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RESEARCH ARTICLE

Vincenzo BIANCO, Federico SCARPA, Luca A. TAGLIAFICO

Current situation and future perspectives of European natural gas sector

Abstract Gas market in Europe is experiencing a radical change for different reasons, partially determined and accelerated by economic downturn of the last period. In the past few years, many European countries adopted energy policies largely based on the utilization of natural gas. In fact, a sharp increase of the demand was observed and, at the same time, a lot of infrastructures were developed to assure the necessary supply. In the last few years, due to the economic downturn, natural gas demand decreased, causing a consistent oversupply on the market, which altered the consolidated dynamics of the sector. Understanding the changes currently under development in the European gas market is of paramount importance in order to design future strategies for the sector; in particular, it is necessary to understand if the present situation will cause a reshaping of the sector.

Keywords natural gas, natural gas market, oil-linked contracts, supply infrastructures, gas hubs

1 Introduction

Natural gas is one of the main sources of primary energy in Europe. From the end of 1990s a sharp increase of its consumption was detected, because of its massive use in all economic sectors and, in particular, in the electricity generation, thanks to the large development of combined cycle gas turbine (CCGT) plants.

The use of natural gas in the power generation sector was also encouraged by the implementation of the EU Emission Trading Scheme (i.e. a scheme for the trading of CO_2 emissions allowances), which gives advantages to low carbon intensive fuels, and by the development of renewable generation, which needs a thermoelectric back-up capacity and gas turbines are considered the best option [1].

The fast and diffused utilization of natural gas was due to the parallel development of a large and efficient transportation and distribution network, which eased and made its usage convenient.

Most of the consumed gas is imported by EU from third countries. Therefore, to support its consumption, large infrastructures, i.e. pipelines, to connect producer countries (i.e. Russia, Algeria, etc.) with consumer ones (i.e. Germany, Italy, etc.) were built and specific supply agreements were developed.

Exporting countries are often characterized by complex political situations. Therefore the security of supply is considered a tangible risk. Thus, to mitigate this risk and to restrict the market power of suppliers, many re-gasification plants have been built all around Europe to allow the import of liquefied natural gas (LNG) from all over the world, in order to create a competition among various suppliers.

Usually, when the furniture is delivered by pipelines, the competition is quite scarce, because of the rigidity of such a kind of transportation system which limits the interaction between demand and supply. Moreover, "market rules" of the consumption countries are often very different from those of the exporting countries. Therefore, there is a condition where the consumption market is separated from the production market [2].

In recent years, because of the economic crisis, a decrease in the consumption of natural gas has been registered, determining a consistent "turbulence" in the market and it is not clear if this represents a transient condition after which there will be a restoration of previous situation or if there will be a complete reshape of the market.

The present paper aims to give a snapshot of the current situation of the European gas market, highlighting the reasons determining the present condition. Moreover, a vision on the possible developments is also provided.

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Vincenzo BIANCO (✉), Federico SCARPA, Luca A. TAGLIAFICO
Division of Thermal Energy and Environmental Conditioning, DIME/TEC, University of Genoa, Via All'OperaPia 15/A, 16145 Genova, Italy
E-mail: vincenzo.bianco@unige.it

2 Regulatory framework

During the 1990s, there was an important discussion regarding the future development of the European gas sector. At that time, natural gas started to be considered as the best substitute for oil in the medium period, as also demonstrated by its increasing consumption. Therefore, EU members states decided to promote a regulation of the sector, in order to enhance concurrency.

To this scope, different options were considered and, in particular, it was agreed to increase the level of privatization and liberalization as well as to enforce the free access of third parties to gas networks.

The intention of the EU legislator was to create a more convenient market for final users, to eliminate national monopolies and to open the market to the free concurrency. The ideal result was to establish a European market of natural gas, where the price was set up by the interaction of supply and demand (i.e. clearing price). To achieve the proposed target, different directives were emanated with the scope to completely redesign European natural gas sector. In particular, three directives were specifically devoted to these issues, namely 1998/30/CE, 2003/55/EC and 2009/73/EC, also known as first, second and third gas directive. The directive 2009/73/EC is the gas legislation in force at present.

All gas directives are based on three main "pillars" of the EU energy policy, which are unbundling of transport and other activities, regulated third party access, and concept of "eligible customer" [3].

The first point regards the separation of the national vertical integrated operators.

