 2011). To the degree that this problem affects investments in local LNG terminals and gas storage facilities, solving this cross-border coordination issue may also improve the scope for unregulated investment.

Fifthly, the scope for competition in gas infrastructure expansion (either negotiated TPA or unregulated) can be improved by a strong competition policy. The wholesale markets for gas in different EU countries are still largely dominated by incumbents. This is often reflected in the ownership and the allocation of infrastructure facilities, including gas storage, LNG terminals and cross-border pipelines. If European policy-makers and national regulatory decision-makers would succeed in reducing this level of market concentration with for example obliged asset divestitures and capacity release programs, then it would open up more possibilities to allow for a larger role of competition in realising gas infrastructure expansion. These types of measures may directly enhance the level of competition across EU markets and have a positive external effect on the way in which gas infrastructure expansion can be regulated. The question is whether policy-makers have the political willingness and legal instruments to implement such measures.

9 Conclusions and reflections

This final chapter sets out the conclusions, including policy recommendations and recommendations for further research, and reflects on the research approach in this study. Section 9.1 provides the main conclusions of this study by answering the research questions stated in chapter 1. Section 9.2 presents recommendations for further research and section 9.3 contains reflections on the research approach.

9.1 Answers to the research questions

The objective of this study, *"To explain and improve regulatory choices regarding gas infrastructure expansion for different types of gas infrastructure and in different contexts"*, was pursued by addressing the following three research questions:

1. What are the drivers for and barriers to gas infrastructure expansion?
2. How can current regulatory choices regarding investment in gas infrastructure be explained?
3. How can regulatory choices regarding the regulation of gas infrastructure expansion be improved?

Q.1 What are the drivers for and barriers to gas infrastructure expansion?

Expansion in gas infrastructure is affected by four different types of factors:

- Private barriers to investment;
- Type and degree of competition;
- Need for coordination with other gas infrastructure elements;
- External effects on the commodity market.

Firstly, there are private barriers to investment. Investment in gas infrastructure is characterised by high levels of asset-specificity, large upfront investment costs and high capital intensity, lumpiness of investment, and inherent uncertainty about the future value of proposed gas infrastructure facilities. This combination of characteristics gives rise to significant ex post hazards that may discourage investment (e.g. the hold-up problem). If the regulatory model does not sufficiently allow investors to mitigate the investment risks caused by these inherent characteristics, then investment may not be realised. The characteristics of gas infrastructures also expose the infrastructure investor to regulatory risks, as it may be inherently difficult for a regulatory authority to credibly commit to a regulatory model.

Secondly, the type and degree of competition affects investment. Gas infrastructure investment projects are subjected to different levels of competition. Competition may come from other, similar, gas infrastructure projects (for example pipe-to-pipe competition) or from other types of gas infrastructure (for example an LNG terminal competing with pipeline supplies). In practice, competition may be limited due to entry and exit barriers. Large-upfront investment costs and a high level of asset-specificity (implying significantly lower value of assets in alternative use) are the key entry and exit barriers. When considering a regulatory model, regulatory decision-makers need to assess the type and degree of competition by assessing the relevant product and geographic market. This provides valuable input for the choice of regulatory model as the type and degree of competition affects the investment risk of the project and the need for regulation of access conditions.

Thirdly, investment in gas infrastructure facilities may be affected by the need for coordination with other gas infrastructure elements. When present in specific gas infrastructure projects, this type of network externalities need to be dealt with either by means of private institutional arrangements or in the regulatory model. Otherwise the project may not go ahead as the future value of the facility depends on the availability of infrastructure capacity elsewhere in the system.

Fourthly, gas infrastructure investment may have positive external effects on the level of competition on the commodity market as it can allow entry of new market parties to the market. However, the level of competition may decrease if incumbents increase their share in the market by acquiring capacity rights to new gas infrastructure facilities. The investor in the infrastructure is unlikely to take into account the external impact on the commodity market. It is up to the regulatory authority to consider an appropriate response to external effects in the choice of regulatory model.

Q.2 How can current regulatory choices regarding investment in gas infrastructure be explained?

The choice of regulatory model differs for different types of gas infrastructure and between different projects within a specific type of infrastructure. This second research question is addressed in three steps by discussing:

- The factors that explain similar or different regulatory choices between different infrastructures;
- The factors that explain different regulatory choices between projects (of the same type of infrastructure);
- How the factors may lead to different regulatory choices.

The differences between the types of gas infrastructure are caused by the following factors. Firstly, private barriers determine the level of investment risk. The level of investment risk varies across infrastructure types and depends on the interplay between the following key factors. All gas infrastructure projects are physically and locationally specific, but not all gas infrastructure assets are necessarily dedicated to a particular transaction (i.e. transaction specific). Even though trends in gas demand and production in Northwest Europe are robust, the factor of uncertainty does play a role as the demand for a particular infrastructure depends on the actual level of competition. Whether the combination of asset-specificity and uncertainty also gives rise to high levels of investment risk depends on the lumpiness of investment, which may vary across pipelines, gas storage facilities and LNG terminals. The less lumpy investment, the better investors may, over time, track demand for infrastructure services, and the less risky the investment project. The size of upfront investments costs, both in absolute terms and in relation to operational costs, varies across types of gas infrastructure and across projects. The larger the upfront investment, and the larger the part of capital cost in total cost of service provision, the larger the barrier to investment. Finally, the level of regulatory risk for infrastructure investment varies across different types of gas infrastructure as the default regulatory regime may differ and multiple regulatory authorities may be involved in the choice of regulation (i.e. in the case of cross-border pipelines and projects applying for an exemption).

Secondly, all types of gas infrastructure can, in principle, be subjected to competition from other infrastructure or non-infrastructure based alternatives. New pipelines may compete with other pipelines on the relevant destination, origin or transit market. LNG terminals may compete on these very same markets, whereas gas storage facilities should be considered part of the larger market for flexibility services.

Thirdly, the need for coordination between a new facility (of any type of infrastructure) and investment in the infrastructure upstream or downstream depends on the role of that facility in the infrastructure system. The facility can be an extension of the system (i.e. creating a new export outlet or import facility) or a substitution (i.e. replacing declining indigenous production capacity). For the case of gas storage expansion in the covered region of Northwest Europe, it seems unlikely that there is a need for coordination because the region is characterised by a large amount of potential gas storage facilities (predominantly in depleted gas and oil fields) that are located relatively close to the demand centres. The default approach to coordinate between different infrastructure investments differs across infrastructures. In the case of transmission pipeline investments regulated coordination via a designated TSO is common, but in the case of gas storage facilities or LNG import terminals it may concern (simultaneous) open season procedures or bilateral coordination via the standard capacity allocation method (i.e. first-come first-served, auctioning).

