

European Gas Infrastructure Operators

*What impact of the current market changes on their business model?
The management perspective*

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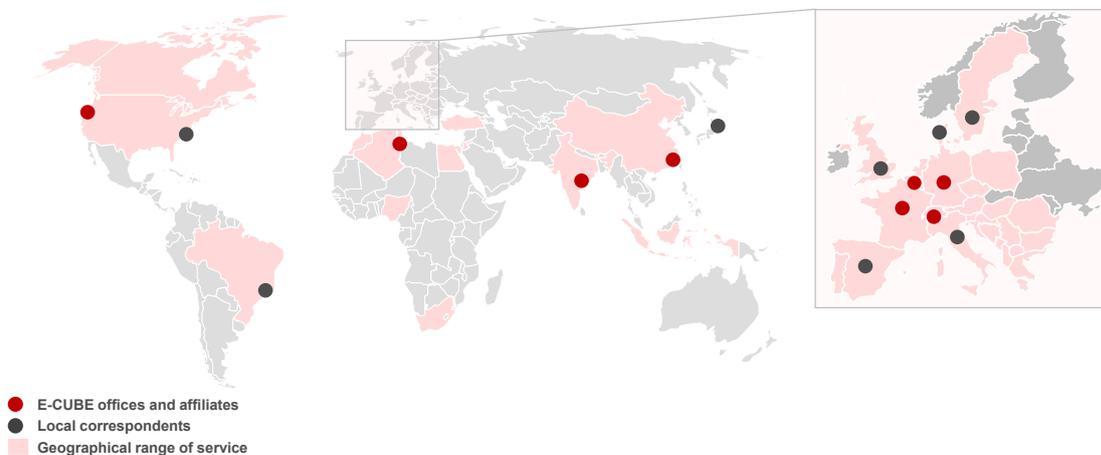
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Executive summary

The European gas market is currently undergoing major structural changes. These changes have the potential to deeply reshape the gas infrastructure industry over the coming years. They lead all players (Gas Infrastructure Operators, regulators, investors) to take a fresh look at the sector in a context of increased risk. To cast a light on these changes, we analyzed their drivers and their impacts, and interviewed top-level executives of 12 major European operators. This paper is a summary of our findings; it can help Gas Infrastructure Operators (GIOs), regulators, and investors to challenge their views on the changes at work and their appreciation of the risk in the industry.

The European gas market is undergoing major structural changes. Changes in the geography of production and consumption are restructuring gas flows in Europe. As domestic production (especially in the North Sea) sharply declines, new sources of gas will emerge. But the respective shares of the many pipeline and LNG suppliers and the routes that will be used are still to be determined. Similarly, the trend for gas consumption in the EU is uncertain. The role of gas in the transition towards a low-carbon economy will depend on many factors, among which the prices of gas, CO₂ and coal, political orientations, the development of renewable energy production and electricity storage technologies. At the same time, shippers are increasingly moving towards short-term, tightly-adjusted bookings, making gas flows more versatile and infrastructure booking more uncertain. This change is driven by market rules and network codes defined at the European level, which incentivize short term bookings. In a context of general overcapacity with utilization rates well below bookings, shippers seize the opportunity of the expiration and non-renewal of Long Term Contracts ¹⁾.

Furthermore, some of the key sectorial trends may seem contradictory, for instance:

- The EU aims at transitioning towards a low-carbon economy by 2050 and pushes for the development of new gas infrastructure (LNG terminals, storage, pipelines), but the uncertainty associated with financing new infrastructure over its life time is high
- The market value of gas infrastructure capacity is low, but it is credited with an important role in the security of energy supply of the EU
- Market valuations of GIOs are very high, although the financial risk of these companies is on the rise because capacity utilization rates

decrease and gas flows become more versatile

- The EU Gas Target Model (GTM) drives gas market areas towards consolidation, but the implementation of this process currently underway is challenged by many stakeholders, including national regulators that want to keep their prerogative.

These deep changes and contradictory trends create uncertainty for GIOs. In this context, is their current business model sustainable? In other words, are GIOs and their shareholders facing a risk of stranded assets? If so, what would be the mechanisms at work?

Our analysis and interviews of top-level EU gas infrastructure operator executives led to the following findings:

- **Revenue cap regulation cannot entirely mitigate the risk of stranded assets**, *i.e.* ensure a fixed level of revenue. Indeed, if the utilization of an asset goes down to zero, there is reason to believe that regulators will not let end consumers bear the whole cost of it. Although most interviewees do not believe that regulators would remove stranded assets from the RAB before full depreciation, increased pressure on tariffs could lower the revenue of operators.
- **In the case of Transmission System Operators (TSOs), the impact of adverse scenarios on the equity value could range between 0% and -20% by 2035 ²⁾.**
 - The risk level can be very different from one asset to another, because it depends on the type of regulation, current long-term capacity bookings, outlook for domestic demand, share of transit in bookings, and the long-term evolution of gas flows. For instance, transit pipelines are considered more exposed than storage because the

1) The volume of gas delivered in the EU from current Long Term Contracts will decrease by 50% between 2015 and 2025, and by > 80% by 2035

2) The impact on equity value also depends on the company's gearing ratio (net debt / enterprise value)

latter is seen as critical for Security of Supply.

- The form of risk is also different for revenue-cap than for non-revenue cap regulated assets. For the latter, it takes the form of lower revenue proportional to lower bookings, whereas for the former it is a risk of increased pressure from the regulator on tariffs. Interviewees unanimously anticipate increasingly fierce negotiation with their national regulators. According to some of them, up to 10 to 20% of their revenue is at risk through increased pressure on WACC and OPEX incentives. Thus, they emphasize the importance of negotiation to realign the RAB depreciation rate with the anticipated utilization level of assets.
- **There is a range of possible mitigating actions GIOs can take to significantly reduce risk, but their relevance has to be assessed on a case-by-case basis** due to the specificities of each GIO:
- **Negotiations with regulatory authorities** are paramount to ensure regulatory stability and secure appropriate allowed revenue. CAPEX and OPEX allowances and incentives, WACC level and RAB depreciation rate are key for security of supply, quality of supply and return on investment for assets amortized over decades.
 - **Energy policy makers can provide the stable political and regulatory framework** over 50 years necessary for new investments in gas infrastructure. This requires the industry to advocate the role of gas more fiercely. Indeed gas has an essential part to play in the next 20 years, in combination with intermittent renewable electricity and as a key contributor to European energy supply's security. Several objectives can be pursued for a more stable framework, including a stable CO₂ pricing mechanism and a revised Gas Target Model (GTM). A full-fledged roll-out of the GTM is not considered likely by most Interviewees beyond the implementation of national initiatives such as HoKoWä (harmonization of entry tariffs for all German TSOs) because of the great diversity of national situations across Europe. Some view it as beneficial from an investor's perspective because it would socialize the risk of stranded assets at a European level.
 - **The development of green mobility and green gas** (biomethane and hydrogen

generated by electrolysis using green electricity) is an opportunity for GIOs. Since it is likely to play a major part in their future, they will need to adjust to it: prospective studies highlight the possibility of gas networks de-carbonated over 50%. The question is: how can they support it? Interviewees generally favor direct involvement in green gas developments, which requires creating innovative models with regulators. Although they see green mobility as a major driver to sustain gas demand in Europe, they differ on their legitimacy to be direct players in this field.

