

DRIVING FORCES FOR CHANGES OF NATURAL GAS MARKET STRUCTURE IN THE ATLANTIC BASIN: A PROSPECTIVE APPROACH

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Keywords: Natural Gas; Driving Forces; Market Structure; Prospective Analysis; Scenarios

Background

In the current world system the economy axis is characterized by the interdependence between the actors of that system. Therefore, the energy can be considered as a subsystem of the international system.

Indeed, the structure of the international system determines the structure of the global economy, understood it as dynamic and changing, where there are interdependent relationships between different actors. These relationships are given in the form of international trade in goods or services which is arranged in a specific geographical area, based on a monetary system.

In the global economic structure, energy plays a decisive role as a strategic resource and inducer of goods, to ensure the development of economies and the welfare of its citizens. Energy has been closely linked to industrial progress and economic development in general to human life.

The main energy sources are fossil fuels (oil, gas and coal), nuclear fission, hydro and new renewable sources: solar, wind, among others. However, since the early Twentieth Century, hydrocarbons have had a larger and faster growth.

Energy demand has risen steadily, from 55 million barrels of oil equivalent per day (Mboe/d) in 1960 to 227 Mboe/d in 2008. It is expected that energy demand continues to increase until 2030, as economies expand, particularly emerging economies, the world population growth and improve living conditions (OPEC, 2010).

The problem is that energy resources are limited and concentrated in the hands of a few actors, which means not only a possibility of exhaustion, but a constant change in international economic relations (Martinez, 1973), because the States that are not self-sufficient in energy requirements are constantly fighting to control the sources of wealth, which makes every type of hydrocarbons a potential resource of power.

This geographical disposition of resources, as fossil fuels, has led to a geopolitical vision according to which the land domain of the "heartland" gives supremacy to the power that it possesses (Liendo, 2009).

Natural gas market as a sub-system of the energy market

Assuming then that natural gas is a strategic element of power and relationships around it are part of the international issue, it can say that the natural gas market is itself a subsystem of the global energy market (Liendo, 2011). This natural gas market, not only sets a structure of power distribution, but a system where also converge the same actors of the international system, which also merge multiple sectors that can be associated depending on their capabilities: economic, military, technological, and others. And while it is a system, what happens within it affects the rest of the parts that comprise it (see figure 1).

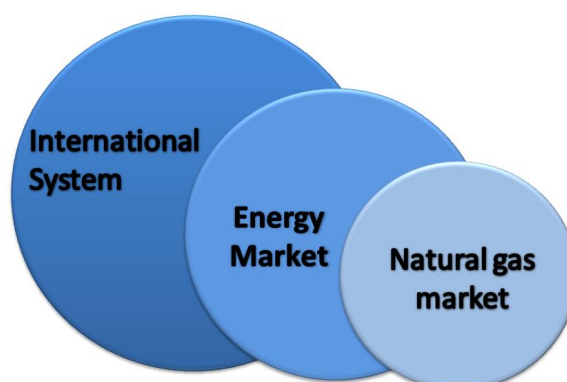


Figure 1. Natural gas market as a structure of the international system

A better understanding of the structure within the international gas system is required to establish how its parts are arranged (what are the actors) and how they are distributed the capabilities among these parts.

The capabilities of the structure members should be observed and compared, not to mention that they have capabilities in other distributional structures of power that can be more or less valuable. For some States the issue of energy, particularly natural gas, can be more strategic than others and this circumstance is given not only by the number of reserves that they have, or for its role as major producers or consumers, but also due to the role that can play this resource on the actor's position or the position that it wish to have in the international system. These states will be the most outstanding natural actors of this structure (Rivera, 2005).

World's gas reserves are 187.1 trillion cubic metres (TCM). Of this amount, 53.0% are concentrated in Russia, Iran and Qatar (BP, 2011). Looking by region, natural gas is concentrated mainly in the Middle East (40.5%), and Europe & Eurasia (33.7%).

However, in 2010 the United States (US) ranked as the leading producer of gas, followed by Russia, Canada and Iran. US production was favoured by the exploitation of unconventional gas reservoirs and reached a peak of 611.0 billion cubic metres (BCM). North America (26.0%) and Europe & Eurasia region are the main producers of natural gas (32.6%). The US also ranked as the largest consumer of natural gas in 2010. Regionally, consumption is also mainly divided between North America (26.9%) and Europe & Eurasia (35.8%).