This sort of organization was very common in Europe, before that EU countries found a common agreement on the energy policy, and it consisted in the creation of a national "oil-company" in charge to supply fossil fuel, usually oil and gas, to the country. This company often incorporated all activities of the fuel value chain, from the upstream up to the distribution to final consumers. Of course, such a kind of model limited the concurrency, because the vertical integrated operator could benefit from a favored position regarding the distribution network and, consequently, the possible customers base. To abolish this privilege, the EU forced vertical integrated operators to separate the activities related to network operations (pipeline, LNG plant and storage management) from the others, by transferring them in new independent companies (or other equivalent measures), in order to allow all gas operators to have the same rights of access to the main infrastructure.

The second pillar refers to the creation of a clear and fair regulation to allow the access to the network infrastructures, for example, by means of public auctions to buy pipelines or other infrastructures capacity.

The third pillar introduces a gradual level of market liberalization from the customers' side. In fact, at first large consumers (i.e. power plant and large industrial customers) could freely choose their supplier. Then, this possibility was gradually opened to all the customers and today residential customers can also choose their suppliers.

Thanks to this legislation, the European gas market radically changed in the past 15 years and more concurrency was introduced in the market, with the establishment of many wholesale and distribution companies.

The future regulations currently under discussion aim at establishing liquid natural gas trading hubs, with the ambition to obtain a European reference price on the basis of the transactions executed on the hubs [4].

3 Role of natural gas in EU's energy mix

3.1 Natural gas consumption

Natural gas consumption started to play a significant role in the European energy mix after 1970. Before this period, oil and coal represented the principal sources of primary fuel.

Due to the main concerns about environmental impact and security of supply, different countries, especially those with scarce internal energy resources, began to look for new sources of energy. Natural gas was immediately considered as a convenient alternative fuel. Therefore its consumption started to increase (Fig. 1 (a)).

The consumption of natural gas is not homogeneous and different categories of consumers can be identified, namely residential, industrial, transportation and thermoelectric.

After the mid 1990s, another substantial increase of natural gas demand could be noticed which was driven by the growth of the consumption in the thermoelectric sector (Fig. 1 (b)), after the liberalization of the electrical generation in EU.

The liberalization of the market allowed the free concurrency in the sector of electricity generation. Therefore, many operators decided to expand their activity abroad. The simplest way to enter a new market, apart from the acquisition of local companies, was denoted by the construction of CCGT plants, because they were relatively cheap in technology and easy to build and to operate. Therefore, they were often considered as the first option among different technologies.

Another reason that pushed the operators to opt for CCGTs was the introduction of the EU-ETS, which introduced the carbon allowances market, where less intensive carbon technologies have a relevant advantage and natural gas has a carbon intensity equal to about a half of that of coal. The deployment of a relevant number of new CCGTs had the consequence to increase natural gas consumption in EU.

Demand of natural gas in EU is inhomogeneous. In fact, few countries account for most of the consumption

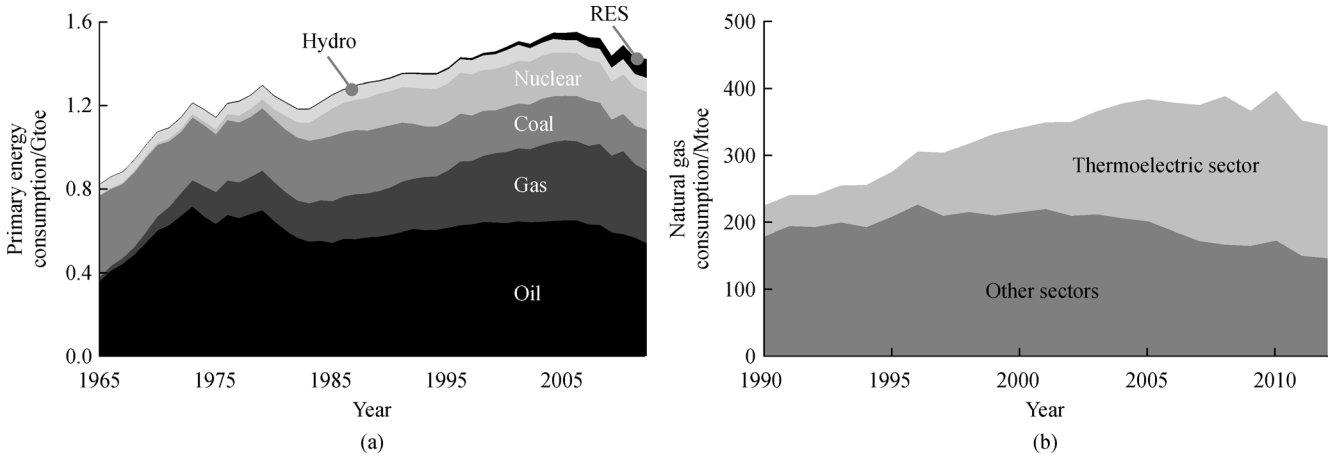

Fig. 1 Development of primary energy consumption in EU15 and relative share of primary energy sources [1)]
(a) Primary energy consumption; (b) natural gas consumption