Fourthly, every single gas infrastructure facility, regardless the type, has external effects on the level of competition and security of supply on the commodity market for gas. The only exception is the situation where an incumbent succeeds in acquiring capacity in a new facility and effectively increases its market share. The magnitude of the external effect depends on the additionality of the new facility to the existing gas supply system (i.e. how much does the facility increase the scope of competition, the level of gas supply diversification, etc.).

In addition to differences between types of infrastructures, infrastructure projects of the same type may differ due to the following factors.

In the case of gas transmission pipelines, projects may differ by a different type and degree of competition to which the pipeline service provided is subjected, the presence of dedicated assets in the new facility, the nature of regulatory risk, the need for coordination with other infrastructure due to network externalities, and external effects on the commodity market.

Gas storage projects can differ with respect to the level of investment risk (in particular the size of upfront investment costs required and the potential transaction-specificity of assets), the type and degree of competition, and the external effect of storage on the commodity market for gas.

Differences between LNG import terminal projects can concern the type and degree of competition on the relevant market, the private barrier for investment (mainly the level of upfront investment costs that depends on local circumstances), the degree of network externalities caused and the consequential need for coordination between investments, and the positive external effects on the commodity market.

Finally, these factors may be reason for implementing different regulatory models, not only for different types of gas infrastructure but also for similar projects in different circumstances.

The key determinant in deciding the regulatory model is the type and degree of competition: if the level of competition is too low a regime of regulated TPA should be implemented. If there is (some) competition, a light-handed regime of negotiated TPA should be implemented. If there is a high level of competition, no TPA is necessary and pipeline expansion can be done competitively. In the case the proposed pipeline is subjected to competition and involves dedicated assets, then the investment could be undertaken in the private domain using private institutional arrangements. However, private investment may become more difficult if there are strong network externalities and there is a consequential strong need for coordination with infrastructure investment elsewhere that cannot be facilitated smoothly with the prevailing coordination mechanism. Then a regulated regime should be adopted as it can more easily realize interdependent investments. Finally, if the gas infrastructure facility has strong external effects on the commodity market for gas, then the regulator may 'overrule' and decide to implement the model of regulated expansion.

The market for gas storage is in principle competitive, as it is part of a larger product market for flexibility services on which gas storage facilities compete with infrastructure and non-infrastructure based alternatives. In the absence of high levels of market concentration and ample opportunities for new facilities, light-handed negotiated TPA should be implemented. In situations of high market concentration and ample opportunities for investment in new facilities, regulation may be based on a default exemption for new facilities on the condition that the capacity share of dominant market companies is limited via exemption conditions. If the market is competitive but options to expand are limited, a competitive tender for the remaining storage location should be implemented. The size of the storage facility indicates in which particular flexibility market it competes, which explains why small and large-scale facilities may be subjected to different regulatory models. When the default regulatory regime for gas storage does not allow for long-term contracts as required to mitigate investment risks, then it becomes more and more important for investors to obtain an exemption, especially in competitive storage markets and for large-scale facilities that generally have much higher upfront investment costs. The need for coordination does not seem to be an important factor in the context of Northwest Europe as the regional gas infrastructure system is dense and contains a large number of potential gas storage sites close to demand centres. Irrespective of the potential to allow light-handed or unregulated investment for storage expansion, the positive external effect on the system's level of security of supply may prompt regulatory decision-makers to adopt the model of regulated expansion (rTPA) in order to ensure capacity adequacy.

The market for LNG terminal services is in principle competitive due to its competition with other gas supply sources (indigenous production, pipeline imports and gas storage). This implies that the default expansion approach should be based on light-handed regulation such as negotiated TPA. As nTPA is not allowed under the EU framework, the default regulatory model for LNG terminal expansion then becomes merchant investment (via exemptions). If the market is concentrated, expansion can still be undertaken merchant-style if exemption conditions contain limitations for the role of incumbents in new facilities and if there are ample opportunities to develop other LNG terminals. If there are limited opportunities, then expansion can be tendered (in the case of low market concentration) or regulated (in case of high market concentration). LNG terminal investment may have network effects that call for investment elsewhere in the system. This depends on the additionality of the facility to the existing system. Regulated expansion may be implemented in cases where coordination between LNG terminal and downstream investment is problematic, i.e. if privately devised institutional arrangements fail or prove to be too costly. Irrespective of the potential for competition in LNG terminal expansion, regulatory decision-makers may choose to adopt the model of regulated expansion when LNG terminal investment is associated with strong external effects on the commodity market.

Q.3 How can regulatory choices regarding the regulation of gas infrastructure expansion be improved?

Irrespective of the improvements that may be achieved under the current EU regulatory framework as put forward in the evaluation of the case study projects, the generalization of case study results in chapter 8 led to some criticism regarding the design of the EU regulatory framework. The following points of criticism are provided:

- A strong EU focus on achieving competition on the commodity market at the start of liberalization seems to have come at the expense of a proper assessment on how to regulate gas infrastructure;
- In designing gas infrastructure regulation the EU has insufficiently taken into account fundamental differences between different types of gas infrastructure;
- The design of exemption regulation has been unnecessarily restrictive when evaluated on its ability to use the inherent potential for unregulated or less-regulated investment;
- The current design of the EU regulatory framework carries the risk that a non-level playing field emerges and continues to exist.

This study argues that the following improvements (both at the EU and member state level) could lead to an improved performance of the gas market and gas infrastructure investments:

- Increase the role for competitive (and lightly regulated) gas transmission pipeline investment;
- Adopt the regulatory design principle of ‘competitive expansion, unless’ instead of ‘regulated expansion, unless’ for LNG import terminals;
- Adopt the regulatory design principle of ‘lightly regulated expansion, unless’ instead of ‘regulated expansion, unless’ for gas storage facilities;

- Increase the scope for competitive expansion by improving the coordination with required gas transmission pipeline expansion elsewhere in the system;
- Increase the scope for competitive expansion by improving the level of commodity market competition via strong competition policy.

9.2 Recommendations for further research

Further quantitative analysis on the drivers behind regulatory choices in gas infrastructure expansion and their impact on market outcomes

Based on the outcomes of this study, a more quantitative line of research may be developed regarding the drivers of regulatory choices in infrastructure expansion. This would involve the development of a larger database of gas infrastructure projects across the EU that contains information on project characteristics, market conditions as well as regulatory choices implemented. Such a database will enable econometric analyses involving the testing of different hypothesized explanatory variables for regulatory choices that are considered key when dealing with gas infrastructure expansion. More specifically, the hypotheses following from the research in this study can be taken as point of departure.

