DOI: 10.1007/s10272-011-0375-6

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European Gas Imports from North Africa

Reassessing Security of Supply in the Light of Political Turmoil

The uprising and military confrontation in Libya that began in February 2011 has led to a disruption of the country's gas exports to Europe. An analysis of how Europe has compensated for these missing gas volumes shows that the disruption has not affected security of supply. However, this situation would change if the North African uprising were to spread to Algeria.

The political uprising in Libya at the beginning of 2011 and the subsequent enforcement of a UN-sanctioned no-fly zone has severely affected the country's pipeline exports to Europe. The Greenstream pipeline from Libya, which supplies around nine billion cubic metres (bcm) of natural gas to Italy each year, stopped operations on 22 February 2011 and deprived the Italian gas market of significant volumes at the end of the winter and into spring.

This article analyses the current and potential effects on the European gas market of supply disruptions in North Africa. The dependence of the individual European countries on North Africa differs significantly but, in general, the European Union (EU) imports 10 bcm annually from Libya, 7 bcm from Egypt and another 47 bcm from Algeria. Together this equates to about 14% of EU gas consumption and about 29% of non-European imports. All imports from Egypt as well as about 45% of the Algerian volumes arrive in Europe as liquefied natural gas (LNG), i.e. they are not transported by pipeline but are shipped on specific vessels across the sea.

In the case of export disruptions from North Africa, the LNG volumes may not be a cause for concern: with the currently well-supplied global gas market, the approximately 28 bcm of LNG may be substituted by LNG from other sources. However, southern European countries are also exposed to disruptions of pipeline supplies from North Africa: the Greenstream pipeline supplies about 12% of Italian gas consumption, while links from Algeria deliver about 30% of Italian and 20% of Spanish gas demand.[1]

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Security of natural gas supply has so far been addressed by studies that focus on aspects of global geopolitical security of supply[2] or on short-term disruptions. Weisser's[3] extensive definition of security of natural gas supply refers to risks associated with source, transit and facility dependence and structural risks of natural gas supplies. According to Weisser, risks from these dependences could be triggered by drivers like natural disasters, political conflicts, terrorism, wars and civil unrest. With respect to short-term disruptions, the limited literature addresses risks arising from transit dependence, such as the transit disruption of Russian gas via Ukraine: Bettzüge and Lochner[4] analyse the gas market's responses to the 2009 crisis; Monforti and Szikszai[5] validate an early warning model using the same event. System resilience to similar disruptions of Russian gas transits in the future, when additional infrastructure may be available, is investigated by EWI[6] and Dieckhöner[7].

1 These percentages are for 2009 and based on BP: Statistical Review of World Energy, London 2010.
2 See for instance F. Holz, C. von Hirschhausen, C. Kemfert: Perspectives of the European natural gas markets until 2025, in: The Energy Journal, Vol. 30, Special Issue, 2009, pp. 137-150; and D. Victor: Natural gas and geopolitics, Coordinating Energy Security in Supply Activities (CeSSA) Working Paper 14, European Regulation Forum on Supply Activities, Brussels 2007.
3 H. Weisser: The security of gas supply – A critical issue for Europe?, in: Energy Policy, Vol. 35, No. 1, 2007, pp. 1-5.
4 M.O. Bettzüge, S. Lochner: Der russisch-ukrainische Gaskonflikt im Januar 2009 – eine modell-gestützte Analyse, in: Energiewirtschaftliche Tagesfragen, Vol. 59, No. 7, 2009, pp. 26-30.
5 F. Monforti, A. Szikszai: A Monte Carlo approach for assessing the adequacy of the European gas transmission system under supply crisis conditions, in: Energy Policy, Vol. 38, No. 5, 2010, pp. 2486-2498.
6 EWI: Model-based Analysis of Infrastructure Projects and Market Integration in Europe with Special Focus on Security of Supply Scenarios, Final Report, 2010, available at http://www.ewi.uni-koeln.de/ERGEG-Study.303.0.html (accessed 1 March 2011).
7 C. Dieckhöner: Simulating security of supply effects of the Nabucco and South Stream projects for the European natural gas market, EWI Working Paper 10/7, Cologne 2010.

The prolonged disruption of natural gas supplies from Libya suggests a different threat to European security of natural gas supplies. It not only concerns a different route and region but is also due to a different cause: domestic political uprisings leading to civil-war-like unrest and, in the case of Libya, outside military intervention and war.

