OPTIMAL GAS GORRIDORS AND INFRASTRUCTURE BETWEEN EU AND ITS NEIGHBOURING COUNTRIES TO SECURE SUPPLY IN EUROPE

-ANALYSIS OF NEEDS AND IMPLEMENTATION-

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Abstract

In this paper we assess the gas infrastructure needs of the EU up till 2030 (i.e. the gas infrastructure investment requirements) and discuss economic and regulatory conditions that hamper the implementation of these optimal gas infrastructure investments, referred to as gas corridors between EU gas markets and neighbouring supplying countries. In addition, we propose some measures for the improvement of current EU policy and regulation and thereby the conditions for gas corridor implementation. We find that there is great need for further expanding the connections, pipeline, LNG, including storage facilities in terms of capacity and diversity of routing and for improvement of regulation in facilitating investments. Especially, we suggest policy and regulatory improvements regarding regulatory uncertainty, a.o. due to differences in regulatory frameworks, and lack of coordination in cross-border projects. Therefore a larger role for EU coordination and regulation on a pan-European level is suggested.

1 Background

The European Commission (EC) has acknowledged the importance of securing in the long run its increasing gas demand from supplies from a limited number of neighboring countries and regions for quite some time. Particularly for that purpose it issued for example a Green paper in 2000, Towards a European strategy for security of Energy supply and in 2006 a new Green Paper entitled "European Strategy for a Sustainable Europe". From these and other recently published Communications (see e.g. "Priority interconnection Plan", end 2006) it becomes very clear that for realizing sufficient levels of supply security the infrastructure connecting gas and electricity markets. Consequently the Commission identified a number of so-called priority gas infrastructure projects in the TEN-E program.[2]

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[2] For more info on this program we refer to the DG-TREN website (http://ec.europa.eu/ten/energy/documentation/index_en.htm).

Recently an EU funded large research project ENCOURAGED[3], for identifying and assessing the economically optimal energy corridors by building new and expanding existing one's, for electricity, natural gas and hydrogen supply between EU and neighbouring countries as well as identifying the barriers and benefits of connecting the different European energy systems, was finished. However in this paper we will focus on the assessment of the in the future required gas supply infrastructure for connecting the EU markets with its key gas suppliers in Russia, South East Europe, Middle East and North Africa as well as with other LNG sources in the next decade. And an important final question we address is whether actors in the gas market will sufficiently and timely invest in these needed corridors.

This paper proceeds as follows. First we present our methodology in Section 2. In Section 3 we present our findings regarding the optimal configuration of EU gas infrastructure, i.e. gas corridors. In Section 4 we deal with the economic and regulatory issues that have to be dealt with in order to be realized. Section 5 presents some conclusions and recommendations.

2 Methodology

2.1 General

In the paper we present the main findings of the ENCOURAGED project part on "Assessment of gas supply infrastructure in the long term in Europe", thereby adopting the following approach:

- Fist step using the results of our model-based analysis for the assessment of economic optimal gas corridors and related infrastructure for connecting the EU with its neighboring gas supply countries and regions. This analysis was based on gas demand, supply and resources analysis in project conducted by OME et al[4] .
- Second step is an evaluation of the technical, economic and regulatory barriers for investing and an assessment of the necessary policy and regulatory improvements to implement the gas corridor investment projects.

In the framework of the first step in the study we identify and evaluated the several so called "Economic optimal gas corridors between the EU and its neighboring key suppliers", which are needed to be developed in the future. The used model GASTALE was specified with a number of projections and assumptions on different gas market developments (supplies/demands per country/region) and their key characteristics and

[3] ENCOURAGED is an acronym for the two year RTD project recently finished and entitled 'Energy Corridor Optimization for the European Markets of Gas, Electricity and Hydrogen. For more info on this project and the final reports consult the website www.encouraged.info.

