SAFEGUARDING PUBLIC VALUES IN GAS INFRASTRUCTURE EXPANSION

A COMPARISON OF TWO INVESTMENT PROJECTS

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Abstract

The realisation of new gas infrastructure projects affects overall gas market performance with respect to the public values of affordability and security of supply. However, the actual contribution of a gas infrastructure expansion project to system affordability and security of supply depends upon the institutional design of the market (legislation, regulatory codes and arrangements, market rules, etc.). In this paper we link the institutional design applicable to two specific gas infrastructure projects with the safeguarding of the aforementioned public values. We conclude that path dependencies can cause large differences in the contribution of the projects to the safeguarding of public values.

1 Introduction

Investment in gas infrastructure expansion in the EU is a hot topic nowadays. The reasons for this are threefold: First, there is a still growing demand for gas, especially in electricity generation. Second, a declining gas reserve base in the EU increases gas import dependency and leads to different gas flow patterns across the EU. Third, additional investment in gas connections between EU member states are promoted for the sake of further market integration.

Against the background of this development the European Commission (EC) has, on numerous occasions (EC 2003, 2006), stated three public goals regarding the internal gas market, including the market for the transport of gas. These are: (1) sustainable development, (2) a competitive, more efficiently working gas market, and (3) secure supply of gas.

Current European gas market legislation (EC 2003, 2005) contains rules and regulations on gas market operations with the purpose of reaching these public goals. Although, national member state implementation of EU legislation is obliged, it does, to some degree provides discretionary space for national member states to further specify elements in EU legislation. Examples thereof are the rate of market opening and the type of unbundling applied to integrated trading and network activities. This has

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led to a wide variety of institutional designs across the EU.[1] The question now is whether these different designs among EU member states have resulted in different performances of gas infrastructure expansion regarding the public goals of the EC. Thus our central research question is:

How do differences in institutional design affect the performance of gas infrastructure expansion projects with respect to the public goals of (1) a competitive gas market, and (2) a secure supply of gas?

In our analysis we refrain from analysing the performance on the public goal of sustainable development since the relevance of this goal in gas infrastructure operations and investment seems negligible.

We aim to answer the research question by performing a comparative case study analysis. Here we assess two different gas infrastructure investment projects in the EU. The first is the investment in a new pipeline connecting the existing gas transmission network in the UK with to planned LNG terminals. The second is the investment in the interconnector between the Netherlands and the UK. By analyzing the different institutional designs applicable to both investment projects, and assess the performance of both investment projects on their contribution to a competitive gas market and secure supply of gas, we gain insight into our posed question.

The structure of the remainder of this paper is as follows. Section 2 presents the institutional framework used in analyzing the two investment projects. Section 3 contains the descriptive analysis of the institutional design applicable to the two investment projects. Section 4 assesses the performance of the institutional design with respect to competitiveness and security of supply and tries to explain any differences by referring provides a cross-case analysis of the two investment projects. Finally, Section 5 concludes and provides suggestions for further research.

2 Institutional framework

2.1 Introduction

In this section we present the starting point of our analysis: a conceptual model that represents the institutional framework in our analysis on the two investment projects later on. Figure 1 depicts this institutional framework. The framework represents five 'building blocks': (1) the informal institutions, (2) the formal institutions, (3) the institutional arrangements, (4) market behaviour, and (5) exogenous factors.

This framework is partly based on the conceptual framework provided by Williamson (1998), which originates from New Institutional Economics (NIE). This stream in economic literature builds further upon the institutional economics idea of the embeddedness of economic activities in legal and social institutions.[2] Institutions can be defined as "Humanly devised constraints that structure political, economic and social interactions. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct) and formal rules (constitutions, laws, property rights)" (North 1991, p. 97). We have chosen to

[1] We define the institutional design as being the whole of formal and informal economic, political and social constraints and rules that guide economic behaviour.

follow this approach since it seems to be able to explain differential market outcomes through the existence of institutions (De Vries and Correljé 2006, 2007, CIEP 2006).

