THE ROLE OF NATURAL GAS IN THE ECONOMIC AND SOCIAL DEVELOPMENT OF LATIN AMERICA AND THE CARIBBEAN

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Editor's note

This report has been produced under the framework of the Networking Experts Platform Project, of the Latin American Energy Association (OLADE). The objective of the platform is to exchange knowledge, lessons learned and successful experiences in order to promote the establishment and consolidation of networking experts in the region in different areas, among which include the hydrocarbon sector.

Under the framework of this network is a call for the preparation and presentation of technical reports on behalf of well-known specialists in our region. As part of this call is the following report on behalf of Alvaro Rios Roca from the consulting agency, Gas Energy.

Executive Summary

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

OLADE - CIDA
Alvaro Rios Roca
April 2013

The general objective of this technical report, created for the Hydrocarbons Network of the Latin American Energy Organization's Networking Experts Platform, is to describe the role of natural gas and it's industrialization in the economic and social development of Latin America and the Caribbean.

Firstly, a brief introduction will be given on the advantages of natural gas versus other energy and variables that influence its prospective. Natural gas has been recognized as the energy of the 21st century due to the varying characteristics it has to offer; but above all, in its abundance, cleanliness, combustion and efficiency.

Secondly, a report on the global supply, demand and reserves of natural gas will be presented, as well as its context within this global setting in Latin America and the Caribbean. It can be established that the reserves and production of natural gas in Latin America and the Caribbean do not represent significant amounts when compared with other regions in the global context.

Following that, there will be a brief description of the gas situation in the region's main countries that produce natural gas. A summary is then provided on the main countries with a potential for gas, with reserves, and with settings and projections of supply and demand. In its conclusion the report emphasizes that several countries in the region have a great potential for natural gas, but that the region is not self-sufficient due to the fact that continued exploration has not been established for several reasons, and that they have turned the region into an importer of LNG. These supply restrictions have put investments in the development of infrastructure and industrialization processes at a disadvantage.

Next, a thorough analysis will be presented on how it is possible to increase economic growth and social development by way of industrialization processes and the role that technology and other conditions play in its development. Within this context, the report reviews the cases of the United States, Taiwan, and South Korea and compares them with Latin America and the Caribbean.

There will then be a brief analysis on how natural gas has been used to generate economic benefits and social improvements in some countries. Excluding Canada, the cases of Trinidad and Tobago, Argentina and Bolivia were analyzed under this context although they are basic industrialization processes.

Lastly, four countries in the region will be analyzed that have short and medium-term (5 years) industrialization plans. Primarily, access to raw material and regulatory and commercial conditions under which these processes expect to be developed will be analyzed. It is important to emphasize that some processes are developed solely by state investment, others are driven solely by the private sector, and others by hybrid models where the state agencies play a very active and balanced role.

Based on the analysis, the further development of the gas industry and the industrialization processes is recommended: maintain continued explorations in a way that does not interrupt service provision of gas or without having to import despite having great geological potential.

Adding value to natural gas is something that the region should continue aiming for, but this should be achieved through parallel processes of technological investigation and development, which allow for more and improved economic resources of investments and higher paying employment in these services and products. The cases of South Korea and Taiwan may very well be examined with greater detail.

It is very important for these industrialization processes to be monitored and developed in petrochemical complexes, and not in private plants, because of the benefits they offer as has been explained in this document. The scale of these complexes must also be at a maximum in order to lower per-unit production costs and to be globally competitive. The complexes and/or plants should be located in preferred strategic areas or as close as possible to the raw material and its markets.

In sum, all of the mentioned points will allow for the economic and social benefits to be of much greater value in the countries that initiate development of their natural gas resources and industrialization processes.

Introduction to Natural Gas

Chapter I

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

The tendency to use certain types of energy is determined by technological advances in order to obtain new energy sources or to improve upon those already available based on the parameters of abundance, efficiency, cost, and more recently, environmental aspects. The following figure shows how these tendencies have changed.

Figure 1. Tendencies in the Energy Industry

Source: Tendencias en las estaciones de Servicio 2011, Gas Energy.

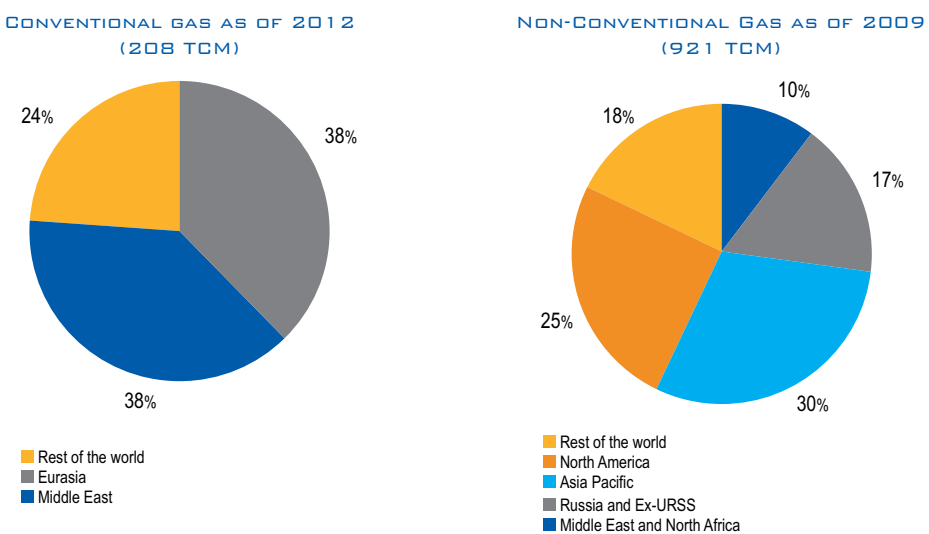
Natural gas is the fuel of the 21st century for the following reasons:

It is very abundant due to the fact that globally as of 2011, there are 208 trillion cubic meters (TCM) of conventional gas reserves, 80% of which are in Europe, Eurasia and the Middle East, the rest of which is distributed throughout other regions in the world.

Also, very recently, important non-conventional gas resources have been incorporated into global use at about 921 TCM as of 2009, most of which is shale gas at 49%. The majority of this gas is found in Asia Pacific (30%) and North America (25%).

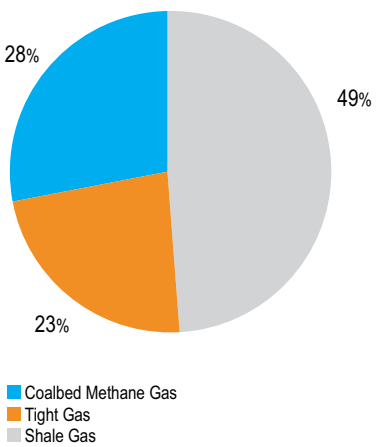
The 2009 reserve/production rates indicate that conventional gas could be produced for 70 more years and non-conventional for 180 years. This means that we would have natural gas for up to 250 more years. These figures are illustrated in the following charts.

Figure 2.
In situ Distribution of Natural Gas Resources



R/P Conventional 70 years
R/P Non-Conventional 180 years
R/P Total 250 years

Estimated Resources of Non-Conventional Gas



Source: IEA 2009 and BP Statistical Review of World Energy 2012. Created by the author.

• Natural gas is clean compared to coal and other oil-based fuels as it produces less nitrogen oxygen and carbon dioxide (up to 50% less than coal when it is burned). It does not produce sulfur or solid waste. Natural gas vehicles (NGV) are improving air quality and energy efficiency in large cities.

• It is accessible with regard to initial investment costs for the generation of electricity, which is the main use of this energy source. Combined cycle gas plants cost 50% less than coal, 67% less than nuclear power plants and 80% less than wind power. Renewable energy is greatly subsidized and the use of natural gas allows countries to reduce their emissions immediately.

• It is reliable since its existing infrastructure is easily accessible through a variety of sources such as gas pipelines and LNG. Natural gas can serve

as a flexible partner in power generation for the intermittent sources of renewable energy such as wind and solar power, allowing for the incorporation of these sources in the future.

• Because the modern natural combined cycle electrical gas plants are 40% more efficient than coal plants and their energy efficiencies near 65%, they are efficient in their combustion. Also, natural gas plants require much less construction time than nuclear or coal plants.

• With regard to its use and supply, natural gas is already a safe source of energy. The world production of conventional and non-conventional natural gas will continue increasing in the following decades. Additionally, the natural gas sector has the greatest safety record in the industry with regard to its supply.

• Due to its abundance, the development of new technologies for natural gas use is progressing with great strides, especially with heavy ground transportation fleets, merchant shipping fleets, trains and others.

• Additionally, natural gas will continue to be increasingly important in the production of basic petrochemicals, particularly with the use of ethanol in the production of polyethylene, and methane for the generation of methanol, ammonia and other derivative products.

Current situation of natural gas: globally and in the context of Latin America and the Caribbean

CHAPTER II

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

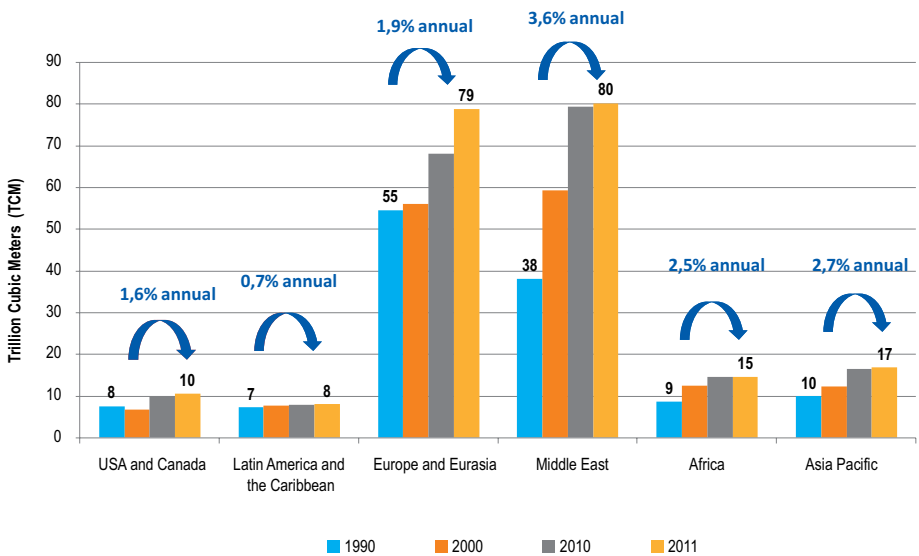
The following is information on the previous and current situation of natural gas with regard to reserves, supply and demand, and the participation of Latin America and the Caribbean in a global context.

The proven reserves of natural gas in 2011 amount to 208.4 trillion cubic meters (TCM). Europe, Eurasia and the Middle East each have 38% of the world total: 78.7 TCM and 80.03 TCM respectively. Asia Pacific has 8% (16.8 TCM), Africa has 7% (14.5 TCM) and Latin America and the Caribbean represent 3.8% of the total world reserves, equivalent to 7.94 TCM. Comparatively, the region's reserves are not very significant on a global scale.

Over 20 years, natural gas reserves have grown in every region. Annual average growth varies by region: the reserves in the Middle East have grown at 3.6% annually; in Asia Pacific they have grown 2.7% annual; in Africa they have grown 2.5% annually; and in the United States and in Canada they have grown at 1.6%. The reserves in Latin America and the Caribbean have grown .7% annually. This means that the gravitation of natural gas reserves in the region have decreased over time in comparison to the global regions.

The following figure shows the volume of reserves by region and year and reveals the annual average growth of these regions.