Focusing on southern Europe, we shall now investigate the disruption of pipeline supplies from Libya to Italy in 2011. Subsequently, a model-based analysis evaluates the effects of a potential extension of disruptions from the potential spread of unrest to Algeria. Implications of the recent developments in North Africa on European security of gas supply legislation are discussed in the concluding part of the article.

The Disruption of Libyan Gas Supplies

On 22 February 2011, Libyan pipeline gas exports to Italy came to a halt because of the political turmoil in Libya. Before the disruption, Italian imports from Libya amounted to about 26 million cubic metres (mcm) per day. In winter, these imports supply about 8% of the average total Italian consumption of 330 mcm per day (see Table 1). In addition to LNG, Italy imports pipeline gas from Algeria, Russia (via Austria and Slovenia) and northern Europe (via Switzerland). Gas from Italian gas fields and from gas storage is also available. Table 1 illustrates how the volumes were compensated for during the early days of the Libyan disruption: mainly by withdrawals from storage and additional imports from Algeria. Volumes supplied from all other sources remained close to the January level or even declined slightly because of lower demand in February/March.

Supply capacities from the alternative sources suggest that additional increases would have been possible, depending on the supply situation in the rest of Europe, primarily imports on the transit routes through Switzerland and Austria. However, in absolute terms, LNG imports and domestic production would not have been able to contribute significant additional quantities.

Regarding storage, which has contributed significantly to meeting demand, the relevant question concerns how long the stored gas volumes will be sufficient. On 17 March 2011, 7.4 bcm were left in Italian storage (Gas Storage Europe data), so even high storage withdrawal rates of 80 mcm per day could have been sustained for more than 90 days. With the arrival of spring, however, such withdrawals will no longer be necessary; therefore, supplies for Italian consumers were secured at all times during the disruption of Libyan imports.

Table 1
Italian Gas Supplies Before and During the Libyan Supply Disruption

Source of gas (entry point)	Max capability[1]	Jan/Feb 2011[2]	Libya disruption[3]	Change
Algeria (Mazara)	100.8	82.6	96.4	+13.8
via Austria (Tarvisio)	112.2	90.0	83.1	-6.9
via Switzerland (Passo Gries)	59.2	29.0	27.7	-1.3
via Slovenia (Gorizia)	0.7	0.5	0.7	+0.2
Libya (Gela)	34.3	25.8	0.0	-25.8
LNG (Panigaglia)	7.8	5.5	6.1	+0.6
LNG (Cavarzere)	25.7	21.0	18.5	-2,5
Storage withdrawals	n/a	55.1	75.8	+20.7
Domestic production	27.1	21.4	21.3	-0.1
Total demand	n/a	330.9	329.7	-1.2

Source: Based on SnamReteGas data.

Notes: All values in mcm per day. [1] Maximum supplied volume between 01/01/2010 and 11/03/2011. [2] Data sample from 01/01/2011 to 20/02/2011. [3] Data sample from 23/02/2011 to 12/03/2011.

However, this stable situation might change if the disruption in North Africa spreads to other countries, particularly Algeria. We therefore analyse two disruption scenarios: one that assumes an additional cut-off of pipeline imports from Algeria in summer 2011 and another that assumes a disruption of supplies from North Africa at times of higher gas demand (e.g. winter 2011/2012).

Scenario Analysis of Continued and Extended Supply Disruptions from North Africa

The situation in Libya is less of a concern to the European gas market than is the potential spread of the North African uprising to Algeria, the EU's third-largest (after Russia and Norway) foreign gas supplier. The effects of disruptions of gas supplies from Algeria are investigated in a simulation analysis that applies the TIGER model, a linear program with high temporal and spatial granularity.[8] It optimises the dispatch of natural gas volumes in Europe, subject to supply, the available infrastructure (pipelines, storage and

8 For a detailed description of the model, see S. Lochner, D. Bothe: From Russia with Gas – An analysis of the Nord Stream pipeline's impact on the European gas transmission system with the TIGER-model, EWI Working Paper 07/2, Cologne 2007; and S. Lochner: Identification of congestion and valuation of transport infrastructures in the European natural gas market, in: Energy, Vol. 36, No. 5, 2011, pp. 2483-2492.

LNG import terminals) and demand.[9] The model provides a dynamic and integrated evaluation of the infrastructure components, their interaction, and the effects of import disruptions on security of supply.