Industrialized countries consumed 1,546 BCM; European Union, 492.0 BCM; and countries of the former Soviet Union consumed 596.8 BCM. Emerging economies, meanwhile, consumed 1,622.8 BCM.

In the last decade natural gas has held its importance in the global energy mix. Between 2000 and 2010, consumption of natural gas had a stable share of 24%. This is mainly because the role of the international gas trade.

While in 2000, only 22.0% of gas sold was trading intra-regional or internationally, in the year 2010, that proportion was 30.8%. Natural gas trade in total rose 10.2% in 2010 compared with the volumes traded in 2009 (BP, 2011).

It is expected that in the long term, this fuel will help to meet global energy needs.

Natural gas market structure

According to the traditional concept, a market consists of buyers and sellers who determine supply and demand. One aspect that characterizes the market is the degree of competition that occurs within it.

In the natural gas value chain, market players are producers and consumers, as well as marketers, financial services companies, Hub operators, transportation: pipelines or liquefied natural gas (LNG), stock exchanges, local distribution companies, energy companies, among others.

The viability of competition in the natural gas industry is determined by three factors: technological development, uncertainties about supply and demand, and regulatory changes. These three factors determine the efficient configuration of the market structure in a dynamic model.

The market deregulation produced structural changes in the industry, as the open access and unbundling, from which emerged different types of market structures, which have introduced competition and new forms of relationships among market participants. According to Juris (1998), these are:

1. Vertical integration.
2. Competition in natural gas production.
3. Open access and wholesale competition.
4. Unbundling and retail competition.
5. Unbundling of pipeline transportation and open access to distribution.

An analysis of the market structure of the natural gas industry in the countries of the Atlantic basin identified that North American region has a deregulated market structure, from introduction of policies such as open access and unbundling. In Europe, United Kingdom and Spain are the countries with the most deregulated markets, but market liberalization policies have not been fully extended to other nations of the European Union. By contrast, natural gas markets in South America still remain restricted to competition, while Central America is a market that still is not made (Liendo, 2011).

Natural gas trade in the Atlantic Basin

Natural gas is traded locally and internationally. The Atlantic region is one geographic area where natural gas is traded internationally between countries in the Americas via pipeline, which in turn is divided into North and South America.

The LNG is traded in two main basins: Atlantic and Asia-Pacific. However, for the purposes of this study the market were limited to the Atlantic basin, which refers to the flow of gas between the east coast of North America and South America, Central America and the Caribbean, West Africa and Europe.

The natural gas market is still not a global one, since only 30.7% is traded internationally (BP, 2011). This makes a more regional market, dominated by North America, Europe and Asia, especially Japan and South Korea, and also where it evidence the importance of transportation methods such as pipeline and LNG.

Despite the geographical constraints, the natural gas trade has performed well in recent years, except for the contraction in 2009, resulting from the global financial crisis. The following paragraphs outline the flow of natural gas, by pipeline and LNG in the Atlantic basin.

The pipeline gas trade has grown 74% in the last 10 years and represents nearly 70% of the total volume of gas that is traded internationally. After a shrinking pipeline shipments in 2009 (-5.8%) due to lower shipments from Russia to Europe and Canada to the United States, natural gas trade by pipeline were recovered 5.4% in 2010 (BP, 2011).

In the Atlantic basin, Canada and the US show that they are major exporters of natural gas by pipeline. To a lesser extent, Bolivia exports natural gas to Brazil and Argentina, and Colombia which send natural gas to Venezuela (see figure 2).

Major importers include the United States, which receives gas from western Canada. However, there is also a gas flow that goes from the US East Coast to Canada. Uruguay, Chile and Mexico are also buyers of gas in the international market (see figure 2).