- **External growth can create value by improving OPEX efficiency and reducing risk.** However, value creation for operators and investors highly depends on companies. It is also limited by incentive OPEX regulation and the systemic sectorial risk in EU gas infrastructure. For GIOs seeking to invest in other GIOs, identifying the level of value creation is key because financial investors are driving M&A transaction levels prices way above net RAB value. In this context, more and more GIOs are considering merging with other types of infrastructure: LNG, transmission and storage; gas and power.

Threats to the sustainability of the business model of GIOs are on everyone's mind. **However, our Interviewees strongly assert their confidence in the long lasting role of gas in the European energy mix.** This may reflect the fact that scenarios of drastic demand reduction in the long run are not considered likely. Indeed, the creation of an effective CO₂ pricing mechanism, or a lowering of costly renewable generation targets could radically change the outlook ³⁾.

This confidence in the future of gas in Europe is also reflected in the appetite of private equity players for such assets. Moreover, price paid in recent transactions (although widely judged as excessive with respect to pure industrial criteria) is a sign that investors believe in the possibility to increase their value.

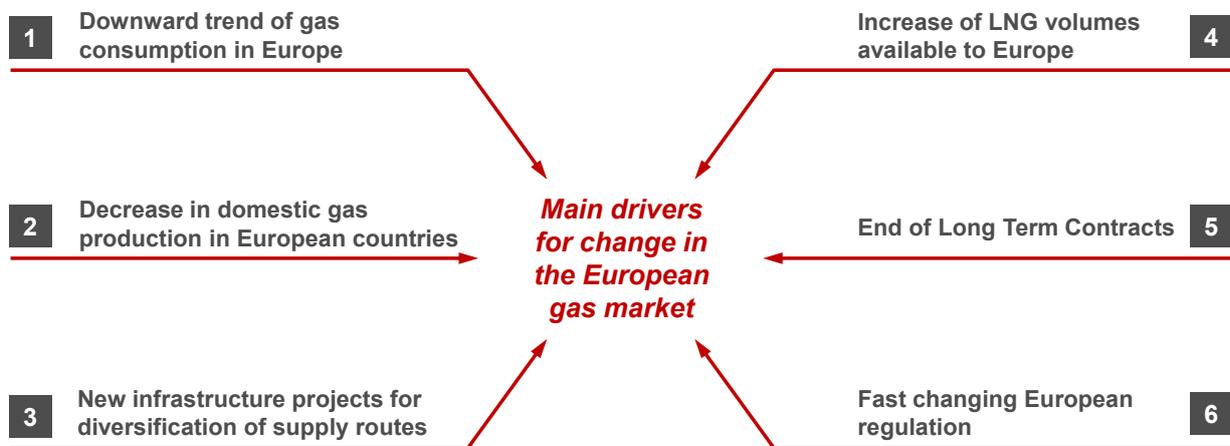
Possible actions to mitigate risk and increase value do not have the same impact and accessibility. Although none should be neglected, the ability to prioritize and implement these actions will be key for GIOs at a crucial time for the gas infrastructure industry: initiative should be taken today in order to influence long term trends.

3) The new November 2016 package proposed by the European Commission is heading towards this direction

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1. Six major drivers of change are currently redefining the European natural gas market



1.1. Gas consumption has decreased by 3,5% per year between 2010 and 2015, and a future upturn is uncertain

Demand for natural gas has been steadily decreasing in Europe in the last years; consumption in the European Union⁴⁾ went down from 477 bcm in 2010 to 368 bcm in 2014, before slightly going up to 399 bcm in 2015. Overall this corresponds to an average decrease of 3,5% per year between 2010 and 2015⁵⁾. Several factors explain this downward trend, which can be observed over all segments of activities: residential consumption, industrial consumption as well as electricity production. Some are situational (economic crisis, warm winters etc.) while others are more structural and likely to last.

Driven by the European commitments to reduce greenhouse gas emissions and the use of fossil fuels (the EU's 20-20-20 plan sets ambitious goals for 2020⁶⁾), countries within the EU improved their energy efficiency and supported the development of renewable energies for electricity production. Germany's Energiewende for instance targets 60% of renewables in final energy consumption by 2050 (from 12.6% in 2015). France aims at achieving 23% of final energy consumption coming from renewables by 2020. Those national targets are reducing the global energy demand and the share of gas within the total energy mix for both final residential consumption and electricity

production.

Renewables are not the only competitors of gas for electricity production: coal is also a major one despite its higher level of CO₂ emissions. Indeed, coal-fired power plants are currently more competitive than gas power plants because of a supply glut on the international coal market (partly because of an inflow of US coal displaced by shale gas) combined with very low CO₂ prices and gas prices still significantly linked to oil prices⁷⁾. An agreement at the EU level to create an effective CO₂ price mechanism could radically change the game for gas-to-power but there is no indication that such an agreement can be found. In the industrial sector, a global move towards less gas-intensive sectors also contributed to the decline of gas demand, which should be a long-term trend.

All those factors combined lead to the conclusion that an upturn in the coming years is uncertain; the situation could however evolve, mostly depending on the development pace of renewable energies and associated storage solutions, and on the relative competitiveness between coal and gas (gas could be valued as an important energy for transition, cleaner than other fossil energies, and supported as such). Gas consumption could also be boosted by a use in

4) EU's 27 countries + the United Kingdom

5) Source: Capgemini "European Energy Markets Observatory", October 2016

6) A reduction of GHG emissions by 20% compared with 1990, an increase in renewable energy to 20% of final energy consumption and an improvement of energy efficiency by 20%

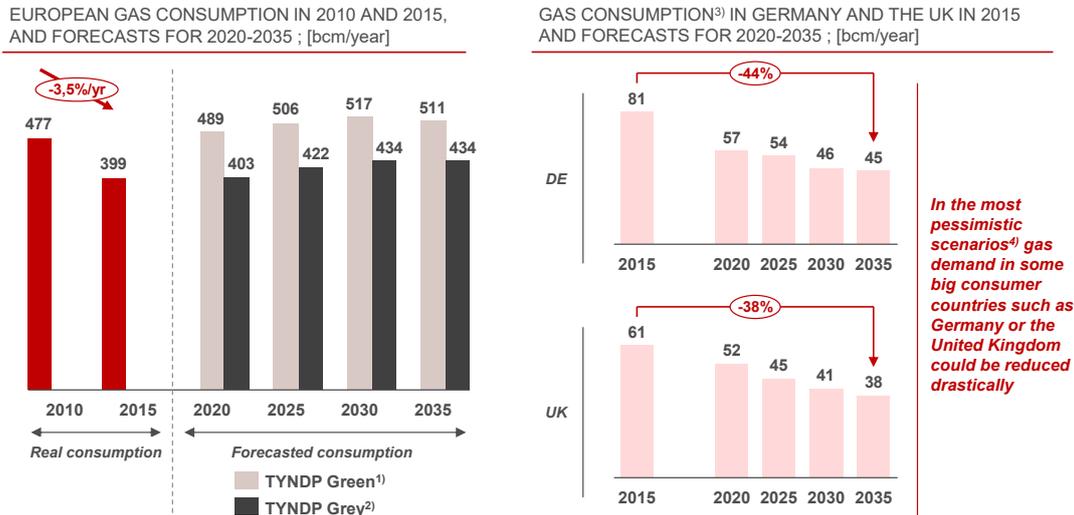
7) Recent changes in the Chinese policy regarding its domestic production of coal is rapidly changing the game: the thermal coal price has almost doubled in a few months; the long term trend remains highly uncertain though

new domains, such as the mobility sector.