Further research on applicability of theoretical framework to other energy infrastructure investments

The theoretical framework developed in this study was successfully applied to the case of gas infrastructure investment, but may also prove to be of value in analysing regulatory decisions in other infrastructure sectors. Interesting applications may concern the market for capturing, transporting and storing carbon, and the facilitation of hydrogen infrastructure, or the more widely researched electricity infrastructure.

Further research of the link between the choice of regulatory model and the approach to realisation of cross-border pipeline connections within the EU

One of the key problems in bringing forward gas infrastructure expansion in the EU concerns the progress in realising infrastructure capacity of European interest: i.e. infrastructure of which (investment) costs under the current regulatory framework are incurred by other parties (in other countries) than the beneficiaries. This is not likely to be solved with the implementation of the third energy package, but the recently adopted

Regulation on Guidelines for trans-European energy infrastructure (EC, 2011b) aims to address this particular problem. A particular measure mentioned in this package is the financing of such projects of European interest with an EU infrastructure financing facility. Alternatives are the adoption of ex ante investment cost sharing mechanisms or ex post compensations mechanisms (like the Inter TSO Compensation (ITC) mechanism). Further research efforts could be directed at the development of a proper cost benefit analysis approach that includes different alternatives and the implications of these alternatives on the effectiveness of other regulatory choices on gas infrastructure expansion.

9.3 Reflection on research

This final section reflects on a number of aspects of the research performed for this study.

Selection of case studies

The particular selection of case study projects analysed in this study warrant a reflection on a number of aspects.

Firstly, one of the case study projects, the Bergermeer gas storage facility, has not been realised at the time of publication of this study. Mid-2011, commercial operations were expected to commence in 2013. This schedule implies that further adaptations to regulatory choices made regarding this project, whether triggered by project-related developments or external gas market developments, may still occur until then. In retrospect it could be argued that already realised infrastructure projects may prove more reliable case study material. Even though one may consider changes in regulatory choices unlikely, changes in regulatory choices applicable to the project are possible. On the other hand, it may be considered unlikely that regulatory authorities would drastically change existing regulatory choices related to specific projects since this would damage regulatory credibility and have further undesirable negative effects on overall investment incentives.

Secondly, although the selected case studies cover different types of gas infrastructure projects, the geographical scope was intentionally limited. Even within the EU, the context for gas infrastructure investment can widely differ regarding in institutions, economic development, energy system characteristics etc. A larger geographical spread would, given the limitation of the number of case studies that could be undertaken, increase the risk of not being able to draw robust conclusions. The choice for a larger geographical scope would have required a different focus and depth of analysis.

Thirdly, the selected case study projects may all be considered success stories, in the sense that three of them have been realised, and one is on the way (which is the Bergermeer storage facility). It would have been interesting to study a project that was not successful and see if this may be explained with the framework developed in this study.

Case study data gathering

The case study approach adopted in this study basically relied on a thorough study of official, formal documentation on regulation. In addition to the method of data gathering, interviews with regulatory decision-makers could have led to observations additional to the observations based on official, publicly available publications. However, since the two jurisdictions wherein the four case study projects were assessed can be characterised by their large degree of transparency and availability of information, it is unlikely that case study interviews would have led to significant new insights and to other observations and conclusions than reported on in this study.

Theoretical perspective

This study adopted a public interest perspective on gas infrastructure regulation rather than a private interest perspective. Private interest based theories explaining regulation, also known as capture theory, assume that regulation serves interests of industry actors rather than public interest. The adoption of this theory and the explicit testing of its main hypothesis that regulatory choices are to a large degree affected by private interests would require a different research methodology since it brings into disrepute regulatory agencies that are designated to serve public interest by law. Therefore, relevant information would be much more difficult to obtain. However, regulatory choices as observed in this study do not seem to favour private sector interests since implemented regulation generally restricts private actor behaviour with in some cases clear negative impacts on profitability of infrastructure activities. It is therefore unlikely that private interests have been successful in influencing regulatory decision-making to any significant extent.

Positive versus normative theories of regulation

This study has adopted a positive approach to regulation theory: it focuses on explaining regulatory choices in practice. Only in one specific part of this study a normative position was taken. The case study chapters include an evaluation of alternative regulatory models. Firm conclusions on this particular aspect require a quantitative social cost-benefit analysis of the different regulatory models. This is out of the scope of this study as acquired case study material did not cover data requirements for cost-benefit analyses. The detailed case study descriptions do give sufficient guidance for performing such an analysis, and as such provide a good starting point for further research in this direction.

Glossary

ACER	Agency for the Cooperation of Energy Regulators
BBL	Balgzand Bacton Line
BCM	Billion cubic meter
BERR	Department for Business, Enterprise and Regulatory Reform
BERR	UK Department for Business, Enterprise and Regulatory Reform
BG	British Gas
BIS	UK Department for Business, Innovation and Skills
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CEER	Council of European Energy Regulators
CHP	Combined heat and power production
CO_2	Carbon dioxide
CRE	Commission de régulation de l'énergie
DECC	UK Department of Energy and Climate Change
DSO	Distribution System Operator
DTe	Dienst uitvoering en Toezicht Energie
DTI	Department for Trade and Industry
EC	European Commission
EK	Energiekamer (Dutch Office of Energy Regulation)
ENTSO	European Network of Transmission System Operators
ENTSOG	European Network of Transmission System Operators for Gas
ERGEG	European Regulators' Group for electricity and gas
ETS	Emmission Trading Scheme (of the EU)
EU	European Union
FCFS	First come first served
FERC	Federal Energy Regulatory Commission
FTR	Financial Transmission Right
GATE	Gas Access to Europe (LNG terminal)

GDF	Gaz de France
GIE	Gas Infrastructure Europe
GLE	Gas LNG Europe
GSE	Gas Storage Europe
GTE	Gas Transmission Europe
GTS	Gas Transport Services
HoA	Heads of Agreement
ISO	Independent System Operator
ITC	Inter TSO compensation mechanism
LNG	Liquefied Natural Gas
MoU	Memorandum of Understanding
MR	Ministeriele Regeling
NAM	Nederlandse Aardolie Maatschappij
NEL	Norddeutsche Erdgasleitung
NMa	Nederlandse Mededingingsautoriteit (Dutch competition authority)
NRA	National Regulatory Authorities
nTPA	Negotiated Third Party Access
NTS	National Transmission System (in the UK)
OIES	Oxford Institute for Energy Studies
OPAL	Ostsee-Pipeline-Anbindungsleitung
OU	Ownership unbundling
PCI	Project of Common Interest
PPP	Public-private partnership
PSO	Public Service Obligation
RAB	Regulated Asset Base
RI	Regional Initiatives
RTO	Regional Transmission Operator
rTPA	Regulated Third Party Access
SO	System operator
SOLR	Supplier of last resort
TEN-E	Trans-European Energy Networks for Energy
TCM	Trillion cubic meter

TO	Transmission Owner
TPA	Third Party Access
TSO	Transmission System Operator
TTF	Title Transfer Facility
UIOLI	Use-it-or-lose-it
UIOSI	Use-it-or-sell-it
VoLL	Value of Lost Load

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Summary

Area of study and research objective

In this study, the focus is on the regulation of gas infrastructure expansion in the European Union (EU). When the European gas sector was liberalised, the infrastructure elements remained largely in the regulated domain because they were considered essential facilities (or even natural monopolies) requiring regulation of access conditions. National gas transmission pipeline systems in the European Union (EU) are regulated monopolies, but other gas infrastructure facilities, such as gas storage facilities and import terminals for liquefied natural gas (LNG), are not, or not necessarily, part of the regulated domain. These facilities (including cross-border transmission pipelines) may be included in the regulatory domain, but may also be amenable to a certain degree of competition.