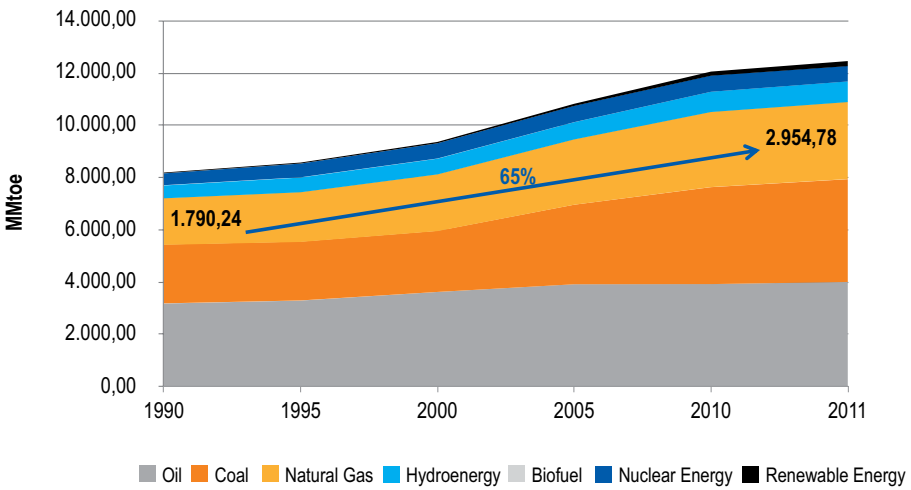
FIGURE 3.
Proven Reserves by Region from 1990 to 2011



Source: BP Statistical Review of World Energy 2012. Created by the author.

With regard to supply, natural gas takes thrid place in the world energy matrix with 24% (2954.78 million toe), following petroleum and coal. As shown in the next figure, it should be noted that natural gas has experienced significant growth between the years 1990 and 2011 when production grew by 65%.

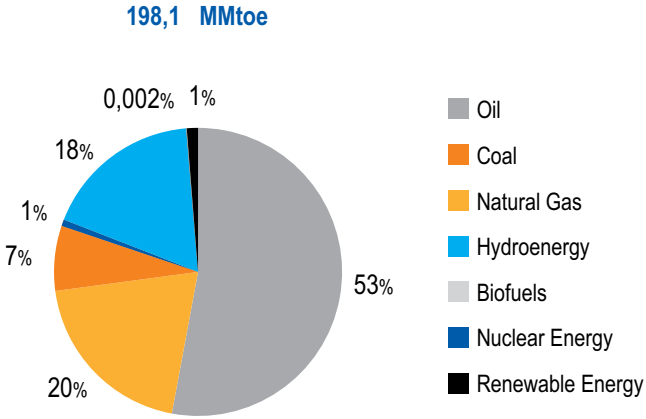
FIGURE 4.
Global Primary Energy Supply



Source: BP Statistical Review of World Energy 2012. Created by the author.

In Latin America and the Caribbean, natural gas is the second most produced energy source in 2011 with a total of 20%, equivalent to 198.1 million toe. Petroleum, which is the main source of energy, represents 53% of the regional energy matrix. It is important to note that coal production is not significant in the region, as has occurred with North America and China. This is demonstrated in the following figure.

Figure 5.
The Primary Energy Supply in Latin America and the Caribbean (2011) by Percent



Source: BP Statistical Review of World Energy 2012. Created by the author.

The world production of natural gas in 2011 was 316.98 billion cubic feet a day (Bcf/d), increasing by 3.1% from the year 2010.

The following lists the aforementioned total world regional contributions of natural gas production, in descending order:

- Europe and Eurasia represent 32% of the total production, equivalent to 100.3 Bcf/d. In this region the Russian Federation (the second greatest producer of natural gas in the world with 18% of the total) and Norway (another great producer) are included, among other countries.

- In second place is the United States and Canada; the first (20%) and third (5%) greatest world producers of natural gas respectively. Both represent 25% of total production, equivalent to 78.5 Bpc/d.

- Third, with a one percent difference, is the Middle East and Asia Pacific

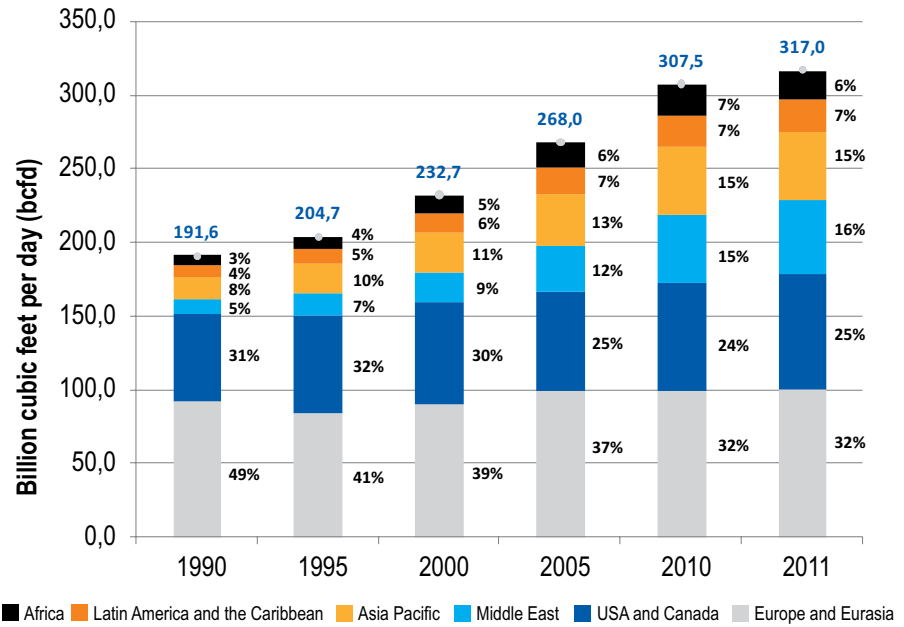
with 16% (50.9 Bpc/d) and 15% (46.6 Bpc/d), respectively.

• Latin America and the Caribbean are separated by one percent from Africa, representing 7% (21.3 Bpc/d) and 6% (19.6 Bpc/d) of global production, respectively.

This order has not changed in over 20 years, except with Asia Pacific, which passed the Middle East in 1990 by three percent.

The following figure represents the previously mentioned regional contributions, making it evident that the gas supply in Latin America and the Caribbean is particularly low in global terms.

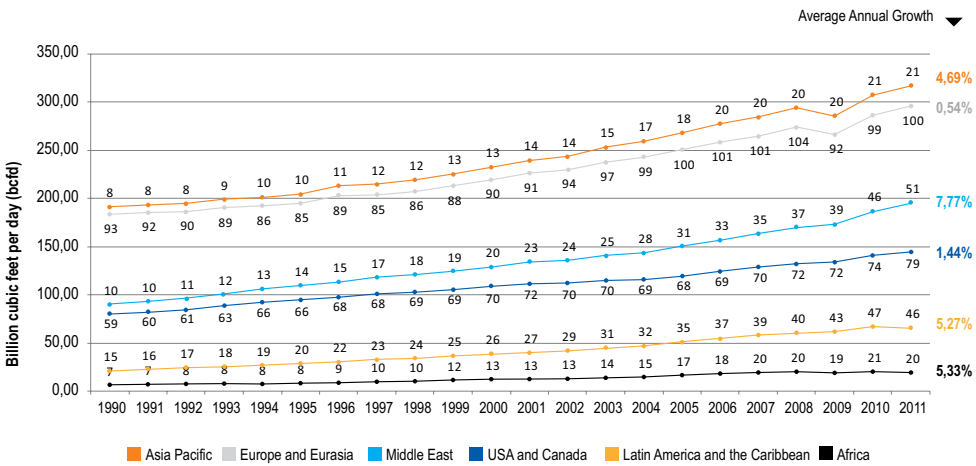
FIGURE 6.
Total Global Natural Gas Supply by Region in Percentages



Source: BP Statistical Review of World Energy 2012. Created by the author.

The following figure illustrates the average annual growth rate in percentages of the regional natural gas supply, accounting for the last 20 years. Growth in Latin America and the Caribbean, which is at 4.69%, is greater than the rate of the two most productive regions and is a result of regional trade: the exportation of LNG from Trinidad and Tobago and Peru, the exportation of natural gas from Bolivia to markets in Brazil and Argentina, and the exportation of natural gas from Colombia to Venezuela.

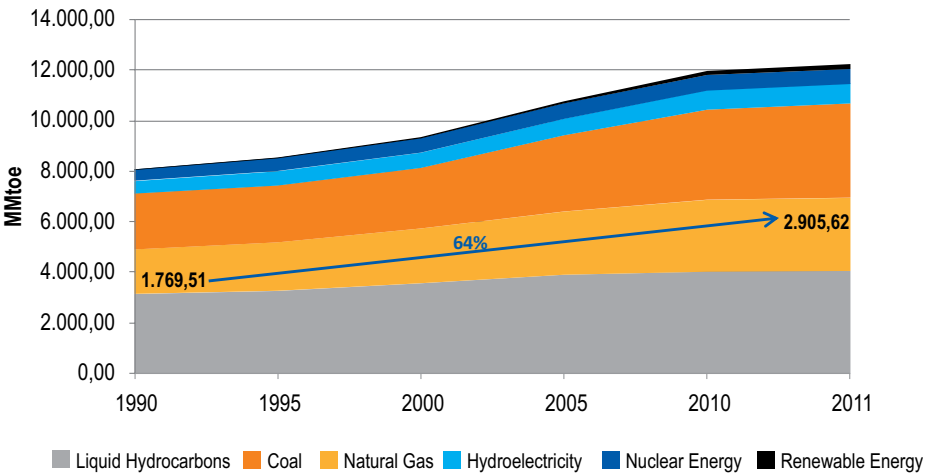
Figure 7.
Annual Average Growth of Natural Gas Supply



Source: BP Statistical Review of World Energy 2012. Created by the author.

With regard to demand, natural gas is the second most consumed primary energy source as of 2011 with 2905.62 million toe, which is the equivalent to 24% of the total global demand. It is preceded only by the demand for liquid hydrocarbons. Between the years of 1990 and 2011, its demand has grown in line with supply at 64%, as illustrated in the following chart.

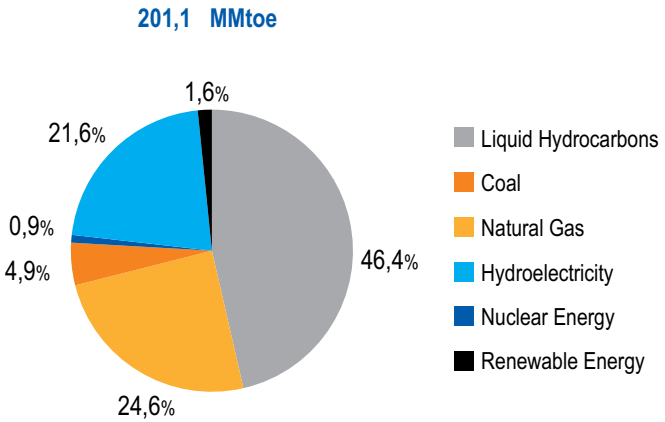
FIGURE8.
World Demand for Primary Energy Sources



Source: BP Statistical Review of World Energy 2012. Created by the author.

The following chart reveals that natural gas in Latin America and the Caribbean is also the second most consumed primary energy source in 2011 with 201.1 million toe; equivalent to 25% of the total regional demand, just after liquid hydrocarbons that have a demand of 46% of the regional total.

