THE SIZE OF MARKET ZONES IN THE GAS MARKET AND EUROPEAN CONTEXT

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Background

In 1998, the Member States of the European Union unanimously adopted a gas directive with the objective of creating an open internal market for natural gas in Europe and increasing competition whilst taking due account of security of supply. While the Member States of the European Union are now implementing the third directive, there has undoubtedly been significant development of the EU gas markets in the past 14 years.

In this respect, the base model of gas network access in the EU has become the entry-exit system. For network users, this model facilitates gas transmission, which is no longer linked to the physical routes taken by the molecules. Within the limits of the capacity booked separately at the different entry and exit points of a market zone, a network user can request its gas to be transmitted from any entry point to any exit point with the sole requirement that the entry quantities balance out the exit quantities for a given gas day. Furthermore, entry-exit zones allow network users to freely trade within each market area, which better supports competition.

In this context, late in 2011, the Council of European Energy Regulators (CEER) delivered a target model for a European gas market to the European Commission. This model provides a vision of 2014 and beyond, and contains a suite of recommended steps. The Gas Target Model aims at facilitating the creation of a well functioning EU market, made of national or cross-border interconnected entry-exit zones with virtual trading points (so-called “hubs”).

As an example, the northwest Europe region has several relatively liquid hubs supported by gas exchanges with a considerable degree of price alignment. There are still opportunities to minimize the number of entry-exit zones in this region of Europe and to enlarge market zones, as France or Germany have done in recent years. Of course, achieving a single gas market and bigger market areas will require sufficient interconnection capacities and development of the core network of each individual zone, with a regulatory framework which supports investments where needed and provides Transmission System Operators (TSOs) with a predictable framework for recovering their costs.

In addition, the gas target model will enable secure supply patterns. Indeed, the European Union is highly dependent on gas produced outside of its borders. This dependency constituted 62% of demand in 2011 and is forecast to rise to 78% in 2020 (source ENTSOG).

Consequently, a well functioning market as well as new investments will be required for ensuring the security of supply of all Member States, connected to the need for additional gas import expected to come from Russia and the Middle East in particular, through pipelines or LNG terminals. Finally, while ensuring security of supply between multiple sources (interconnections, GNL and so shale gas) and building bigger entry-exit zones, the wholesale market competition and arbitrage between spot prices and long-term contracts will increase. This should certainly benefit the end-consumer.

Specific situation and developments in France

Almost all natural gas consumed in France is imported: the natural gas enters the network at cross-border interconnection points or at interconnection points with LNG terminals and exits downstream towards the distribution networks or directly to major industrial customers. Part of the transmitted volumes is channelled to neighbouring countries. The volumes injected into storages and then withdrawn primarily cover needs related to the climatic modulation of consumption, but also allow the capitalisation of price spreads over time (economic arbitration).

With more than 32,260 km of high pressure pipelines, the GRTgaz transmission network in 2010 enabled the flow of nearly 688 TWh of natural gas and the consumption of about 489 TWh to be met, covering more than 80% of French demand.

In more detail, the GRTgaz network is interconnected:

- At the borders with the Belgian, German and Swiss transmission networks;
- In south-western France with another TSO network (TIGF), which is itself cross-connected with the Spanish network;
- Along the coast with the Fos and Montoir LNG terminals, as well as with the Norwegian network GASSCO;
- With storage facilities spread across each of the two GRTgaz zones (see Figure 1);
- With downstream distribution networks that deliver gas to end consumers.

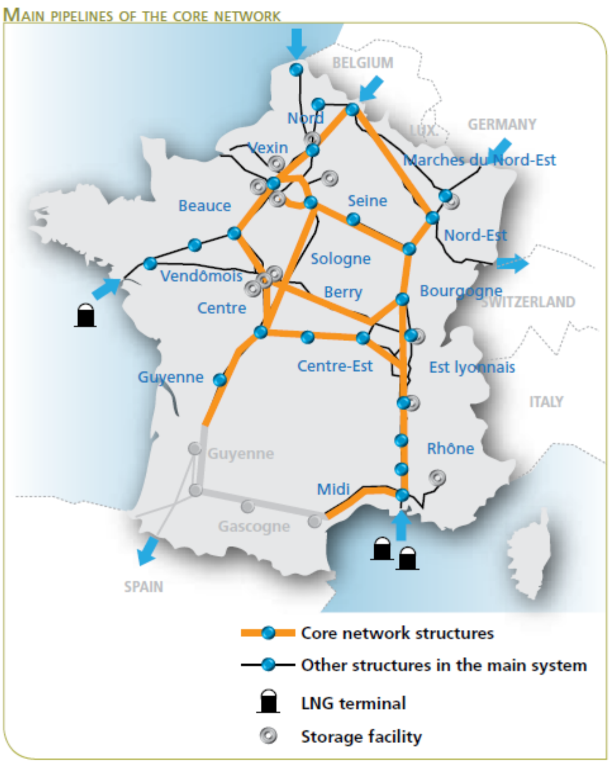


Figure 1: Main pipelines of GRTgaz core network

The French transmission system can be split into two different parts: the regional / local network and the national transmission system. The national transmission system consists of compressor stations and the network components which link the interconnection points with adjacent transmission networks, LNG terminals and storage points. This network is composed of large diameter pipelines, almost always greater than or equal to 600 mm. A significant portion of this network is meshed and forms the “core network”. In this part of the national transmission system, gas can flow in both directions, depending on the configuration of forward and reverse flows at interconnection points; flow direction can vary from day-to-day or even within a given day. Thus, it is not possible to specifically assign a core network structure to the delivery of gas from an entry point or to an exit.

The French natural gas market relies on an entry-exit system. The existence of several entry-exit zones reflects the physical constraints of the network and the impossibility, in certain scenarios, to ensure gas transmission from one zone’s entry point to another zone’s exit point.

Figure 2: Current structural organization of GRTgaz’s network

Since its creation in 2005, GRTgaz has made significant changes to its network structure in order to reduce the number of entry-exit zones in response to demands from most market players. The merger of three zones in northern France was possible thanks to the 360 million € investments made by GRTgaz in its core network over the period from 2007 to 2010. So far, in a European context characterised by a strong desire for integration and the need to secure gas supplies, GRTgaz is developing its network to meet market demand.