The EU gas market is confronted with an increasing dependence on gas from outside the EU and changing demand dynamics due to the advent of renewable energy, while the push to integrate European gas markets continues. In this context, the regulation of gas infrastructure investment will need to maintain the balance between fostering competition and stimulating sufficient investment to maintain the security of supply.

Using the room provided in the EU regulatory framework, Member States make different choices regarding the regulatory treatment of gas infrastructure expansion. This leads to the question of what is the best regulatory approach in different situations.

This study provides insights into how different factors affect the investment in gas infrastructure, how these factors can differ from type of infrastructure to type of infrastructure and from project to project, and how these may lead to different regulatory choices. These insights allow for an explanation of different regulatory choices in practice, for a reflection on the current EU regulatory framework, and for recommendations on how to improve this framework.

Research approach

This study performs an analysis of the drivers for and barriers to infrastructure expansion that play a role in the choice for a regulatory model. Based on insights from

neoclassical economic theory and new institutional economic theory, a framework has been developed that links the choice of regulatory model to four categories of factors that affect gas infrastructure expansion (i.e. drivers for and barriers to investment). The choice for these fields in economic literature is based on earlier research that demonstrated their applicability in the field of infrastructure regulation.

The applied framework distinguishes between the following categories of factors. The first category consists of project-specific barriers (i.e. investment risks) that may discourage gas infrastructure investment. The second category involves factors that affect the type and degree of competition in the relevant market. The third category consists of factors that determine the need for coordination between gas infrastructure investment and investment elsewhere in the system. The fourth category covers the factors that affect the presence and magnitude of external effects of gas infrastructure investment. External effects are the effects that are unintended and not accounted for by the private investor. The most important external effects in the case of gas infrastructure investment are the effect on the level of competition on the commodity market for gas and the effect on the level of security of supply in the system.

In addition to the above categories of factors that affect gas infrastructure investment, the choice of regulation depends on the regulatory objectives. Authorities who need to decide about regulation will need to weigh their various objectives. In the case of gas infrastructure this generally concerns the objectives of economic efficiency and security of supply. For example, long-term capacity contracts with a limited number of customers may be required to ensure the go-ahead of the project – which may contribute to capacity adequacy – but at the same time may negatively affect the level of competition in the wholesale market as access to capacity is limited.

Regulatory authorities can choose from a range of different regulatory models. These regulatory models may differ with respect to the role for competition and the role for regulation in realising gas infrastructure investment. The range of potential regulatory models is identified on the basis of relevant economic literature. At the ends of this range are competitive, private investment, and fully regulated infrastructure investment with a full socialisation of costs and benefits.

Summarising: within the developed framework the choice of regulatory model depends on the four categories of factors affecting investment, the regulatory objectives, and the available range of regulatory models.

A case study approach is used to validate and refine the framework described above. By analysing individual gas infrastructure projects and the regulatory framework to which they are subjected, insight is gained into the common and distinctive factors that may explain regulatory choices in gas infrastructure expansion. The rationale for a case study approach is the scarce literature on explaining different regulatory choices in energy infrastructure expansion in general and in gas infrastructure expansion in particular. The focus is on infrastructure projects realised in mature gas markets in Northwest Europe. This focus ensures the comparability of the cases with respect to their institutional context. The unit of analysis concerns individual gas infrastructure projects involving transmission pipelines, gas storage and LNG import facilities. Case study analyses are undertaken for the following four individual infrastructure projects: (1) the gas transmission pipeline between the Netherlands and the United Kingdom (UK), known as BBL[82], (2) the gas transmission pipeline connecting two LNG terminals at Milford Haven (UK) with the national UK gas transmission pipeline network, (3) the gas storage facility Bergermeer in the Netherlands, and (4) the LNG import terminal in Rotterdam in the Netherlands, known as GATE[83] terminal.

Results and conclusions

Results and conclusions are obtained regarding:

1. The factors that differ for different types of infrastructure;
2. The factors that differ for different projects of the same type of infrastructure;
3. The choice of regulation in different situations.

Within the earlier mentioned categories of factors affecting investment, the following factors give rise to differences between different types of gas infrastructure.

[82] BBL stands for Balgzand Bacton Line.

[83] GATE stands for Gas Access to Europe.

Within the first category of factors – the project-specific barriers to investment – the degree of asset-specificity, the level of uncertainty, and the lumpiness of investment play a key role. Gas infrastructures in general are physically and locational specific, but not all gas infrastructure assets are necessarily dedicated to a particular transaction (i.e. transaction specific). The level of uncertainty about the future demand for the infrastructure is important in the following way. In the region of Northwest Europe this is mainly caused by the level of competition in the market for infrastructure services. Uncertainty about general demand for gas is less important in this region as the trends in gas demand and production seem robust. Whether the combination of asset-specificity and uncertainty also gives rise to high levels of investment risk depends on the lumpiness of investment, which may vary across pipelines, gas storage facilities and LNG terminals. The less lumpy the investment is, the better investors may, over time, track demand for infrastructure services, and the less risky the investment project is. In addition, the size of upfront investments costs, both in absolute terms and in relation to operational costs, varies across types of gas infrastructure and across projects. The larger the upfront investment is, and the larger the part of capital cost in total cost of service provision is, the larger the barrier to investment is. Finally, the level of regulatory risk for infrastructure investment varies across different types of gas infrastructure as the default regulatory regime may differ and multiple regulatory authorities may be involved in the choice of regulation (i.e. in the case of cross-border pipelines and projects applying for an exemption).

Within the second category of factors, the level of competition varies across different types of infrastructure dependent on the relevant market for infrastructure services. Competition may come from the same type of gas infrastructure, from other types of gas infrastructure, or from non-infrastructure based alternatives. New pipelines may compete with other pipelines on the relevant destination, origin or transit market. LNG terminals may compete on these very same markets, whereas gas storage facilities should be considered part of the larger market for flexibility services.