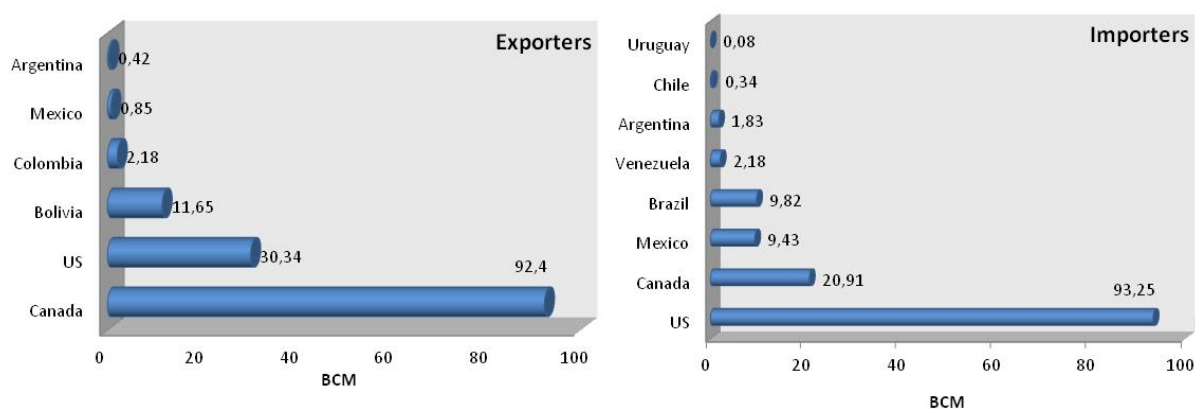


Figure 2. Exports & Imports by pipeline in the Atlantic Basin (2010). Source: BP, 2011.

According to BP statistics (2011), LNG has increased its importance in exports, from 5.9% in 1970 to 30.0% in 2010. Natural gas trade by LNG has grown 117% over the past 10 years, which has contributed to the globalization of business. In 2000, 136.96 BCM of LNG was traded and in 2010 this volume increased to 297.63 BCM (BP 2001, BP, 2011). Qatar exports were responsible in the increase of 22.6% recorded in the LNG trade in 2010, representing 53.2% of LNG cargoes shipped that year (BP, 2011).

The natural gas flows by LNG are mainly in the Asia-Pacific, Middle East and Africa regions. Although LNG trades in the Atlantic basin grew 6.1% in 2010, this region has been losing ground, as its market share fell from 32.5% in 2009 to 28.8% in 2010, mainly because of reduced exports from North Africa (GIIGNL, 2010).

Qatar, Trinidad and Tobago, Nigeria and Algeria are the main exporters of LNG in the region, with a volume of almost 99 BCM traded within the same region (85%). On the side of importers, Spain leads the group followed by the UK, France and the United States. The flow of LNG that moved in the Atlantic basin in 2010 was 110 billion cubic meters approximately (see figure 3).

International trade in natural gas is not only affected by the role played by the main participants: producers, consumers and carriers. Access to natural gas reserves, development of unconventional gas sources, geopolitical tensions, policies of security of supply, the increasing role of the NOCs, spot market –that rise 40% in 2010 (GIIGNL, 2010)- and financial services companies, among others aspects, have changed the way in which these market players in the Atlantic basin interrelate each other. In the short term, natural gas business will continue receiving the impact of these trends, marking the transition to a new structure of physical natural gas market.

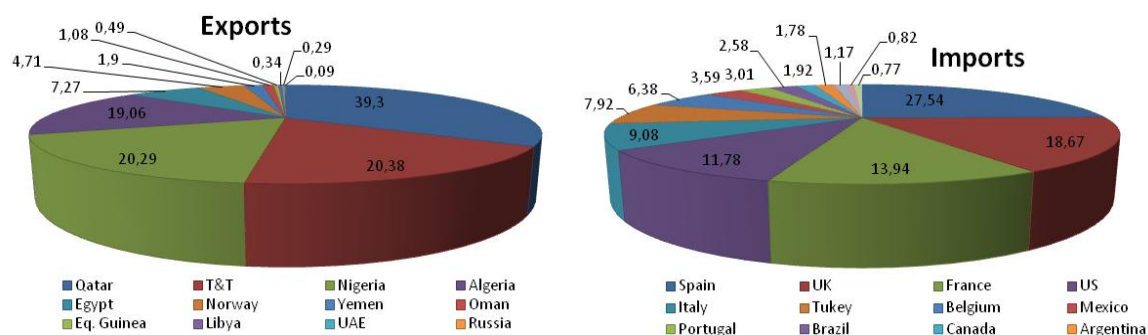


Figure 3. Exports & Imports by LNG in the Atlantic Basin (2010). Source: BP, 2011.