Disruptions During Summer

The first scenario (summer disruption) assumes a disruption of North African supplies from 15 March to 30 September 2011. Figure 1 compares the aggregated effects for the Italian gas supply mix in this time period relative to a simulation without supply disruptions.[10]

The missing volumes of 19 bcm from Libya and Algeria are compensated for mainly by additional LNG imports in Italy (5.6 bcm) and LNG imports to the UK that are transported to Italy via Belgium, Germany and Switzerland (6.7 bcm). Additional Russian volumes are routed to Italy via Austria, and injections into Italian storage in summer decline (compensated for by additional LNG imports the following winter). Therefore, even a prolonged halt to the transport of pipeline gas from both Libya and Algeria causes no disruption to consumers if it starts in spring and does not last into the winter.

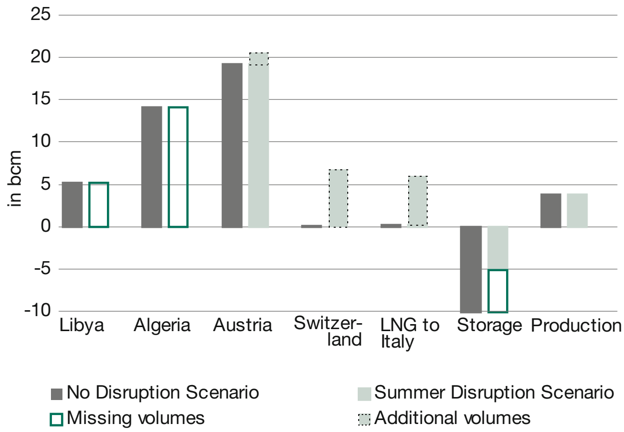
The situation in Spain, whose dependence on pipeline supplies is lower than that of Italy, is similar. Additional LNG imports can easily compensate for the volumes that Spain does not import from Algeria in summer.[11] As there are sufficient LNG capacities, this also holds true for Spain in the winter months. However, the situation is different for Italy, where LNG import capacities are limited and winter demand is significantly higher.

Disruptions During Winter

Our second simulation investigates a disruption of supplies from October 2011 to March 2012. As in the summer analysis, we find that significant volumes of gas can be rerouted. In addition to LNG transported to the Italian terminals, compensation for the missing volumes in Italy comes from additional LNG imported from other European countries and the routing of additional Russian and Norwegian gas to Italy.

Figure 1

Simulated Gas Supplies to Italy, March to September 2011



However, with these measures, all import infrastructures must operate at capacity, and any additional volumes required need to be withdrawn from Italian gas storage. Therefore, Italian gas storage is depleted much faster than it would be under normal circumstances. The time until depletion of gas stocks then depends largely on the temperature (which determines household gas demand) and the price elasticity of demand in the industry and power sectors. Assuming these to be inelastic, the first disruptions to consumers would occur between 86 and 114 days after the start of the disruption – that is, in December 2011 or January 2012. Figure 2 illustrates the accumulation of unsupplied demand in such a scenario.[12] At this time of the year, industrial gas consumption is approximately 7.5 bcm, so unless the power sector can substitute sufficient gas-fired power plants with other types of power generation, household consumption may also have to be rationed. Because of the infrastructure bottlenecks into Italy in such an extreme scenario, suppliers in other countries would not be able to supply additional volumes, despite presumably high prices in the day-ahead market at the country's trading point (Punto di Scambio Virtuale, PSV). The congestion into the country would also prevent price spikes at other locations.

The expected unsupplied demand in Italy for the entire winter season is 7.6 bcm. A comprehensive valuation of the welfare losses from such a supply shortfall is beyond the scope of our brief analysis, but relating this loss of gas sales to the current PSV future price for the 2011/2012

9 Demand assumptions here are based on P. Capros, L. Mantzos, N. Tasios, A. DeVita, N. Kouvaritakis: EU energy trends to 2030 – update 2009, Publications Office of the European Union, Brussels 2010; infrastructure and supply assumptions are based on EWI, op. cit., pp. 21-29.

10 The model's suitability for replicating actual gas flows is shown in EWI, op. cit., pp. 41-44.

11 We assume that the well-supplied global LNG market allows the purchase of additional cargo from other sources.

12 We analysed temperature-demand correlations and temperatures to derive a distribution of gas demand for Italy. (See Figure 2 caption for summarised results.) Average demand for the October to March period is 49.67 bcm.

winter[13] of €31.30/MWh yields €2.6 billion in lost sales. Hence, based on the model results, a prolonged supply disruption from North Africa poses a severe threat to the security of Italian natural gas supplies. Most other countries are less dependent on the region, and Spain has sufficient redundant capacities.