Within the third category of factors affecting investment, two factors affect the need for coordination between a new facility (of any type of infrastructure) and investment in the infrastructure elsewhere in the system: the role of the new facility in the infrastructure system and its specific location therein. The facility may be considered an extension (i.e. creating a new export outlet or import facility) or a substitution (i.e. replacing declining indigenous production capacity) of the gas infrastructure system. Furthermore, the need for coordination depends on the specific location of the proposed facility with respect to existing gas supply sources and gas demand centres.

The key factor causing differences between different types of gas infrastructure in the fourth category of factors – the external effects – is the 'additionality' of the new gas infrastructure facility. Although every single gas infrastructure, regardless of the type, has external effects on the level of competition and security of supply on the commodity market for gas, but the magnitude of the effect may vary substantially. The magnitude of the external effect depends on the 'additionality' of the new facility to the existing gas supply system (i.e. how much does the facility increase the scope of competition, the level of gas supply diversification, etc.). Large external effects due to gas infrastructure investment may influence the choice of regulatory model as their internalisation may contribute achieving regulatory objectives.

The following factors lead to differences between projects of the same type of gas infrastructure.

In the case of gas transmission pipelines, projects may differ regarding the type and degree of competition in the relevant market for transmission services, the presence of dedicated assets in the new facility, the nature of regulatory risk, the need for coordination with other infrastructure, and the presence and magnitude of external effects on the commodity market.

Gas storage projects can differ with respect to the level of investment risk (in particular the size of upfront investment costs required and the potential transaction-specificity of assets), the type and degree of competition, and the external effect of storage on the commodity market for gas.

Differences between LNG import terminal projects can concern the type and degree of competition in the relevant market, the private barrier for investment (mainly the level of upfront investment costs that depends on local circumstances), the need for coordination between investments, and the positive external effects on the commodity market.

The factors mentioned above can lead to the following regulatory choices for the different types of gas infrastructure investment.

In the case of investment in gas transmission pipelines that are part of a larger transmission system, the limited degree of competition and the need for coordination with other parts of the system will often result in the choice for regulated expansion. However, there is a larger scope for competitive investment or light-handed regulation then observed in practice for two reasons. Firstly, there may be (some) competition in the relevant market. Secondly, there may be only limited need for (regulated) coordination. This is for example the case for dedicated pipeline connections (such as the analysed Milford Haven pipeline) and for international transmission pipelines (such as the analysed BBL pipeline). As both are subjected to competition there is less urgency to strictly regulate access conditions. In addition, the role for private parties in realising gas transmission investments can be increased by tendering required capacity expansion in the system and applying a system of an independent system operator and multiple transmission pipeline owners, but this requires that only limited need for coordination with investments elsewhere. If there is a large need for coordination between different infrastructure elements, then the scope for competitive investment and third party involvement decreases because it becomes too difficult to properly allocate costs and benefits among parties involved. In that case, the default of regulated expansion based on third party access, with some degree of socialisation of costs and benefits, could be implemented.

As both the gas storage and LNG market are, in principle, competitive, the default approach to expansion should be based on competitive investment (i.e. using an exemption) or light-handed regulation (i.e. based on negotiated third party access (TPA)). Even when the existing market is concentrated, competitive investment or light-handed regulation of new facilities is feasible and beneficial for society as long as conditions targeting the maximum amount of capacity that companies with a dominant market position may acquire are imposed. In the situation of limited opportunities for investment in new gas storage or LNG terminal facilities, expansion can be governed by a competitive tender. In other cases, with high market concentration and limited opportunities for new investment, a regime of regulated TPA should be chosen. For investors in storage facilities and LNG terminals it is important that regulation allows them to enter into long-term contracts with customers because of the project-specific risks involved. If this is not the case, then it becomes more and more important for them to obtain an exemption. In the case of LNG terminals, there may be an issue in coordinating with investment in transmission assets downstream. If market parties cannot successfully conclude private institutional arrangements that ensure coordination, this could be a reason to impose regulated expansion. Irrespective of the scope for competitive or lightly-regulated investment in storage facilities, the positive external effect on the system's level of security of supply may prompt authorities to adopt the model of regulated expansion (i.e. regulated third party access) in order to ensure capacity adequacy.

Policy recommendations

The current EU regulatory framework for gas infrastructure investment fails to capture potential benefits related to a larger role for competitive expansion. At the beginning of the liberalization process, policy-makers did not fully appreciate the scope for competitive, private investment in gas infrastructure, which may be explained by a strong focus on introducing competition in the commodity market. In response to concerns over insufficient investment in gas infrastructure, exemption regulation was introduced. Although it succeeded in bringing about investment, its design failed to take into account differences between types of infrastructures.

The regulation of gas infrastructure can be improved by allowing a larger role for competitive investment in the different types of gas infrastructure by default. At the national level, a larger role for private companies in gas transmission pipelines could be allowed. This can be in the form of competitive tenders for required transmission investments or by allowing private companies to invest in transmission pipeline connections. For gas storage (LNG terminal) facilities, the current regulatory design principle of 'regulated expansion, unless', should be replaced by the principle of 'lightly regulated expansion, unless', since both markets can in principle be competitive. This would increase market efficiency and might reduce the cost of regulatory oversight. The potential for competitive investment in gas infrastructure may be further enhanced by improving (international) coordination between gas infrastructure investments by, for example, organizing parallel open seasons across borders, and by enforcing strong competition policy in order to improve the limited degree of competition in the commodity market for gas across the EU.

Jeroen de Joode

Samenvatting

Onderwerp en doel van het onderzoek

Dit onderzoek richt zich op de regulering van investeringen in gasinfrastructuur in de Europese Unie (EU). Bij de liberalisering van de Europese gassector is de gasinfrastructuur (zoals pijpleidingen voor gastransport, gasopslag en terminals voor de import van LNG[84]) grotendeels gereguleerd gebleven teneinde een gelijk speelveld op de groothandelsmarkt te creëren en mogelijk machtsmisbruik door de beheerder van de infrastructuur in te perken. Binnen de EU worden nationale netwerken voor gastransport als natuurlijk monopolie beschouwd en gereguleerd. Andere typen infrastructuur hoeven niet per se te vallen onder een strikt reguleringskader aangezien daar wel concurrentie mogelijk geacht wordt.

Als gevolg van een toenemende importafhankelijkheid van het gasaanbod, een veranderende dynamiek van de gasvraag als gevolg van de toename van duurzame energiebronnen (vooral de onvoorspelbare elektriciteitsproductie van windenergie) en het streven naar verdere integratie van de Europese gasmarkten zijn er investeringen nodig in de gasinfrastructuur. Hierbij is het van belang dat het reguleringskader leidt tot een goede afweging tussen publieke doelen als het stimuleren van concurrentie op de groothandelsmarkt voor gas, het efficiënt realiseren van capaciteitsuitbreidingen en het waarborgen van voorzieningszekerheid.