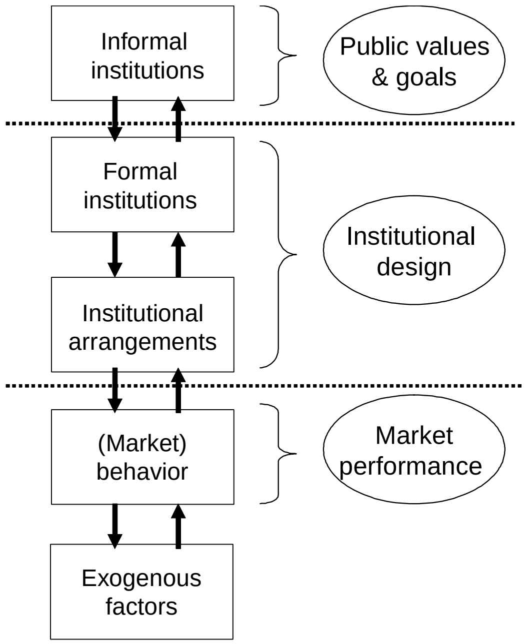

Figure 1 Institutional framework

The *first* building block of the institutional framework represents the informal institutions. These contain the formal institutions, or what we refer to as public values.[3] Examples of public values are fairness, justice and equality. The *second* building block contains the formal institutions, or speaking in Williamsons' terms, the "rules of the game". General examples of formal institutions are polity, judiciary and bureaucracy, whereas examples of sector specific formal institutions are European directives, acts and decrees. The formal institutions are influenced by the prevailing public values in building block 1. The *third* building block represents the institutional arrangements.[4] Examples of institutional arrangements are regulatory codes, industry standards, and market rules. The institutional arrangements are restricted by the formal institutions. The formal institutions (building block 2) and the institutional arrangements (building block 3) together represent what we call the *institutional design*. The *fourth* building block consists of short-term resource allocation and optimization and is described here as market behaviour. All market actors optimize their operational and investment decisions given the formal institutions and institutional arrangements laid down in building blocks two and three. In addition, the actors on this level are

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[2] In contrast with 'old' institutional economics, new institutional economics aims to integrate theories on asymmetric and distributed information into mainstream neo-classical economics.

[3] Williamson (1998) ranks 'customs, traditions, norms, religion' under the informal institutions.

[4] Williamson defines this as the governance: "the means by which order is accomplished in a relation in which potential conflict threatens to undo or upset opportunities to realize mutual gains" (Williamson 1998, p. 37). It involves the possible modes of organisation given the formal institutions.

constrained in their behaviour by so-called exogenous factors. With exogenous factors we refer to technical, economic or geographical conditions. Examples of exogenous factors affecting economic behaviour are the presence of rivers and lakes affecting the options for electricity generation from hydro plants and the size of the geographical market affecting the ability to profit from economies of scale.

Figure 1 also shows top-down and bottom-up relation by means of the arrows. The top-down arrows indicate that lower level institutions are affected by institutions at the preceding higher levels. This has been illustrated in the brief description of the building blocks. However, also a 'feed-back loop' can be identified. When behaviour or certain institutional arrangements lead to undesirable (market) outcomes, bottom-up information signals may incentivise a change in formal institutions. For example, existing market rules might pose an unacceptable economic risk for investment in new gas infrastructure resulting in little investment in gas infrastructure expansion, thereby threatening security of supply in the region. Policy-makers or regulators could respond to these bottom-up signals by adapting regulation or regulation, in order to speed up gas infrastructure investment.

The focus of the analysis in this paper is on the institutional design: the formal institutions and institutional arrangements. Given the two identified policy goals of competitiveness and security of supply (policy goals in building block 1), we assess the variables representing the institutional design and the market performance with regard to these public goals. For this purpose, we devote the next section to the identification of the institutional design in the case of gas infrastructure expansion.

2.2 Filling out the institutional framework

In this section we consecutively describe (1) the formal institutions, (2) the institutional arrangements, and (3) exogenous factors. The formal institutions and institutional arrangements can be described by identifying a number of *institutional variables*. With each variable having different potential values, a large number of different institutional designs can be constructed.

Formal institutional variables

The formal institutions can be divided into generic laws and decrees affecting all economic sectors, and sector specific laws and decrees, affecting only targeted sectors. For gas infrastructure expansion, the relevant formal institutions are European Directives and Regulation, and additional member state legislation. Assessment of these institutions led us to identify the institutional variables listed in Table 1. Although the list of variables may not be exhaustive we feel it sufficiently contains the variables relevant for our purposes.

Table 1 Variables representing formal institutions

Variable	**Motivation**
Market opening (degree/pace)	Co-determines the role of the market in providing incentives for new infrastructure investment.
Regulatory authority	Provides governments the opportunity to delegate regulatory

(existence)	tasks. (Not all issues need to be dealt with in, for example, the Gas Act).
Network regulation (general access conditions)	Affects the general conditions on which third parties gain access to infrastructure capacity. In addition, it has long-term impact on investment incentives for new investment projects.
Unbundling (vertical/horizontal, type)	Affects the independence of network operators and, hence, their interest in providing equal network access conditions. Generally affects the competitiveness of the market.
Public versus private ownership	Public ownership provides a means for direct government control, but may include certain financial risks.
Public service obligations (type)	Directly affects the private goals for transmission operators.
Investment support (existent, type)	Provides (additional) incentives for the realization of new gas infrastructure projects.

Institutional arrangements' variables

The institutional arrangements consists of elements such as regulatory Codes, gas market rules, guidelines of good practice, type of contracts, integration of firms and ownership issues. The arrangements on this level can originate from a large number of gas market actors. Energy regulators design regulatory codes, network operators decide on balancing rules, financial market actors set up energy exchange platforms, gas shippers decide on industry standards, etc. Assessment of the aforementioned sources resulted in Table 2.

Table 2 Variables representing institutional arrangements

Variable	**Motivation**
Network regulation (Type regulation, tariff basis, tariff methodology, tariff system)	The type of tariff regulation codetermines the willingness of system operators to invest in the network (cost of service regulation, incentive based regulation, etc)
Public versus private ownership (Type, strategy)	Affects the ability for public actors to directly control operational and investment decision-making. Different public-private structures are possible.
Capacity allocation	Capacity allocation methods affect the degree of competition (both on capacity and wholesale markets).
Congestion management	Congestion management approaches can provide (additional) incentives for gas infrastructure expansion
Capacity rights contract (Type, clauses, products)	Structure of contracts for capacity rights can differ and offer different opportunities for the holder of such contracts.
Secondary market for capacity rights	Secondary trade of capacity rights contracts can provide

	(additional) signals on system bottlenecks, and hence, new gas infrastructure investments.
Gas exchange (Existence, type of products)	A gas exchange provides market information allows for more effective competition and arbitration, dependent on products traded.
Organization (type, form)	The organizational form of the infrastructure operator affects its risk position and investment incentives (e.g. a joint-venture ensures risk sharing).
Security of supply monitoring	Provides additional information on the need for new gas infrastructure.