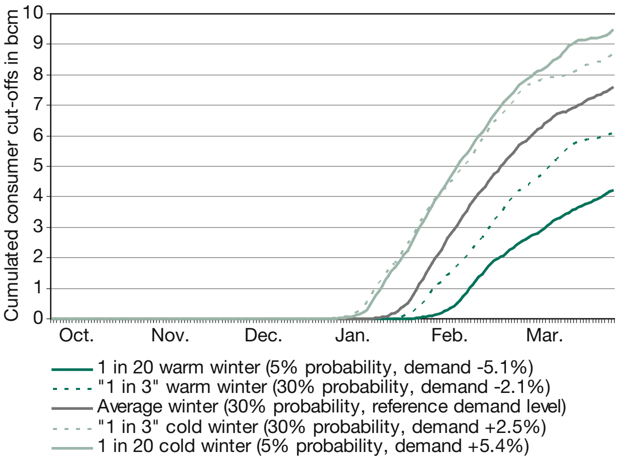
Reassessing Security of Supply

The current disruption affecting Libyan supplies to Italy is also the first major incident since the adoption of the new regulation "concerning measures to safeguard security of gas supply" by the European Parliament and the Council of the European Union.[14] Hence, in this context the contributions of envisaged measures to enhance security of supply regarding the aforementioned threats are reflected. Generally, the regulation is based on a top-down and a bottom-up component: universal security standards and regional risk assessments.[15] Preventive action and emergency response plans are to be set up based on the two.

With respect to the risk assessment, the country-specific analyses performed by the individual member states were not completed at the beginning of 2011. However, it seems that contemplating potentially prolonged supply disruptions such as the one from Libya, the causes of which are beyond the gas market, was not in the focus of the Commission's request for risk assessment. The regulation's emphasis is on supply disruptions "such as the one that occurred in January 2009" in Ukraine, and risk assessment is supposed to be based on "history, probability, season, frequency and duration" of supply disruptions.[16] Gas supply disruptions in Europe in the past were due either to technical problems or economic disputes with transit countries. Examples of technical incidents include the disruption of the Transitgas line in Switzerland following a landslide in 2010 and the explosion and fire at the UK's Rough gas storage facility in February 2006. Gas transits were disrupted in the past because of economic disputes between Russia and the transit countries, for instance Belarus in 2004 and Ukraine in 2009.[17]

Figure 2

Supply Disruptions to Consumers Based on Level of Demand



The technical issues lasted several months (five each in the aforementioned cases) and concerned only single infrastructure elements. The transit disruptions lasted between a few days and two weeks, i.e. their durations were relatively short. Indeed, one should not expect transit disruptions to last particularly long: they harm producers, transit countries and consumers and negatively affect the reputation of natural gas as a securely available fuel. Hence, they are not in the long-term interest of the stakeholders; the incentives for a speedy resumption of deliveries are great.

This might be different in civil-war-like conflicts. These depress economic activity in general and the long-term prospects of gas exports may not be a priority. Therefore, a quick resumption of gas supplies cannot be guaranteed. In the case of Libya, the affected volumes are relatively small. However, as we have seen, political turmoil in Algeria might lead to a much more critical scenario. Hence, the risk assessments for countries supplied with gas from potentially politically unstable regions will need to ensure the inclusion of the possibility of such events: in a political and military confrontation within a country, large gas supply volumes might not be available for prolonged time periods.

The universal infrastructure standard includes the n-1 criterion and the installation of reverse flow capacities at all cross-border connection points. The former requires each country to be able to ensure gas supply on a peak demand day without its single largest infrastructure capacity; the latter requires that pipelines between countries can be operated in both directions. This feature means that gas can flow against the normally prevailing direction

13 ICIS Heren data, 27/04/2010.

14 European Union: Regulation (EU) No. 994/2010 of the European Parliament and the Council of 20 October 2010 concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC, Official Journal of the European Union, Brussels 2010.

15 P. Noël: Ensuring success for the EU Regulation on gas supply security, University of Cambridge (EPRG) & European Council on Foreign Relations (ECFR), Cambridge 2010.