Consequently, since 1 January 2009, the GRTgaz network has consisted of two entry-exit zones, the North Zone and the South Zone, which are interconnected by the so-called North-South link. The South Zone is connected to the TIGF zone by a single contractual interconnection and marketed jointly by the two transmission operators, GRTgaz and TIGF.

With the European context, the Gas Target Model and the particular French situation in mind, some market design options have been considered, or should be in the future. These options can be summarized as follows:

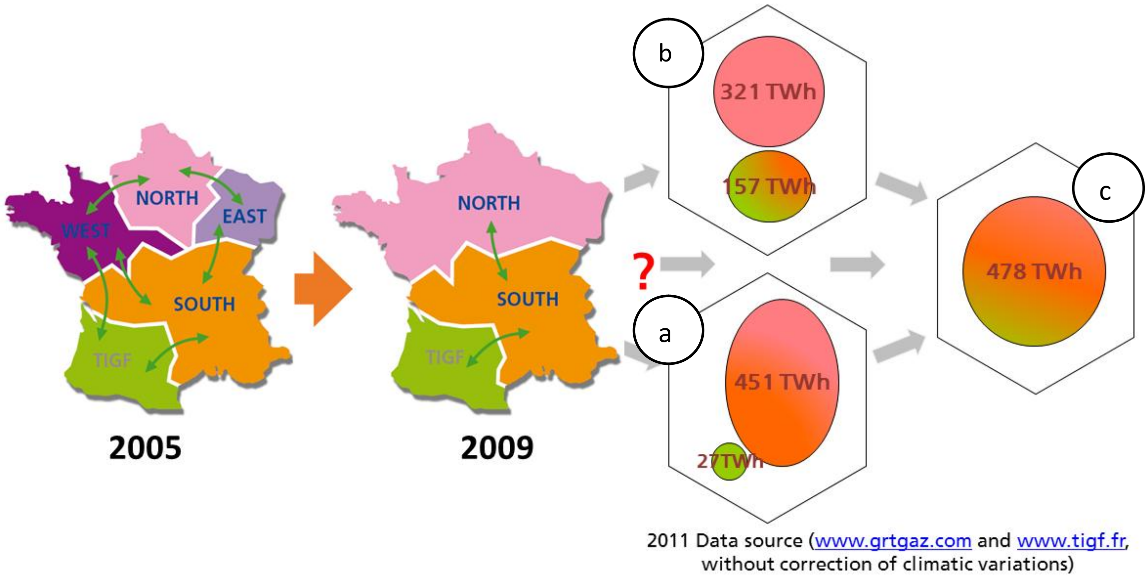


Figure 3: Possible Options for French market design evolution

GRTgaz has already studied the complete merger of the zones (illustration "a") using two different approaches: the first is based on additional investment and the second relies solely on contractual mechanisms. This second approach was discussed in 2009 with the French regulatory authority and the various market players. It revealed its limits because of the deployment of complex contractual tools that would be hard to scale (i.e. the necessary flow commitments).

However, the context has changed since 2011. GRTgaz has launched the first gas market-coupling experiment between the North and the South Zones (see case box). This service contributes to market integration. It improves liquidity and price convergence between two virtual trading points. The French regulatory authority has also approved two major future developments of the transmission system in the north and south parts of France (see Figure 5). These investments are part of the reinforcements needed to merge the zones in a unique network-strengthening solution. They will mean a significant development in the North and South Zones at the same time. Last but not least, Europe is strongly focusing on merging entry-exit zones: the Gas Target Model working area has defined what a well functioning European market should be, and a future balancing European network code will be a major input to developing liquidity and promoting the merger of zones.

The completion of the merger of these two market areas requires the existing physical bottlenecks along the North-South link to be removed. Historically, the southeast of France was largely fuelled by natural gas coming from the Fos terminals with additional gas from the north arriving via the Est, Bourgogne, Est Lyonnais and Rhone pipelines (see Figure 1). The North-South link capacities reflect this supply scheme and are limited to 230 GWh/day.

The next chapters will describe how GRTgaz is currently investigating different ways for enabling a complete merger of its current areas, GRTgaz North and South, without having to undertake all investments to avoid physical congestion in a single market area, at least at an initial stage.

<u>Context of TIGF and GRTgaz South zone (illustration "b")</u>

In response to a request by the French ministry in charge of energy, GRTgaz and TIGF conducted a joint study between September 2009 and June 2010 for a network operation simulation. The objective was to assess the risk of congestion and operational modalities to operate the two transmission systems in the event of a merger of the two market zones.

To this end, GRTgaz and TIGF shared a common network analysis including the characteristics of their networks, and shared flows and supply scenarios. A team of analysts from the two operators supported this study under the supervision of a steering committee, which was also attended by representatives of the ministry in charge of energy, the French regulatory authority, and Storengy (French Storage System Operator).

The study showed that taking the two networks into account enables a relief of some constraints on the network and thus an increase in available firm capacities (30 GWh/d more).

In addition, the flow patterns studied showed that there was no risk of structural congestion between GRTgaz South zone and TIGF zone as of 2013, except in very specific situations (in case of maintenance reducing physical capacities or during winter in a not so probable configuration of flows corresponding to a non-homogeneous usage of storages in the south zones).

GRTgaz and TIGF positions on this study were different. GRTgaz was ready to consider operational rules to deal with the special configurations listed above, meaning that the merger of the two market areas was a possible option. However TIGF did not share this point of view, considering in particular that the benefits for the market were not proven.

Aims

Gas market areas such as entry-exit zones should be large enough to support the competitiveness of energy supply. The Gas Target Model defined by European regulators identified five criteria to assess if a market is functioning effectively (a Herfindahl-Hirschmann Index HHI below 2000, three different sources of supply and gas demand within the zone of at least 20 bcm, a churn rate of 8 and a Residual Supply Index (RSI) of more than 110% for more than 95% of the days of the year). These indicators provide a reasonable basis for the likely conditions needed to deliver a functioning wholesale market.