Exogenous factors

Exogenous factors deemed relevant for gas infrastructure expansion are listed in Table 3, motivation included. Again, this list may not be exhaustive but is sufficient for our purposes.

Table 3 Overview of exogenous factors

Variable	**Motivation**
Physical size of the market	Due to scale effects, small wholesale markets are likely to be more concentrated.
Demand characteristics (size, consumer groups, growth)	Gas demand profile is different for various sectors: industry, power sector and households. For example: large share for demand in power sector might induce high valuation for security of supply whereas a large share of demand for industry raises more concerns on competitiveness (affordability of the gas supply system).
Endowment with natural resources (gas, coal, oil, uranium)	The presence or absence of gas has a strong impact the penetration of gas in the economy and consequently on gas demand characteristics. In addition, it has influence on the perception of security of supply.
Policy history	Due to the long life cycle of gas infrastructure assets, past decisions have a long-lasting influence.
Geographical position (coastal region (LNG), position versus gas reserves /demand)	The position of a country towards large gas deposits and (other) gas demand centres influence the need of, and willingness to invest in gas infrastructure expansion. In addition, the geographical position may limit certain types of investment (e.g. landlocked countries can’t invest in LNG infrastructure).
Diversity of gas imports	A country with a diverse portfolio of gas supply has a

(# of suppliers, diversity)	different perception of security of supply and need for additional gas infrastructure investments.
Presence of gas storage (presence, capacity, potential)	Gas storage can be regarded as substitute for gas network expansion is certain cases (when motivation for expansion is security of supply).

3 Application of the institutional framework

3.1 Introduction

In this section we apply the institutional framework - presented in the previous section – to two gas infrastructure investment projects. Both are briefly described below. After this introductory description we compare (i) formal institutions, (ii) institutional arrangements, and (iii) exogenous factors of the two investment projects. This comparison enables us to explain differences in the performance of institutional design in section 5

Investment project 1: the Milford Haven (UK) connection and upgrade

At Milford Haven (in the Southwest of Wales), two investment projects involving LNG import facilities were simultaneously initiated. The two proposed LNG terminals (the Dragon terminal and the South Hook terminal) would have a combined import capacity of about 27.5 billion m^3 per year by 2008/2009. In order to bring the gas from the terminals into the national transmission system (NTS), a new network connection was required between Milford Haven and the existing NTS, as well as an upgrade of transmission capacity further down the system. Since this investment project involves an extension and upgrade of the existing NTS owned by the transmission system operator National Grid, it is National Grid responsible for the investment project.

Investment project 2: the UK- Netherlands interconnector (BBL)

The second investment project studied is the interconnector between Balgzand in the Netherlands and Bacton in the UK, also known as the Balgzand-Bacton Line (BBL). This investment project was realized December 2006 and is operated by a private company called BBL Company. The approximated capacity of the interconnector – with a one-way flow towards the UK – is 16 billion m^3 per year. This investment project is more extensively described in De Joode (2006).

In assessing the institutional framework applicable to this investment project, we need to consider both the UK and Dutch institutions, since the project combines both markets. Stated differently, we assume the UK and the Netherlands are part of one system; the North Western European gas market.

3.2 Comparing formal institutions

Regarding the formal institutions in the two considered projects, we note that at the European level, both investment cases share the same institutions: the EU Gas Directive (2003) and Regulation 1775 (2005) in specific. The member states involved in the two investment projects, the UK, and the UK and the Netherlands respectively have fully transposed the EU legislation into national legislation. In the UK, this is the amended Gas Act of 1986 and the Utilities Act of 2000. In the Netherlands this is the Gas Act of 2000. Both countries have been early advocates of energy market liberalization. The UK was the first European country to liberalize its energy markets, the Netherlands followed in a later decade. In a European context, the UK and the Netherlands were among the first countries to fully implement EU legislation on the creation of one internal market for gas.

Table 4 shows the filled-in values for the formal institutions.

Table 4 Filling in the variables representing formal institutions for the two investment projects

	'Value' of variable in investment project	
Variable	**1. Milford Haven**	**2. BBL interconnector**
Market opening (degree)	Full market opening at time of project initiation	Partial market opening in the Netherlands but full opening in the UK, at time of project initiation
Regulatory authority (presence)	Yes	Shared responsibility for two national regulatory authorities.
Network regulation (access)	TPA, with possibility of exemption	TPA, with possibility of exemption
Unbundling	Ownership	Legal
Public versus private ownership	Both public and private allowed	Both public and private allowed
Public service obligations	Yes, regarding security of supply	No
Investment support	No	Yes, through TEN-E programme

Below we briefly go through the presented variables.