16 European Union, op. cit., p. 4 and p. 12.

17 M.O. Bettzüge and S. Lochner, op. cit.; and F. Hubert, I. Suleymanova: Ostsee-Pipeline: Die Gewinne werden neu verteilt, in: Wochenbericht des DIW Berlin, No. 7/2009, pp. 114-120.

of a pipeline link. Both universal infrastructure standards have been controversial for two reasons: they are not necessarily efficient and they put too much of a focus on capacity instead of volumes. The economic inefficiency arises from the generalisation. The individual costs of, and the willingness to pay for, the provision of additional security are not considered.[18] Furthermore, the specific security-enhancing benefits of investments in redundant capacities may differ between projects. This is also not taken into account. Hence, the welfare optimal level of security of supply is unlikely to be provided through a universal standard.

The focus on capacity may also be misleading: adequacy of capacity is a necessary but not a sufficient condition for a certain level of security of supply. After all, one still needs the volumes to utilise pipeline, storage withdrawal or LNG import capacity in order to enable the delivery of gas to consumers. So security of supply may not be as high as the n-1 criterion suggests.

Regarding Italy (and ignoring the inefficiency argument for the moment), a 2009 analysis by the European Commission[19] ranked EU members by compliance with the n-1 criterion: Italy was found to comply handsomely as its production, storage withdrawal, and LNG and pipeline import capacity minus the capacity of the largest infrastructure equalled 124 per cent of the conceived maximum demand. Only eight EU countries did better than Italy; additional investments were not required.

However, the difficulty of focusing on capacities becomes evident from a detailed consideration and the analysis in this article: 70 per cent of Italy's aforementioned n-1 capacity is storage withdrawal capacity.[20] If storage is depleted over time – as it would be in prolonged supply disruptions, for instance as simulated for Algeria – withdrawals from storage will decline or stop. Gas from all the other capacities (assuming quantities are there) can then satisfy only 54 per cent of the theoretical maximum daily consumption in Italy. So even the country's compliance with n-1 does not mean supply is secure. Defining the level of security of supply through infrastructure capacities makes the assessment heavily dependent on storage in Italy's case; this might deplete quickly if the disruption duration is long.

18 For a discussion of this issue see N. Ahner, S. Rüster: Challenges for European natural gas supply security regulation, in: Network Industries Quarterly, Vol. 12, No. 3, 2010, pp. 6-9.

19 European Union: Commission Staff Working Document, Accompanying document to the Proposal for a Regulation of the European Parliament and of the Council concerning measures to safeguard security of gas supply and repealing Directive 2004/67/EC, Impact Assessment COM(2009) 363, SEC(2009) 980, Brussels 2009.

20 Ibid, p. 32.

Conclusion

Past supply disruptions that have affected Europe were brief and were due to either technical problems or economic disputes with transit countries. These concerns are also reflected in the relevant regulation: the security of supply guideline by the European Commission emphasises system resilience for supply disruptions lasting up to thirty days; infrastructure capacities are used as one measure. The situation in Libya falls into neither of those categories. Unlike technical issues (or potential terrorist attacks), a war-like situation may affect whole countries, not just single infrastructure components. A speedy resumption of gas deliveries in such a scenario is far from certain: if a country like Algeria is affected, large import volumes would be missing for a long period of time. Storage volumes needed to sustain supply to consumers would decline rapidly.

Such a scenario can also be observed in the results of our model simulations: short-term interruptions of gas supply can be compensated for, but prolonged interruptions of gas supply from North Africa in winter would pose a severe threat to security of supply and cause disruption to end consumers.

Therefore, a reassessment of the short-term security of gas supplies might be required in which the potential for long-lasting supply disruptions, especially from politically unstable countries, is taken into account. Such investigations are only possible through simulations (as shown here) in the context of comprehensive risk assessments. Considering infrastructure capacities (n-1 standard), which is one of the measures in EU Regulation 994, is insufficient: in prolonged disruptions, the availability of gas volumes becomes even more relevant – capacity is only a necessary condition. Asking member states to make such comprehensive risk assessments, as the regulation also does, therefore contributes to improving security of supply.

Nevertheless, the findings of this article do not imply that security of supply obligations should necessarily be strengthened. Risk assessment should also explicitly take into account the costs and benefits of each potential measure; maintaining the supply of gas to all consumers at all times is highly unlikely to be optimal from a welfare perspective. A comprehensive evaluation of the probability and societal costs of potential supply disruptions, as well as the costs of increasing the level of security, is necessary. Because of differing supply and consumption structures, each of these factors may vary between individual countries and regions. This strengthens the case for the regional character of the risk assessments already envisaged by the EU, but also for country-specific measures to improve security of supply in addition to the rather limited standards mandatory for all EU member states.