Overall, no spectacular rise in the European gas demand should be expected between now and 2035, but rather a stagnation. ENTSOG's Ten Year Development Plan (TYNDP) forecasts for 2035 are situated between 434 bcm/year and 511 bcm/year for the EU28 countries. In some of the

biggest consumer countries, some scenarios of drastic consumption decrease are considered; in Germany for instance, the most pessimistic scenario of ENTSOG's TYNDP presents a demand reduced by 44% compared to the 2015 level; in the United Kingdom, National Grid considers a scenario with total demand reduced by 38% compared to 2015 (See Illustration 1).

Illustration 1: European gas consumption in 2015 and forecasts for 2020-2035 [bcm/year]



The level of gas consumption in Europe in the years 2016 to 2035 should be in between the levels of 2010 and 2015

1) EntsoG TYNDP "Green Scenario" (high CO₂ price, limited evolution of gas prices due to their decorrelation from oil prices); 2) EntsoG TYNDP "Grey Scenario" (medium prices of energy and CO₂); 3) Total domestic consumption including industries and electricity production; 4) For Germany : EntsoG TYNDP "Grey Scenario"; For the UK : National Grid Gas Ten Year Statement 2015, "Gone Green Scenario"

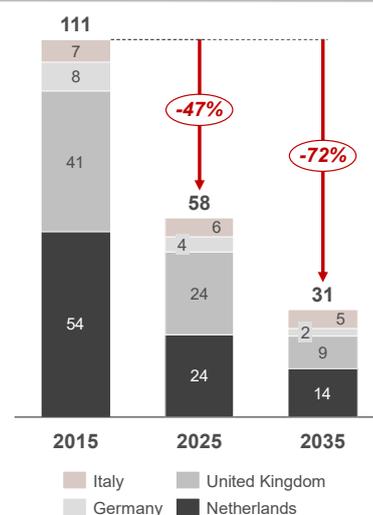
Source: ENTSOG, National Grid, Capgemini, Société Générale Energy Pulse, E-CUBE Strategy Consultants analysis

1.2. European domestic gas production will drop by 47% by 2025

All gas producers in the EU are facing a production decrease at a very rapid pace; the phenomenon is mainly caused by the depletion of gas reserves in the North Sea, affecting the Netherlands, Germany and the United Kingdom. According to forecasts, total domestic production will drop by 47% by 2025 (from > 110 bcm in 2015 to < 60 bcm) and by ~72% by 2035 (to ~31 bcm/year) – See Illustration 2.

Unconventional gas is unlikely to compensate for this decrease in natural gas domestic production: Exploration & Production is restricted for environmental reasons in many European countries including France (a moratorium on hydraulic fracking is in place since 2011), Germany, Belgium, Austria and the Netherlands. Moreover the profitability threshold for shale gas extraction, is estimated between 18 and 48 EUR/MWh, which is currently out of the money on European gas markets (~14,5 EUR/MWh on the PSV, ~13 EUR/MWh on the TTF etc.)⁸⁾

Illustration 2: European gas production in 2015 and forecasts for 2025 and 2035 [bcm/year]



Source: AIE ; ENTSOG TYNDP ; E-CUBE Strategy Consultants analysis

8) European Commission "Quarterly Report on European Gas Markets, volume 9 fourth quarter of 2015 and first quarter of 2016" - Wholesale gas prices in the first quarter of 2016 (p30) ; Pöyry and Cambridge Econometrics, « Macroeconomics effects of European Shale Gas Production », Novembre 2013

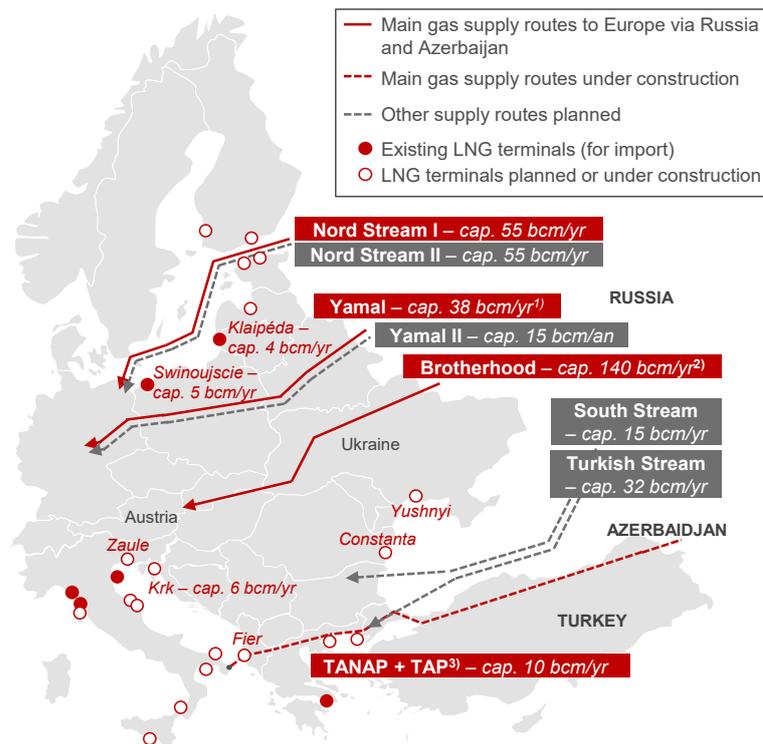
1.3. New pipeline and LNG projects will redistribute transit flow patterns in European countries

Today's gas flows within Europe are shaped by the current main supply sources: the Netherlands provide L-gas to Germany, Belgium and France; ~60 bcm of Norwegian gas flow through the Zeepipe, Franpipe, Europipe and Norpipe lines to the North-West of Europe as well as to Italy through the North-South corridor (via Germany – TENP – and Switzerland – Transitgas). Russia is Europe's biggest gas provider with ~132 bcm of exports made by Gazprom in 2015⁹⁾. Those volumes are mainly flowing through Nord Stream to Germany, through Yamal to Poland and Germany and through Brotherhood and Ukraine to Slovakia. The South of Europe is also supplied by North African countries (~30 bcm to Spain and Italy).

The total number of suppliers is low, and the European Commission's main concern is to diversify sources to increase the Security of Supply (SoS), especially in a context of increased dependency due to the decline of domestic

production. Interest in SoS has also increased since the Russia-Ukraine crisis that threatened gas provision to Europe. For this reason, several transnational projects are being developed. The TANAP and TAP projects, costing respectively EUR ~8 and ~4.5 billion¹⁰⁾, are under construction with the goal of providing 10 bcm/year of Azeri natural gas to Europe through Georgia and Turkey from 2019. Many LNG import terminal projects are also being developed, especially in the Baltic and Adriatic seas. The first Polish LNG terminal (Swinoujscie), for instance, started operations in 2016. In addition to new suppliers, Russia is also planning to develop more supply routes and aims at reducing flows over the Brotherhood road through Ukraine for geopolitical reasons. Projects include a doubling of Nord Stream and Yamal, but also a "Turkish Stream"¹¹⁾. The probability of development for those projects is rather uncertain, as Europe is reluctant to increase its dependency on Russia – See Illustration 3.