Het reguleringskader van de EU biedt lidstaten de ruimte om verschillende keuzes te maken als het gaat om de regulering van investeringen in gasinfrastructuur, hetgeen in de praktijk ook daadwerkelijk gebeurt. Verschillen in de keuze van regulering doen de vraag rijzen welk reguleringsmodel het meest geschikt is onder verschillende omstandigheden.

Dit onderzoek maakt inzichtelijk hoe de factoren die van invloed kunnen zijn op investeringen in de gasinfrastructuur kunnen verschillen van infrastructuur tot infrastructuur en van project tot project, en hoe deze kunnen leiden tot verschillen in de keuze van regulering. Hiermee kan worden verklaard waarom de keuze voor regulering in de praktijk verschilt per situatie. Op basis hiervan kan worden gereflecteerd op het huidige reguleringskader en kunnen aanbevelingen worden gedaan voor het verbeteren hiervan.

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[84] LNG (*Liquified Natual Gas*) is vloeibaar aardgas.

Onderzoeksaanpak

In deze studie is een analyse gemaakt van de factoren die een investering in gasinfrastructuur stimuleren of belemmeren en zo van invloed zijn op de keuze van het type regulering door de verantwoordelijke autoriteit. In dit onderzoek is met behulp van inzichten uit de neoklassieke economie en de nieuwe institutionele economie een raamwerk ontwikkeld dat een relatie legt tussen de keuze voor een bepaald reguleringsmodel en vier categorieën van factoren die van invloed kunnen zijn op de reguleringskeuze. Er is gekozen voor een raamwerk op basis van inzichten uit deze stromingen in de economische literatuur omdat deze in eerder onderzoek hun waarde in het analyseren van economische infrastructuurvraagstukken hebben bewezen.

De volgende vier categorieën van factoren zijn van invloed op de investering in gasinfrastructuur en de keuze voor een reguleringsmodel. De eerste categorie omvat de specifieke risico's voor de investeerder die voortkomen uit het karakter van het investeringsproject. De tweede categorie bestaat uit factoren die de mate van concurrentie in de relevante markt bepalen. De derde categorie bevat factoren die bepalen of er een noodzaak bestaat voor coördinatie tussen een investering in gasinfrastructuur en investeringen elders in het systeem. De vierde categorie betreft factoren die de mate waarin externe effecten zich voordoen als gevolg van investeringen in gasinfrastructuur beïnvloeden. Dit zijn effecten die niet door de private investeerder wordt meegewogen in de investeringsbeslissing. Bij gasinfrastructuur gaat het met name om externe efecten op de groothandelsmarkt voor gas en het niveau van voorzieningszekerheid in het systeem.

Naast de factoren die van invloed zijn op een investering in gasinfrastructuur wordt de keuze voor een reguleringsmodel ook beïnvloed door de beleidsdoelen. Deze kunnen met elkaar conflicteren, waardoor de verantwoordelijke reguleringsautoriteit ze tegen elkaar zal moeten afwegen. Bij investeringen in de gasinfrastructuur is de voornaamste belangenafweging die tussen de betaalbaarheid van de gasvoorziening (het verhogen van economische efficiëntie) en de voorzieningszekerheid. Het ruimhartig toestaan van lange-termijn contracten voor de afname van capaciteit van nieuwe gasinfrastructuur kan bijvoorbeeld het investeringsrisico verminderen en zo de investering bespoedigen, maar kan tegelijkertijd een negatief effect hebben op de concurrentie in de groothandelsmarkt voor gas wanneer deze wijze van capaciteitsallocatie leidt tot sterkere marktposities voor een beperkt aantal aanbieders.

Bij het reguleren van investeringen in gasinfrastructuur kan de autoriteit een keuze maken uit een spectrum van reguleringsmodellen, waarbij deze modellen verschillen ten aanzien van de rol van concurrentie en de rol van regulering bij het realiseren van nieuwe infrastructuurcapaciteit. Het spectrum van mogelijke reguleringsmodellen voor investeringen in gasinfrastructuur is geïdentificeerd aan de hand van economische literatuur. Aan de ene kant van het spectrum bevindt zich de optie van concurrerende, private investeringen waarbij de markt bepaalt in welke mate kosten worden terugverdiend, en aan de andere kant bevindt zich de optie van sterk gereguleerde investeringen waarbij zowel kosten als opbrengsten worden gesocialiseerd.

Samenvattend: de keuze van regulering van investeringen in gasinfrastructuur wordt bepaald door factoren die de investering beïnvloeden, de beleidsdoelen, en de beschikbaarheid van reguleringsmodellen.

Dit raamwerk is gevalideerd en verfijnd door middel van enkele case studies. Een gedetailleerde, systematische analyse van concrete investeringsprojecten en de bijbehorende reguleringskaders vergroot het inzicht in de factoren die ten grondslag liggen aan de keuze voor bepaalde typen infrastructuur (pijpleidingen voor gastransport, gasopslagfaciliteiten en LNG importterminals) en in verschillende situaties. De keuze voor een case studie benadering was ingegeven door het feit dat er slechts weinig literatuur beschikbaar is aangaande de invloed van situatie-specifieke factoren op de keuze van het reguleringsmodel. Het onderwerp van elk van de uitgevoerde case studie analyses is daarom een individueel, concreet investeringsproject. De selectie van case studies beperkt zich in geografische zin tot de Noordwest-Europese markt, omdat een vergelijkbare institutionele context bijdraagt aan de vergelijkbaarheid van de casussen en de robuustheid van conclusies die kunnen worden getrokken. De volgende investeringsprojecten zijn gekozen als onderwerp voor een case studie analyse: (1) de internationale gaspijpleiding tussen Nederland en het Verenigd Koninkrijk (bekend als de BBL[85]), (2) de gastransportpijpleiding tussen twee LNG importterminals nabij Milford Haven en het nationale transportnetwerk in het Verenigd Koninkrijk, (3) de gasopslagfaciliteit nabij

[85] BBL staat voor Balgzand Bacton Line.

Bergermeer in Nederland, en (4) de LNG importterminal in Rotterdam (bekend als GATE[86] terminal).

Resultaten en conclusies

De resultaten en conclusies bestaan uit de volgende delen:

1. De factoren die leiden tot verschillen per type gasinfrastructuur;
2. De factoren die leiden tot verschillen tussen diverse projecten van dezelfde type infrastructuur;
3. De keuze van regulering in verschillende situaties.