The UK had a *market opening* of 100% at the time the investment decision was made whereas the *market opening* in the Netherlands almost completed (except for the small end users). Both the UK and the Netherlands have an independent *regulatory authority* for the energy sector that is awarded the task of market monitoring the implementation of national legislation. Both countries implemented an infrastructure access regime based on TPA and allowed for exemptions from TPA requirements as specified in Article 22 of the Gas Directive (EC 2003). Concerning ***unbundling*** of gas transmission and gas trading activities, the UK had adopted full ownership unbundling at the time the investment project was considered, while the Netherlands had only implemented legal unbundling (and implemented ownership unbundling at a later point in time). Both UK and Dutch gas market legislation allow for either *public or private ownership* of gas infrastructures. A *public service obligation* with regard to security of supply is imposed on the investor of the Milford Haven connection and upgrade project. This beholds a monitoring of system reserve margins in case of peak winter demand, and the guarantee to deliver gas at all times. The investor in the BBL interconnector does not have public service obligations. *Investment support* under the TEN-E programme of the EU was given to the BBL Interconnector. This programme aims to promote the realisation of so-called priority infrastructure projects. [5] Under this header, the BBL interconnector project was financially assisted in the undertaking of technical feasibility studies and market studies. The investment project of the Milford Haven pipeline did not receive any investment support.

We observe that the variables shaping the formal institutions applicable to the two investment projects in most cases show different values. The BBL interconnector project was realised against the background of (i) a not yet fully opened gas market (in the Netherlands), (ii) an absent independent 'international regulatory authority' (two national regulatory authorities were in charge instead), (iii) only legal unbundling requirement, (iv) responsibility for public services, and (v) additional financial support in the planning phase of the project.

3.3 Comparing institutional arrangements

Here we assess the differences in institutional arrangements that were in place at the time gas infrastructure investment project realisation. Table 5 lists the variables that shape institutional arrangements provides the values of these variables for the two studied investment projects.

Table 5 Filling in the variables representing institutional arrangements for the two investment projects

	'Value' of variable in investment project	
Variable	**1. Milford Haven**	**2. BBL interconnector**
Network regulation (access)	TPA	TPA exemption for 16 years
Network regulation (tariff methodology)	Cost-based	Market-based
Network regulation (regulatory regime)	Revenue control (incentive regulation with revenue cap)	Exempted
Private versus public ownership	Fully privatized	Private, but indirect public involvement through legal subsidiary.
Capacity allocation	Auctioning	- Open season used for long-term contracts (12 – 16 yrs). - First come, first served for monthly and daily (interruptible) capacity contracts.

[5] TEN-E stands for Trans-European Networks for Energy. For more information on this programme we refer to its web site: http://ec.europa.eu/ten/energy/index_en.htm.

Congestion management	Auctioning	First come-first served
Capacity right contract (product type)	Products: quarterly, monthly, daily, daily interruptible	Products: Majority of capacity contracted for app. 16 years, remainder sold monthly (minimal 1 month/maximal 9 months) or daily (interruptible) basis.
Capacity right contract (capacity period)	Capacity period: - 3 – 17 years ahead (for quarterly capacity) - 1 or 2 year ahead, or month ahead (for monthly capacity) - Day ahead and on the day (for daily (interruptible) capacity)	Capacity period: - 1 – 9 months ahead (monthly capacity) - Day ahead and on the day (for daily (interruptible) capacity)
Secondary market for capacity rights	Capacity rights transferable. Use it or lose it (UIOLI) principle applicable: used for offering of daily interruptible capacity.	Capacity rights are transferable. Bulletin board set up by BBL operator. Use it or lose it (UIOLI) principle applied to monthly capacity rights, according to 4 conditions. UIOLI not applicable to holders of the multi-annual contracts signed in open season procedure.
Gas exchange	Yes, both spot and forward contracts traded.	Yes, both spot and forward contracts traded.
Organisation	Integrated with UK electricity transmission. In addition, network assets in the US are acquired.	Joint-venture of subsidiaries of three large Western European transmission system operators.
Security of supply monitoring	Annual consultation process with involvement of National Grid, Ofgem, Department of Trade and Industry (DTI), and other stakeholders.	Not applicable.

Below we briefly discuss the value of these variables for both investment projects in consecutive order.

Network regulation

Both UK and Dutch legislation requires operators of gas infrastructure to provide access to third parties. However, exemptions are granted under specific conditions. The additional capacity in the investment project of the upgrade of the Milford Haven connection by National Grid is subjected to TPA, but the BBL interconnector has been granted an exemption with duration of 16 years for full capacity.

This implies that tariffs charged for capacity rights are differently designed as well. Whereas National Grid is subjected to revenue cap regulation that is based on cost reflective charging, the BBL interconnector is allowed to charge market-based charges in the next 16 years.

Public versus private ownership

The company undertaking the Milford Haven connection and upgrade project, National Grid, is fully privatised, and is even listed on the London Stock Exchange (LSE). The company that undertook the BBL interconnector project, BBL Company is also privately operated, but has indirect public shareholders. The three owners of BBL Company are Gasunie BBL BV, Fluxys BBL BV and Ruhrgas BBL BV. Gasunie BBL BV is a legal subsidiary of Gasunie NV, a company fully owned by the Dutch government. Another business division of Gasunie NV is Gas Transport Services: the Dutch transmission system operator.