Illustration 3: European main gas supply routes from the East and LNG terminals, 2015



1) Yamal (main pipeline ~33 bcm/yr) + secondary branch Kobrin – Poland ; 2) Brotherhood (main pipeline, ~100 bcm/yr) + other secondary pipeline capacities ; 3) Initial capacity for Europe
Source: ENTSO, E-CUBE Strategy Consultants Analysis

- 9) Source: Gazprom Export delivery statistics, natural gas exports made to: Austria, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Switzerland, UK, Bosnia and Herzegovina, Bulgaria, Czech Republic, Hungary, Macedonia, Poland, Romania, Serbia, Slovakia and Slovenia
- 10) Source: OIES « Azerbaijan's gas supply squeeze and the consequences for the Southern Corridor », July 2016
- 11) The current Turkish Stream project consists of two lines of 15.75 bcm/year each, one aimed at supplying Turkey and the other one which could supply Europe

All those projects will deeply redistribute transit flow patterns amongst European countries. For example, Eastern Europe will be more likely to be supplied with Russian gas from the North of Europe and through Germany, the Republic Czech and Austria, thus reversing the current flow from Brotherhood to Slovakia, Austria and Germany. An increase of available volumes in the South of Europe could drastically reduce gas flows through the North-South corridor. Alternatively it could be argued that the new flows would go from South to North (as showed by the reverse flow projects on the Transigas and TENP pipelines linking Italy to Germany, Belgium and the Netherlands). The development of LNG could

make more and more countries relatively self-reliant and therefore reduce the need for transit pipelines.

Those possible scenarios are highly dependent on which of the supply projects (pipelines as well as LNG terminals) will be effectively built. This will depend on many factors, including the prices of each routes and SoS concerns (which would lead Europe to favor LNG projects, even though they are currently less competitive than Russian gas¹²⁾). Profound changes in European gas transit flows must anyway be expected in the next 20 years.

1.4. 10 to 40 bcm of additional LNG volumes should arrive to Europe annually between 2016 and 2020

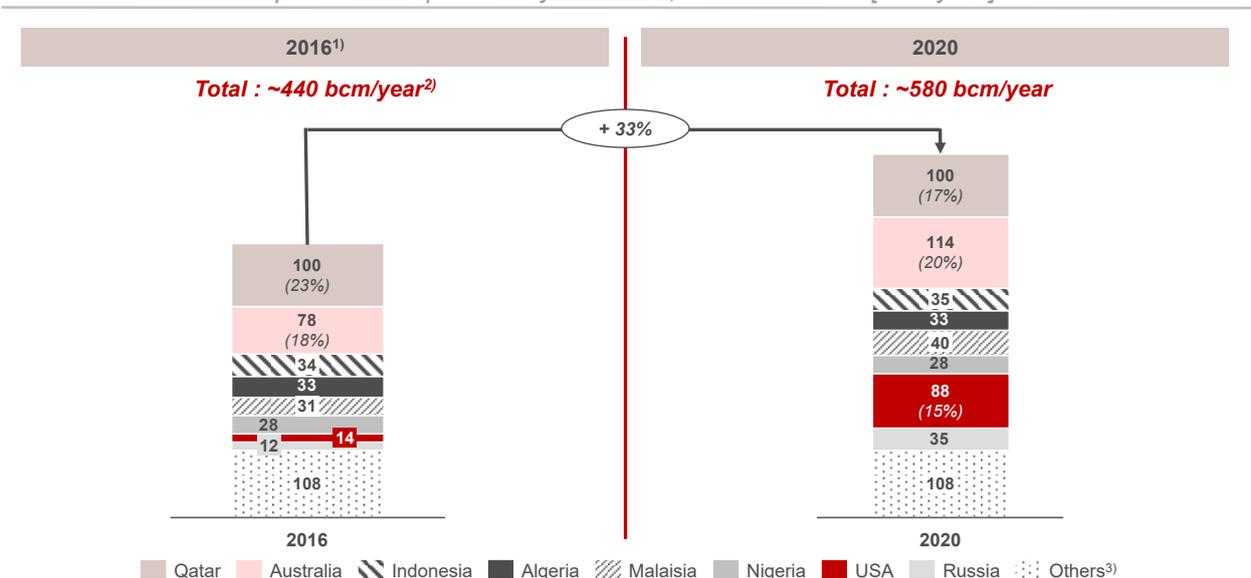
The world LNG offer should progressively rise from ~440¹³⁾ to ~580 bcm between 2015 and 2020 (+33% in 5 years), as a result of major investments in new liquefaction infrastructure in Australia and the United States who will become two of the three major countries in terms of liquefaction capacities, along with Qatar – See *Illustration 4*. Those new projects were all initiated before 2015, at a time when the LNG price was high at ~20 USD/MMbtu and demand in Asia was booming. At the beginning of 2016, prices had gone down to ~5 USD/MMbtu, mainly as a result of the decrease in the Asian demand (for the first

time since 2009). This particular context, with an increase in supply and a decrease in demand, will lead to an important supply glut for the next five years at least.

As a result, 10 to 40 bcm of additional LNG (i.e. ~15 to 50% of the total oversupply estimated in 2019) should arrive to Europe every year in the period 2016-2020¹⁴⁾. Indeed, Europe plays the role of a “swing market” that helps clear the global LNG balance by absorbing surpluses:

- As the most flexible and liquid market for LNG, Europe is the privileged market for LNG

Illustration 4: Global liquefaction capacities by countries, 2016 and 2020 [bcm/year]



1) As of October 2016 2) Among those liquefaction capacities, ~65 bcm is off-line according to the International Energy Agency; 3) Other countries: Trinidad, Egypt, Oman, Brunei, Yemen, Papua New Guinea, United Arab Emirates, Angola, Peru, Norway, Eq. Guinea

Sources : IEA « Global Gas Security Review 2016 », IGU « 2016 World LNG Report », E-CUBE Strategy Consultants Analysis

- LNG total supply costs are around 10-12 EUR/MWh, compared to 7-8 EUR/MWh for Russian gas; when considering marginal costs however, US LNG is more competitive at ~3,5 EUR/MWh
- Among which 65 bcm of capacities are off-line according to the IEA “Global Gas Security Review 2016”
- Timera Energy, « Gas Rebalancing: Clearing the Global Gas Glut », October 3rd 2016

volumes' hedging.

- Demand is high (~15% of the global gas demand);
- Europe benefits from efficient hubs, and only a small part of total volumes is indexed to oil prices (32% in 2015);
- The regasification capacities are high and largely underutilized;
- The storage and transmission capacities are under a Third Party Access regime

– The European market sets the global LNG floor price: due to the availability of competitive supply sources, European gas prices are not attractive to LNG shippers; a significant share of futures sold is therefore rerouted to other areas with higher prices (such as Asia). However when the LNG offer is above the demand in more attractive areas, Europe absorbs the excess volumes.