[4] Note that we used the official EU energy scenarios published by DGTREN for projecting the gas demand and supply in the long term in Europe. Some recommended international EU actions are based on an ENCOURAGED report drafted by G Luciani. Furthermore model analysis and specification was for large part based on ENCOURAGED work by OME, Manfred Hafner, regarding gas supply costs, production and analysis of specific gas routes. See for different contributions also our website www.encouraged.info.

drivers. To address the uncertainty in long term gas market developments and their consequences for an optimal gas infrastructure for connecting and balancing of supply and demand in the long run up to 2030 we developed a number of relevant scenarios for gas markets in Europe. Firstly a so-called Business-as-Usual (BAU) scenario, and further a high and low gas demand scenario and a "deferral of investments" scenario. This last scenario reflects the current postponement of key gas infrastructure projects today, that might continue in the next ten years and would influence gas demand, supply and prices in Europe substantially.

Next on the basis of the Business-as-Usual (BAU) scenario, we assess the required new gas infrastructure (pipeline connections, storage capacity and LNG facility) for the next decades. Capacities were assessed and optimal supply routes/corridors identified. Furthermore the investments in and the investment-costs of building all those gas infrastructure facilities (e.g. pipelines, storage and LNG), over the period 2005-2030 in Europe were calculated.

Finally we analyzed the impacts of short term interruptions in gas supply from the different key suppliers for the year 2010 and 2020 using the BAU scenario. These shows how vulnerable the EU will become for gas supply interruptions and what type of investments could enhance the supply flexibility and thus improving the supply security.

2.2 Model GASTALE

The model GASTALE uses a computational game theoretic model with recursive dynamics to represent investment by transmission and storage system operators. The model solves for a short-run equilibrium in each five-year period, and makes investments at the beginning of each period based on anticipated market situation including congestion costs at the end of each period.

The assumed market structure in the model is as follows. Market participants include producers, consumers, transmission and storage system operators. Producers contract with pipelines and LNG shippers to transport gas to customers in consuming countries. Producers can exercise market power, playing a Cournot game subject to some forward contracting against other producers as well as arbitragers and storage, and anticipate how quantity demanded depends on price. However, owners of transmission and storage are assumed to be regulated or otherwise operated in such a way that transmission is priced efficiently. That is, the price of transmission (or storage) equals long-run marginal cost, unless transmission (storage) capacity constraints are binding, in which case the price of transmission (storage) reflects a congestion premium in order to clear the market for transmission (storage) capacity. Because of this assumption, transmission (storage) can be equivalently modeled as being owned by a single transmission (storage) system operator TSO (SSO) who is price-taking. Although producers anticipate demand changes in response to price, they do not exercise market power with respect to transmission, that is, they are price taking with respect to the cost of pipeline and LNG shipping.

GASTALE model is mainly used to study the required gas supply infrastructure necessary to meet the projected gas demand with available gas supply from the key suppliers (countries) surrounding the EU in

the period 2005–2030. Today (2005) a substantial part of production of natural gas takes place in the EU, which is sufficient to meet about 60% of the demand and the remaining 40% of demand is met by production outside the EU. However this EU production will decline in the next years and decades very fast. The model distinguishes among consumers in ten European regions. Figure 1 illustrates the geographical coverage of GASTALE. For the analysis and identification of optimal gas supply routes all relevant options, including estimated costs of new investments to build capacity are specified in the model, e.g. gas transport from Russia can be transited via Central Europe into Germany. Other corridors are between Norway and the UK, three South-North corridors, namely the corridors between Algeria and Spain, Algeria and Italy, Libya and Italy and the two corridors between Turkey and the Balkan, one extending to Italy. As shown in Figure 1, various LNG supply options to Europe are specified in the model. Finally it is assumed that there is a trend towards a further liberalized market with a few key players (suppliers) in the long run. Gas prices are established via demand/supply equilibrium; there is seasonal flexibility in demand and the finally producer export capacity to the EU is exogenous in the model and investments in transport corridors (pipelines, LNG, storage) are endogenous variables.