Capacity allocation and congestion management

In the case of *the BBL*, capacity rights were allocated in an open season procedure. This indicates a certain time period in which the initial investor allows third market parties to express their interest in transmission capacity and project participation. After this period, and after negotiation between interested parties, long-term capacity rights are awarded to the interested market parties. In the case of the BBL this indicates a non-availability of short-term capacity rights for the duration of the long-term contracts (which is about 12 to 16 years). The BBL operator offers the (little) remaining capacity - after obligations towards long-term contract holders have been taken into account – on a first come first served basis.

The allocation of capacity rights for the Milford Haven entry point is based on periodic *auctions* as presented in Table 5. UK network regulation provides the opportunity to auction future capacity expansions for new entry points. In the case of the Milford Haven project, indeed, National Grid sold significant entry capacity for the 2007/2008 period in the long-term system entry capacity auctions in 2004. In other words, before actual realisation of capacity expansion, majority of capacity has already been contracted.

Table 6 Overview of UK transmission capacity auctions

Auction type	**Product type**	**Capacity period**	**Auction timing**
Long-term system entry capacity auction	Quarterly	Y+2 to Y+16	Annually (September)
Monthly system entry capacity auction	Monthly	Y+1 & Y+2	Annually (February)
Rolling monthly system entry capacity auction	Monthly	Next calendar month	1 – 5 last business days preceding next month

Daily system entry capacity auction	Daily	Day ahead	7 days before to 02.00 on the day
	Daily	On the day	After 06.00 on the day
Daily interruptible system entry capacity auction	Daily interruptible	Day ahead	7 days before up to 13.00 on the preceding day

Primary and secondary market for capacity rights

The primary market for capacity rights can be characterised by the number of market participants and the 'deepness' of the market in the sense of type of products. The fact that a large share of BBL interconnector capacity is reserved for the long-term contract holders, the products offered by the BBL operator are limited. Offered products are monthly (with maximum of 9 months), daily and daily interruptible contracts. Capacity right contracts for entry capacity at Milford Haven however show a much larger variety (see Table 5).

In case the primary market for infrastructure capacity rights is not successful in efficient allocation of existing capacity rights, the secondary market may offer opportunities to come to an efficient capacity right allocation. In both investment projects, secondary trade in capacity contracts is facilitated with a bulletin board. Here, expressions of interest in capacity contracts and offers for reselling capacity contracts are posted.

Gas exchange

Both investment projects are undertaken in the presence of an active and liquid gas exchange. The NBP in the UK is the most liquid gas hub in Europe, while the Dutch TTF/APX gas shows reasonable levels of liquidity as well. In addition, both regions contain an active market for future commodity contracts; the IPE in the UK and Endex in the Netherlands.

Organisation

The organisational form of the companies behind the investment projects, National Grid and BBL Company, differs largely. Earlier on we saw that a both companies are in principle private, but that BBL is indirectly publicly owned through legal unbundling.

In addition, National Grid has integrated operations on gas transmission with electricity transmission, and hence, is the appointed TSO for both the UK gas and electricity system. Moreover, National Grid operates network business in the United States as well. This horizontal integration can be an indication of potential economies of scope between the different businesses. Moreover, it might positively impact the risk position and creditworthiness of the company as a whole.

BBL Company on the other hand was founded with the purpose of investment in and operation of the BBL interconnector. The fact that the company is a joint-venture of neighbouring TSOs can be an indication of the high level of risk attached to this project since a joint venture is an effective risk-sharing method.

Security of supply monitoring

The need for investment in new LNG terminals (such as in Milford Haven) and consecutive investment requirements in the national transmission network have been signalled and anticipated on in a series of monitoring reports on the level of security of supply in the UK. In an annual consultation process called Transporting Britain's Energy (TBE), all legislative and regulatory authorities and stakeholders are involved. For example, the operator of the national gas network publishes a Ten Year Statement every year on future infrastructure needs and developments. In addition, National Grid publishes a Winter Outlook every year. The Department of Trade and Industry through its working group on energy supply security (JESS) monitors the adequacy of UK gas supply in the upcoming years.

None of the above applies to the BBL interconnector, presumably since it isn't an extension of a national network but rather a connection between two independent networks. However, on an EU level, the need for an interconnection between the UK and the Netherlands (a second UK – Continental Europe connection) has been acknowledged in various documents, fore mostly in TEN-E programme. Therein, the BBL Interconnector was identified as a priority project.

3.4 Role of exogenous factors

The exogenous factors affecting the studied investment projects show more similarities than differences.

Both investment projects are undertaken in a region where *gas demand* is high, where gas penetration in electricity generation is considerable, and where growth in demand is expected to be comparable (about 2% per year). In addition, the *gas balance* of the regions involved in the two investment projects is comparable: both have started from self-sufficiency and are now entering a period in which gas import dependency is about to rise. Finally, both have relatively little *gas storage capacity* in comparison with other EU member states, but both have considerable potential for gas storage in the future, notably in depleted gas fields. Also comparable is the *diversity of gas suppliers*, although diversity of UK gas supply is relatively higher due to the development of a large number of LNG import facilities.