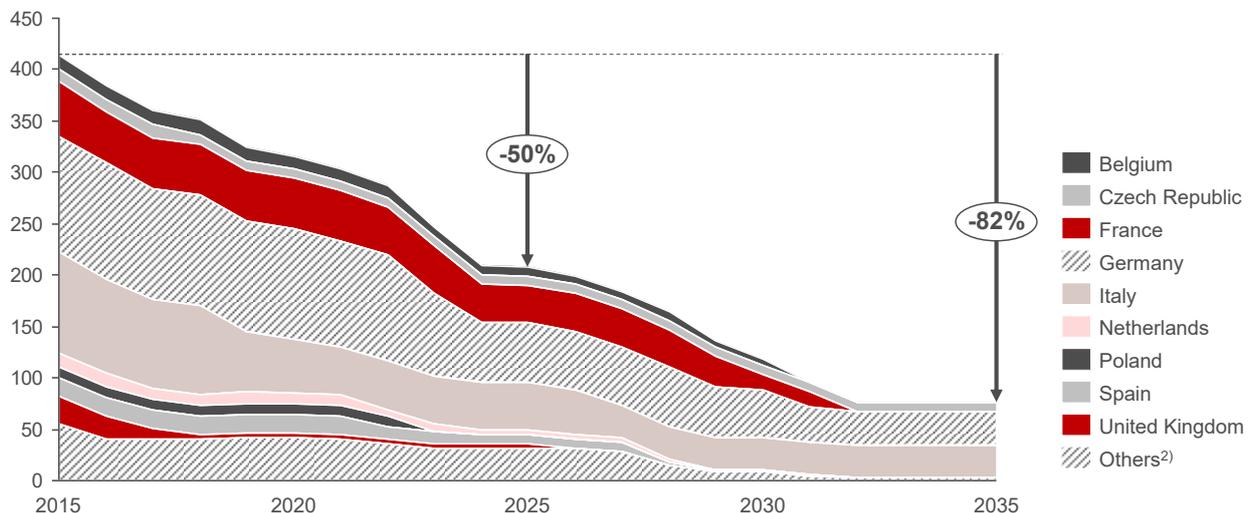
1.5. The volumes of gas under Long Term Contracts will drop by ~80% between 2015 and 2035

The share of Long Term Contracts (LTC) in European gas supply is steadily decreasing in Europe: from > 400 bcm of gas under LTCs in 2015¹⁵⁾, the total volume will have decreased by 50% to ~200 bcm in 2025, and by >80% to ~75 bcm/year in 2032-2035 – See *Illustration 5*.

Except for potential new supply routes with long term reservations such as TAP (several long term contracts were set for the period 2019-2044 for a total plateau volume of 10 bcm/year), no new LTCs should be put in place in the coming years. Indeed, the increased flexibility obtained in the gas market through liberalization measures and

the new European network codes (Congestion Management – 2012, Capacity Allocation Mechanism – 2013, Gas Balancing – 2014 etc.) provide enough short term capacities to shippers. The availability of short term capacities at market price eliminate incentives to reserve long term capacities with prices indexed to oil prices, and in which shippers have to bear a volume risk through “take-or-pay” clauses. Claudio Descalzi (CEO of ENI) summarizes this situation by saying: “If we could cancel all Long Term Contracts, we would do so immediately” (2015).

Illustration 5: Volumes of gas under Long Term Contracts by importing countries in Europe, 2015-2035 [bcm/year]



NB: The plateau volume of each contract has been taken in this analysis ; 2) Includes all countries which have one or several long term contracts wit a total plateau volume < 10 bcm/year in 2015: Austria, Bulgaria, Croatia, Denmark, Finland, Greece, Hungary, Lithuania, Luxemburg, Portugal, Romania, Serbia, Slovakia, Slovenia, Switzerland
Sources : Cedigaz, E-CUBE Strategy Consultants Analysis

15) Plateau volume of the contracts

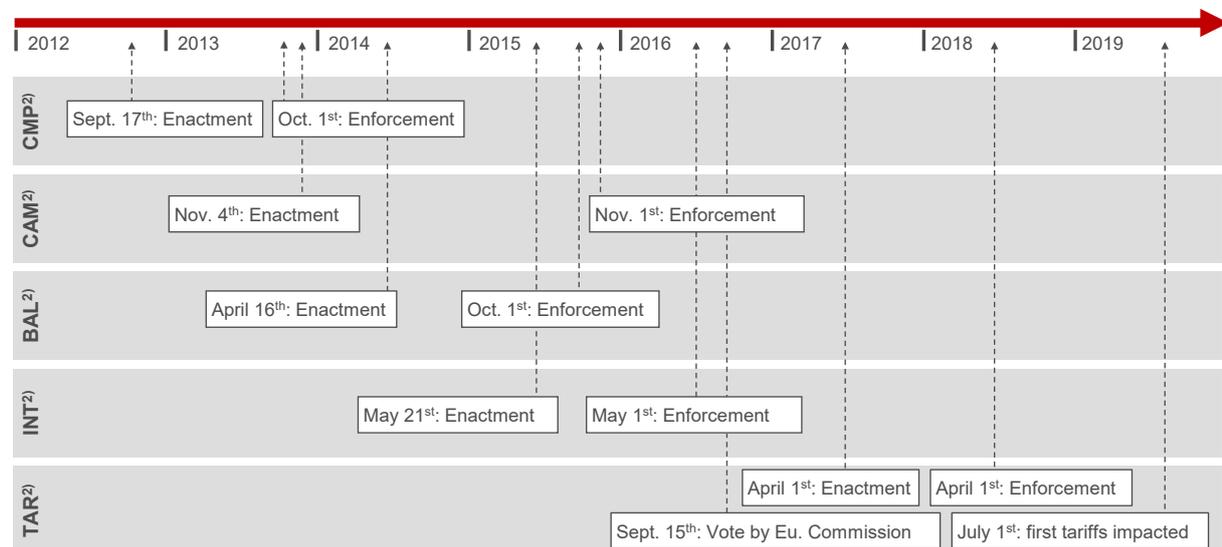
1.6. The European Gas Target Model is harmonizing rules amongst European TSOs and will lead to increased regional market integrations

The EU is pursuing a vision of “a competitive, secure European gas market that benefits all consumers”¹⁶⁾. All regulatory evolutions initiated at the EU level in the past years aim at developing this liquid and efficient gas market, called the “Gas Target Model”.

Since 2012 the European Commission has enacted four new “Network Codes” designed to establish new harmonized rules for all TSOs on operations and information exchanges (network code on Interoperability and Data Exchange – INT) and on the way to use and sell capacities (Congestion Management Procedures – CMP,

Capacity Allocation Mechanism – CAM, and Balancing network code – BAL). Following the CAM, a common platform for capacity booking, Prisma, was developed; 37 European TSOs are currently using it to offer transmission capacities on the primary market through auctions, and on the secondary market. A fifth network code on tariffs (TAR), which will give a common framework to TSOs for setting tariffs structures and reserve prices of auctions, was proposed by the European Commission in September 2016 and should be enforced during 2019 – See *Illustration 6*.

Illustration 6: Calendar for enactment and enforcement of the European Network Codes



1) From the enactment date, TSOs have a delay to set up the enforcement measures; at the expiry of this delay the code becomes mandatory ;

2) CMP = Congestion Management Procedure ; CAM = Capacity Allocation Mechanism ; BAL = Gas Balancing ; INT = Interoperability and Data Exchange ; TAR = Code on Tariffs

Sources: ICIS, National Grid, European Commission, E-CUBE Strategy Consultants Analysis

The Gas Target Model aims at increasing price convergence in Europe, through the reduction in the number of separated Entry-Exit zones in Europe. A progressive merger of zones and a reinforcement of interconnections should therefore occur in the coming years; indeed: “the size of each zone [should be] as large as the existing infrastructure allow”¹⁶⁾.