Within these trends are also included: a) globalization as a form of interdependence of the international system; b) the changing role of state companies versus private companies; c) importance of gas in power generation, for its efficiency and reduced environmental impact; d) liberalization of markets to promote competition in the industry, which is related to the maturity of local markets, because once the industry reaches this level is more likely to establish different business models and regulation; and e) changes in patterns supply, as new areas are incorporated to the exploitation of natural gas, as is the case of unconventional gas sources (Liendo, 2011).

It is also clear that in the natural gas business, boundaries between each of the areas of the value chain are becoming increasingly blurred, as participants in upstream activities are taking an important role in downstream activities and vice versa, but also new actors, such as investment banking and oil traders, are entering into the market even if they do not have natural gas-based assets.

Aim

The aim of this work is to identify the driving forces in natural gas market that, in a competitive environment, will determine the configuration of a new structure of the physical market for natural gas in the Atlantic basin in a five years horizon.

Methods

It has been done an assessment of the current situation of international gas trade and the market structure in the different sub regions of the Atlantic basin, that it has been summarized in the first part of this paper. It has defined a set of variables that can potentially affect the whole system under study (see Table 1).

The variables identified were consulted among 15 experts. The consultation showed that 22 of the 24 identified variables affect or potentially will affect the natural gas market structure (see Table 1).

Through the method of consultation with technical experts and the scenarios techniques developed by Peter Schwartz (1991), it has been identified predetermined variables (its evolution is considered foreseeable) and critical variables (subject to uncertainty) within the system under study.

The results showed that only 9 of the 22 variables have been rated with the higher percentage of uncertainty, as more than 50% of 15 experts estimated so. Therefore, there are 9 critical variables (see Table 2).

Table 1. Variables that will impact the market structure in the Atlantic basin

V1.- Availability of natural resources and technology for its exploitation
V2.- Volatility in natural gas price
V3.- Pricing mechanism
V4.- Role of electricity and transport sectors, technological development, energy policies and environmental regulations in the expected increase on demand
V5.- New uses of natural gas in the expected increase on demand
V6.- Development of unconventional gas resources, available technology, production costs and environmental risks associated with its operation
V7.- Geopolitical tensions
V8.- Role of financial services companies
V9.- Growth of the LNG spot market
V10.- Development of new floating technologies for production, liquefaction, regasification and storage
V11.- Gas glut
V12.- Increasing traders' role
V13.- Growing role of National Oil Companies (NOC)
V14.- Changes in business model
V15.- Availability of human resources, financial, and goods and services
V16.- Rising capital expenditure of onshore LNG plants
V17.- Restrictions on the deregulation of markets in South America
V18.- Role of gas emerging markets
V19.- Role of natural gas shipper
V20.- Role of interregional pipeline
V21.- Growing role of electronic commerce
V22.- Energy integration based on natural gas among countries in the Atlantic region, especially in Central and South America.

Table 2. Critical variables

V2.- Volatility in natural gas price
V7.- Geopolitical tensions
V17.- Restrictions on the deregulation of markets in South America
V11.- Gas glut
V14.- Changes in business model
V6.- Development of unconventional gas resources, available technology, production costs and environmental risks associated with its operation
V9.- Growth of the LNG spot market
V16.- Rising capital expenditure of onshore LNG plants
V22.- Energy integration based on natural gas among countries in the Atlantic region, especially in Central and South America.

Critical variables were evaluated according to degree of impact on market structure and level of uncertainty, allowing identifying the driving forces.

Thirteen (13) experts were asked to indicate the degree of impact and uncertainty of the 9 variables: high, medium or low. To determine indicators for each variable, the following assessment system was established, similar to that used by the method of MicMac®-LIPSOR, developed by French prospective school (Godet, 2007):

Table 3. Assessment system of uncertainty variables

Level	Points
High	3
Medium	2
Low	1

Once obtained values and index for each variable, ordered pairs are constructed and used to set the level of relationship between these variables.

These values lead to a Cartesian plane, where uncertainty is measured on the horizontal axis (X) and impact will be measured on the vertical axis (Y). This also provides an arithmetic mean that divides the plane into four spaces (Mojica, 1991). The variables that serve as the axis of the scenarios should be above average.