The differential exogenous factors are policy history, industry structure, and 'transit country position'. An important exogenous factor that might explain any differences in institutional design and market outcomes is the *policy history*, and in particular the history on gas market liberalisation. The UK has a much larger experience with gas market liberalisation than the Netherlands: the UK has been fully liberalised in 1986, the Netherlands only in 2004. This implies that the UK gas market has had the chance to evolve its gas market institutions over a longer period of time, presumably resulting in 'higher quality market design'. Another relevant differential exogenous factor is *industry structure*, especially with regard to concentration in the gas sector. On the production side, concentration in the Netherlands is much higher than compared to the UK. Measured according to the Herfindahl-Hirschmann Index (HHI)[6], the Dutch gas market has a concentration of 5500 (DTe 2005), while the UK has a score of about 700 (ADL 2004).

Another difference between the two projects is the contribution to the transit of gas within NW Europe (e.g. geographical position). While the BBL interconnector is an exponent of the natural transit position of the Netherlands in NW Europe (transporting gas from East to west, and North to South), the Milford Haven connection predominantly serves the UK gas market

In the next section we analyse the performance of the two investment projects with respect to its contribution to the policy goals of a competitive internal gas market and a secure supply of gas. Our research question is answered by linking performance with differences in institutional design on the one hand, and the role of exogenous factors on the other.

4 Performance analysis

4.1 Introduction

Both gas infrastructure investment projects contribute to the goal of a competitive internal gas market and secure supply of gas. As mentioned earlier, the goal of a competitive internal gas market can also be described as striving for increasing market efficiency. The contribution of the investment projects to market efficiency is potentially realised in two markets: the market for the commodity (the gas wholesale market), and the market for capacity (gas network). The contribution of the investment projects to security of supply only concerns the capacity market. Below we consecutively discuss the performance of the projects on (1) market efficiency on the wholesale market, (2) market efficiency on the capacity market, and (3) security of supply. Thereafter we assess the linkage between the project's performance and its institutional design.

4.2 Efficiency performance on wholesale market

The impact of the investment project on market efficiency can be assessed by different indicators or 'proxies'. Examples of such are: (i) the impact on the number of (new) suppliers, (ii) the impact on market shares or market concentration, and (iv) the impact on gas market liquidity. The difficulty in exactly quantifying these indicators is, on the one hand the availability of data, and on the other hand the isolation of the project impact from other possible factors and developments.

Milford Haven connection and upgrade project

The new pipeline from Milford Haven to the existing UK gas transmission network delivers gas from four different gas suppliers; BG Group and Petronas through the Dragon LNG terminal, and ExxonMobil and Qatargas through the South Hook LNG terminal. BG and Petronas have acquired capacity rights for the

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[6] The HHI can be calculated by summing the squared market shares of all market participants. A monopoly results in a HHI of 10000, whereas a market of five players of a 20% market share each results in a HHI of 2000. The Dutch regulator DTe takes a value of 1800 as a limit for high concentration.

delivery of 3 billion m^3 per year each, while ExxonMobil and Qatargas seem to have acquired about 7 and 3 billion m^3 per year of initial total capacity of 10.5 billion m^3.

The impact of the project on market efficiency based on the number of gas suppliers seems to be positive, since two new entrants enter the market. Although BG Group and ExxonMobil have a respective market share of 6.3% and 13.2% (ADL 2004), a lack of data prevents us to say something on the market share situation after project realisation. The same goes for overall market concentration. The impact on market liquidity is ambiguous. Whether the gas delivered by BG Group and ExxonMobil at Milford Haven will be (partly) offered at the UK gas exchange is not known: chances are that the gas is (internally) sold to vertically integrated partners downstream and does not enhance gas exchange liquidity at all.

Favourable for wholesale market functioning is the fact that not all entry capacity can be sold by National Grid on a long-term basis. This theoretically creates opportunities for new market entrants to enter the market.

BBL interconnector project

The three shippers that have acquired long-term capacity rights for the BBL interconnector are GasTerra (NL), E.On Ruhrgas (GE), and Wingas (GE). Of these three, GasTerra and E.On Ruhrgas are new gas suppliers to the UK market, while Wingas already owns gas production assets. GasTerra will largely use the long-term capacity rights in the BBL to deliver its long-term supply obligations to Centrica (De Joode 2006). E.On Ruhrgas is already a large player in the gas retail market and in the electricity market.

At first sight, the level of competition on the UK wholesale market would seem to be positively affected, with the arrival of two new gas suppliers. Indeed, the level of market concentration is projected to be lower in the presence of the BBL interconnector. ADL (2004) quantified the level of market concentration as measured with the HHI in a situation with and without the BBL interconnector realised. Within the studied period of 2004 until 2010, they find that concentration levels remain unchanged in the first half of the period, but lower towards the end of the period (2010). For the year 2010, the index decreases from 666 to 626. This indicates a positive impact of the project on market competition, albeit only in the longer-run. However, as was just illustrated two out of the three BBL shippers are expected to use their long-term capacity rights to deliver gas to either their electricity businesses (E.On Ruhrgas) or to counterparts in long-term gas supply contracts (GasTerra to Centrica). The share of ‘BBL gas’ offered freely on the gas exchange can therefore assumed to be substantially smaller than total BBL delivery capacity. Still, in the long-run (>15 years), realisation of the BBL interconnector affects wholesale market efficiency through it role in the competition for new gas delivery contracts.