On one side, merging existing entry-exit zones is probably the easiest way to increase the size of market areas, to move towards better market integration and to foster competition. The main advantage of a larger entry-exit zone is its attractiveness due to the total final consumption, the flexibility tools available such as storages and the number of interconnections with several diversified gas sources.

As a consequence, merging zones is a significant opportunity to focus liquidity at a particular virtual point (the gas hub), to increase competition between gas sources and to construct a robust price index. It is also a key element in creating significant forward markets.

For shippers, merging zones leads to simpler transportation arrangements because of the reduction in interconnection points where capacity booking and nominations are needed and because of easier balancing of the new zone. Access to a bigger entry-exit zone means more opportunities and more flexibility to supply a variety of final consumers with a diversified portfolio of gas supply. The valuation of such an advantage strongly depends on each shipper portfolio, considering short and long term gas prices, and the entry / exit capacities available in the new zone.

On the other side, transmission system operators have to deal with additional risks of internal congestion when merging zones. The main challenge is to anticipate all possible flow patterns resulting from the competition between the different gas sources (spot prices / LNG prices / development of unconventional gas / long term import prices). Additional investments in the transmission system used to be the standard solution for taking into account additional flow patterns. However, other possibilities exist, relying on commercial arrangements such as flow commitments with market players. These various solutions have different costs and different impacts, especially on wholesale market competition.

The approach developed in the following chapters describes a general framework for merger studies, which is needed for a cost-benefit analysis. The first step is to identify physical congestion within the newly merged entry-exit zone. A set of assumptions must be made on infrastructure development, demand and network utilisation. Congestions must be identified by simulation (congestion occurs when the transmission network is unable to transport a certain amount of gas from one part of the zone to another, although this amount of gas was allowed to enter / to exit the market area).The next steps consist of analysing the scope of solutions. Each congestion must be evaluated and solutions should take the costs, risks and reliability into account. After identifying a mix of optimal solutions, a road map has to be established and the market should be consulted on the cost, the global benefit and the tariffs impacts.

This approach will be illustrated with the GRTgaz North Zone and South Zone merger study conducted in the second half of 2011. Stakeholders played a key role in assessing the benefit of the merger; therefore they were strongly involved in the process of this study, thanks to many consultations and different working groups. In addition, a steering committee was created with the French regulatory authority, the ministry in charge of energy and

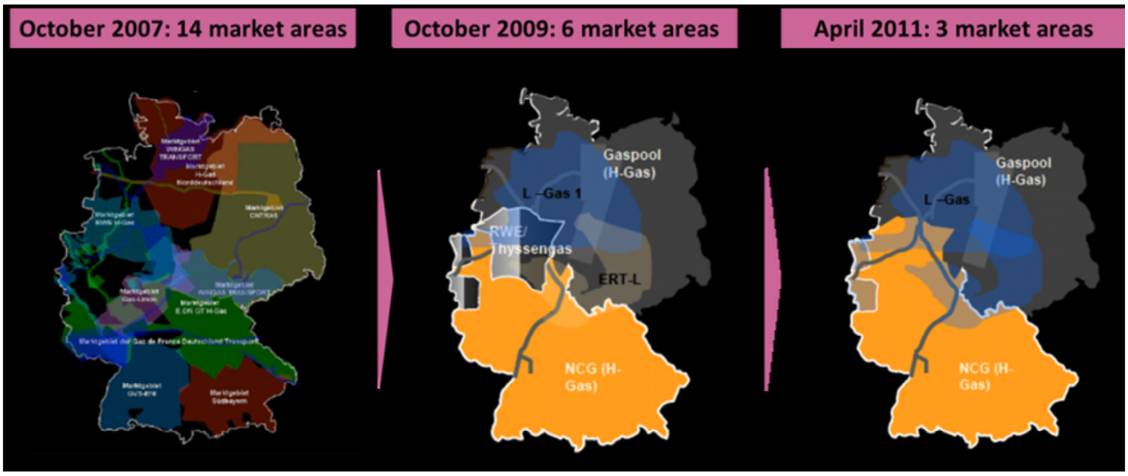
GRTgaz. KEMA, as a European consultant, analysed the different flow scenarios and assessed the different mechanisms accordingly to solve the congestions that were identified when merging the North and the South areas.

German gas market areas, an example of decreasing complexity required by law with important needs for alternative contractual mechanisms

The German network has historically been built by a large number of national and international players leading to a complex system based on several major pipelines.

Indeed, Germany is a production and transit country hosting gas routes from the Netherlands, Norway, Denmark and Russia to France, Switzerland and Austria.

Initially, the number of market areas was important. The main impetus to reduce the number of zones was provided by law and the number of market areas has dramatically decreased since October 2007.



In September 2010, German legislation imposed a further reduction to two market areas. The German natural gas market reduced the number of market areas to three in April 2011. This merger duly fulfilled the requirements of the new German Ordinance on Access to Gas Networks (GasNZV) within the specified time frame. The GasNZV had stipulated that the number of market areas had to be reduced to three by 1 April 2011 at the very latest. The merger triggered the birth of the first cross-quality market area in Germany.

The high-pressure pipeline network in Germany's largest market, NCG, extends a total distance of approximately 20,000 km, linking nearly 500 gas distribution networks. Between the North Sea coast and the Alps it covers well over half the gas transmitted in Germany.

The two other market areas, GASPOOL and Aequamus, finally combined their market areas in October 2011 to create a new cross-quality market area, known as GASPOOL. The new GASPOOL market area connects around 400 gas networks and thus covers approximately half of the German gas market.

The transmission system operators involved in the process have faced and are still facing different challenges which generate costs – especially merging L-gas with H-gas zones –

and need weighty contractual alternatives and review of capacity at every entry-exit point. Since the merger is required by law and in the short term, TSOs cannot invest in the network to solve potential physical congestion. Moreover, in a bigger zone, the calculation of available capacities at entry-exit interconnection points needs to be reconsidered. German TSOs have introduced different types of capacities such as “conditionally firm freely allocable capacity” or “dynamically allocable capacity”.