Figure 9.
Demand for Primary Energy Sources in Latin America and the Caribbean by Percent as of 2011



Source: BP Statistical Review of World Energy 2012. Created by the author.

The global demand for natural gas in 2011 was 311.7 billion cubic feet a day (Bcf/d), an increase of 2.2% from the year 2010.

The following positions the regions according to their level of demand for natural gas, in order of the greatest to least consumers of this fuel:

- Europe and Eurasia represent 34% of the total demand, equivalent to 106.5 Bcf/d. Here, the Russian Federation has a particular and great influence, as it is the second country in the world to consume the most natural gas at 13% of the global demand.

- The United States and Canada represent 25% of the total demand for natural gas, equivalent to 76.9 Bcf/d. The United States is the number one consumer of natural gas in the world with almost 22% of the total,

and Canada is the sixth greatest consumer with 3%.

• Asia Pacific represents 18% (57.1 Bcf/d), in which China and Japan are the fourth and fifth countries with the greatest demand, equivalent to 4% and 3% of the total respectively.

• The Middle East represents 14% (39 Bcf/d). Here, Iran is the world's third country with the most demand with almost 5% of the world total and Saudi Arabia, which is seventh, is at 3%.

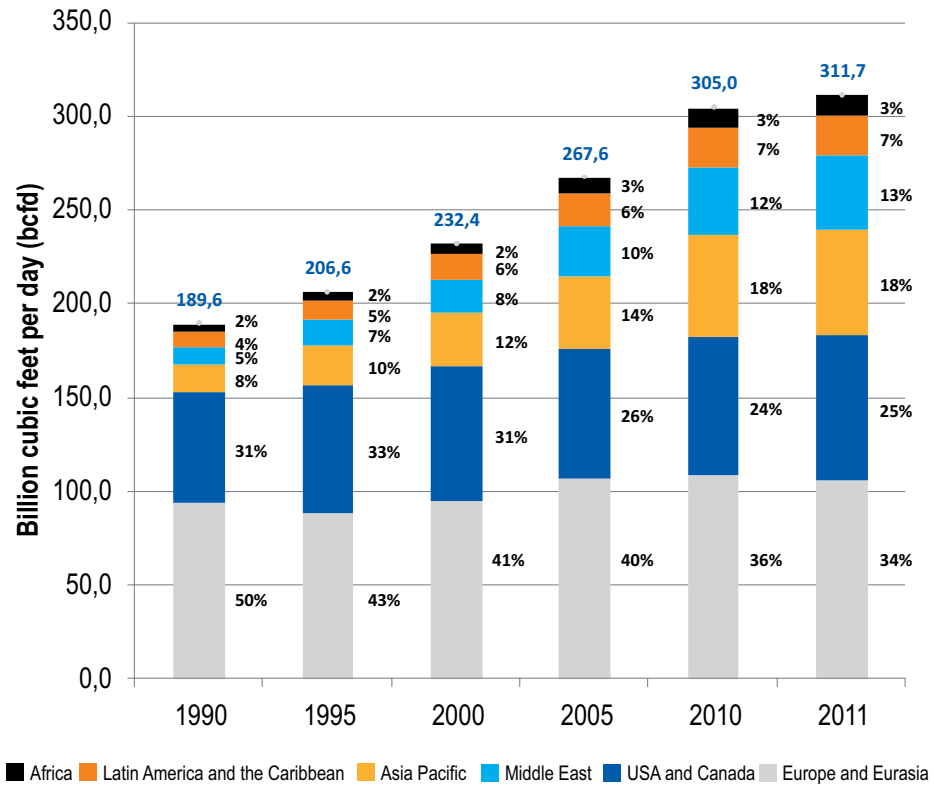
• Latin America and the Caribbean have a demand of 7% of the world total, an equivalent of 21.6 Bcf/d. Here, Argentina and Venezuela lead in the regional natural gas consumption with 4.5 Bcf/d and 3.2 Bcf/d respectively. On a global scale, Argentina is 19th (1.4%) for demand and Venezuela is 20th (1%).

• Africa represents 3% (10.6 Bcf/d) of the global demand. The greatest consumer of this region is Egypt, which globally holds 15th place with 1.5% of the total demand.

For over 20 years this regional order for demand has been very steady. The percentages of global demand have grown significantly for Asia Pacific and the Middle East, due to great economic growth mainly in the generation of electrical and industrial energy. These percentages have fallen at the same rate for the United States and Canada as well as for Europe and Eurasia.

The following chart represents the aforementioned regional contributions and changes.

Figure 10.
Total Global Natural Gas Demand by Region in Percentages

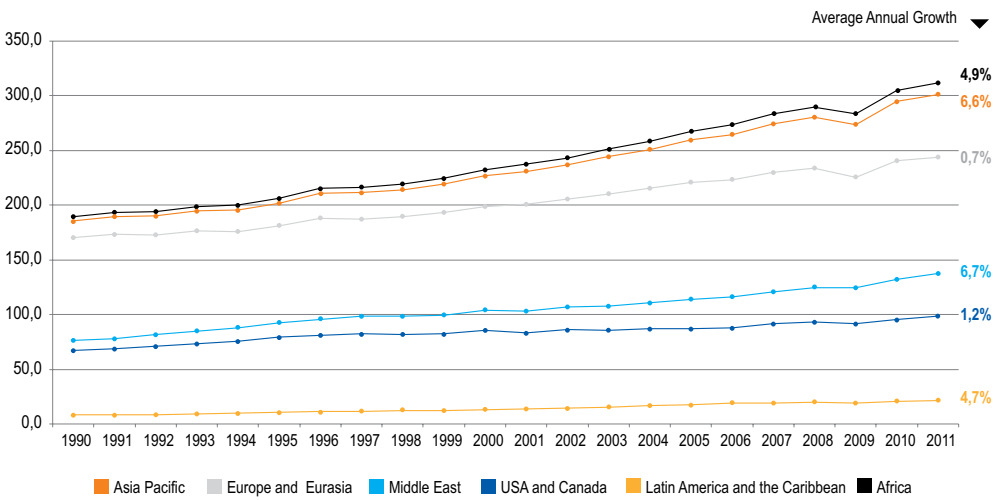


Source: BP Statistical Review of World Energy 2012. Created by the author.

As shown in the following graph, the annual average growth rate in the demand for natural gas in Latin America and the Caribbean is 4.7%. This is less than the rate of four regions and greater than that of two regions that are in demand for more natural gas: Europe and Eurasia, and the United States and Canada (this equation will change as the production of shale gas in North America increases).

FIGURE 11.

Annual Average Growth of Regional Natural Gas Supply



Source: BP Statistical Review of World Energy 2012. Created by the author.

Brief Overview
of the primary natural gas producing countries in Latin America and the Caribbean

CHAPTER III

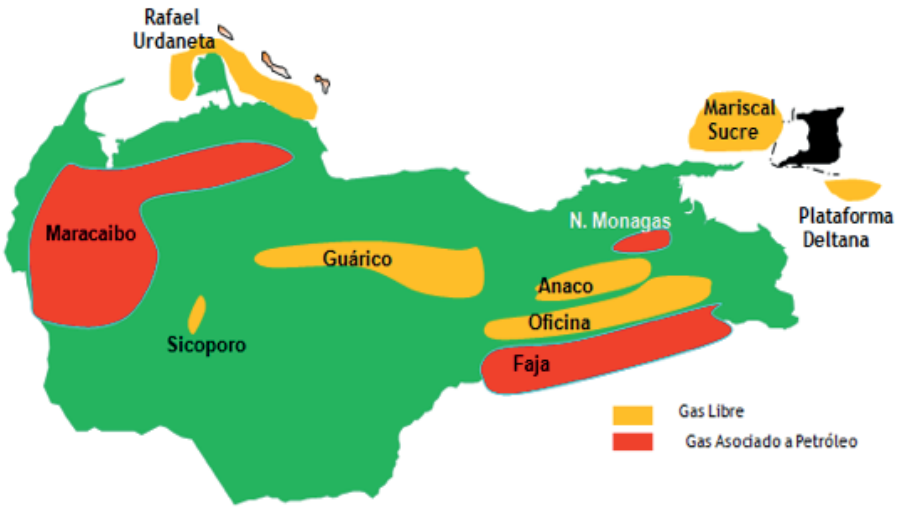
The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

This section includes a brief summary of the state of natural gas in the primary natural gas producing countries in Latin America and the Caribbean. It provides a context in order to understand the information that is to follow further on.

3. 1 Venezuela

Venezuela has proven gas reserves of 195 TCF. Of these reserves, 82% are in natural gas fields and the remaining amount is free gas (non-associated). The following figure shows the geographic distribution of the reserves.

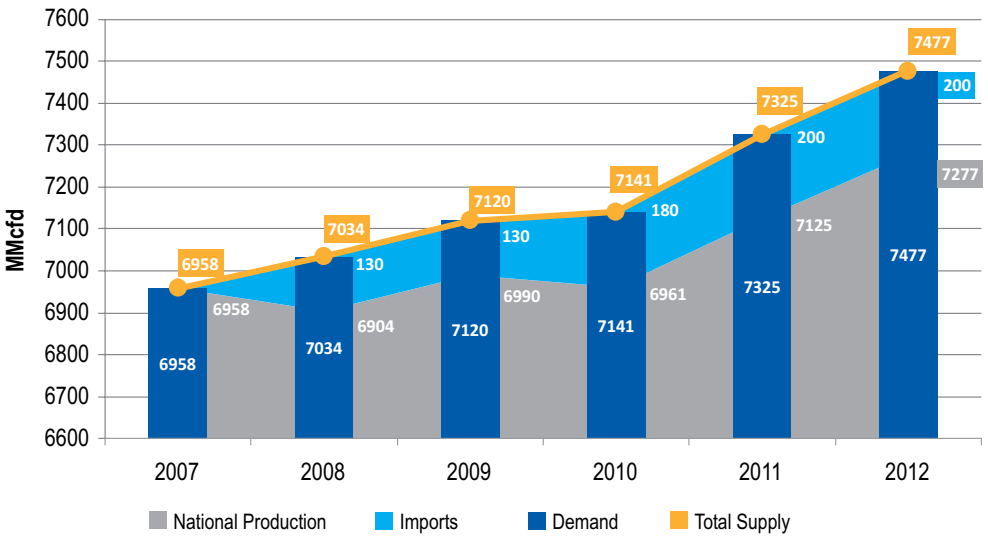
Figure 12.
Map of Principle Natural Gas Fields in Venezuela



Source: PDVSA, Menpet, 2013. Created by Gas Energy.

The following graph shows the balance between the supply of natural gas produced and the national demand. Despite the enormous amount of natural gas reserves in Venezuela, there is a growing and marked deficit between what is produced and what is demanded in the country.

FIGURE 13.
Balance of the Supply and Demand of Natural Gas in Venezuela



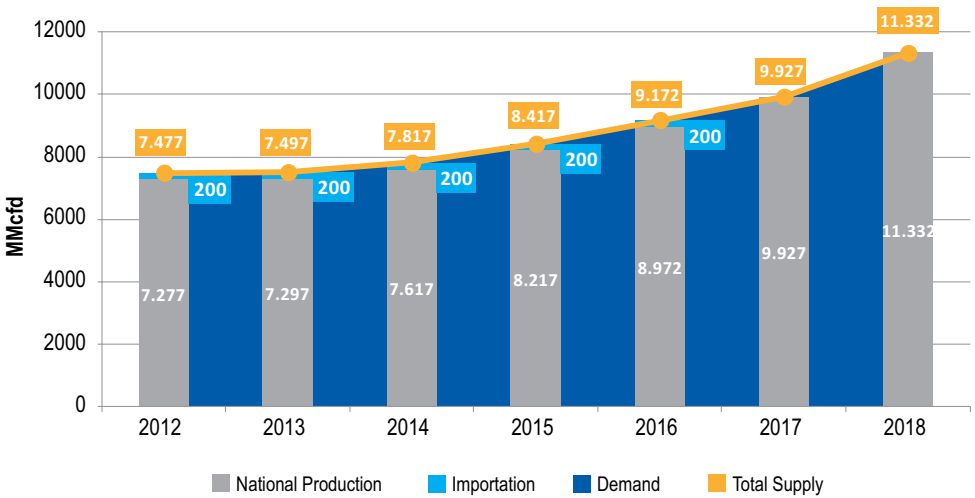
Source: PDVSA Gas, 2013. Created by the author.