(Fig. 2).The amount of the consumption is often linked to the magnitude of gross domestic product (GDP), but it is also influenced by the energy policy. For example, France and Italy are more or less comparable in terms of GDP, but Italy has a gas consumption almost twice as much as that of France, because its energy strategy is largely based on natural gas, whereas France opted for a massive use of nuclear energy.

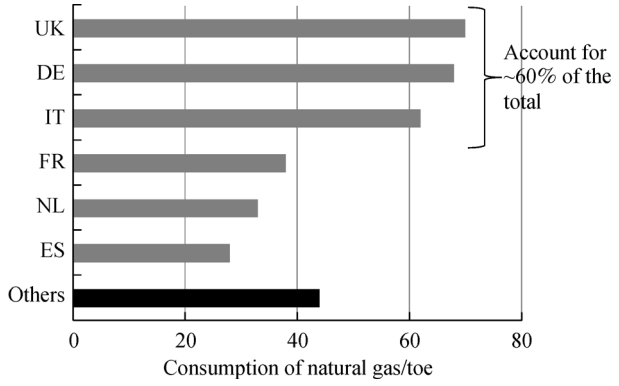

Fig. 2 Main consumer countries in EU[1)]

In recent years, because of the effect of economic crisis, natural gas consumption decreased, provoking a relevant turbulence on the market. At present, it is quite difficult to formulate a future outlook of the consumption, but it is likely to expect an increase of the demand linked to the increase of EU's GDP, even though the growth rates will probably be smaller than the pre-crisis values.

An average growth of approximately 1% per year is expected in Europe up to 2020, whereas from 2000 to 2010, a growth of 1.3% per year was registered [5]. This is due only in part to the crisis effect, because a relevant role is played by the aggressive development of renewable electricity generation, which reduces thermal market space for thermal generation and for gas in particular, as it represents the marginal technology (i.e. the first to be displaced) in most European markets, and by the implementation of energy saving policies, which aim to reduce primary energy consumption.

All this will probably lead to a review of the development of new infrastructures.

3.2 Development of infrastructures

The diffused utilization of natural gas in EU is mainly due to the presence of an efficient and integrated gas distribution and transportation infrastructure, which allows to deliver, via pipelines, natural gas to a relevant share of customers.

Europe imports most of its natural gas to satisfy its internal demand and its indigenous production is declining. Therefore, it is necessary to increase the imports in order to sustain the demand. To do so, it is mandatory to develop new infrastructures to connect consumption side with the supply one, which means to build new pipelines linking production and consumption countries.

At the moment, different projects are under valuation and some of them aim at increasing the security of supply by offering the possibilities to obtain gas from alternative suppliers. As pointed out by Roupas et al. [6], the situation in EU significantly differs among different countries.

Currently, three main projects are in competition among them, namely Nabucco, South Stream and trans-adriatic pipeline (TAP). Nabucco and TAP are intended to import natural gas from alternative suppliers, other than Russia, such as Azerbaijan, Georgia and Caspian Sea, in order to reduce the energy dependence on Russia.

Nabucco and TAP are connected with the trans-anatolian pipeline (TANAP), which links Turkey directly with

1) Eurostat. 2014. http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database (Accessed 29/01/2014)

Georgia. But Nabucco would transport Caspian gas from Turkey to Austria, passing through Bulgaria, Romania and Hungary; whereas TAP would transport gas from Turkey to Italy through Greece and Albania. The capacity of the supply of these infrastructures range from 10 to 20 bcm for TAP and around 30 bcm for Nabucco.

As one can imagine the political relevance of such kind of infrastructure is very high, because to follow one route or another means to move billions of euro in investments from one country to another [7]. Moreover, according to the chosen route, some countries may have the possibility to increase the utilization of natural gas, as is the case of the power sector in Romania [8], where most of the electricity is generated by means of lignite plants which have a high carbon footprint. A similar situation is also present in Bulgaria.