As another example, flow commitments may be necessary when merging market areas, since original market area borders between the relevant networks cease to exist. Flow commitments secured by a network operator from shippers are intended to ensure an increase or decrease in the physical gas flows at the points of congestion risk, depending on the actual physical status of the network, so as to guarantee network integrity on a permanent basis. In this respect, any network user intending to offer flow commitments firstly has to pass a pre-qualification procedure in order to be in a position to offer concrete flow commitments within a market-reflective tender for a defined period.

Methods - outline of overall approach

Figure 4 illustrates the general approach taken by GRTgaz and KEMA to study the potential merger of the GRTgaz North Zone and South Zone into a single market area. As shown, the work combined both technical and economic analysis, in order to derive a comprehensive assessment of the potential feasibility and costs of the market merger. Firstly GRTgaz carried out a technical network analysis, in order to identify potential areas of physical congestion in a joint market area. In parallel, KEMA was leading the efforts on the definition of several scenarios for the future development of the French gas market in the time horizon 2016 to 2020, including assumptions on the potential supply and price of gas from neighbouring markets as well as under long-term contracts and through LNG imports.

In a second step, these assumptions were used in a simplified market model to simulate a range of possible market outcomes in the future and, most importantly, to derive the resulting flow patterns through the French gas network. This in turn enabled us not only to identify but also quantify the frequency and scope of physical congestion. In addition, it also helped us to assess and quantify the potential impact of physical means for relieving congestion. This quantitative part of the analysis was supplemented by a qualitative assessment of potential mechanisms for dealing with congestion, which are described in more detail below.

Afterwards, the outcome of both the quantitative and qualitative analysis was combined, in order to assess detailed options for managing congestion in the French gas market. Based on the corresponding findings, the study delivered a set of recommendations for managing different types of physical congestion and assessed the costs of managing congestion. As a final step, the study developed a road map for further study and potential implementation of the corresponding proposals.

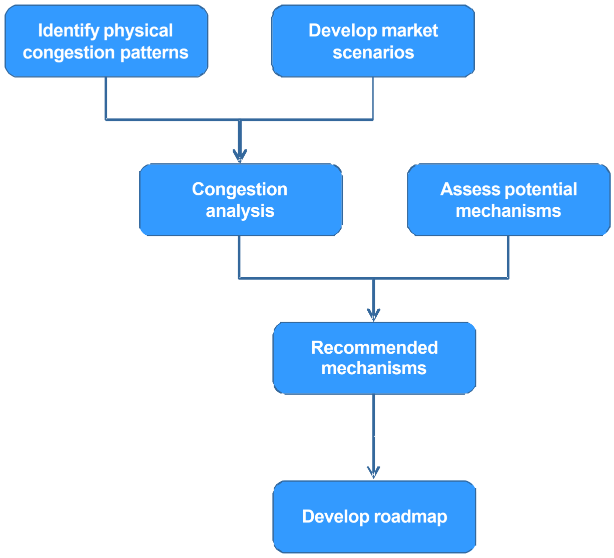


Figure 4: Outline of approach for the French market merger study

Identification of physical congestion scenarios

The analysis in this study has been based on the expected situation in the year 2016. For this purpose, GRTgaz has developed a set of assumptions on the future development of the network up to the year 2016 and potential congestion patterns which may be encountered in a combined market area. Apart from a description of the relevant infrastructure, the former involved assumptions on the evolution of consumption and, equally importantly, assumptions on the operation of underground storages (injection in summer and withdrawal in winter). In a second step, GRTgaz carried out extensive network simulations and analysis in order to identify and describe physical congestion scenarios which could emerge in a fully merged entry/exit zone. The corresponding assumptions, the methodology and the results of this analysis were reviewed and validated by KEMA in the first phase of the project. In addition, individual assumptions and their impact on physical congestion were further checked and discussed in the course of the congestion analysis performed by KEMA, which has in some cases resulted in a more detailed specification and/or revision of the conditions describing each individual congestion.

Since this study is based on the expected situation in the year 2016, it takes into account a number of ongoing or planned investments, including the projects "Eridan", "Arc de Dierrey" and "Hauts de France 2", as well as two compressor stations at Cuvilly and Chazelle (see Figure 5). These investments are connected to the requested increase in firm capacity at several entry/exit points. As a consequence, the firm entry/exit capacities assumed for this study and illustrated in Figure 6 are higher than current values at several locations. In this context, we emphasise that all quantitative analysis is based on firm entry/exit capacities only.

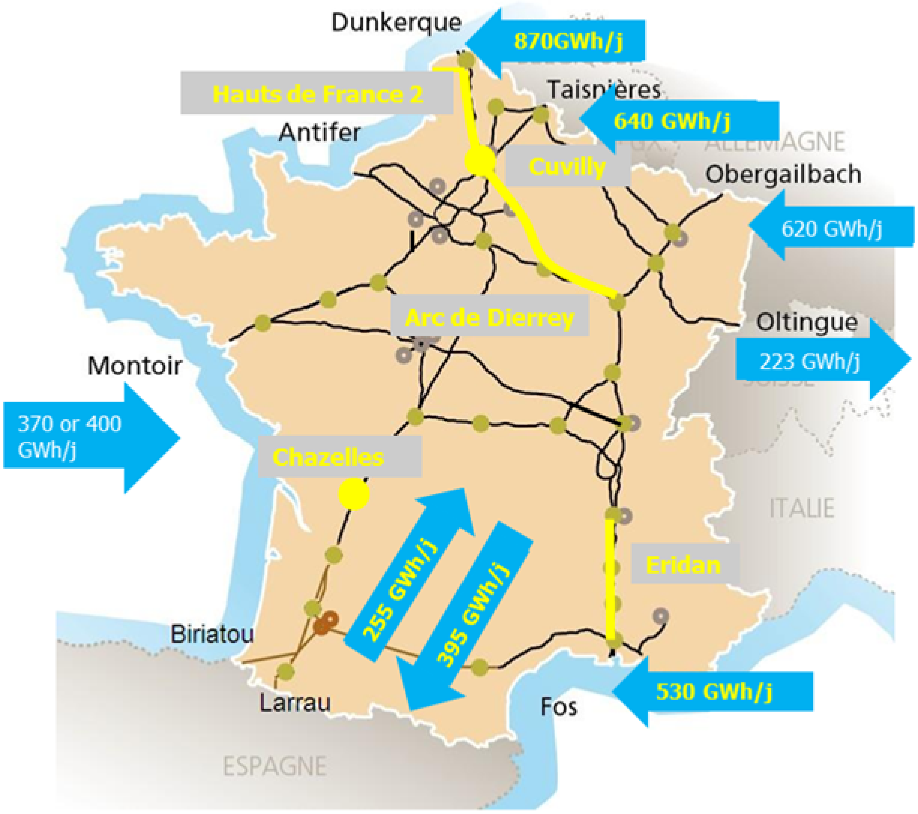


Figure 5: Assumptions on firm entry/exit capacities in the joint GRTgaz area in 2016