Part of this production deficit has been due to importations from Colombia since 2008; it is also in part due to the use of alternative liquid fuel for the generation of electric energy.

The main cause of this deficit is that Venezuela has not been able to develop its free gas reserves, mostly located offshore. This development requires a tremendous amount of investment in infrastructure for the upstream and downstream sectors, which is not taking place.

As the following figure shows, Venezuela will continue having a natural gas deficit, at least for the next 5 years and may become an importer of LNG if it does not make timely investments. If corrective measures are taken, and investment takes place quickly, it could have an exportable surplus of natural gas or have use for industrialization processes for more than those 5 years.

Figure 14.
Projection of Supply and Demand of Natural Gas in Venezuela



Source: Created by Gas Energy, 2013

3. 2 Mexico

The proven gas reserve in Mexico towards the end of 2011 was 12.5 TCF. Natural gas fields were discovered at the end of 2011 in eastern Mexico equivalent to approximately 330 MCF (million cubic feet).

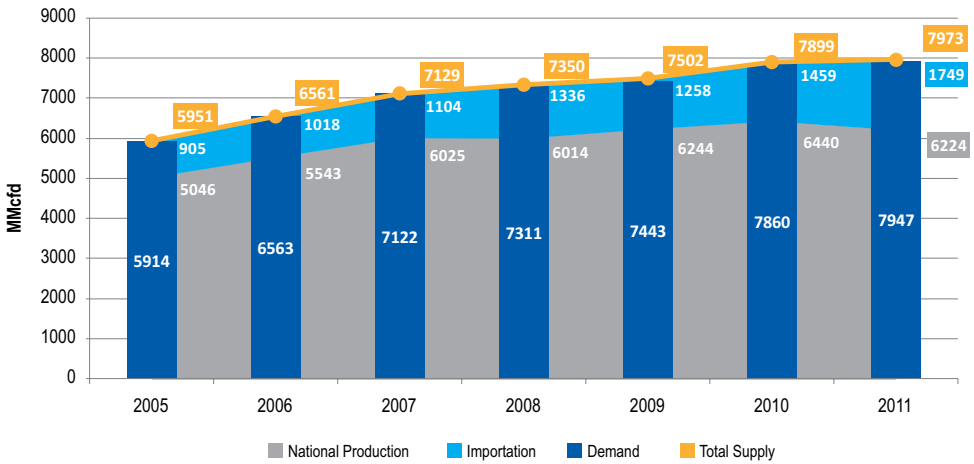
Additionally, the IEA has reported that the country has 681 technically recoverable TCF as of 2009. The primary natural gas fields are illustrated in the following map.

Figure 15.
Map of the Primary Natural Gas Fields in Mexico

Source: Pemex, 2008

The deficit that exists in the balance between the national supply and demand of natural gas can be seen in the following chart.

Figure 16.
Balance of Supply and Demand of Natural Gas in Mexico



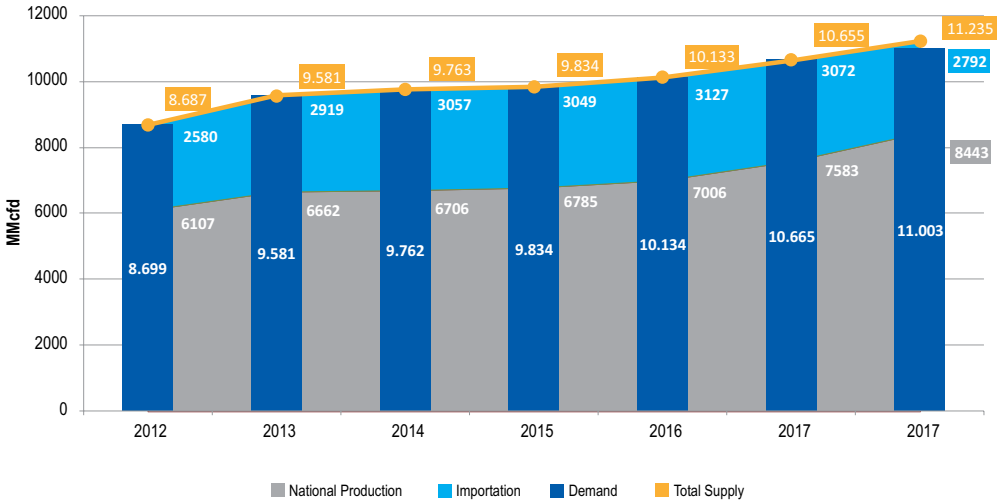
Source: Energy Secretary of Mexico, 2012. Created by the author.

Of the total deficit, 1749 Mcf/d in 2011, 77% have been covered by gas pipelines from the United States and the rest has been covered by shipments of LNG to regasification plants in Tamaulipas and Baja California that came from Qatar, Nigeria, Peru, Indonesia and Yemen. The new regasification terminal in Manzanillo began to be used in 2013.

Currently, Mexico by way of Pemex, is progressing towards a new energy reform in order to attract greater private investment in the hydrocarbon sector. In addition to this, Pemex is embarking on an ambitious plan to import a much greater amount of natural gas and create gas pipelines that connect with the United States with integrated market costs from North America, which could alleviate the deficit. It is also working towards developing greater reserves and producing conventional and non-conventional natural gas with a final use of petrochemistry.

Mexico receives natural gas from various import sources and also develops its own reserves. This allows it to generate a supply for the development of the petrochemistry industry. The following is the projection of the balance of supply and demand.

FIGURE 17.
Projection of Supply and Demand of Natural Gas in Mexico



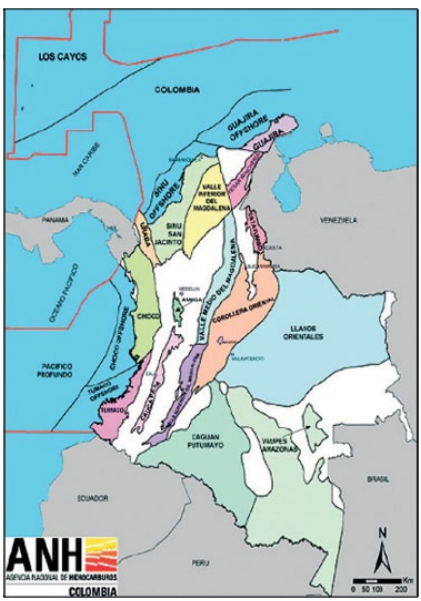
Source: Energy Secretary of Mexico, 2012. Created by the author.

3.3 Colombia

The proven reserves of natural gas in Colombia reached 5.4 TCF in December of 2011, which at the current production rate will last for up to 17 years.

Thirty prospective areas have been proposed for the exploration of non-conventional fields, 1.2 TCF of which have a potential for tight gas, 7.5 TCF have a potential for methane gas associated with coal, and 31.7 TCF for shale gas. The following figure shows the location of its primary gas fields.

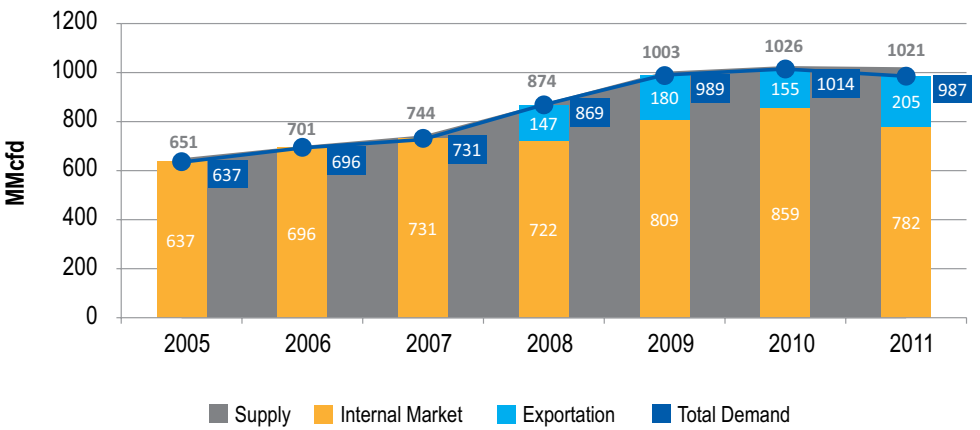
Figure 18.
Map of the Principal Natural Gas Fields in Colombia



Source: ANH Colombia, 2008

The production of natural gas in 2011 was 1.021 MCF and its demand for the same year was 987 MCF. The following figure shows the balance between the national supply and demand of natural gas. A slight surplus can be observed.

FIGURE 19.
Balance of Supply and Demand of Natural Gas in Colombia

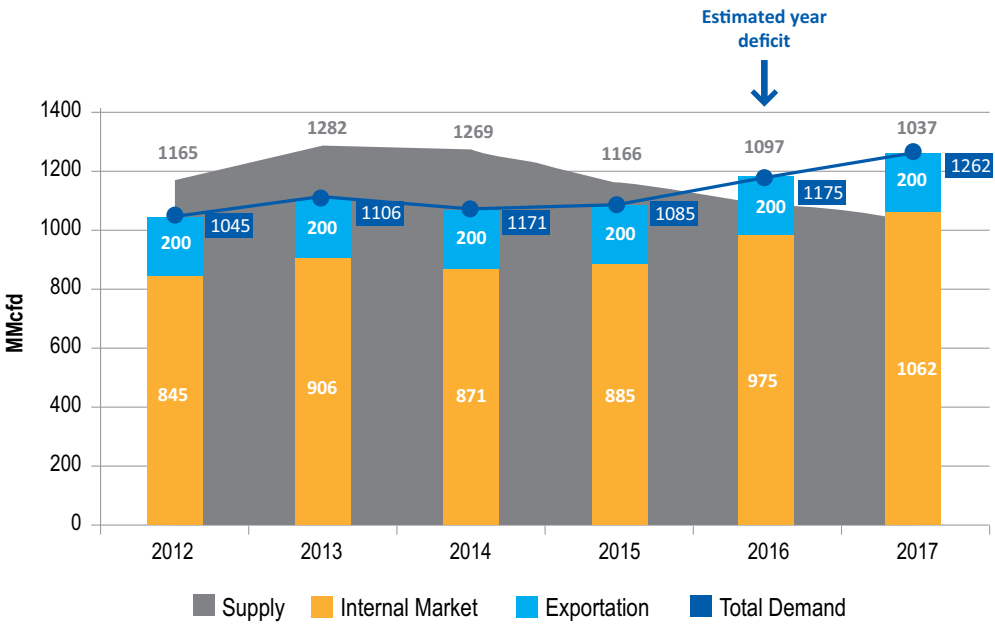


Source: UMPG, 2012. Created by the author.

Colombia is taking advantage of the ease of its natural gas production and since 2008 it has been exporting natural gas to the western region of Venezuela (an average of 200 Bcf/d in 2012). It also has plans to export mini LNG to Central America in 2014/2015.