The average is obtained by dividing 100 by the number of variables. That is:

$M = 100 / n$, where n = number of variables, which gives an average of 11%

The evolution of these key variables will allow anticipating, through the situational scenarios technique, changes that will occur in the natural gas market structure in the period 2011-2016.

Table 4. System of ordered pairs

Code	Variables	Index /Ordered Pairs	
		Uncert. X	Impact Y
PriceVol	Volatility in natural gas price	13,01	12,25
GeopTen	Geopolitical tensions	11,38	12,25
BusinessMod	Changes in business model	8,94	10,67
LNGPlantCost	Rising capital expenditure of onshore LNG plants	10,16	11,46
MarkRest	Restrictions on the deregulation of markets in South America	10,57	10,67
SpotMark	Growth of the LNG spot market	10,57	10,67
Enelnt	Energy integration based on natural gas among countries in the Atlantic region, especially in Central and South America.	10,16	9,09
GasGlut	Gas glut	12,6	11,46
UnConv	Development of unconventional gas resources, available technology, production costs and environmental risks associated with its operation	12,6	11,46

For the configuration of scenarios, the context in which system will evolve is limited. Then, the more likely scenario is woven through a plot based on prices and geopolitical tensions moderate to low. Those will be the axes, as Schwartz called, because these variables have a constant evolution, according to the results obtained from Morphological Analysis (Godet, 2007). The examination of results obligates to build an alternative scenario just in case those events take different paths.

Results

The resulting plane (see Figure 4) of impact-uncertainty assessment reveals that the variables geopolitical tensions (GeopTen), volatility in natural gas prices (PriceVol), gas glut (GasGlut) and development of unconventional gas sources get the higher rate (UnConv). As a result, these variables are located in the power zone; so, its evolution will have a decisive influence on future development of the studied system as a whole. These variables have now become driving forces and, for this reason, will be subject to further and deeper analysis.

All other variables are also influential in the system, but are placed in a conflict zone since they can be simultaneously influenced by the driving forces.

The variable “energy integration based on natural gas in the Atlantic region” (EneInt) has the lowest weight, which is considered an independent variable, while not affecting the other variables and may be more the result of evolution of the rest of key variables within the system.

Further analysis of evolution of these variables, at the power zone, results in the configuration of two scenarios. First of all, the blue gold scenario will be developed in a context of low gas prices and geopolitical tensions moderate to low, as we mention above; while the alternative scenario, the black gold scenario, is developed in a context of high volatility in natural gas prices.