The scope of the South Stream project is the diversification strategy for gas supply routes to the EU. In fact, the main reason for the building of this infrastructure is to by-pass Ukraine and to allow the direct delivering of Russian gas to EU by eliminating transit risks.

These three infrastructures are in concurrency with each other and, probably, only one of them will be built. Other pipelines under development are the Nord Stream and GALSI pipelines. Nord Stream should ensure a direct connection between Russia and Germany, whereas GALSI links Algeria and Italy.

At the moment, many of the above mentioned projects are in a stand-by phase, because the future development of the natural gas demand is quite uncertain and the investments, especially for the pipelines, are huge. The risk to get an unsatisfactory level of revenue to pay back the investment is too high and unsustainable also for most solid companies and governments.

Together with the development of pipelines, many re-gasification terminals all around Europe are under consideration, in order to allow the import of LNG. LNG has the important advantage to be much more flexible with respect to pipeline furniture, because a relevant number of suppliers are available, thus reducing their negotiations power and the volumes can be easily diverted toward the most attractive markets worldwide. Currently, a total capacity of more than 160 bcm is under development [9].

LNG re-gasification terminals have the relevant advantage to be much more flexible for level of investments and dimensions with respect to pipelines. Therefore, they are attracting the interest of gas and thermoelectric operators, who can develop their own terminals in order to exploit very cheap natural gas provisions from all over the world.

4 Pricing of natural gas

When natural gas started to be used as primary energy, it was mainly seen as a substitute for oil. Therefore, it was sold by linking its price to oil price, by means of pricing formulas. This pricing structure has been maintained for a long period and it is still valid. Both the buyer and seller have been convinced of the validity of such a pricing approach, because it links natural gas to the highly liquid and transparent world oil market, whereas natural gas market has a more regional connotation.

By using the oil linked formulas, the seller assumes the price risk, connected with oil price dynamics, whereas the buyer assumes the volume risk through the so called “take or pay” clause, which sets a minimum volume of natural gas to be retired each year, even though it is not needed by the buyer.

Such a kind of system has dominated natural gas supply agreements for more than 40 years and only in the last period this mechanism started to be weakened by the development of “gas hubs”.

Trading hubs are points in a natural gas pipeline network where gas is exchanged between owners. They can be physical or virtual.

Physical hubs represent injection and extraction points in a gas network, whereas a virtual hub usually covers an area with different injection and extraction points and all these points are assumed to belong to the same hub.

The fact that natural gas is extracted and injected means that there are different transactions in progress, because suppliers inject natural gas in the network and users extract it. Therefore, the volumes of gas exchanged in a hub have a determined price level, which, in ideal conditions, should correspond to the clearing price expressed by the interaction of supply and demand. The more liquid is the hub (i.e. high level of exchanged volumes), the closer to the ideal conditions it is.

The development of natural gas trading hubs is supported by the EU, who wants to develop a free and transparent natural gas market, in opposition to the confidentiality which characterizes the oil-linked agreements.

It is supposed that the price level expressed on the trading hubs is to be considered fair [4], because it directly derives by the interaction of supply and demand on the gas market and it is not linked to other market which are driven by different economic fundamentals, as is the case of oil. Nowadays, natural gas cannot be considered any more as a substitute for oil.

Trading hubs started to massively develop in the last four years, because of a combination of different situations which stressed European gas market, in particular:

1) Economic downturn caused a reduction in natural gas demand, with the consequence of increasing volumes on the market;

2) Such as natural gas, also electricity demand decreased and electricity generators try to sell on the gas market part of their “take or pay” quotas of their contracts, in order to reduce financial losses;

3) Because of the strong development of unconventional gas extraction in USA, a huge quantity of LNG, originally directed in USA, is diverted toward European and Asian markets.

These three events led to a massive oversupply of natural gas on the European market and determined a relevant increase of the volumes on the European trading hubs, which started to express price levels significantly lower than oil-linked contracts.

Given these facts, many small power operators started to look with interest to the development of the hubs and began to buy volumes of gas to supply their plants, which could be offered to the power market with more competitive prices.

This provoked a "closed loop" because small operators, without large long-term oil linked contracts, bought gas on the hubs and were competitive on the power market, where they displaced the plants of big operators, which have large long-term oil linked contracts.