Based on its analysis, GRTgaz has identified three main patterns of physical congestion, which have been categorised as follows:

- Congestion in the north-south direction;
- Congestion in the south-north direction; and
- Congestion in the west-east direction.

These three major patterns combine potential congestion along five different corridors and/or directions. For the purpose of this study, GRTgaz has defined each congestion pattern by a set of inequations which define the maximum or minimum aggregate flow at one or more entry/exit points that can be realised without causing physical congestion in the network.

For example, in the north-south direction, congestion is, among others, defined by the following diagram and four different inequations.

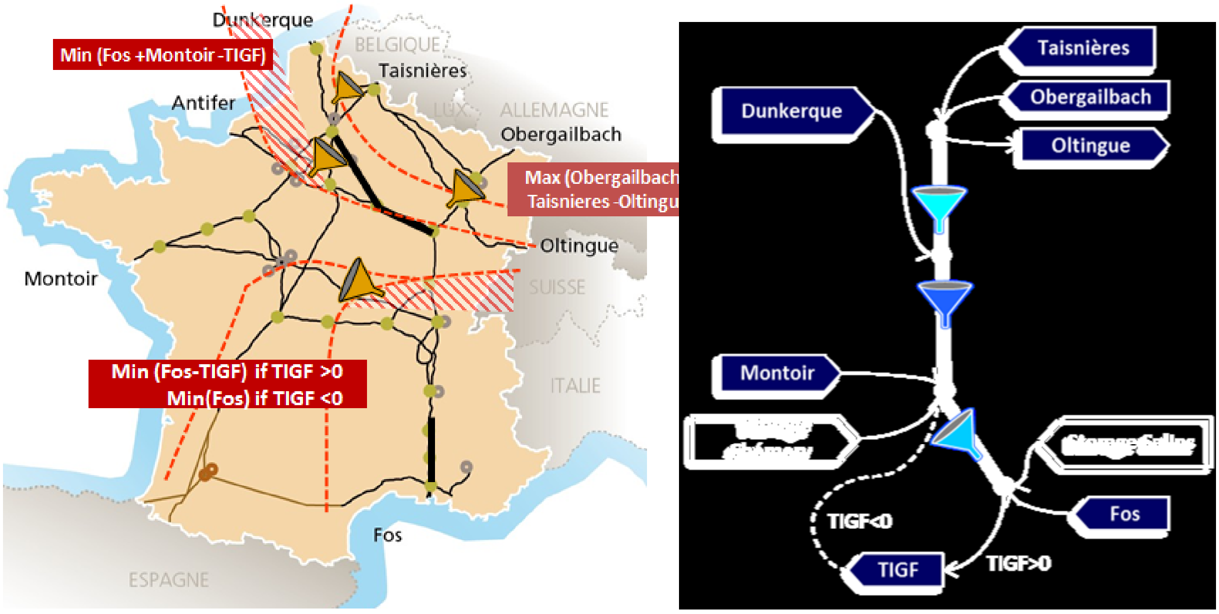


Figure 6: Main bottlenecks and congestions for congestion from North to South

Figure 6 provides the corresponding information for congestion in the North-South direction, which can be differentiated into congestion along a 'western' and 'eastern' corridor. As indicated by the orange 'funnels' in this picture, this pattern includes a total of four different areas of physical congestion, two of which are equivalent for both corridors.

The constraints on inequations developed by GRTgaz depend on temperature. Therefore the relevant constraints may change on a daily basis.

Each physical congestion (north-south, south-north or west-east directions) has been defined by corresponding inequations as illustrated for north-south direction congestions as before.

Identification and initial assessment of potential mechanisms

The quantitative analysis in the study confirmed that there would be significant risk of physical congestion in certain situations after the intended merger of the two market areas GRTgaz Nord and GRTgaz Sud. In line with the overall objectives of this study, a conceptual analysis was therefore carried out, in order to identify and evaluate potential mechanisms which may allow physical congestion to be resolved, even within the scope of network reinforcements planned to be realised in the French gas network by 2016.

As illustrated by Table 1, this analysis covered a variety of different measures, ranging from simple restrictions of capacity rights or direct interventions into the market to more sophisticated contractual and/or market arrangements between the TSO, on the one hand, and shippers or infrastructure operators, on the other. Moreover, whilst some products were targeted at the allocation and use of capacity rights, others were directly related to transactions for commodity or, alternatively, variations of nominations to the TSO.

	Administrated *(mandated restrictions and changes)*	**Market-Based** *(based on voluntary arrangements)*	
Counterparty	***Shippers***	***Shippers***	***Infrastructure operators***
Capacity	0. Intervention outside Normal Operating Conditions 1. Interruptible Capacities 2. Locational restrictions	3. Capacity buy-back	
Commodity / Nominations		4. Locational trades 5. Flow commitments	6. TSO-contracted storage 7. Locational swaps 8. TSO-to-TSO swaps 9. Re-routing flows

Table 1: Clustering of potential mechanisms for congestion management

When considering these mechanisms, one can differentiate between two fundamentally different approaches. To start with, the TSO may use **administrated measures** to restrict the operational flexibility of shippers or to mandate changes to the planned use of the network. An example is the definition of capacity products, including potential restrictions on the use of contracted capacities within the entry/exit regime. By intervening before potential problems occur, the TSO can ensure the feasibility of all potential flows from the beginning. Alternatively, the TSO may be entitled to intervene in the market at the stage of the daily gas market only, for instance by rejecting nominations. It is the nature of such mechanisms that they are administrated by the TSO and are thus not reliant on the voluntary participation of shippers or other market parties.