The exact model and degree of achievable market integration is however unclear, as several major obstacles remain:

- The complexity of administrative harmonization amongst numerous countries;

- The complexity of setting up an inter-TSO compensation system at the European level;
- The necessity to implement some new market tools to identify investment needs within a big Entry-Exit zone in which there is no price signal for congestions;
- The requirement for major investments in new infrastructures in order to achieve a single market at the European level where gas can flow totally freely, at a time where the decreasing gas demand is questioning the economic efficiency of such investments.

However it is very likely that some regional

16) Agency for the Cooperation of Energy Regulators – “European Gas Target Model Review and Update” 2014

market integrations will take place, following the initiatives of the Belgium and Luxembourg zones' mergers (BeLux) or the creation of one common market place out of the two balancing zones PEG Sud and PEG TIGF in the South of France (since April 2015). The German HoKoWä regulation which should be implemented by 2019 will homogenize entry tariffs of all TSOs within the NCG and Gaspool market zones.

Among other market connection initiatives to be launched in the next 10 years is the merger of PEG Nord and PEG Sud in France. Studies for this merger are ongoing since 2009; the total cost of necessary investments to eliminate congestions was estimated at EUR ~2.5 Billion, resulting in a 10% tariff increase for consumers.

The corresponding infrastructures are under construction and the merger will take place in 2018. A merger of the two German zones NCG and Gaspool is also under discussion, as well as the merger of those two zones with the Dutch TTF. In Eastern Europe, several market integration projects are under study (mainly the market integration between Poland, the Czech Republic, Slovakia and Hungary, and the implementation of a Trading Zone between Austria, the Czech Republic and Slovakia). Eastern Europe being short in interconnection capacities, such projects would require major investments (supported by the EU's Projects of Common Interest Program).

2. Those changes are strongly impacting the business models of European Gas Infrastructure Operators, to the point where their viability can be questioned

The six drivers of change in the European gas market incur major strategic challenges for GIOs which see their business models changing. Indeed, the decreasing share of Long Term Contracts and the increasing liquidity and homogenization of gas hubs incentivize shippers to change strategies towards short term capacity bookings more tightly adjusted to actual needs. As the existing long term reservations of capacities are to a large extent underutilized, this trend should lead to a global decrease in capacity

bookings. Moreover, price spreads between hubs and volatility follow a downward trend because of the decrease of oil prices and the gas surpluses of incumbent midstreamers holding LTCs; GIOs are therefore exposed to the decreasing market value of their transmission capacities up to the point where some fear a risk of stranded assets for their infrastructure.

2.1. The fear that part of the European transmission infrastructure face a risk of stranding is widespread amongst the Transmission System Operators

Stranded assets can be defined as assets that are unable to recover their investment cost because they have become obsolete or non-performing well ahead of their useful life, resulting into a loss of value for investors¹⁷⁾. In the transition to a low-carbon economy, many assets related to fossil fuels are considered at risk; in its 2°C-compatible 450 Scenario the International Energy Agency estimated that the risk of stranded asset would impact ~USD 304 Bn of investments by 2035, including USD 180 Bn for upstream oil and gas investments, USD 120 Bn for new fossil fuel capacity in the power sector and USD 4 Bn for coal mining.

The concrete mechanisms involved in asset stranding for gas transmission infrastructure are unclear, as the large majority of assets are

regulated under a revenue cap regime, where the TSO does not bear the volume risk (the TSO's annual "authorized revenue" is covered by the tariffs which evolve according to reservation levels). Nevertheless, many of the GIOs interviewed believe that asset stranding could become a reality in the near future, due to the fact that they deal with highly capitalistic infrastructure with long recovery time, while the associated activity is becoming increasingly short term and with low volumes.

GIOs have no clear conviction on which assets have the highest risk of stranding, except for some general remarks:

- Poland and the Baltic States are politically sensitive areas, with a lack of infrastructure and historical dependency on Russian gas.

17) Definition given by the OECD in "Divestment and Stranded Assets in the Low Carbon Transition", October 28th 2015 ; other definition given by Caldecott and McDaniels: "Assets that have suffered from unanticipated or premature write-downs, devaluations or conversion to liabilities" (Caldecott and McDaniels, 2014a)

Therefore there shouldn't be any drastic cuts in this area; latest investments in LNG terminals in this area support this idea;

- Transit pipelines should be more affected than LNG terminals, which are valued for their role in diversification of supply even though their utilization rates are low;
- Amongst transit pipelines, the merchant (i.e.

non-regulated) ones bear the highest risk, especially those that are located on gas routes that could disappear with the remodeling of transit flow patterns;

- Storage infrastructures are out of the money, however GIOs assume that they will be protected by regulators to preserve Security of Supply.

2.2. Most GIOs do not believe in the possibility of a drastic intervention from the regulator that would “breach basic rules”, such as arbitrarily removing assets from the RAB before their full depreciation

The form and mechanisms involved in asset stranding is unclear in the case of assets under revenue-cap: globally GIOs do not believe in the fact that their regulators could arbitrarily decide to stop remunerating an investment that it agreed to remunerate in the past.

Although they recognize that there is a risk in the long term if a vicious circle of decreasing demand/increasing tariffs was set up (*“The very last client will not be able to bear the cost of the whole network”*), most GIOs refer to this possibility as an “expropriation” of the investor that would not be considered by a national regulator. Indeed, the obligation of the regulator to remunerate the GIO for all investments necessary for providing an efficient service to end consumers is inscribed in the national law of most countries, such as in France (Energy Code, L452-1) or in Belgium (Gas law, April 12th 1965, Art. 15/5 bis §5.2). Although the law usually keeps a certain level of ambiguity in the wording (e.g. the “necessary” investments), it is globally considered that assets integrated in the RAB as “necessary” at a certain point in time cannot be removed even if the transit levels change drastically.

Another “practical” reason for GIOs not to believe in a removal of assets from the RAB before depreciation is that isolating one “stranded asset” within a whole network is technically difficult. Indeed, there are very few cases where shippers totally cease to use an asset: in most cases, even if the demand for capacities decreases sharply, a few connections to distribution networks or to industries remain, and therefore some flows that cannot be cut. Moreover, supply schemes can change in time and assets that are underutilized at one point in time can become necessary in the future. Globally, the increasing need for flexibility

and security of supply makes it unlikely that a regulator would take the responsibility to “abandon” an existing asset.

All GIOs also believe that they are protected from such event by the fact that regulators need to preserve their private owners’ interests. Indeed, achieving the Gas Target Model will require a large amount of new capital-intensive infrastructure in the coming year, and private investors will therefore be needed. In this context, regulators cannot afford to introduce some regulatory uncertainty by ceasing to remunerate past investments. This assertion seems to be confirmed by the fact that amongst all European TSOs, only the State-owned Gasunie Transport Services (GTS) experienced the decision by its regulator to decrease its authorized revenue to 65% of its current level in the next regulatory period (an efficiency factor of only 65% was attributed). This decision was taken on the basis of a benchmarking exercise on the “pan-European efficiency of gas transmission system operations” – project E2GAS – commissioned by the Council of European Energy Regulators (CEER).

The German regulator also considered the option of not attributing 100% efficiency to all TSOs for the next regulatory period, but did not retain it. The investment needs in Germany (to convert the L-Gas networks to H-Gas, or to prepare the NCG and Gaspool markets’ merger for example) can partly explain this choice.