Binnen de vier eerder genoemde categorieën van factoren die een investering beïnvloeden, zijn het de volgende factoren die leiden tot verschillen tussen verschillende typen gasinfrastructuur.

Binnen de eerste categorie van factoren – de omvang van aanwezige investeringsrisico's – speelt de specificiteit van de investering een rol. Investeringen in gasinfrastructuur in het algemeen zijn specifiek qua locatie en gebruik van een bepaald type gas, maar zijn niet noodzakelijkerwijs transactie-specifiek. Ook is de onzekerheid over de toekomstige vraag naar infrastructuur van belang. Hoewel onzekerheid over de algemene vraag naar gas in Noordwest-Europa beperkt effect heeft op de toekomstige waarde van nieuwe infrastructuur (omdat de gasmarktontwikkelingen robuust lijken te zijn), speelt onzekerheid een rol als het gaat om de vraag naar specifieke infrastructuurprojecten. Deze vraag hangt af van de mate van concurrentie in de relevante markt. Of de combinatie van een hoge mate van specificiteit en onzekerheid ook daadwerkelijk leidt tot grote investeringsrisico's is afhankelijk van de mate waarin een investering in fases kan worden gerealiseerd. Dit hangt samen met de schaalvoordelen die behaald kunnen worden. Wanneer een investering in fases kan worden gerealiseerd, dan kan beter op de daadwerkelijke vraag naar infrastructuur worden ingespeeld, en is de investering minder risicovol. Ook kunnen de verschillen in de omvang van de investering in zowel absolute als relatieve termen (gerelateerd aan operationele kosten) tussen verschillende infrastructuur projecten groot zijn: hoe hoger deze investeringen zijn, hoe groter het investeringsrisico dat gedragen moet worden. Daarnaast kan de mate waarin het project aan reguleringsrisico's bloot staat verschillen. Dit is

[86] GATE staat voor Gas Access to Europe.

afhankelijk van het bestaande reguleringskader voor het type infrastructuur. Verder kan de betrokkenheid van meerdere reguleringsautoriteiten bij het realiseren van een investering een negatief effect hebben op de mate van aanwezig reguleringsrisico.

Binnen de tweede categorie van factoren geldt dat alle typen gasinfrastructuur in principe onderworpen kunnen zijn aan concurrentie, maar dat de mate van concurrentie kan verschillen afhankelijk van de relevante markt. Concurrentie kan komen van andere, gelijksoortige gasinfrastructuur of van niet-infrastructuur gebaseerde alternatieven. Gaspijpleidingen kunnen onderling concurreren in relevante markten: de markt voor transit, de markt voor transport vanuit een specifieke regio, en de markt voor transport naar een specifieke regio. Importterminals voor LNG concurreren met pijpleidingen in dezelfde markten, terwijl gasopslagfaciliteiten concurreren met alternatieve middelen die de gasmarkt van flexibiliteit voorzien.

Binnen de derde categorie van factoren geldt dat de noodzaak van coördinatie afhankelijk is van de rol die de nieuwe infrastructuur gaat spelen in het systeem: het kan een uitbreiding betreffen (zoals de realisatie van een nieuwe mogelijkheid tot export of import van gas) of een verbetering van een bestaande functie de gasinfrastructuur (zoals het vergroten van importcapaciteit om dalende productiecapaciteit te ondervangen). Daarnaast speelt de specifieke locatie van nieuwe infrastructuur ten opzichte van bestaande aanvoerbronnen van gas en vraagcentra een rol in de mate waarin afstemming dient plaats te vinden. De opties voor het coördineren van investeringen verschillen per type infrastructuur en bepalen samen met de noodzaak tot coördinatie mede de keuze van een reguleringsmodel.

Binnen de vierde categorie van factoren is de mate waarin externe effecten zich voor doen als gevolg van investeringen in gasinfrastructuur afhankelijk van de ‘additionaliteit’ van het investeringsproject bezien vanuit het perspectief van het huidige gassysteem. Dit kan bijvoorbeeld worden afgemeten aan de omvang van de nieuwe infrastructuur in relatie tot de omvang van de relevante markt. Grootschalige positieve externe effecten kunnen de keuze van het reguleringsmodel beïnvloeden wanneer de internalisering ervan in grote mate bijdraagt aan het realiseren van beleidsdoelen.

Tussen projecten van hetzelfde type infrastructuur leiden de volgende factoren tot verschillen.

Bij pijpleidingen voor gastransport zijn dit: de mate van concurrentie die de nieuwe investering ondervindt na realisatie, de specificiteit van de investering (i.e. is de investering transactie-specifiek), de mate van een aanwezig reguleringsrisico, de noodzaak tot afstemmen met investeringen elders in het gasinfrastructuursysteem, en de omvang van positieve externe effecten.

Gasopslagfaciliteiten kunnen van elkaar verschillen ten aanzien van de omvang van de initiële investering, de mate van specificiteit, de mate van concurrentie op de relevante markt, en het belang van externe effecten op de groothandelsmarkt voor gas.

Bij LNG importterminals zijn de mate van concurrentie in de relevante markt, de omvang van investeringen (die afhangen van lokale omstandigheden), de noodzaak tot afstemming met investeringen *downstream*, en de aanwezigheid van (sterke) positieve externe effecten bepalend.

De hierboven geïdentificeerde factoren kunnen leiden tot de volgende reguleringskeuzes ten aanzien van investeringen in gasinfrastructuur.

Bij investeringen in gastransportpijpleidingen zorgen de noodzaak tot coördinatie met andere infrastructuur en de vaak beperkte mate van concurrentie er voor dat deze grotendeels in het gereguleerde domein van de *transmission system operator (TSO)* vallen. Niettemin is er meer ruimte voor concurrerende investeringen of investeringen met beperkte regulering (zoals investeringen met onderhandelbare toegang voor derden) dan wordt gerealiseerd in de huidige reguleringspraktijk. Enerzijds omdat pijpleidingen geen of een slechts geringe mate van coördinatie vereisen, en anderzijds omdat er sprake is van concurrentie in de relevante markt. Voorbeelden van pijpleidinginvesteringen die zouden kunnen worden gerealiseerd in een meer competitieve omgeving zijn transactie-specifieke investeringen (zoals de bestudeerde Milford Haven pijpleiding) en internationale transportpijpleidingen (zoals de bestudeerde BBL pijpleiding). Aangezien beide type projecten concurrentie ondervinden van alternatieven is er minder noodzaak tot strikte regulering van toegangscondities voor derden. Een reguleringsmodel dat kan zorgen voor een grotere rol voor concurrerende investeringen in pijpleidingen is het competitief aanbesteden van benodigde investeringen, waarbij een systeem van een enkele zelfstandige beheerder van het infrastructuursysteem met mogelijk meerdere netwerkeigenaren dient te worden geïmplementeerd. Dit model is echter alleen werkbaar in gevallen waarin er slechts in beperkte mate coördinatie nodig is tussen verschillende onderdelen van het infrastructuursysteem. Dit houdt verband met de complexiteit van het correct alloceren van kosten en baten over betrokken partijen. Wanneer er een noodzaak tot coördinatie is, dan ligt gereguleerde coördinatie via de TSO eerder in de rede.