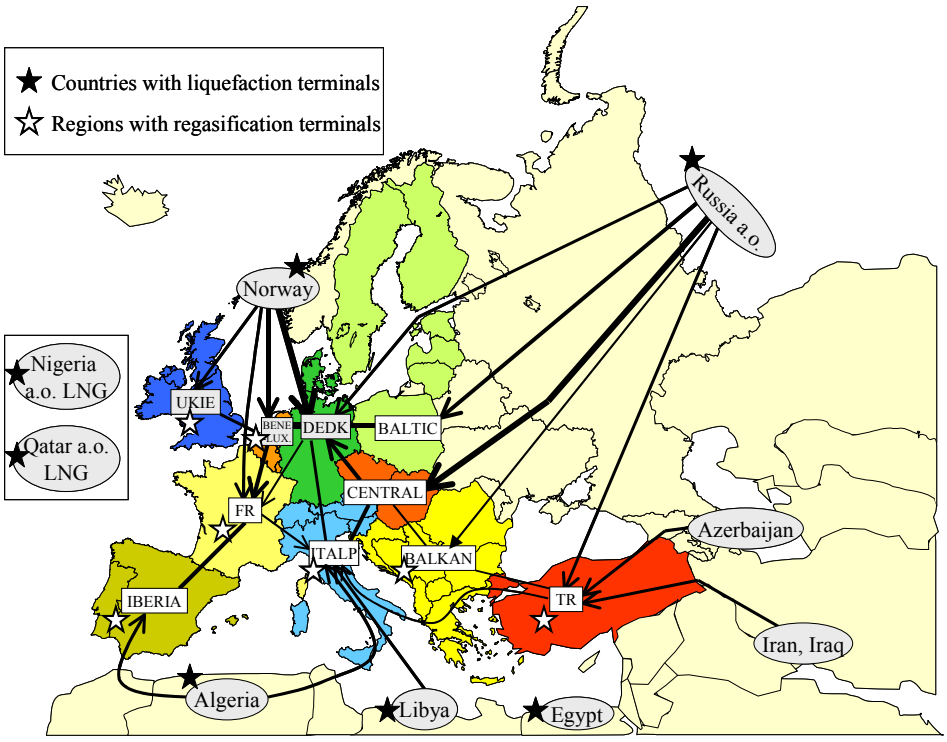

Figure 1: ***Overview of options for connected consumers and producers in GASTALE for 2005-2030.***

3 Analysis of Gas infrastructure needs in the long term

3.1 Capacity of EU gas supply infrastructure

The identification of required extension of existing infrastructure capacity and development of new routes is based on model analysis using different gas scenarios for representing uncertainty of the long

term. On the one hand by scenario implications themselves and on the other hand by comparing the BAU results with the results of the other alternative scenarios (variants related to the key drivers for further development of infrastructure investments). So with comparing BAU and other scenario results we deal with uncertainties in some key gas market assumptions and assess the robustness of our findings in the BAU scenario and also learn where sensitive decisions are located. The main underlying drivers (model assumptions) we analyze are the changes in gas demand (lower/higher) and delays in investment in gas transport infrastructure (pipeline transport, LNG facilities and storage capacity). Note that these different assumptions (scenarios) also have a direct and different bearing on gas prices (congestion) and flexibility and thus supply security in Europe.