2.3. However GIOs generally feel that negotiation with national regulators is increasingly hard, resulting into lower levels of remuneration for investors and less opportunities to invest into regulated projects

If the risk of stranded asset will not materialize as drastically as taking assets out of the RAB before full depreciation, all GIOs experience increasingly fierce negotiation with their national regulators. Exercises such as the E2GAS benchmarking project provide to regulators opportunities to compare TSOs with each other and to align remuneration and incentives accordingly.

Regulators have two main negotiating tools to limit the GIOs' remuneration levels, which could affect, according to some of the interviewed GIOs, 10 to 20% of their current revenues:

- Decrease the WACC¹⁸⁾, which is used as a basis to calculate the remuneration of the capital invested ($WACC \times RAB = \text{Remuneration of Capital}$). This can be done by setting a lower Bêta (risk of the asset) or a lower Market Risk Premium¹⁹⁾.
- Set ambitious OPEX reduction objectives, along with measures incentivizing the GIO to reach them (e.g. OPEX above the target set are not included in the authorized revenue).

In addition to those mechanisms, the depreciation pace can be used as a negotiating tool between the GIO and its regulator: GIOs can ask for a reduction of the depreciation length for their assets in order to fully recover their investment in a shorter (and less uncertain) time period; on the contrary the regulator can extend the depreciation period to limit tariff increases.

Another effect of fiercer negotiation is the reduction of the number of new investments, thus limiting growth opportunities for GIOs and threatening their future development. Indeed, regulators are increasingly cautious regarding the new projects to be included in RABs, and according the interviewed GIOs “no major investments will be included in RABs in the coming years” in order to keep the risk of stranded asset low. This concern is obvious at the European Commission level in their communications on new gas infrastructures: “[...]

Care should be taken with regard to investment in LNG or gas infrastructure to avoid the risk of [...] stranded assets in fossil fuel infrastructure²⁰⁾.

From an investor's perspective, the main risk of this situation is to get a return significantly lower than expected at the time of the investment. Surprisingly, the transaction levels observed recently on the market do not reveal any worry from investors (mostly investment funds) about those perspectives of lower returns; on the contrary, the EV/RAB²¹⁾ ratios were largely above 1, and sometimes very high (up to 1.5). This was the case, for example, of the acquisition of Open Grid Europe by Macquarie, MEAG, British Columbia IM and ADIA (May 2012), or of Total Infrastructures Gaz France by EDF Invest, Snam Rete Gas and GIC (April 2013). More recently, the acquisition of Thyssengas by EDF Invest and DIF can also be cited (June 2016).

The main hypothesis put forward by interviewed GIOs to explain this apparent contradiction is that financial investors, given the low interest rates worldwide, have huge amounts at their disposal and few secure infrastructure projects to invest in; pension funds such as Allianz (buyer of Net4Gas and Gas Connect Austria) or Borealis (buyer of Net4Gas) are therefore ready to put large amounts of money for a regulated asset that ensures secure revenues even though the rates of return are low. Moreover, GIOs believe that those investors value the assets at a very short time horizon (5 to 10 years) in which they are confident about being able to get value by increasing efficiency, while the main sector risks are identified at a longer time horizon.

Such a logic is however not sustainable in the long term if the market fundamentals deteriorate the final value of the RAB within a 10-year time horizon. Moreover, GIOs view a big risk that regulators use those levels of transactions to justify that remuneration is too high in the sector and to increase pressure in negotiations.

18) Weighted Average Cost of Capital = Cost of debt x Share of Debt + Cost of Equity x Share of Equity

19) Cost of Equity = Risk Free Rate + (Bêta x Market Risk Premium)

20) “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on an EU strategy for liquefied natural gas and gas storage” 16/02/2016

21) Enterprise Value/Regulated Asset Base

3. Faced with those challenges, Gas Infrastructure Operators and their shareholders have several mitigation levers at their disposal

Infrastructure operators list various kinds of levers for risk mitigation, both at GIOs and their investors' levels. Although those levers have various levels of impact and accessibility, none of them should be neglected and initiatives should

be taken today in order to influence long term trends. They can be classified into three main categories: "levers at constant perimeter", "growth levers" and "diversification levers".

3.1. Levers at constant perimeter include lobbying efforts, commercial strategy and partnerships, as well as financial support to gas consumption and renewable gas injection projects

Levers "at constant perimeter" are levers that do not imply a change in the infrastructure operator's perimeter (i.e. selling of buying assets); they include:

– Lobbying efforts at the European and the national levels

This lever is considered by several infrastructure operators as key to mitigate the risk of stranded asset. Indeed, faced with the regulators' possibilities to reduce their remuneration, GIOs also have some negotiating power, especially in areas where investments will be needed in the coming years to achieve the Gas Target Model. Several GIOs believe that they will be able to negotiate shorter depreciation durations or higher WACC levels in compensation for the unstable environment. Additionally some argue that new investments can boost utilization of existing infrastructures (for example, it could be argued that the Easting pipeline project connecting Slovakia to Romania and Bulgaria would imply the use the Slovakian network to bring gas from Nord Stream to Eastern Europe, while this network would otherwise be at risk of stranding if Russia ceases to use Brotherhood).

At the European level, GIOs have a role to play in designing their future business model. If negotiations on the Network Codes are now nearly over, many discussion and negotiation will occur in the coming year on the Gas Target Model, in which GIOs have the opportunity to participate. Lobbying efforts on the GTM can have important effects on the level of risk faced by TSOs. In particular, depending on the way the integrated model is built (size and geographic breakdown of the final market zones, inter-TSO compensation system, market tools developed to identify investment needs, method for identification and financing of infrastructures with no commercial rationale but necessary for Security of Supply etc.), some TSOs could manage to strongly protect their assets from stranding through a socialization of risks.

More generally, several GIOs argue that lobbying

efforts should be more directed towards the advocacy of the gas sector against other energy sources (coal for electricity generation for instance); the role of gas in the energy transition and further should be highlighted in front of public bodies.

– Set up of strategic partnerships with other GIOs

Strategic partnerships between GIOs can theoretically participate to risk mitigation through several channels: they can bring a stronger support to a particular project of interest for the two partners, in front of other competing projects; they can allow developing commercial strategies along a common gas route; they can also facilitate co-financing of investments of common interest.

However, it must be noted that few of those "strategic alliance" were developed in practice as their theoretical effects are difficult to achieve. The European Network Codes strongly limit opportunities for commercial strategies' implementation and new infrastructure developments are strongly regulated (in particular, an "open season" must prove the need for new interconnection capacities). Moreover aligning interests of two actors in the long term is difficult and the efficiency of alliances is limited by the fact that they remain short term, variable and opportunistic.

– Commercial strategy implementation on transit tariffs

The Network codes (setting harmonized rules for selling periods and auction models, capacity allocation and tariff setting methodologies) and the development of the GTM (harmonizing tariffs at the Entry and Exit points of larger market areas) will progressively reduce the effect of this lever for TSOs as room for commercial strategies will disappear. More flexibility could however remain in the case of interconnectors such as IUK (UK <> Belgium) or BBL (Netherlands > UK) as they might benefit from exemptions on some aspects of the Tariffs Network Code.