Nevertheless, the situations of the balance of natural gas supply, shown in the following graph, suggests that unless there is success with commercial exploration, in 2016 there will be a gas deficit and Colombia will have to recur to the importation of LNG. Colombia is also aware of the natural gas conditions in Venezuela that must be reverted to.

Figure 20.
Projection of Supply and Demand of Natural Gas in Colombia



Source: Created by Gas Energy, 2012

There are many areas that are being explored with committed investments for several years, but still lack palpable results in order to have an influence on this trend. These investments must result in new reserves and in production. In this does not occur, however, Colombia will continue being a country with a deficit in natural gas and therefore does not have concrete plans for petrochemical projects.

3.4 Brazil

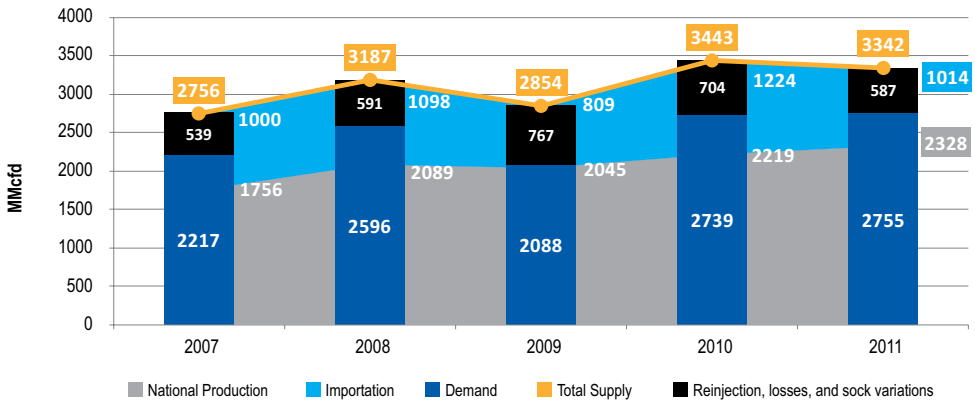
Brazil has proven reserves of natural gas at 13 TCF as of 2011. Eighty-three point nine percent of natural gas reserves are located offshore and 67.8% of the total are a combination of gases and liquids. The year 2007 brought the discovery of the Pre-salt layer (immense offshore fields as deep as 800 to 3,000 meters). It also has the potential for 226 TCF of techincally recoverable shale gas. The most important gas fields are shown in the following.

Figure 21.
Map of the Principal Natural Gas Fields in Brazil

Source: Petrobras, 2012

The following figure shows the balance between the national supply and demand of natural gas produced. Likewise, one sees that they compensate for the deficit by importing gas.

Figure 22.
Balance of Supply and Demand of Natural Gas in Brazil



Source: Ministry of Mines and Energy of Brazil 2012. Created by the author.

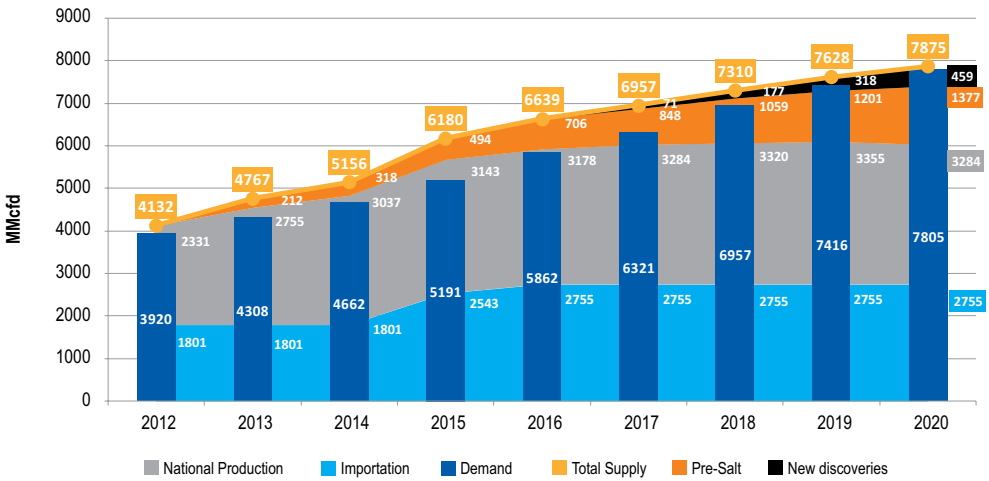
They receive imports from Bolivia, and the rest of LNG imports originate from countries like Qatar and Trinidad and Tobago, destined for their regasification plants in Pecém, Bahia Guanabara. Beginning September of 2013, they will receive shipments at the Bahia plant.

Brazil is a BRIC country. The Brazilian economy continues to grow and is among the largest in the world, which makes it dependent on natural gas imports.

Exploration in Brazil has commitments for both onshore and offshore investments. Also, in 2013, they held biddings on numerous blocks for exploration and exploitation of non-conventional resources. In this scenario, Brazil will continue importing natural gas from Boliva and LNG until new developments

make the country self-sufficient, a situation that will not happen in the next 5 to 10 years. This is shown in the following figure.

FIGURE 23.
Projection of Supply and Demand of Natural Gas for Brazil



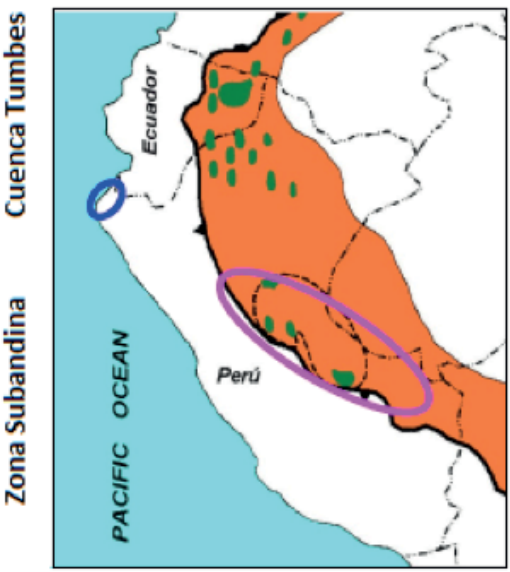
Source: Created by Gas Energy, 2012

Brazil is a country with a deficient and protected petrochemical industry. Despite having insufficient natural gas, it has begun developing petrochemical plants through its state company Petrobras, which has monopoly-like characteristics and mixes internal and import prices in order to grow economically.

3.5 Peru

Peru, as of 2012, has 12.7 TCF of proven reserves of conventional gas (whose location is shown in the following figure). The reserves/production rate indicates that Peru will have gas for 35 more years. Also, non-conventional gas potentially exists in the Ucayali basin equivalent to 75 TCF, and additional resources that can be converted to reserves once they strengthen in new markets.

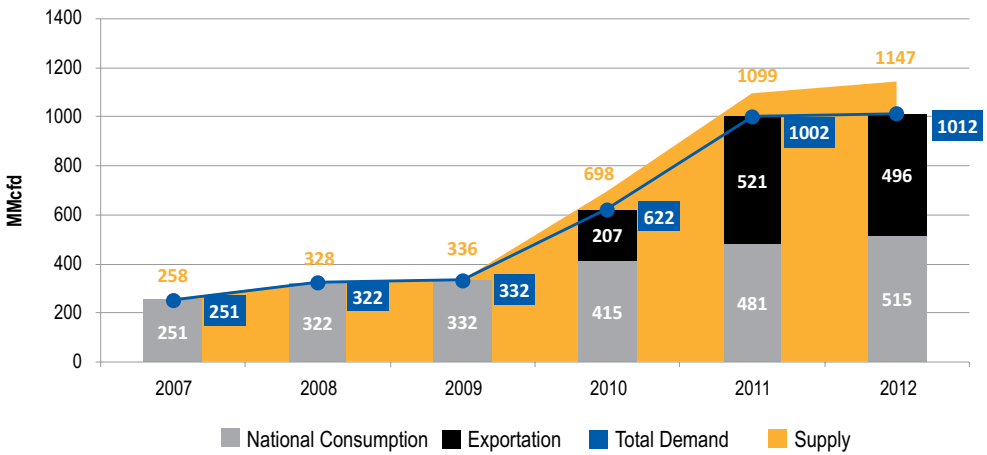
Figure 24.
Map of the Primary Natural Gas Fields in Peru



Source: Perupetro, 2012.

The production and demand of natural gas in Peru is shown in the following figure. One can see that there is a surplus of production.

FIGURE 25.
Balance of Supply and Demand of Natural Gas in Peru

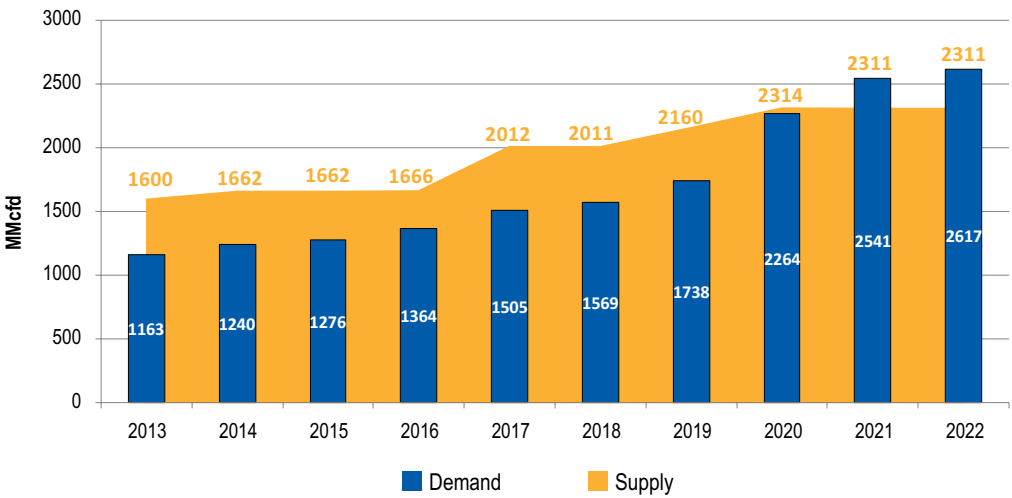


Source: Ministry of Energy and Mines. Created by the author.

Peru has reserves and surplus resources due to sharp increase in production by its primary fields "88", "56", "57", "58", and "76".

Peru, since 2010, has been exporting LNG to Asian, European, and North and South American markets, and it seeks to develop the Andean Pipeline project, in order to transport gas from these sources to the southern part of the country, including the petro-chemical industry. The projections for the supply-demand balance follow.

Figure 26.
Projection of Supply and Demand of Natural Gas for Peru



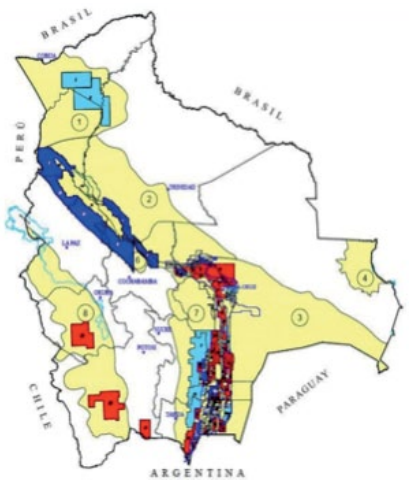
Source: PeruPetro, 2012. Created by Gas Energy.

Although there is a deficit of natural gas, this is limited by the transport restrictions, which is a product of insecurity and socio-community factors, not because of resources and reserves found in the aforementioned sources. In these fields, resources are near 20 TCF and there is enough natural gas available to develop the South Andean Gas Pipeline project, which includes development of petrochemistry.