The **BAU scenario** and the analysis of its gas market impacts lead to the following observations and findings. According to the model-based analysis and with hindsight several existing **pipelines** to connect the EU are not fully based on economic considerations, e.g. the Baltic line between Russia and Germany and the Blue Stream pipeline between Russia and Turkey. Furthermore, the cheapest way of supplying Norwegian gas to the European market is to "land" all gas in the UK and from there on transport it further to mainland Europe. The expansion of existing pipelines of Norway to Belgium, Germany and France are economically less attractive than this route. Furthermore, the North-African connection into Europe is used at its maximum capacity, which results in additional investments in production of North-Africa for extra supplies of **LNG** to Europe as a second best option for transporting gas into Europe. Also the Russian option to export LNG to Europe seems to be an attractive option, as this could lead to extra export outlets or substitution of expansion in pipeline exports. But such an evolution is, however, unlikely to be of importance in the next decade according to experts. In addition, investments in expansion of pipeline connections of Norway to the UK and of Northern Africa to Spain and Italy are economically attractive. Furthermore LNG proves to be an attractive option from a purely economic point of view and could on economic grounds substitute an increasing part of the newly planned pipeline network in next decades. The pipeline connection between Egypt and Turkey is also an economic attractive project; however it is very uncertain when precisely this connection will be realized. This leads to LNG as the second best economic viable option for supplying gas to the EU from Egypt.

3.2 Long term gas prices and the impact of supply interruptions

Regarding the foreseen impacts on upstream **gas supply prices**, the conclusions on the basis of the BAU scenario are that price differences among countries depend on two major factors, namely 1) the distance from the main producer and 2) the impact of strategic market behavior and in particular that of Russia the largest producer. For instance, prices in France are high due to factor 1), while prices in the Baltic countries are high due to factor 2) from 2015 onwards. Prices are the lowest in Turkey, due to potentially good access to relatively less expensive supplies from nearby producers, namely Russia, Azerbaijan and Iran, making Turkey altogether an important transit hub to the EU. For this reason gas

flows from the EU towards Turkey are not attractive in the model analysis and so probably will never occur in the future. Prices in the low demand scenario are lower than the BAU prices, while prices in the high demand and deferral scenario are higher than the BAU prices. Investments are either lower or taking place later in time in the deferral scenario as compared to the BAU scenario. This happens for all type of infra investments (pipeline transport, LNG facilities and storage capacity).

Simulation of the **short-term supply security** concerns by analysing the impacts of possible interruption of gas supplies from the several key suppliers to EU in 2010 and 2020 shows that this will lead to substantial (20-100%) gas prices increases in EU countries (highest in those closely located to interrupted gas supply route and lower in better connected countries "inside the EU"). Also the changed impacts over time were tested. The price impact is higher for a disruption of imports from Algeria and Azerbaijan/Iran in 2020 than 2010 due to assumed higher gas flows from those countries in that year, while the price effect is lower for Central Europe (New MS) in 2020 than in 2010, due to the than increased availability of alternative gas supplies in that year. Disrupted supplies are mainly made up by Russia exports in the Algerian and Caspian interruption case, while long distance LNG supplies mainly provide the extra production to Western Europe in case of the Russian supply interruption. Given the than more Russian transit of gas through Turkey, supplies from Central Asia are reduced as well. The urgency for more investments in intra-EU connections to facilitate easier reallocation of gas suppliers within the EU to meet interruptions at EU-borders in the short term is again illustrated by the model analysis very clearly.

Storage is an important instrument for managing swing production and for arbitrage between low summer demand and high winter demand. But also for meeting small supply disruptions gas storage can play an important strategic role in reducing too extreme price rises. Alternatively, excess transport capacity can be constructed which is only used for transport during medium and high demand. However, the latter option would be rarely used in the economic analyses, indicating that storage is more an economic option to deal in the long-term with "swing production/supply".

3.3 Conclusions and findings of model analysis

The analyses in this report indicate that substantial **investments** in gas transport corridors are needed to match the rising demand as projected officially in EU scenarios. Especially the pipeline connections running from East to West need to be prioritized in the coming years and decade. Future gas price developments will largely depend upon the sufficient availability of gas from key resource owners such as Russia, Iran, and several Central Asian countries. Further a number of conclusions can be formulated:

- Already in the short term considerable **investments are needed by 2010**, mainly for intra-EU connections. In the medium and longer term substantial investments are needed to build sufficient gas transport infrastructure capacity in Europe to connect the EU with its key suppliers. The total need amounts to about 20 billion € of yearly investments, out of which about 50% are needed for pipelines, 40% for the LNG train, and 10% for storage facilities. Particularly congestion in the East–West route

should be avoided because it could drive up gas price in countries in the EU closest to connections with the main suppliers.