The impact of the BBL interconnector on wholesale market efficiency in the Netherlands is more difficult to asses. Although the interconnector only has a forward flow towards the UK, contractual counter flows or swaps (for example with Norwegian gas deliveries to the UK) could result in gas deliveries to the Dutch market.

For the NW European gas market as a whole, any remaining BBL interconnector capacity besides the one contracted out long-term – now matter how small, and mostly interruptible capacity flow – will contribute to overall arbitraging possibilities and further market integration.

4.3 Efficiency performance on capacity market

In assessing the contribution of both investment projects to efficiency on the capacity market we distinguish between static efficiency and dynamic efficiency. Static efficiency refers to efficient usage of existing capacity whereas dynamic efficiency refers to the provision of efficient signals for further capacity expansion. Static efficiency can be stimulated through incentive based network regulation and the existence of anti-hoarding rules. The degree of dynamic efficiency depends on the information signals provided by the system.

Milford Haven connection and upgrade project

National Grid, the operator of the Milford Haven pipeline is explicitly incentivised to improve operational efficiency through regulatory price control. In the recent price control period 2002-2007 for example, National Grid was required to improve overall efficiency in network operations by an annual 2%. This implies a direct benefit for all network users and end-consumers. In order to ensure efficient network usage, the UK regulatory authority has imposed rules on capacity hoarding. The effectiveness of these rules however remains unclear. In general it is acknowledged that it is difficult to for the network operator to prove hoarding of capacity rights. In response, the network operator has been offering more network capacity to the market on an interruptible basis, based on historic usage ratios of longer term capacity rights holders.[7]

With regard to information signals for further capacity expansion, the same arrangements for entry capacity auctions will apply as for other network entry points: shippers can express their interest in more capacity through long and medium term auctions. Since the value placed on additional capacity can directly be confronted with the costs of expansion for the network operator, the system seems to achieve high degree of dynamic efficiency.

BBL interconnector project

The BBL interconnector is exempted from default regulatory arrangements on TPA and tariff regulation, which implies that during the exemption period all efficiency savings are for the network operator. Incentive based regulation will be applied after the exemption period. Anti-hoarding rules have been included in the long-term capacity contracts between BBL Company and the tree shippers but remain undisclosed. According to the Dutch regulator the rules on use it or lose it and the tradability of capacity

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[7] More in general, the effectiveness of use it or lose it regulation remains an issue in all EU member states. The EC is currently researching alternative regulation, for example based on the 'rucksack' principle where network capacity goes with the customer.

rights were sufficient for now but it was agreed that both the UK and Dutch regulatory authority would periodically evaluate the effectiveness of these rules and could enforce improvement of these rules (DTe 2005).

The performance of the BBL interconnector on dynamic efficiency is considerably lower than for the Milford Haven pipeline primarily since there is no market-based capacity allocation scheme installed. Whereas the UK investment project applies the market-based allocation method of auctioning, the BBL interconnector applies a first come first served approach.

4.4 Security of supply performance

The contribution of both studies investment projects to security of supply can be measured by the impact on total import capacity, the impact on total system peak delivery or the degree of interconnection within the region.

Milford Haven connection and upgrade project

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 billion m^3 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%.[8] Total deliverability of the combined LNG terminals would contribute to about 19% of peak demand. A more precise impact on security of supply could be produced by analysing peak delivery from all UK gas production, gas storage and gas import facilities.[9]

BBL interconnector project

Since formerly, no connection between the UK and the Netherlands existed; the existence of a new supply route itself increases the security of supply position of the UK. The interconnector increases current total UK import capacity with 21% and can deliver about 16% of current total gas demand. The contribution of the BBL interconnector to UK daily peak demand is estimated at 10%.

For the Netherlands, the impact of the project on security of supply is ambiguous. On the one hand, it might see an increase in security of supply through indirect access to gas supplies from the UK continental shelf and Norway trough swaps. The potential and significance of such happening is difficult to estimate though. On the other hand, the emergence of a new gas export route could decrease Dutch security of supply; there is an increasing demand for Dutch gas. Another line of reasoning is that the realisation of the BBL interconnector is beneficial for Dutch security of supply since it might trigger new investments towards the Netherlands (and for example speed up the Northern Europe Gas Pipeline (NEGP) planned by Gazprom).

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[8] Other planned import projects not accounted for.

[9] We refrain from this type of analysis in this paper, but will include in later drafts of this paper.

The impact on the level of security of supply in the region of NW Europe is considered to be positive, since internal interconnections increase. In times of supply disruptions or demand peaks this increasing interconnection results in lower price volatility.

4.5 Linking performance with institutional design

Having compared the institutional design behind the two projects and having assessed the performance of both projects with respect to their contribution to the public goals of an the effective working of the internal gas market and secure supply of gas, we are now able to answer our research question: *How do differences in institutional design affect the performance of gas infrastructure expansion projects with respect to the public goals of (1) a competitive gas market, and (2) a secure supply of gas?*

Efficiency performance on wholesale market

The impact of both infrastructure expansion projects on the effective working of the internal gas market (wholesale market efficiency) seems to be low in the very short term due to vertical foreclosure: only a limited amount of new gas deliveries enabled by the infrastructure projects has large potential of being available for short-term trading on the gas exchange. In addition, in the case of the BBL interconnector, efficiency benefits seem to be allocated asymmetrically between the UK and Dutch gas market, favouring the former market. On the whole, the Milford Haven project seems to contribute more to UK gas market competition than the BBL interconnector.