3.6 Bolivia

Bolivia has 11.40 TCF in proven reserves of conventional natural gas, as of 2012, including those in Incahauasi. There is an estimated 48 TCF of shale gas technically recoverable in the traditional zone of the country's south.

Figure 27.
Map of the Primary Natural Gas Fields in Bolivia

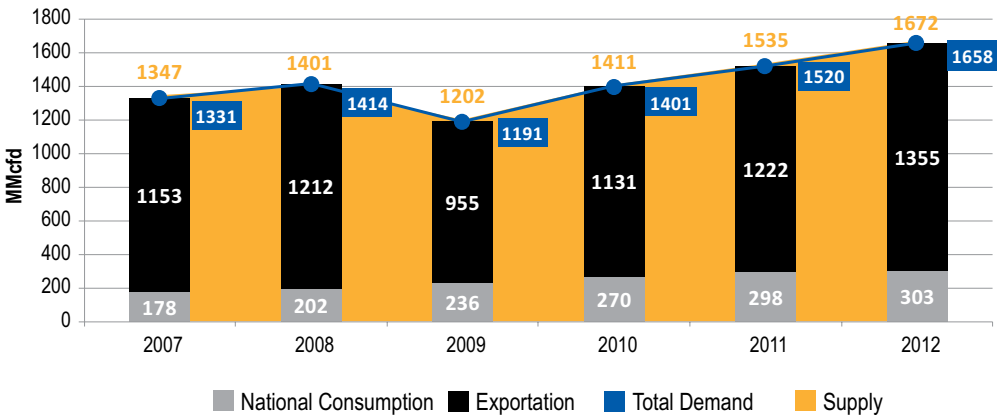


Source: Ministry of Hydrocarbons and Energy, 2010

The following figure shows the balance between supply and demand of natural gas in Bolivia. The data shows us that the domestic demand is very small compared to production (in the last five years it reached a maximum of 20%).

Bolivia is a natural gas exporting country. It has taken advantage of the reserve capacity in its fields (the majority of which are associated liquid gas) and the demand of its neighbor countries (Brazil and Argentina). Today, it is the largest exporter of natural gas in South America.

Figure 28.
Balance of Supply and Demand of Natural Gas in Bolivia

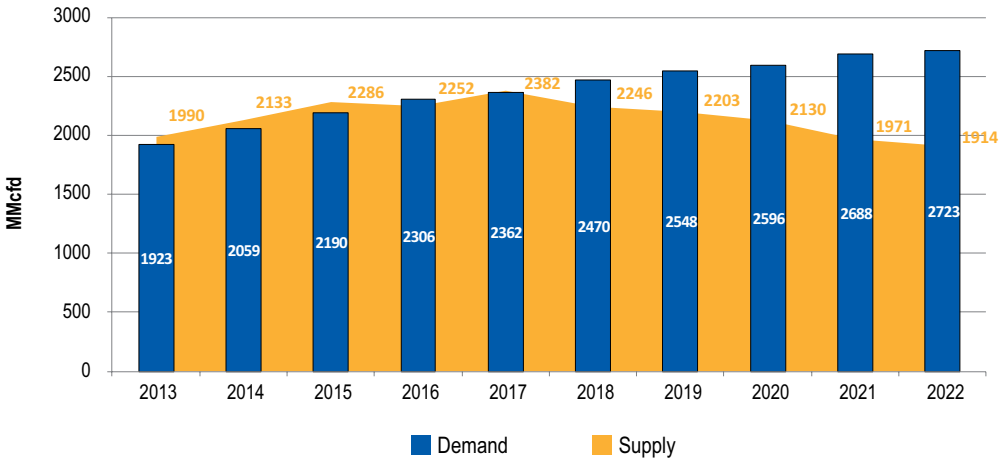


Source: YPFB. Created by Gas Energy

The projection of natural gas balance in the following figure shows us that, beginning in 2015-2016, Bolivia will have a deficit (decline in the production of its wells) in order to maintain its export agreements and its domestic market. Bolivia is working toward providing incentives and conditions to promote investment in exploration, considering it has great potential.

Included within the projection are the volumes of petrochemical plans Bolivia is developing.

FIGURE 29.
Projection of Supply and Demand of Natural Gas for Bolivia



Source: Created by Gas Energy 2012

3.7 Argentina

Argentina, as of 2012, has conventional natural gas reserves equivalent to 12 TCF, and the reserves/production rate indicates that there is 6 and a half more year of gas. However, it already has a chronic gas production deficit and is unable to attend their domestic market for several years.

Argentina has large non-conventional natural gas resources. The International Agency of Energy reported 774 TCF of technically recoverable resources. In particular, the Vaca Muerta field in Neuquen is the leader of these reserves in Argentina; it has great possibilities from undergoing intense developments. The following figure shows the primary gas deposits.

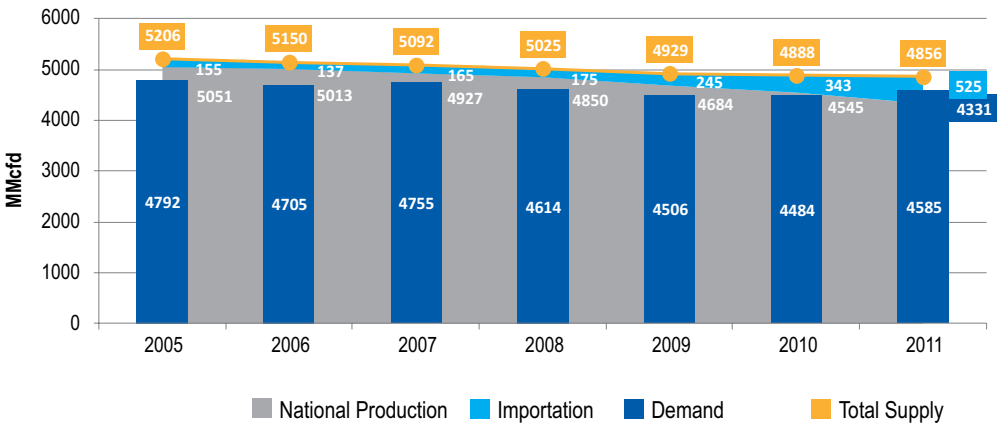
Figure 30.

Map of the Primary Natural Gas Fields in Argentina

Source: Repsol YPF, 2012

The following figure shows the supply and demand of natural gas in Argentina. One can see there is a large deficit compensated by the importation of Bolivian gas and LNG to their regasification plants in Bahia Blanca and, more recently, in Escobar.

FIGURE 31.
Balance of Supply and Demand of Natural Gas in Argentina

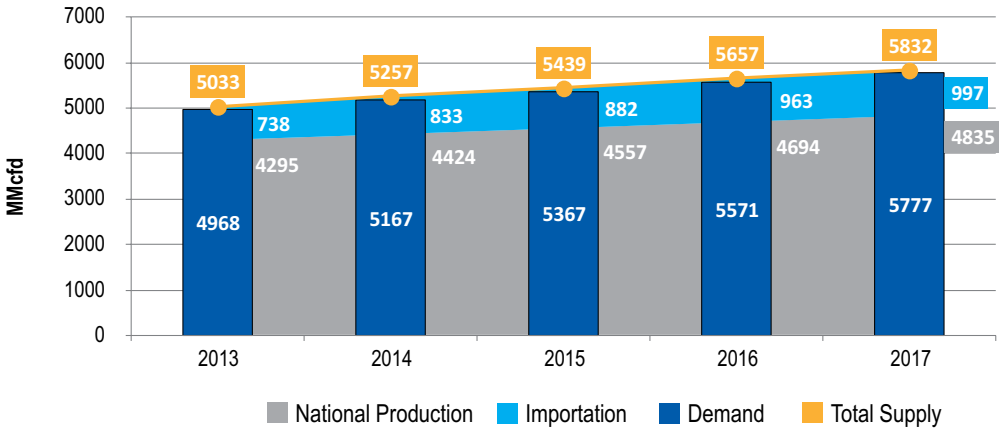


Source: Secretariat of Energy, 2012. Created by Gas Energy

Argentina must massively invest in order to overcome the deficit, and a large part of the investments should be made in non-conventional gas and in improved recuperation of conventional gas.

Figure 32.

Projection of Supply and Demand of Natural Gas for Argentina



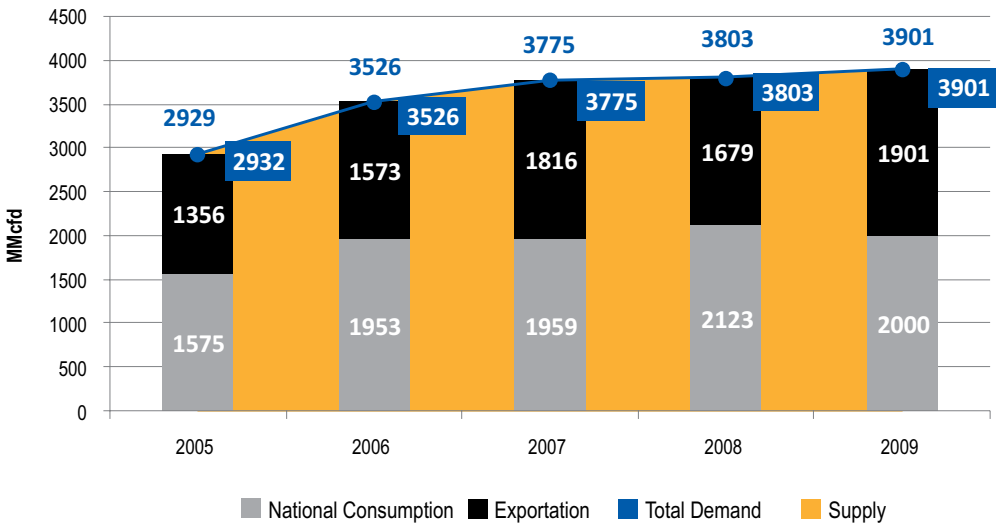
Source: YPF, 2012. Created by Gas Energy.

3.7 Trinidad & Tobago

Trinidad and Tobago, as of 2012, have 14.2 TCF in natural gas reserves. The production and demand of natural gas are shown in the following figure. One can observe that a large part of production leaves via exports in the form of LNG, which they liquefy to transport in four trains, in operation since 1999, from their Atlantic LNG plant and, also, in the petro-chemical industry.

FIGURE 33.

Balance of Natural Gas in Trinidad and Tobago



Source: Created by Gas Energy, 2010.

Trinidad and Tobago has declining reserves and production, as well as problems developing the offshore deposits shared with Venezuela. The low prices of shale gas from the United States are taking away the market for its LNG, but they have opened new markets, further away in South America and Asia. Trinidad and Tobago is promoting new, deeper offshore areas, primarily for exploration and to compensate their declining reserves and production.

Relation between industrialization of natural resources and economic and social development

CHAPTER IV

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

The concepts of economic and social development are linked. In general, economic development implies an economic growth that generates employment opportunities and fair distribution of economic resources. This equitable redistribution of economic resources must be oriented toward generating well-being (improved quality of life of people, which is the goal of human development theory) with social investments in food, education, health, infrastructure, and others.

Without economic growth, it's basically impossible to generate human development. For there to be economic growth, one must develop investments that allow the products and services to be in the market. **The generation of markets can stimulate economic growth and, therefore, human development.** The best example, in current times, is China; it has generated investments in diverse areas in order to mass-produce goods and services, and it has promoted its arrival to markets with products of higher technological value than Latin America. South Korea and Taiwan are other countries with a high level of economic and human development.