- In the very short run through realizing a number of what we call **"smart" investments** (partly already identified in the TEN Priority interconnection Plan of DGTREN) in **EU intra-pipeline connections** between the different EU countries, the market access and competition in EU country markets will increase substantially. This would also bring down the ability of key suppliers/producers to exercise market power at the European gas hubs and would lower gas prices in EU member states by about 14% on average.
- Iran and Russia are always (2005–2030) marginal (**price setting**) gas suppliers; Nigeria, Qatar, Egypt and Azerbaijan are sometimes marginal suppliers (2005, 2010) and sometimes reap rents (from 2015 onwards), while other suppliers mainly reap rents (produce at full export capacity to EU).
- **LNG capacity** is forecasted to develop fast. In 2030 about 20% of total supplies to the EU should be transported in the form of LNG, and 80% via pipelines. LNG comes from Qatar (33%), Nigeria (25%), Algeria (17%), and Egypt (15%), others (10%) using aggregate figures for the period 2005–2030. LNG goes to UK and Ireland (28%), Iberian peninsula (19%), Italy (18%), France (15%), BENELUX (13%), others (7%).
- **Alternative gas demand** scenarios (lower and higher demand ±20%), lead to lower and higher investments (±30%) and lower and higher EU-border supply prices (±10%).
- Impacts of **"deferral of investments"** in gas infrastructure drives up gas prices (+25%), in the next decade and moreover leads to a "lower resilience" to interruptions in gas supply and less security of supply for consumer countries. Consequently the continuation of the past and currently observed postponement of investments in Europe (intra EU gas connections and connections between EU and its neighbours) would drive up the gas prices, by growing interconnection "bottle-necks", by around 25% in EU markets in the medium and long run.
- Despite the impressive growth of **LNG terminal capacity** pipelines are expected to stay the most dominant means of gas supply/transport in Europe in the future: varying from 83% (low demand scenario), 81% (high demand & BAU scenario) to 77% (deferral of investments scenario) in 2030.
- **Storage** comes forward as the best option for arbitrage between summer and winter demand volumes, whereas LNG is the second best option.
- With hindsight, in the past some **investment decisions** for gas transport projects have not always been based on sound economic reasoning, e.g. The Baltic pipeline between Russia and Germany and the Blue Stream pipeline, but more on political and strategic considerations.

Final, concerning the building of pipeline connections with the EU and its neighbouring gas suppliers we can briefly summarize that pipeline connections from North Africa into EU, Norway into UK and Turkey into Balkan need to be assigned the highest priority, as these investments are undertaken in the BAU scenario by 2010. Around 2015 the Russia into Central Europe and Turkey into Italy pipeline projects should be given the highest priority. By 2020, the connections from Norway to Benelux and Russia to

Balkan are a “next order priority”. Later in 2025, building the connections from Norway to Germany and Russia to Baltic is necessary. The Balkan to Turkey and Norway to France connections have a low priority in overall economic optimality terms. Note that the Russian pipeline to Germany (through Baltic Sea) and from Russia to Turkey (Black Sea) are assumed to be built according to current planning, but from a European-wide perspective are not “economic optimal investments”. The table 1 below summarizes when, what (additional) new investments in supply connections are necessary according to the BAU scenario.