This observation can largely be explained by the differences in institutional arrangements and more in particular by arrangements with respect to network access regulation and capacity allocation. For example, whereas the operator of the Milford Haven pipeline connection is required to offer some capacity short-term, the BBL operator was rewarded an exemption, thereby enabling 100% long-term contracting of BBL capacity. To some degree, this difference follows from the formal institutions with regard to regulatory authorities. The BBL interconnector was developed under the regulatory supervision of both the UK and Dutch regulatory authority, with each of these authorities being responsible for the monitoring of compliance with legislation representing national interests. The absence of a European regulator responsible for the European interest of the project might explain the difference in performance with respect to wholesale market efficiency.

Another explanation for the difference in performance is the influence of other public goals on institutional design than the researched goals of a competitive gas market and a secure supply of gas. In the BBL interconnector project, the goal of Dutch government and gas industry sector to let the Netherlands emerge as *the* gas hub for North Western Europe might have influenced institutional arrangements (Energieraad 2005). Being the gas hub for North Western Europe could bring a certain number of advantages through for example large market for flexibility services (gas storage), a boost for gas trade, higher gas sector employment, and prestige. The Dutch regulator noted in its decision document on final exemption to the BBL interconnector that realisation of the project might speed up investments in other gas infrastructure linkages towards the Netherlands (of which the Northern European Gas Pipeline (NEGP) planned by Gazprom and partners is one example).

Efficiency performance on capacity market

The Milford Haven connection project scored better than the BBL interconnector on capacity market efficiency, both on static and dynamic efficiency. Although both projects show that the institutional design was successful in providing sufficient incentives for the network operators to realise the project, the Milford Haven project more effectively combined long-term certainty for the investor, with short term impact on market competitiveness. This is represented by capacity allocation methods applied in the considered projects. In addition, current regulatory arrangements for the Milford Haven connection include an explicit market-based mechanism for further expansion of the project (auctioning of additional capacity). This type of arrangement is clearly lacking in regulatory arrangements for the BBL.

However, this large difference in institutional arrangements, and thus in efficiency performance, could be explained by on of the identified exogenous factors: the concentration of the gas market. Market concentration is much higher in the Netherlands than the UK. This implies that certain market-based arrangements, such as capacity auctions, might lead to inefficient market outcomes. This, however, needs to be researched more carefully.

Security of supply performance

The projects' contribution to security of supply for the UK, the Netherlands, and NW Europe are large and positive since both enable new gas supply deliveries and increase the level of interconnection in the whole region. However, the performance of the BBL interconnector with respect to security of supply seems larger for the UK than the Netherlands, mainly due to the one-way physical flow of the pipeline. Acceptance of this particular feature by the Dutch regulatory authority might be influenced by the earlier mentioned influence of the goal of making the Dutch market the gas hub for NW-Europe.

5 Conclusions

In this paper we focussed on the safeguarding of public values in gas infrastructure expansion. As a starting point we took the European Commission's public goals of a competitive internal gas market, and secure supply of gas. The question that interested us was how differences in institutional design affect the performance of gas infrastructure expansion projects with respect to these public goals.

First we developed an institutional framework (based on New Institutional Economics) that identified different institutional variables on two different institutional levels: the formal institutions and the institutional arrangements. An important additional element in this framework is the exogenous factors that influence the overall institutional design.

Second, we analysed two gas infrastructure expansion projects, (1) the Milford Haven pipeline between the planned LNG terminals and the existing network, and (2) the BBL interconnector between the UK and the Netherlands, using the developed institutional framework. We observed that in particular the institutional arrangements related to the two investment projects were quite different.

Third, we assessed the performance of the two projects with respect to the public goals of a competitive internal gas market and a secure supply of gas. We found that the Milford Haven project scored better with respect to the first goal, but that both projects scored comparable with respect to the second goal.

Fourth, we tried to explain differences in performance by referring to differences in institutional design and exogenous factors. We argue that particularly the different network regulation conditions (on the institutional arrangements level) have caused this difference. In turn, these differences are caused by exogenous factors such as market concentration (industry structure), and policy history. In addition, the influence of another public goal (developing a national gas hub) in the case of the BBL interconnector partly explains the observed differences.

The analysis in this paper implies that path dependencies play a large role in the development of the internal EU gas market, since implementation of single EU legislation does not prevent differences in institutions on a lower level. To more effectively integrate European gas markets, EU legislation should more explicitly deal with member state specific public values and exogenous factors.

Although we acknowledge that the applied institutional framework needs further refinement, we conclude that it is fruitful in providing explanations for differences in the safeguarding of public values on an independent project basis. We aim to further develop this framework in the future. In addition, we need to further improve the performance indicators used in analysing the contribution of a gas infrastructure expansion project with respect to the achievement of public goals. An interesting issue in this respect is how to deal with the valuation of performance on public goals when the goals are conflicting.

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