The indicator that evaluates economic growth is the GDP, which measures the monetary value of all the final goods and services produced by an economy in a determined period. It can also be measured with the rate of unemployment, which is the proportion between the employed population and economically active population. Social and economic development can be evaluated through the HDI, which measures the aspects of health, education, and the standard of living of a determined population.

The industrialization of natural resources has the objective of generating as much economic development as social development, which is to say that by giving greater value added to raw materials, one can take advantage of the economic activity associated with investment to generate employment, productivity, technological development and, finally, better wages and quality of life for the citizens of a country or region.

Some countries believe that industrialization is necessarily linked to better economic incomes when one commercializes natural gas versus some product with value added. This is not necessarily true and it depends in large part on the location of the projects, the value chain, the scale of the projects and, above all else, the level of technological development a country has.

As consequence of the aforementioned, certain questions arise: What are the effective economic benefits of industrialization for the countries of the region? Why are there cases where the economy has grown significantly thanks to industrialization, while others have not done it on the same scale? And in the specific case of natural gas, what is necessary in order to maximize the positive impacts in the development of a country through industrialization?

To respond to the first question, in the following one can make a general examination of the economic benefits associated with industrialization of any natural resource (including natural gas) during construction of the industrial unit and its operation.

- For the construction of the industrial unit, one must invest millions in engineering, materials, construction services, and start up. It should be pointed out that this type of industry is technology dependent and highly automated.

  If we break down the investments in this stage, one clearly realizes that a large part of the resources are destined for the purchasing of technological goods and services. This means that they invest in engineering and

machinery (in the case of petrochemistry: fractionating towers, reactors, heat exchangers, pumps, ovens, motors, among others).

The reality shows us that engineering services of the project like acquiring equipment and machinery, in general, are not innovated and/or produced in the Caribbean and Latin American countries that industrialize or seek to industrialize their natural resources. There are some exceptions like Brazil, Mexico and, on a smaller scale, Argentina where they generate some innovation and production of technological goods and services necessary to develop the value added or petrochemical industries.

Therefore, a large portion of investment leaves the borders toward countries that provide technological goods and services, where true economic activity and the desired human development happen. In countries without technological development, investment remains limited to civil projects, some construction, and unskilled labor.

• As mentioned previously, these types of industries are highly automated, which means operation of the plant does not require a high amount of human resources

A large part of automation technology comes from outside the region, and industrialization only leaves value added in the contraction of some technical and administrative professionals, and local unskilled labor. There is a more significant activity associated with employment in areas of minor maintenance, transport, and associated services that do stay in the enterprising country.

Another fundamental aspect of the process of adding value is related to the integration of the productive chain in products of, pardon the repetition, higher value. This is notable in petrochemistry and is detailed later.

Furthermore is the effect of the economies of scale and the location of projects inside large industrial complexes. Large scale plants result in lower per unit costs in production. The location regarding the markets and

sources of raw materials is also important and influences the sustainability of the project. This is also explained later on.

When they are unable to complete the situations above, it's necessary to provide raw materials (read natural gas) at low prices to the projects in order to make them sustainable, competitive, and allowing them to remunerate the investment and generate rent. Frequently, one sacrifices very important fiscal income by selling raw material in the interest of generating economic activity and employment. This topic deserves to be well analyzed prior to the management of the industry.

Continuing, the economic development since the industrialization of natural gas in the international context will be analyzed, in order to know why there are countries that have managed to launch their industries, and others that have not been able to have the same results. It's necessary to evaluate what conditions have been present to allow greater success.

This is the case of the United States which, since the Second World War, has been developing its petrochemical industry on the large scale. The largest petrochemical complex in that country is the ExxonMobil Baytown Area, in Texas, which includes refining (since 1920), two chemical plants (since 1940 and 1979), a plastics plant (since 1982), as well as having a technology center.

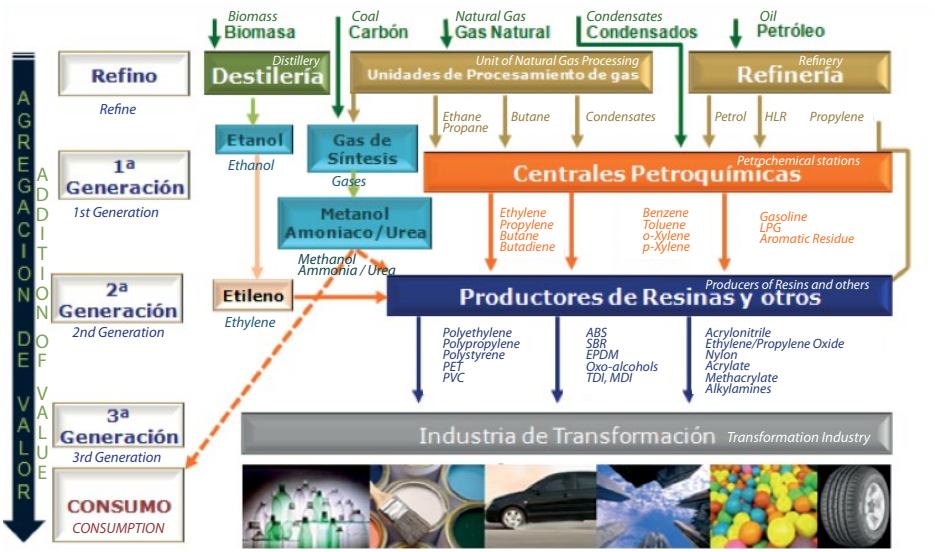
The United States and its petrochemical enjoys (and they are doing it again with the development of shale gas) six advantages:

First, it has abundant and economical raw materials, which assure the guarantee of provisions that provide sustainability to the endeavor over time. Second, they have plants located in integrated complexes, allowing considerable savings through sharing facilities of manipulation, transport, electric energy services, and provision and disposal of water, among others. Third, they are highly integrated industries, meaning they use the products of basic petrochemistry as raw material for amplification (of second and third generation) and thereby obtain products with greater value added and greater marginal utility. Fourth, they possess and constantly develop science and technology through large investments in research and development centers, allowing them to obtain more efficient methods of production and competitive advantages in the market. Fifth, technological products and services in sectors that affect the value chain are generated in the same country, which allows for competitiveness and growth of the national economy, this being a source of high-skilled employment.

The following figure shows the basic petrochemistry (first generation) with expansion (second and third generation), in which the results of the first generation are sub-products to those only needing to pass through other processes of transformation, in which they will receive added value.

Figure 34.

Structure of Advanced Petrochemistry



Source: Gas Energy, 2012

It's also interesting to bring up the South Korean petrochemical experience, which is similar to Taiwan's. South Korea is a country that has scarce hydrocarbon reserves, and yet, it has strongly developed the industrialization of these resources.

The South Korean government, at the beginning of the 1960s, made clear that the panorama of industrial development, in general, would base itself on the formation of large conglomerates.

It has also favored education, and research and development (R&D). It incentivized the professional training of its population, so that it can quickly assimilate new technologies from any sector. In regard to R&D, first it based it on the limitation of products and reverse engineering, then it created attractive investments so that more developed, foreign countries would exchange

the know-how of the industry. Today, the country invests in generating its own science and technology and, in the future, the government expects to intervene less and less in R&D, leaving it in the hands of private institutions.

Regarding petrochemistry, South Korea observed that this industry would make several others in need of these final products surge. That's why it decided to import gas and crude. The volatility of prices did not mean a lot because they already had planning that would make the new industry become competitive and generate benefits for South Koreans. Today, it works in joint-ventures with companies from the upstream sector to ensure raw material. The following figure shows the petrochemical complex developed between Samsung and Total, the largest, privately developed one in South Korea to date.

Technology plays a very important factor in this industry, for which the South Korean government sought foreign partners that can provide knowledge and technology, provided financing to national entrepreneurs in exchange for using advanced technology in its processes, encouraged competitive prices of final products by transferring part of the production costs to the prices of combustibles, and created a promotion committee for the petrochemical industry.

These countries have been taking maximum advantage of, and they continue to do it, the potential benefits of the aforementioned industrialization of natural gas and, therefore, they are important contributing factors to the economic incomes and social development of their citizens.

Some countries in Latin America and the Caribbean have managed natural gas industrialization processes with different results. These are Brazil, Mexico, Venezuela, Trinidad and Tobago, and Argentina.

In these last years, some Latin American and Caribbean countries with supply (especially surplus) of natural gas and without previous industrialization experience, have assumed a role of promotion or of direct participation in adding value to its natural gas, and they are doing it with different methods,

such as the case of Peru and Bolivia, touched on later in this study.

To respond to the questions raised at the beginning and as a way of concluding this point, the aspects to take into account are described in order to take advantage, with greater force, of the economic and social benefits of the processes of natural gas industrialization in the region.

- Generation of science and technology

It involves large investments in obtaining knowledge and encouraging research and development in the petrochemical sector (new methods, production of licensing, patents) and in sectors that contribute to the value chain (engineering and industry of highly complex equipment and machinery, like turbines). A country, after achieving the expected economic growth, must not remain static; it's more an obligation to continue in the production of goods and services more technological in order to be more competitive. On the contrary, other products will enter the market, and the economic consequences can drastically reduce the per capita income, leading to a contraction, returning the economy to the same state in which it found itself before the economic boom.

- Creation of petrochemical complexes and integrated chemical companies

One must strategically plan the location of the complex (near the raw material and markets) in order to place plants there that complement basic petrochemicals and transform the sub-products until obtaining higher value synthetics of the third generation. Due to the proximity of the pants in the complex, one can achieve reduced costs (common facilities) and time (transfer of the sub-products from one plant to another).

- Economies of scale

It includes increasing the size of the plants and the volumes produced, thereby generating a lowering in the unit cost of production, making them more competitive.

- Legal security

It's necessary to promote private, national, and/or foreign investment in order to cover the constant investments in a capital intensive industry like petrochemistry. Concurrently, one must generate confidence in investors that their investment is safe, providing them legal backing, via regulations.

- Provision of raw material

In the case of having raw material, this results in an additional competitive advantage and must be backed with long-term contracts while maintaining continuous exploration in a way that the investments in and expansions of the industrialization process continue.

International experiences where natural gas has been employed as a primary factor of development

CHAPTER V

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

Below, four countries are described in which natural gas has promoted economic growth and has supported improving people's quality of life. The economic and developmental efficacy will be measured through the indexes we previously described.

5.1 Trinidad & Tobago

The development of natural gas in Trinidad and Tobago has generated a great impact in the economy through the exportation of LNG to different countries of the world, and the exportation of ammonia, urea, methanol, and melamine as a result of the industrialization of natural gas.