Table 1 ***“Optimal timing” of required new investments in the capacity of gas corridors between non-EU and EU countries in the BAU scenario (bcm/year)***

From	To	2010	2015	2020	2025	2030
Algeria	Spain	14	14	8	6	6
Algeria	Italy	16	16	8	8	8
Balkan	Turkey	0	0	0	0	0
Libya	Italy	9	8	9	5	4
Norway	Belgium	0	0	6	10	4
Norway	Germany	0	0	0	1	7
Norway	France	0	0	0	0	0
Norway	UK	16	15	10	8	8
Russia	Balkan	0	0	3	4	4
Russia	Poland	0	0	0	7	10
Russia	Slovakia	0	7	36	27	26
Turkey	Balkan	12	14	11	8	8
Turkey	Italy	0	4	6	2	2

4 Investment conditions for gas infrastructure projects

4.1 Introduction

Pipelines are expected to remain the most dominant means of gas transport in Europe. According to the simulation, pipelines should represent 83% (low demand), 81% (high demand & BAU) or 77% (deferral) in 2030, the remaining shares being covered by LNG. LNG is expected to come from Qatar (33%), Nigeria (25%), Algeria (17%), Egypt (15%) and others (10%). LNG should supply the UK (28%), Spain (19%), Italy (18%), France (15%), Benelux (13%) and others (7%). According to the different scenarios, investment needs from 2005 to 2030 are estimated between €90 billion (low demand) and €164 billion (high demand). In the BAU scenario, the requirements are €126 billion. These figures include pipelines, storage facilities and liquefaction and gasification terminals. If one excludes the liquefaction plants, investment needs amount to €66 billion in the low demand scenario and €126 billion in the high demand scenario, compared to €94 billion in the reference case. However policy makers and traders experience a

substantial deferral of many gas infrastructure projects over the last five years or more, which is claimed by many stakeholders as being the result of current great uncertainties surrounding such large investments by investors. The study in ENCOURAGED analyzed the potential reasons of "not investing" or "postponing investment projects". Below we discuss a number of investment conditions for gas infrastructure investment project realization. From assessing the conditions we derive a number of potential barriers for gas corridor realization. Finally, this identification of potential barriers leads us to propose some recommendations for policy makers for improving the investment conditions for investors.

4.2 Investment conditions for Gas corridors

Gas corridor investments are only undertaken when there is a structural need for the new corridor and when market and regulatory risks can either minimized or sufficiently hedged through hedging instruments by the infrastructure investor. The impact of risk on projects' sustainability is fundamental for their completion. The different 'risk positions' of gas corridor investors or operators is crucial (see Table 2). For example, operators with a large market share on the wholesale market are better able to cope with investment risk. The three categories are the following: exporter promoted projects (e.g. Nord Stream), importer promoted (e.g. Medgaz) and midstream promoted (e.g. Galsi and Nabucco). *Exporter* and *importer* promoted projects are relatively the least difficult to complete due to their ability to reduce investment risks, respectively through a large market shares and financing capacity of investors.

Table 2 ***Main characteristics of import projects by category***

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

Source: OME (2006)

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

three quarters of the capacity. So the project has therefore shifted from ‘midstream’ promoted to both ‘exporter’ and ‘importer’ promoted corridor.

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

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

4.3 Recommendations for improving regulatory framework

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

4.3.1 Decreasing market risk

Market risk, i.e. the risk of non-recovery of investment costs due to adverse price or volume developments, can be reduced by removing anti-competitive elements in current gas markets and by implementing market-based allocation mechanisms where appropriate. Both type of actions can enhance market transparency and increase the value of prices (both for commodity and capacity) as signals for gas corridor investments. This does not remove all uncertainty on investment recovery but can facilitate the investment decision-making process. It positively affects investment decision-making for investors in both regulated and merchant gas corridor projects. In the former case it can prevent wasteful investment spending of public money. In the latter case it can prevent the loss of private money. Some of the specific actions we recommend below are already stated as European policies. So we urge for the completion and/or overall **implementation in all member states of the EU Directives**, guidelines etc, such as those concerning the:

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

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

4.3.2 Increasing coordination

In order to invest efficiently and effectively in gas corridors an **increasing coordination** across borders on interconnection investment projects is recommended. More precisely coordination should involve national regulators and transmission system operators. To the degree that coordination is already present; an analysis on the added value of institutionalization in terms of authority, responsibilities of the coordination processes is recommended. More centralized coordination on supra national level will increase the public value of gas corridor investments and furthermore create a more stable investment climate in Europe. For a start, coordination can be arranged on regional level.