In a liberalised market, however, preference should principally be given to **market-based mechanisms**, which are based on voluntary agreements between the TSO and the shippers or other infrastructure operators. Market-based mechanisms aim at incentivising shippers to avoid and/or adjust entry and/or exit flows which (can) lead to infeasibilities, or to carry out adjustments which help to resolve the congestion problem. In contrast to administrated measures, which may be free of charge to the TSO, market-based measures generally involve remuneration for corresponding obligations and/or actions.

In order to evaluate the individual mechanisms described above, we have defined a set of eight different criteria which were subsequently used for a structured and comprehensive assessment of each mechanism. These criteria, which are summarised in Table 2 below and which combine a number of partially conflicting objectives, were grouped into three different categories to reflect their nature and importance, i.e.:

- **Essential requirements**, which must be fulfilled;
- **Primary objectives** which are key to the underlying goals of market integration and the establishment of a liquid and competitive gas market; and
- **Additional objectives**, which should be fulfilled as far as possible but are not deemed to be critical, such that they may have to be traded off against the fulfilment of other criteria.

Category	Criterion
Essential requirements	• Ensure reliability of the gas system • Ensure compliance with EU and national legislation and regulation
Primary objectives	• Promote economic efficiency • Ensure 'fair' distribution of risks • Ensure robustness against gaming
Additional objectives	• Ease of implementation • Facilitate regional integration • Transparency

Table 2: Criteria for evaluation of potential mechanisms for congestion management

It is beyond the scope of this article to comment on the assessment of each and every mechanism. However, our analysis has clearly shown that none of the mechanisms is clearly superior with regards to the whole set of evaluation criteria. As a general rule, market-based mechanisms, including in particular locational trades, can be considered the preferred solution from the perspective of economic efficiency and the underlying objective of developing a liquid and competitive gas market. However, with the potential exception of flow commitments, market-based mechanisms are not generally able to ensure a guaranteed reliability of the network. This implies that it may be necessary to consider the application of other, administrated solutions, at least where it is absolutely necessary to ensure the physical integrity of the network. As a consequence, the TSO will likely have to rely on a combination of different mechanisms in practice, which can be best tailored to different types of physical congestion.

This is indicated by Figure 7, which schematically depicts the relation between the frequency and impact of physical congestion on the one hand, and the resulting requirements for congestion management mechanisms on the other. Based on Figure 7, one can draw the following conclusions with regards to the selection of suitable mechanisms for congestion management:

- Wherever possible, some form of **locational trades,** which should be procured on a daily basis, should be regarded as the preferred choice.

- In case of insufficient competition, **flow commitments** may have to be considered as an alternative, in order to minimise the risk of high prices and/or to mitigate the potential impact of market power. Similarly, flow commitments may have to be applied in case of structural congestion, which will often coincide with a limited scope for competition.

- Thirdly, **capacity buy-back** mechanisms may potentially be considered especially in cases of infrequent congestion, i.e. where it may not be economic or practical to rely on locational trades.

- Finally, where capacity has not yet been allocated to the market, the **conversion of firm to interruptible capacity** may provide another instrument for managing structural congestion that occurs at high frequency.

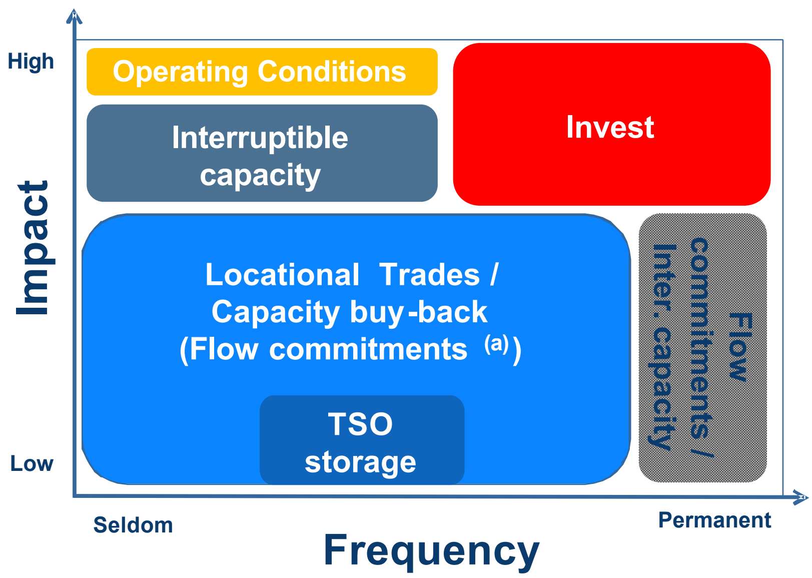


Figure 7: Schematic clustering of congestion management mechanisms to different types of physical congestion

Market coupling on the GRTgaz network as an interim step: a first time for natural gas in Europe

On 1 July 2011, GRTgaz launched its market coupling service between the north and south virtual trading points with the support of the French Gas Exchange Operator, Powernext.

This service, which has been operating successfully in the electricity sector since 2006, is a first in the European gas sector. It required an in-depth adjustment of the coupling mechanism to the specificities of natural gas and the terms of continuous trading.

The principles of this service were developed with all market participants, professional associations and the French regulatory authority, the CRE.

The coupling of the north and south virtual trading points enables GRTgaz to broaden the range of services offered to shippers. This service may be viewed as an implicit day-ahead auction whose price is indicative of the market situation, but it is in fact a way of merging the two virtual trading points where possible. The coupling is managed through the Powernext gas exchange IT system and is based on a spread product (between north and south hubs) launched by Powernext in May 2011, thanks to the interconnection capacity made available by GRTgaz.