Bij zowel gasopslagfaciliteiten als LNG importterminals is het logisch om competitieve expansie dan wel expansie op basis van onderhandelbare toegang voor derden als uitgangspunt te nemen, omdat deze typen infrastructuur in principe concurrerend zijn. Zelfs wanneer de bestaande markt geconcentreerd is kan een reguleringsmodel op basis van competitieve expansie worden toegepast, mits er een maatregel wordt getroffen die voorkomt dat dominante marktpartijen hun positie op de markt verder versterken.[87] Wanneer er slechts beperkte, fysieke mogelijkheden zijn voor investeringen in gasopslag of LNG terminals kan een competitieve aanbesteding van de door de markt gevraagde capaciteit worden toegepast. Wanneer er sprake is van sterke marktconcentratie en zeer beperkte mogelijkheden voor expansie zou de keuze voor een model gebaseerd op gereguleerde derdentoegang logisch zijn. Gegeven de private investeringsrisico's bij zowel gasopslag als LNG importterminals is het voor de investeerder belangrijk dat lange-termijn contracten kunnen worden aangegaan met (toekomstige) klanten. Als deze ruimte niet wordt geboden in het standaard (*default*) reguleringsmodel, wordt het des te belangrijker voor hen om een vrijstelling (oftewel: exemptie) hiervan te verkrijgen. In het geval van investeringen in LNG importterminals in Noordwest Europa zou er een behoefte aan afstemming met investeringen in het Noordwest-Europese transportsysteem kunnen bestaan. Deze afstemming zou bijvoorbeeld door middel van parallel georganiseerde marktbevragingsprocedures[88] kunnen plaatsvinden. Indien private partijen hier niet in slagen zou het een reden kunnen zijn om gereguleerde expansie van LNG importterminals te overwegen. De behoefte aan coördinatie in het geval van investeringen in gasopslag in Noordwest-Europa is beperkt vanwege het grote aantal mogelijke locaties dicht bij de markt en de grootschalige omvang van bestaande pijpleidinginfrastructuur. In het geval van gasopslagfaciliteiten kan de aanwezigheid van grote positieve externe effecten op vooral het niveau van voorzieningszekerheid van het gassysteem een rol spelen in de keuze voor

[87] Oftewel, negatieve externe effecten van investeringen in nieuwe gasinfrastructuur op het niveau van concurrentie op de groothandelsmarkt voor gas dienen voorkomen te worden.

[88] In het Engels: *open seasons*.

een model gebaseerd op gereguleerde investeringen met socialisatie van kosten en baten. Een voorbeeld hiervan is een investering in gasopslag bedoeld voor inzet in extreme vraagsituaties.

Beleidsaanbevelingen

Op basis van dit onderzoek kan worden gereflecteerd op het huidige reguleringskader en kan een aantal aanbevelingen worden gedaan die het huidige EU reguleringskader kunnen verbeteren. Het huidige kader slaagt er onvoldoende in om de baten te realiseren die horen bij een grotere rol voor concurrentie bij het investeren in gasinfrastructuur. Dit zou kunnen worden verklaard uit het feit dat Europese beleidsmakers bij het liberaliseren van de gasmarkt relatief weinig nadruk hebben gelegd op het aspect van uitbreidingsinvesteringen: men richtte zich vooral op het zo snel mogelijk creëren van een gelijk speelveld op de groothandels- en eindverbruikersmarkten. Teneinde investeringen in nieuwe gasinfrastructuur te stimuleren in de nieuwe institutionele context werd enige jaren na de start van de Europese marktliberalisering een model van exemptie-regulering ingesteld: bij uitzondering konden infrastructuurprojecten competitief worden gerealiseerd, zonder regulering van derdentoegang. Hoewel exemptie-regulering succesvol is gebleken in het stimuleren van bijvoorbeeld investeringen in LNG importterminals, houdt het algemene reguleringskader, inclusief exemptie-regulering, onvoldoende rekening met de verschillen tussen verschillende typen gasinfrastructuur die in dit onderzoek naar voren zijn gekomen.

Het huidige reguleringskader zou kunnen worden verbeterd door standaard een grotere rol voor competitieve investeringen toe te laten voor de verschillende typen gasinfrastructuur. Op het vlak van nationale gastransportpijpleidingen zou meer ruimte voor competitieve expansie kunnen worden gegeven door private partijen te laten investeren in specifieke pijpleidingen en door competitieve aanbestedingen te organiseren. In het geval van gasopslag en LNG importterminals verdient het aanbeveling het huidige reguleringsprincipe van 'gereguleerde expansie, tenzij' te vervangen door 'competitieve expansie, tenzij'. Hierbij kan competitieve expansie, afhankelijk van de specifieke omstandigheden, ook een lichte vorm van regulering behelzen, zoals expansie op basis van onderhandelbare derdentoegang. Beide typen infrastructuur concurreren immers in principe met alternatieven. Deze aanpassing kan de economische efficiëntie van de gasmarkt ten goede komen en leiden tot verlaging van de kosten van regulering. Het potentiële bereik voor competitieve expansie zou verder kunnen worden verhoogd wanneer de coördinatie van investeringen tussen verschillende landen wordt verbeterd (bijvoorbeeld door middel van parallel georganiseerde marktbevragingsprocedures) of wanneer de concurrentie op de markt wordt verbeterd door strenge toepassing van mededingingswetgeving.

Jeroen de Joode

Curriculum Vitae

Jeroen de Joode was born in Gouda, the Netherlands on 5 April 1980. He studied economics at the University of Tilburg between 1998 and 2003, with a specialization in international economics and environmental & resource economics. Taking part in the Erasmus student exchange programme, he studied at the Bradford School of Management (UK) during the spring semester of 2002. As part of obtaining his MSc degree in economics in 2003, he was an intern with the Dutch Bureau for Economic Policy Analysis (CPB) researching the impact of Russian gas market reforms on European security of gas supply. After graduating, he continued working for CPB. Following his strong interest in the policy aspects and economics of energy markets, he started working for the Energy research Centre of the Netherlands (ECN) in 2004, first as researcher and more recently as coordinator of gas market research. To realise his ambition of obtaining a PhD, he took a part-time position at the Faculty of Technology, Policy and Management at Delft University of Technology in May 2005. His research interests lie in the policy aspects and economics of energy markets and the regulation of energy infrastructures.

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