4.3.3 Minimizing policy & regulatory risk

An adagio that is already well-known and needs to be repeated here is that the governments' most important tasks is to provide a stable and transparent policy and regulatory framework with appropriate degree of commitment. Short-term unanticipated changes in energy policy or energy regulation are detrimental to investors' confidence to make a proper return on proposed and undertaken investments stretching over a much longer period. National governments should envisage the importance of **long-term policy and regulatory commitments**, for example by communicating and committing to a **clear vision** on the future energy system.

4.3.4 Options for risk mitigation

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

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

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

Introduction of competitive elements in the different stages of entering and operating under a long-term contract is recommended. An example of such a concept is the 'open season' procedure for merchant gas corridor projects. Requiring open season procedures for new large infrastructure projects and promotion of open season procedures for gas corridor projects where EU legislation is not required.

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

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

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

4.3.5 Role of TSO in merchant gas infrastructure projects

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

4.4 Concluding remarks on realization of gas corridors

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

regulation should explicitly recognize the interdependency between EU external and internal projects. Establishment of European coordinators would be an important improvement in this respect.

5 Summary and conclusions

Main results are that pipelines are expected to remain the most dominant means of gas transport in Europe. According to the simulation, pipelines should represent 83% (low demand), 81% (high demand & BAU) or 77% (deferral) in 2030, the remaining shares being covered by LNG. LNG is expected to come from Qatar (33%), Nigeria (25%), Algeria (17%), Egypt (15%) and others (10%). LNG should supply the UK (28%), Spain (19%), Italy (18%), France (15%), Benelux (13%) and others (7%).

According to the different scenarios, investment needs from 2005 to 2030 are estimated between €90 billion (low demand) and €164 billion (high demand). In the business as usual case, the requirements are €126 billion. These figures include pipelines, storage facilities and liquefaction and gasification terminals. If one excludes the liquefaction plants, investment needs amount to €66 billion in the low demand scenario and €126 billion in the high demand scenario, compared to €94 billion in the reference case.

Several gas corridors are already in a stage of reinforcement or planed to be developed. The traditional routes to Europe are all being strengthened. Six new pipeline corridors are also under development, from Norway to the UK (Langeled pipeline), from Russia to Germany across the Baltic (North European Gas Pipeline), from Algeria to Spain (Medgaz) and to Italy (Galsi). Another important route under development is the corridor from the Middle East and the Caspian across Turkey, further prolonged by pipelines across Greece (Turkey-Greece-Italy interconnection) or across the Eastern Balkan to Austria (Nabucco) which would allow Europe to diversify its supply sources. If all these projects are completed, the identified pipeline projects would represent an additional supply capacity to Europe of about 100 bcm by the beginning of the next decade.

The by investors/operators announced projects roughly correspond to the infra requirements identified in the BAU (business as usual) scenario through our model analysis. It seems, however, that projects mainly focus on carrying more gas into the European market while fewer operators are keen on developing the needed interconnections inside the EU connecting different member states. While not being the scope of this study, it might be useful to investigate the incentives for ‘de-bottlenecking’ the internal EU gas market, because our model based analysis showed that substantial gas price reductions and greater intra gas market flexibility towards unexpected supply interruptions can be achieved in that manner.

Moreover, the number of projects proposed could support the idea that there is no problem of investment in international gas infrastructure to Europe. On the contrary our analysis evaluated a number of important economic, regulatory and political constraints such as uncertainty regarding future policy and regulation applicable to the investment as well as co-ordination issues surrounding the investment are negatively influencing the necessary gas corridor investments. A larger role for EU coordination on development of a common gas infrastructure regulatory framework is suggested.

The results of the project provided useful insights in gas infrastructure requirements for connecting the EU gas markets with our key suppliers outside the EU and resulted in an EU report in support of the European Commission.

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