On the other hand, big operators, to reduce their financial losses, tried to sell their "take or pay" quota on the gas hubs feeding the oversupply. Then, faced with this situation, many operators have tried to renegotiate their contracts with suppliers (many renegotiations are still in progress) and, sometimes, an indexation also to gas hubs has been introduced, breaking up the "oil-link" (Fig. 3).

Now for many operators the problem is to understand if there will be the so called "re-coupling" of hub price to oil-linked contracts, which means if the price of natural gas on the trading hubs will grow again up to the level of oil-linked supply formulas.

This problem contains a self-contradiction and generates confusion. In fact, as well explained by Stern [4], there is no relation between price formation on the hubs and the price level of the oil-linked contracts.

The level of price on the gas hubs is given by the interaction of supply and demand. Therefore, it can be even higher than that expressed by the contracts, which are linked to the oil market, completely uncorrelated to the gas one. Anyway, from the practical point of view, it might be considered a "rule of thumb" that the oil-indexed gas formulas represent the highest limit for gas price level.

If gas price on the hubs should exceed oil-indexed formulas, it does not make any sense for large consumers to purchase on the hubs due to the complex issues connected with the physical delivery. On the contrary, it is more convenient to sign a long-term agreement to obtain a stable furniture, even though less flexible.

5 Conclusions

European natural gas sector is experiencing a period of radical changes mainly induced by the economic downturn, which exacerbated and accelerated tendencies already in act.

The present paper attempts to highlight the changes currently in progress, trying to explain their reasons. In particular, it is evidenced that the oversupply condition, caused by the reduction of the consumption due to the economic downturn, represented a boost for the development of gas hubs. This has determined a relevant increase of the volume transacted on the hubs which, therefore, attracted the interest of all the operators, that, until a couple of years before, completely ignored them and transacted natural gas on the basis of oil indexed long-term supply agreements.

This phenomenon has also determined the "de-coupling" of hub-gas price from oil-linked price, leading to a discussion about the future development of the price level.

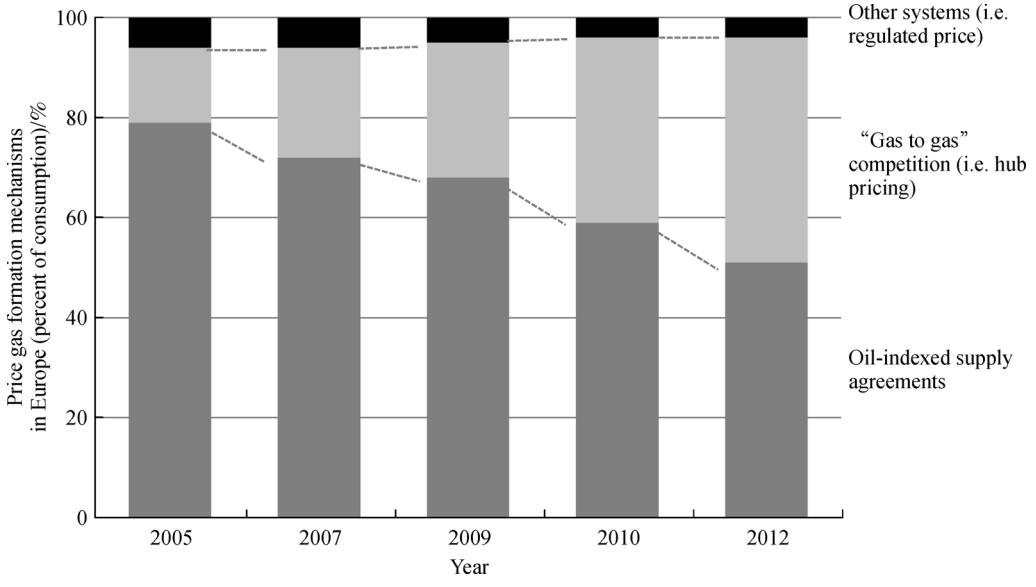

Fig. 3 Share of price formation systems in EU [10]

In particular, it is fundamental for the operators to understand what is more convenient between hub-price and oil-linked contracts, even though, as highlighted in the paper, from the theoretical point of view, there is no correlation between these two pricing mechanisms.

All these unusual conditions are pushing the natural gas market to move from a regional dimension to an international/worldwide one, similarly to the oil market and this trend goes in the direction of what is auspicated by EU, who tried to stimulate the establishment of a transparent and open market by means of its directives.

In conclusion, it can be said that after this period of turbulence, when there will be a recover of the economy, a new natural gas market will be established, more linked to the dynamics of the natural gas industry, rather than linked to the oil one.

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