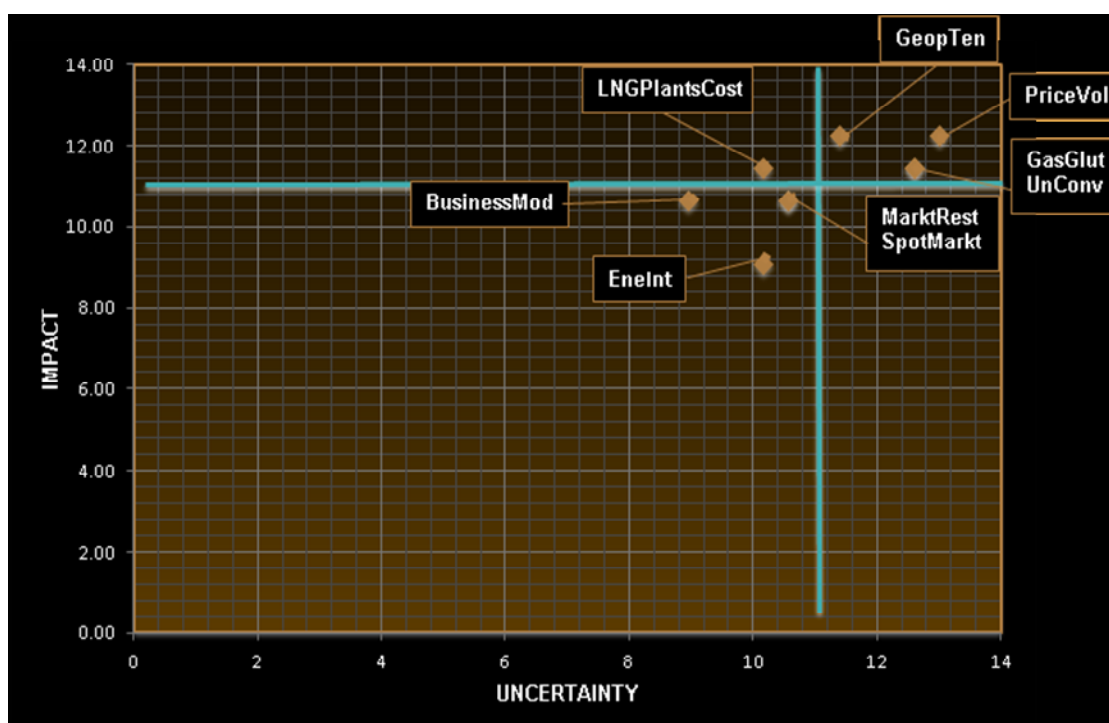


Figure 4. Relation between critical variables

The blue gold scenario:

It is estimated that in the period 2011 - 2016 international relations will continue to be characterized by an interdependent and stable international policy, although historically troubled regions like the Middle East and North Africa, will remain hotspots of political tension, for its own internal problems. These may cause some uncertainty about the development of these events, which in turn will have limited geopolitical impact on a regional scale.

In this context, natural gas market in the Atlantic basin will maintain their relative importance, tending to grow, both in domestic markets and in international trade, which will encourage the replacement of fossil fuels like oil and coal, which promote a more sustainable energy system in the medium and long term. This growth is based mainly on the price level, which is expected to maintain a trend of low to moderate, ranging between US\$4 and US\$8 per million British thermal units (MMBTU), particularly in the US market.

In Western Europe prices tend to be higher and more volatile, since it still tied to oil prices for the period of study. However, as deregulation is balanced in all countries of the region and

increase competition in the downstream value chain, for example, transmission and distribution, the pricing mechanism will tend to be equally competitive (gas-to-gas).

It is estimated that natural gas glut in the market will continue to beyond 2012, but the market will be swinging toward the end of the period (2016), as larger volumes of gas were due to a temporary situation that will be corrected progressively as the market will go rearranging.

The exploitation of unconventional gas is associated with and dependent on the development and access to technology for its exploitation, infrastructure development, transport and storage, the implementation of environmentally and socially responsible policies, with little or no barriers to competition among multiple actors in different segments of natural gas value chain.

As above, the natural gas market in the period 2011-2016 will be characterized by a change in supply patterns mainly in North America, due to the exploitation of unconventional gas sources, particularly shale gas. It will cause changes in the local market, since it will be supplied by its own reserves, and lead to the development of a larger network of transportation and storage yards, which invigorates the sector of goods and services related to the natural gas industry in this region, especially the United States and Canada.

This means that transport market will also record changes as the business will increase inter-and intra-regional by pipelines and LNG business.

The structure of natural gas market in North America will present changes in the upstream and mid-stream, with the addition of a greater number and diversity of participants, which will be visible strategic partnerships between companies that serve different segments of the business, it has different economic interests, but with one common goal: energy security.

In this short-term horizon, no changes are expected in market structure of the regions of South America and Western Europe. The challenge for many countries in these regions, where natural gas is very important to its energy matrix, is that its reserves are in decline phase, which compromises the security of supply.

However, as technology and legal environment are factors that introduce the feasibility of competition in the markets, it is estimated that countries that have potential to exploit unconventional gas can take this occasion to promote and facilitate the implementation of a regulatory framework which may lead to the development of these resources in medium and long term in a competitive environment. This will require segmentation of the downstream value chain and open the competition in transmission and distribution sectors, thus contributing to establish a mechanism to fix the price of natural gas by the free play of supply and demand.

Indeed, shale gas exploitation on the European continent, in countries like France and Poland, can be developed faster than in South America, which could boost the Third Energy Package implementation of market liberalization for the countries of the union. However, the expected demand in that region in front of a narrow resource base, make it inevitable that this region continues to rely on Russian gas imports, and shipments of LNG from the countries of the Middle East region, West Africa and the North Sea.