This marks the first step in the solutions explored by GRTgaz to merge the North and South Zones and to provide a single balancing zone for the GRTgaz network in the medium term. Indeed as an interim step to a full merger, market coupling between two zones can enhance liquidity and price convergence between two hubs, even if it is not able to lift physical congestion. By carrying out a partial merger of the order books for GRTgaz' North and South Zones, this service helps to promote efficiency in the French gas market. Indeed, it enables comparison with the prices of both North and South PEGs and increases the attractiveness of the French market, particularly in the South Zone.

The service began with an experimental phase. In this first phase, the capacity offered by GRTgaz was a firm capacity of 10 GWh/day in each direction, north-south and south-north, which proved to be sufficient for obtaining significant results. It has been decided to increase the capacity dedicated to market coupling in 2012.

Quantitative assessment

As mentioned above, the study involved the use of a simplified market model which allowed simulation of the expected flows through the French gas network in different scenarios. Based on this model, we were able to test the potential risk and impact of congestion in different market environments. For illustration, Figure 8 shows an example with the corresponding results for two different congestion patterns, once in the north-south direction (left) and once from South to North (right). More precisely, each of the two graphs shows the daily violation (in GWh/d) of the corresponding constraint for a full chronological period of one year and five different scenarios.

A comparison between the two graphs clearly shows that there is a high risk of structural and substantial congestion in the first case (north-south), whilst similar problems are limited to a few days in the opposite direction. Moreover, a closer analysis also reveals that congestion in the north-south direction is likely to occur especially in scenario 1, which was assuming high prices for the import of LNG in the south of France. Conversely, there is hardly any congestion in scenario 2 with opposite assumptions on relative price levels.

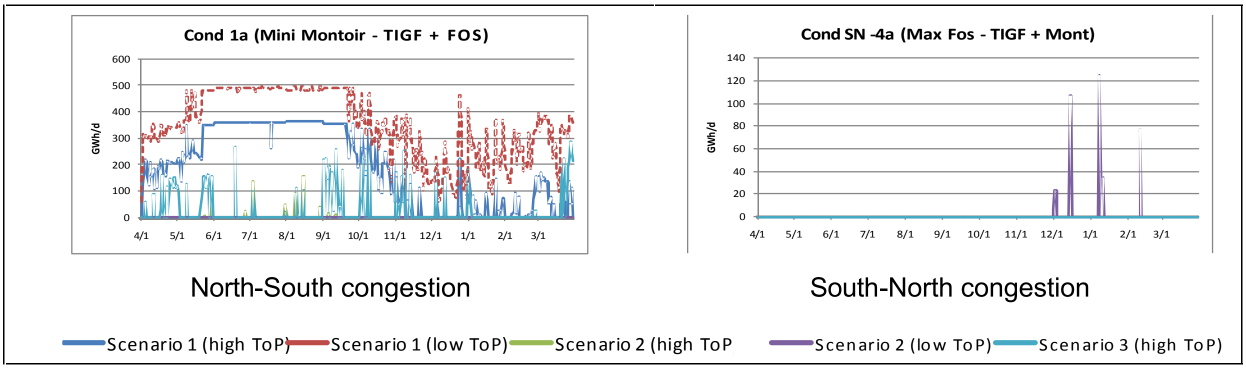


Figure 8: Example of physical congestion in different scenarios and directions

Note: Figure shows daily violation of congestion inequations (in GWh/d)

Based on these results, we were able to assess the risk of each type of physical congestion both in terms of frequency and scope (volume). In a second step, we investigated different physical means of mitigating physical congestion, such as revised flows at the entry/exit points to underground storages, LNG terminals, interconnectors, or CCGTs. In some cases, this analysis identified a significant potential to relieve congestion, either on a daily basis or on average over an extended time period, as also shown in Figure 9.

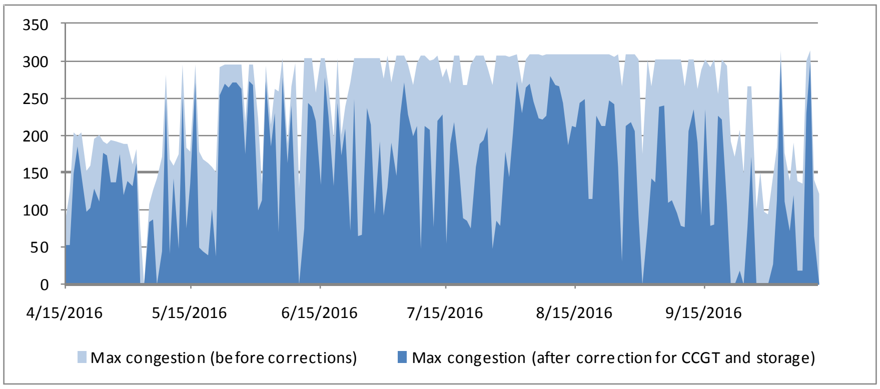


Figure 9: Example of potential to reduce congestion from North to South through revised operation of underground storages and CCGTs

Our experience shows that this part of the study was absolutely vital. For example, it revealed that most types of congestion could be easily resolved by different means. For the particular case of congestion in the north-south direction with its major volumes and structural nature (compare Figure 8 above), however, congestion management effectively requires the use of one of only two major entry/exit points in the south of France, i.e. either reduced exit flows to the remaining market area in south-west France operated by TIGF or, even more importantly, increased entry flows from the LNG terminals at Fos. As further explained below, it therefore became necessary to take into account the specific scheduling arrangements for LNG terminals when developing a proposed set of measures for the combined market area.

The final part of the quantitative assessment included an estimation of the potential costs for relieving physical congestion. Corresponding estimates were partially developed from the initial set of assumptions underlying the market simulations, but we also made use of historic prices and current forward quotations for different locations and/or sources. In line with the volatility of potential flow patterns through the network, but also due to uncertainty on the future development of gas prices, this analysis resulted in a relatively wide range of cost estimates. Hence, whilst we found that it might be possible to operate the combined market area at almost no additional cost in some years, it also turned out that congestion management might cost in excess of € 100 million in other years.