– Support to gas consumption and to renewable gas development and injection projects

Beyond lobbying efforts, several GIOs converge with the analysis that financially supporting new gas consumptions, especially in the electricity production and mobility sectors, can help to mitigate the sector's risks. The potential for new gas consumption volumes could indeed be significant: in Germany for instance, where ambitious emissions' reduction targets are set for 2050, the potential for Small Scale LNG for industrial consumption and mobility and of Compressed Natural Gas for vehicles could represent ~9 to 15% of the 2035 consumption projected by ENTSOG²²). In Sweden, the total estimated potential for those same gas usages could represent 1 bcm, which is above the current level of consumption in the country (0.8 bcm). To this potential, significant volumes of natural gas consumption as maritime fuel could be added, especially in the North of Europe where the "Sulphur Emission Control Area" regulation encourages this development.

Some of the interviewed GIOs therefore picture themselves as infrastructure operators for LNG and CNG refueling stations and other projects of

this kind; however the risks involved in such investments, very different from their core businesses, are high. Some other interviewee are therefore more conservative, pointing out that many elements which are key for the development of those sectors are totally out of control for the GIO. Some discussions were engaged by GIOs with national authorities to include in the Regulated Asset Base perimeter infrastructures such as NGV refueling stations, but without any positive sign from the public side so far.

If GIOs globally have mixed feelings about the impact they can have in downstream gas consumption development, they are more numerous to believe that their financial support can be key to trigger the development of renewable gas injections in the gas transportation networks. Indeed, this activity is closer to the GIO's core business, including technical interventions for connecting biomethane or power-to-gas plants to the network, for adapting to pressure and hydrogen levels requirements etc. Financially, TSOs can also support this kind of project by bearing all or part of the connection costs²³.

3.2. Growth levers can bring significant gains through improved OPEX efficiency, which can only partly be kept by GIOs and their shareholders

Acquiring assets that allow operational and commercial synergies can represent a strong lever for GIOs to compensate diminishing remuneration perspectives and increasing pressure on OPEX levels. Indeed, our analysis suggests that synergies due to the rationalization of real estate and of transverse functions (HR, IT, procurement etc.) can reach up to 4 to 7% of the RAB values of the acquired entities. Those synergies can be even greater in the case of TSOs that have connected networks and can work together on commercial aspects (for example, Gasunie Transport Services and Gasunie Deutschland).

In practice however, several GIOs express doubts on the usefulness of synergies. Even if the amounts represented can be significant, only part of the gain is earned by the GIO's shareholder (the other part being kept by the regulator to reduce tariffs); moreover, "you can only outperform the regulator over one regulatory period" (as OPEX objectives will be adapted to the new situation in the following regulatory period). Finally, several GIOs point out that the

recently observed transactions concern acquisitions of networks that are not closely connected and that remained in practice largely separated, including in the support functions.

However, from a collective point of view, achieving synergies and better efficiency on OPEX contribute to gas competitiveness and therefore benefits all actors of the sector. Operational cooperation between GIOs with connected or close assets, easier to set up than proper acquisitions, should therefore increase in the future (between German TSOs for instance).

Another advantage of "growing" for GIOs can be an additional "negotiating weight" in front of the regulator (national or European); this point can however be debated: if bigger financial resources and economic weight can help defending a position in front of the regulator, it can be also be argued that regulators would be more sensitive to several small actors defending one position than to one big actor alone.

22) Depending on the TYNDP scenario retained: 70 bcm in the TYNDP "Green" scenario, or 44 bcm in the TYNDP "Grey" scenario

23) The cost of injecting biomethane to the transmission network is evaluated at ~300 000 EUR/year for an injection capacity of 1 000 (N)m³/hour (including the OPEX and CAPEX costs); in comparison, the cost of injection of the same capacity in the distribution grid is ~3 times lower (~99 000 EUR/year). Source: DNV Kema, "Injecting Green Gas into the Grid, Dutch Example", 2012

3.3. A portfolio diversification strategy can contribute to risk reduction, without suppressing a systemic sectorial risk

More globally than acquiring a specific asset for synergies or economic weight purposes, GIOs and (more easily) their investors can engage in a complete risk diversification strategy through the constitution of a portfolio of assets that present risk profiles different from the historical one (in or outside Europe). This lever is almost unanimously recognized as efficient by the interviewed GIOs, the most efficient strategy being in their view to acquire assets located on alternative competing supply routes, or assets that present a different exposure to risks (regulatory, operational) from the assets already in the portfolio. For example, if the historical asset is highly exposed to the risk of transit – such as Gas Connect Austria, the rationale would be to invest in an asset with a higher share of captive clients – i.e. domestic consumers – such as GRTgaz or Open Grid Europe. Similarly, if a substantial part of the historical asset's revenues comes from merchant activities or assets under a *price cap* regime, the acquisition of assets regulated under *revenue cap* can help reducing the risk of diminishing capacity reservation.

According to our analysis, the investor's risk is higher for an asset with a significant exposure to transit than for an asset with a low exposure to transit: measured in terms of ratio "Shareholder Remuneration at Risk²⁴⁾ / Total Equity Value", the risk is 5-7% for the first asset, while it would be between 0 and 4% for the second asset (depending on other risk factors such as the decrease of domestic consumption). An asset under *price cap* would have a higher ratio, up to 12%.

Two main limits can be identified to this reasoning:

- Firstly, a diversification strategy inside Europe does not reduce the sectorial systemic risk (i.e. if the gas sector is deemed to disappear in Europe, then having a portfolio instead of one single asset does not reduce the associated risk). From an investor's point of view, the total risk in absolute value can even increase with such a strategy as it implies putting more capital in the same sector, and therefore raising the exposure to the systemic risk. One solution to this is a diversification strategy outside Europe, however GIOs point out the high risks of such investments and unanimously believe that such a move should be considered only when the GIO is confident that it has some real added value to the acquired project or asset. The main example today is Enagas, which invested in LNG activities in Latin America.
- Secondly, some interviewed GIOs note that the value of portfolio diversification strategies is reduced by the fact that it does not lead to any form of market consolidation overall in Europe. Indeed, market players are not consistent in their alliances so far (E.g. Allianz acquired Net4Gas in alliance with Borealis, but acquired OMV's interest in Gas Connect Austria with Snam; Fluxys acquired Swedegas with Enagas but acquired Eni's and E.ON's stakes in IUK with Snam etc.) Due to the difficulty to conciliate very different goals (strategic, financial...) and constraints (financial capacity, shareholder's will...), building a long term alliance for acquisition is nearly impossible and therefore market consolidation cannot be reached.

Additionally, from a GIO's perspective, the amounts that financial investors are ready to pay in the market, valuing asset sometimes well above the RAB value, is another major structural barrier for such strategy, unless they have a specific mandate from their shareholders.

24) Measured as the difference between the « reference remuneration » (RAB x WACCR in the reference conditions) and a "downgraded remuneration" (RAB x WACCD, with WACCD < WACCR) following re-negotiation with the national regulator.

References

Among other sources of information for this paper, E-CUBE Strategy Consultants interviewed 12 top-level executives from the following EU gas infrastructure companies:

- **Austria:**
 - Gas Connect Austria
- **Czech Republic:**
 - Net4Gas
- **Denmark:**
 - Energinet.dk
- **France:**
 - GRTgaz
 - TIGF
- **Germany:**
 - Open Grid Europe
 - ONTRAS
- **Greece:**
 - DESFA
- **The Netherlands:**
 - Gasunie Transport Services
- **Slovakia:**
 - Eustream
- **Spain:**
 - Enagas
- **Switzerland:**
 - Gaznat

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