The increasing availability of natural gas will contribute to Central America and the Caribbean come together as an emerging market in growth and maturation process, where natural gas becomes more important as a fuel for power generation. Given the size of this market, supply is expected from countries whose reserves allow modest development of liquefaction infrastructure, so floating technologies play a fundamental role.

The change in supply patterns in North America, also bind to traditional suppliers of LNG to seek new markets.

The "shale gas revolution" in the US and Canada leads a discussions seeking new legislation encouraging the consumption of natural gas through new uses, such as Natural Gas Vehicles. US also moves to develop gas export projects by LNG, representing a greater number of actors, including regional powers such as Russia, competing for the other major market: Western Europe. Due to the US energy needs and incentives for natural gas as a useful fuel for the industry of electricity and transportation, exports depend heavily on the behaviour of domestic demand.

This new condition of the US market will increase competition among natural gas suppliers of new and traditional supply the European market, which will become the most desired. Caribbean, Central America and the Asia-Pacific basin will also be new destinations, promoting integration into a global gas market.

The black gold scenario:

In the black gold scenario, the world has grasped the interdependence as its form of relationship among the international system. In this context, energy security, both supply and demand, is at the top of the political agenda of governments and other actors in the global energy market, understood as a subsystem of the international system.

Despite the shared vision of cooperation among members of the global village, price volatility becomes a feature of the new trading environment. Geopolitical tensions are not moderate enough to keep the market stability. Other economic and structural foundations of energy market impact the natural gas market. These factors include a sustained increase in oil prices, the debt crisis in Europe and uncertainty about the fate of the economy and US foreign policy, with the possibility of a change of government in 2012.

In this context, in which natural gas prices remain coupled to oil prices, this fuel is no longer an option to replace coal and oil, because its price has more than doubled, reaching above the US\$12/MMBTU.

The loss of opportunity to replace liquid fuels and take them a portion of the market share represents a disadvantage for projects to exploit unconventional gas resources in the Atlantic basin countries, especially in the North American region. Investment in these projects, that are technically and economically complex, discouraged by the inability to envision a market to absorb the offer.

Natural gas market in the Atlantic basin during the period 2011-2016 will be characterized by a change in supply patterns in North America, due to exploitation of unconventional gas sources. However, development of these resources is less than expected, so the offer is also lower. In this sense, the structure of natural gas market in North America has changes only in the upstream value chain with the presence of a greater number and diversity of participants in the production segment.

Given that growth of unconventional gas supply is limited in North America, international trade flows just present some slight variations. Western Europe will continue to supply part of its energy requirements through LNG, as well as Central and South America (Brazil, Chile, Argentina), where prevail the use of floating regasification technology. North America will reduce the number of shipments of LNG, but the consumption of this product will vary over the period. These fluctuations depend on price competitiveness between this source of supply and domestic supply originates in unconventional gas fields.

Although this scenario is less favourable to the exponential growth of natural gas market, moderate change in patterns of supply in North America, will force traditional suppliers of LNG to continue the search for new markets, opening a space for traders and financial services companies. This will allow to these companies take advantage of the arbitrage mechanism in international trade of LNG. However, these are rare circumstances, because in this scenario gas supply is carried out under traditional contract terms, characterized by long-term / medium-term contracts and minimum volume clauses (take or pay), but possibly with fewer restrictions to the reloading.

After Western Europe, Asia-Pacific basin represents the most attractive region, among other reasons, market size and natural gas prices. To a lesser extent, the market of Central America and the Caribbean is an opportunity not to be out of sight. It is a still growing market in medium and long term.

Summary

This work identified four driving forces that will impact the natural gas market structure in the Atlantic basin. These variables are geopolitical tensions, volatility in natural gas prices, gas glut and development of unconventional gas sources.

The study shows that technological factors, uncertainty about the supply and demand and the legal environment will be critical to set up a new market structure in the Atlantic basin in the short term, in a competitiveness environment.

At a horizon of 5 years, major changes in the market structure will give it in the upstream and mid-stream natural gas value chain, particularly in the North American region.

In a scenario favourable to the exponential growth of the natural gas market, energy security will promote market deregulation in the downstream value chain (transmission and distribution), mainly in European and South American markets. This will lead to a competitive environment to the exploitation of unconventional gas sources.

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