Proposed measures for enabling the market merger

In the last part of the study, KEMA proposed a set of measures which might be taken to enable the merger of the current GRTgaz North and South zones. As illustrated by Figure 10, these measures are centred around a set of short- to medium-term market mechanisms. More precisely, KEMA suggested relying on locational trades in the daily wholesale market (or capacity buy-back) as the default solution for congestion management. Due to the importance of the LNG terminals at Fos for mitigating congestion in the north-south direction, however, KEMA furthermore proposed to provide for the option of an additional medium-term market mechanism. More specifically, this would entail the use of, for instance, monthly tenders which would serve to procure flow commitments at Fos, ideally in combination with options for capacity buy-back at other locations.

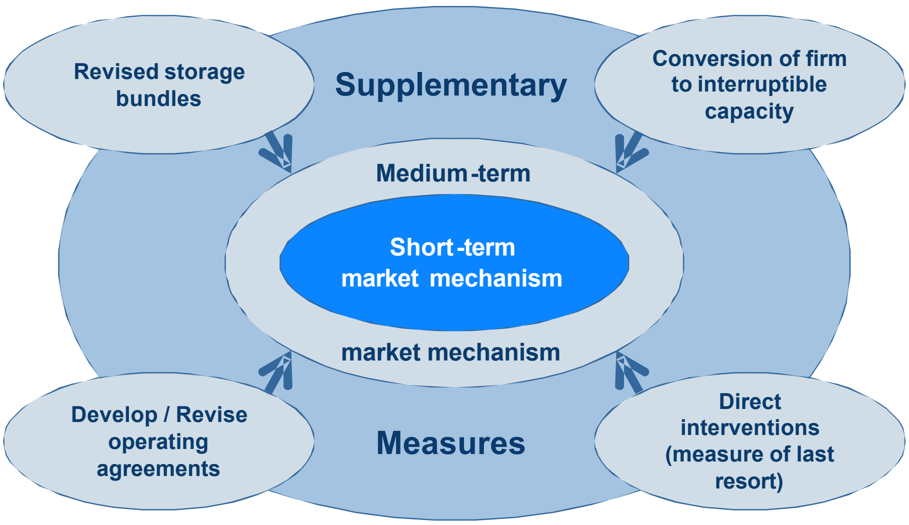


Figure 10: Overview of proposed measures to enable the market merger

Figure 10 shows that the study furthermore proposed four types of supplementary measures. On the one side, this included improved cooperation between infrastructure operators (i.e.

with neighbouring TSOs, storage and LNG terminal operators) and direct interventions as a measure of last resort. Given the effective role of underground storage in managing some types of physical congestion, and taking into account the existence of a single operation of all underground storages in the GRTgaz area today, it was furthermore suggested to study a possible revision of the current locational definition of storage products, in order to enable a system of locational swaps by the storage operator for the benefit of GRTgaz.

Last but not least, the study also found that it might be cost-efficient to convert a share of current exit capacity from GRTgaz to TIGF, which has not yet been marketed, to interruptible capacity. This option would help to significantly reduce the risk of congestion, without any direct impact on the current commercial and contractual position of any shipper. However, due to the limited regional scope of this study, which has not covered the TIGF area, it is clear that this solution would require further analysis before a decision can be made.

Conclusions
Summary of results and main findings

The size of market areas is a critical issue for a well functioning wholesale market. There is strong political and market aspiration towards larger zones within the European Union. It is a challenging issue for the transmission system operators who need to implement adequate tools to make these large zones work with a high level of reliability. Cost-benefit analyses are certainly necessary before deciding to merge existing entry-exit zones. This document aims at sharing the general framework used by GRTgaz for such studies.

We have shown that a set of technical and economic analyses, covering both quantitative simulations and conceptual analysis, enables a comprehensive analysis of physical congestion and the means for its mitigation in an enlarged market area. In addition to a qualitative assessment, the approach described above has in particular enabled us to quantify the risk of congestion in terms of frequency and scope, to identify suitable counter measures, and to estimate the associated costs.

Moreover, our analysis has clearly illustrated that several different measures may be used, either jointly or in isolation, to avoid and/or relieve physical congestion. Therefore no “one fits all” solution should be sought. Merging zones when minor investments are required is the most efficient solution, but time is still needed for implementation (around five years for designing, deciding and building new transmission infrastructures). In the meantime, it is however possible to consider contractual arrangements for an earlier merger of the market zones, keeping in mind their potential limitation for a full functioning wholesale market (cf. market coupling).

Merging zones can even require no investment at all, but still be difficult to manage if different market players are involved (different transmission system operators, different countries).

When significant investments are needed, a clever mix of contractual arrangements and investments has to be designed and discussed with all market players. However, we have learnt from the German experience that the costs of contractual arrangements are difficult to assess ex-ante, without any binding tender.

Finally, the benefits have to be valued by network users in order to analyse the impact of the merger on the social welfare of the global community.

French situation

France is the fourth largest gas market in Europe, with consumption of around 45 bcm, accounting for 10% of EU demand. In 2009, GRTgaz invested in its core network and merged three zones to reduce the number to only two zones. Therefore, market participants can rely on two virtual gas trading exchanges which favour interaction between all gas market actors (consumers, suppliers, producers, traders, etc.) and are backed by large entry/exit zones. GRTgaz has certainly become more and more attractive. At the end of 2011, 89 shippers were present on the GRTgaz network and volumes of 449 TWh were traded at the two virtual trading points.

As discussed, there is a strong market demand in France to merge the GRTgaz North and South Zones in order to offer one unique zone to network users. Although two core network developments have been recently decided, some physical congestion will still remain and will not allow a full merger. While studies have been conducted on the different contractual alternatives listed in this document, a market coupling project between the GRTgaz North and South Zones has been initiated by GRTgaz and Powernext. As an interim step towards a full merger, market coupling between two zones can enhance price convergence between two hubs, even if it cannot lift physical congestion.

Solutions to manage the current limitation of gas flows between the North and South Zones (investments as well as contractual mechanisms) will need to be implemented to allow this merger. The approach developed in this document provides a tool box of contractual mechanisms. The path taken and the number of tools used to reach the target will need further investigation, a dedicated roadmap and a consultation process with market participants.

GRTgaz is willing to implement a unique market zone in 2016. This will certainly give more options for arbitrage between gas sources and should also positively impact neighbouring markets such as Germany, especially considering GNL imports from Spain or France.

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