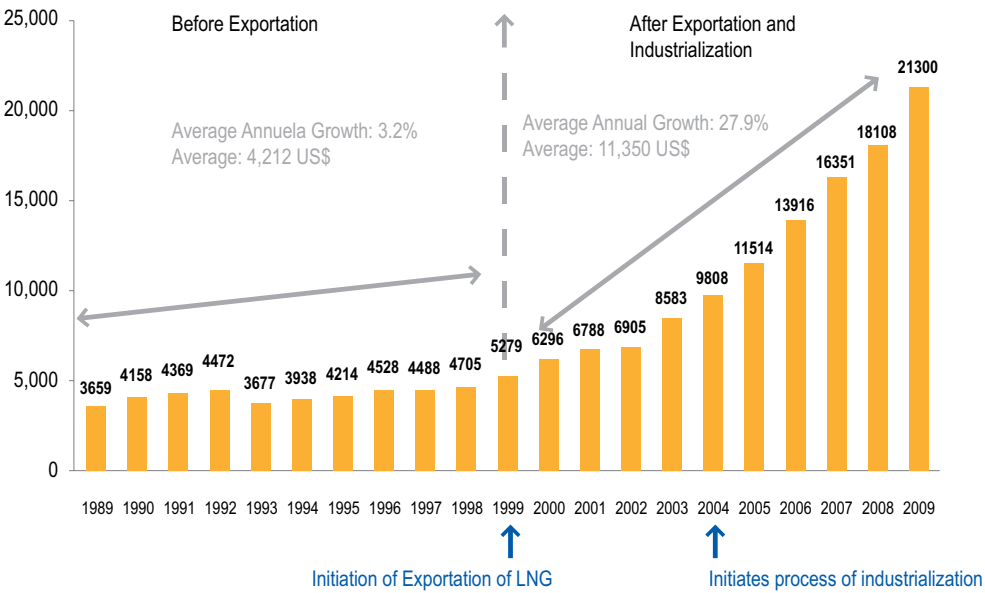
In the case of Trinidad and Tobago, despite not having the technological aspects previously mentioned, the impact of the rent received from raw material and basic petrochemicals has been strongly felt in the economy and social development, due to the scale of the exports, the location of the plants, and the low population of this country.

The growth of economic and social indicators like the Gross Domestic Product (GDP), rate of unemployment, and Human Development Index (HDI), among others, backs this evidence. They began exporting LNG in 1999 and producing petrochemicals in 2004.

For the period 1999-2009: the average growth of GDP per capita was around 27.9%, compared to 3.2% during the previous decade.

Figure 35.

Average Annual Growth of GDP per Capital in Trinidad and Tobago Before and After Exportation and Industrialization

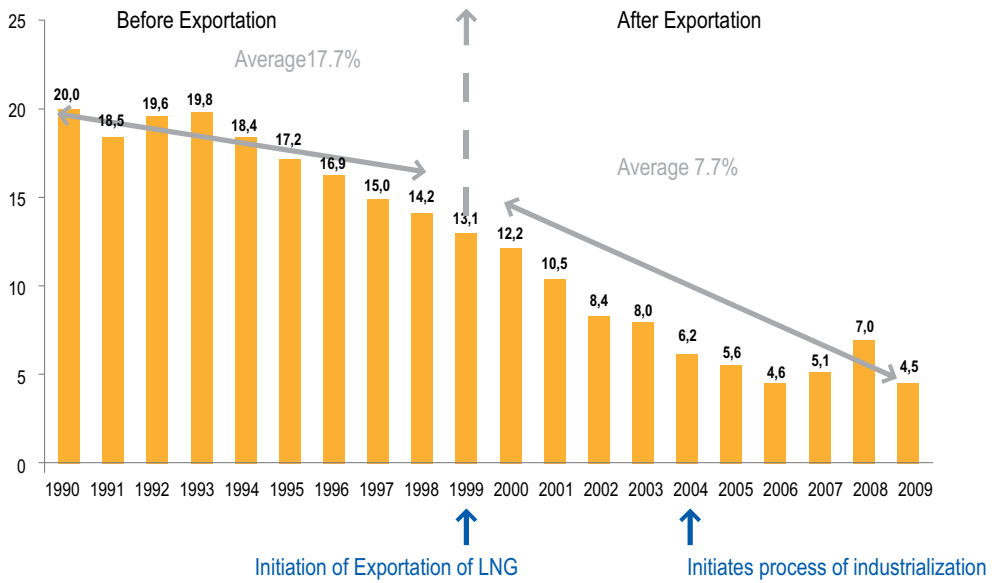


Source: World Bank, 2010

The rate of unemployment averaged 7.7% compared with the previous decade when it was higher than 17%.

FIGURE 36.

Rate of Unemployment in Trinidad and Tobago Before and After Exportation and Industrialization

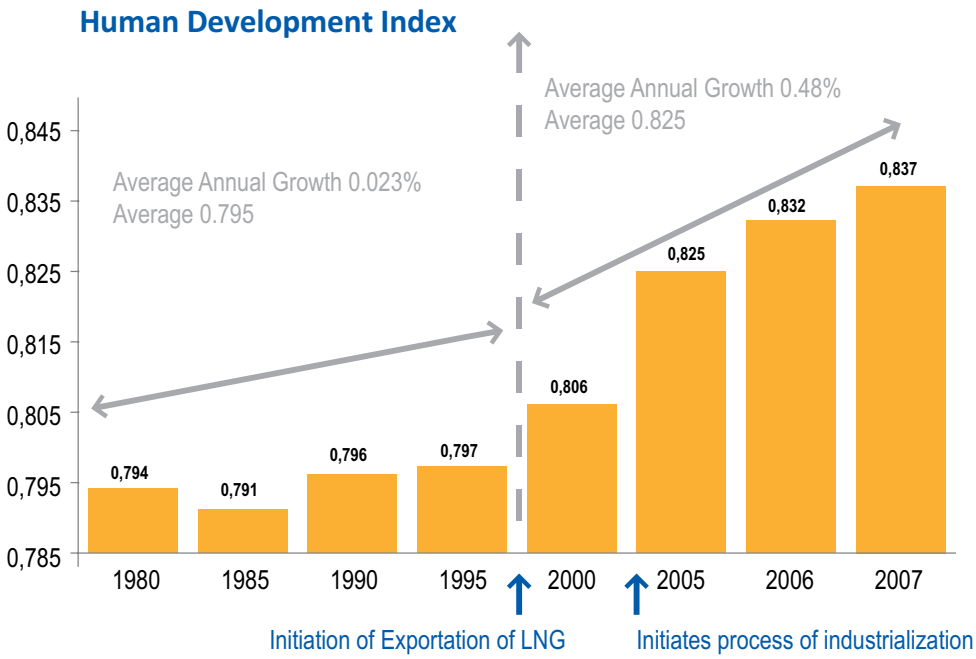


Source: International Monetary Fund, 2010

On the other hand, the average HDI for the decade prior to the exportation of LNG was 0.795 and, at the commencement of exportation of LNG and the process of industrialization, in rose to 0.825.

Figure 37.

Human Development Index in Trinidad and Tobago Before and After the Exportation and Industrialization



Source: ECLAC, 2010

But despite the success of natural gas development in Trinidad and Tobago, on the other hand, we see a rentier state that is not promoting another type of technological and productive development capable of generating greater well-being for its population in the long-term.

5.2 Bolivia

Bolivia is a country that has exported natural gas to its neighbors for years. It has high economic revenues as a result of exporting natural gas to Brazil and Argentina over the last 10 to 15 years. These revenues come from the Direct Tax on Hydrocarbons (IDH, Spanish acronym), royalties, shares that are collected on-site, as well as income from liquids associated with exported natural gas, among others.

High prices and increasing demand from Argentina and Brazil allowed Bolivia to obtain millions in revenue, used to fund bonds, subsidies, social projects, and construction of mega-plants to industrialize natural gas.

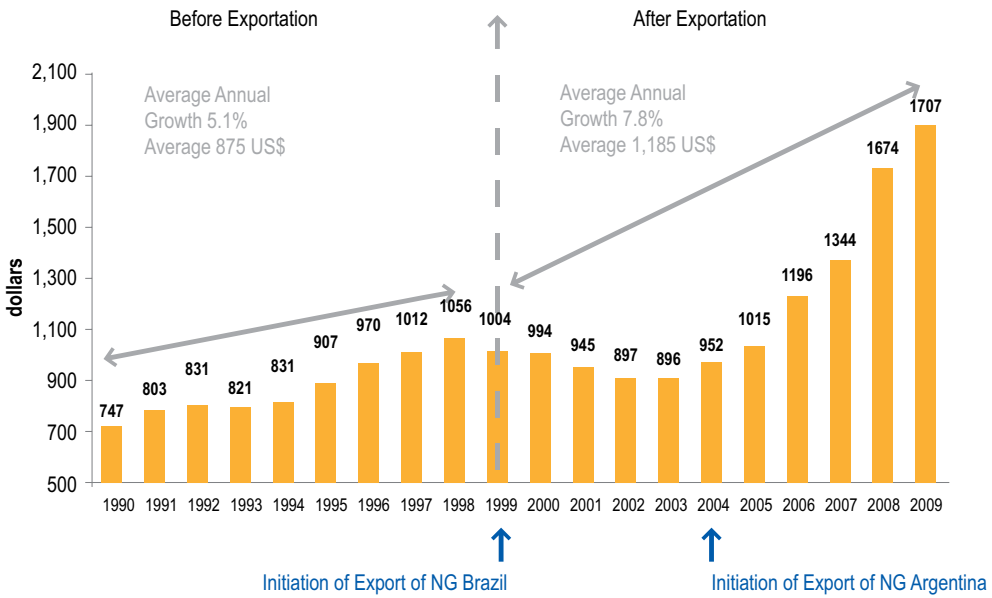
The case of Bolivia is very similar to the case of Trinidad; both are countries that base their revenues on the exportation of gas and in basic petrochemicals (Bolivia will shortly be entering this cycle, a situation described later in this study).

The exportation of natural gas in Bolivia began in the year 1968, with the signing of the first contract with a neighbor country, Argentina, but the largest volumes of natural gas exported happened in 1999, with the Brazilian market and, later, with the Argentinean market again in 2006.

For the period 1999-2009: the average growth of GDP per capita was around 8%, compared to 5.1% during the previous decade.

Figure 38.

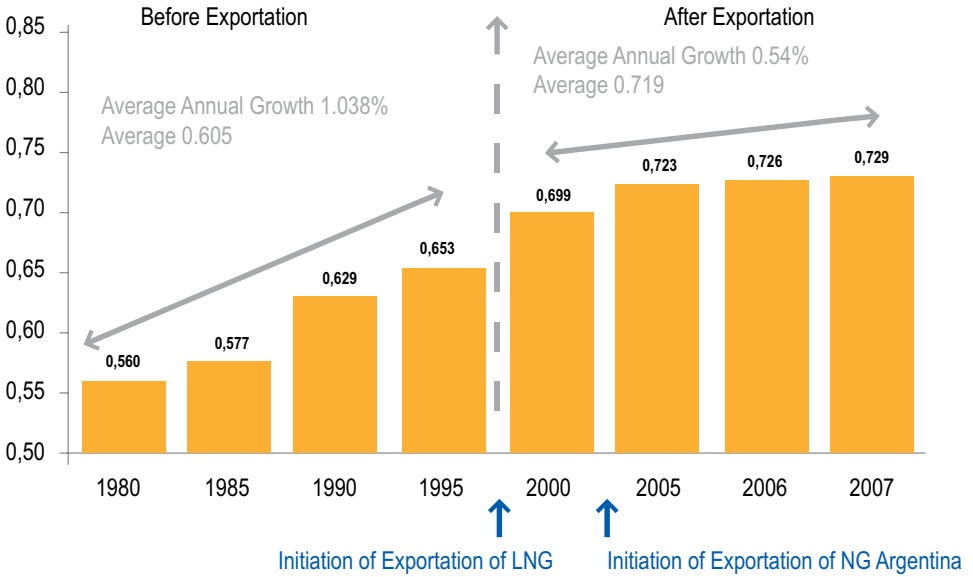
Average Annual Growth of GDP per Capital in Bolivia Before and After Exportation



Source: World Bank, 2010

Although the average annual growth rate GDP is good on the lower half, one must note that the average value of this index for the previous decade of exportation did not exceed 0.65 and, when exportation to Brazil and later Argentina commenced, it rose from 0.7 steadily upward.

FIGURE 39.
Human Development Index in Bolivia Before and After Exportation

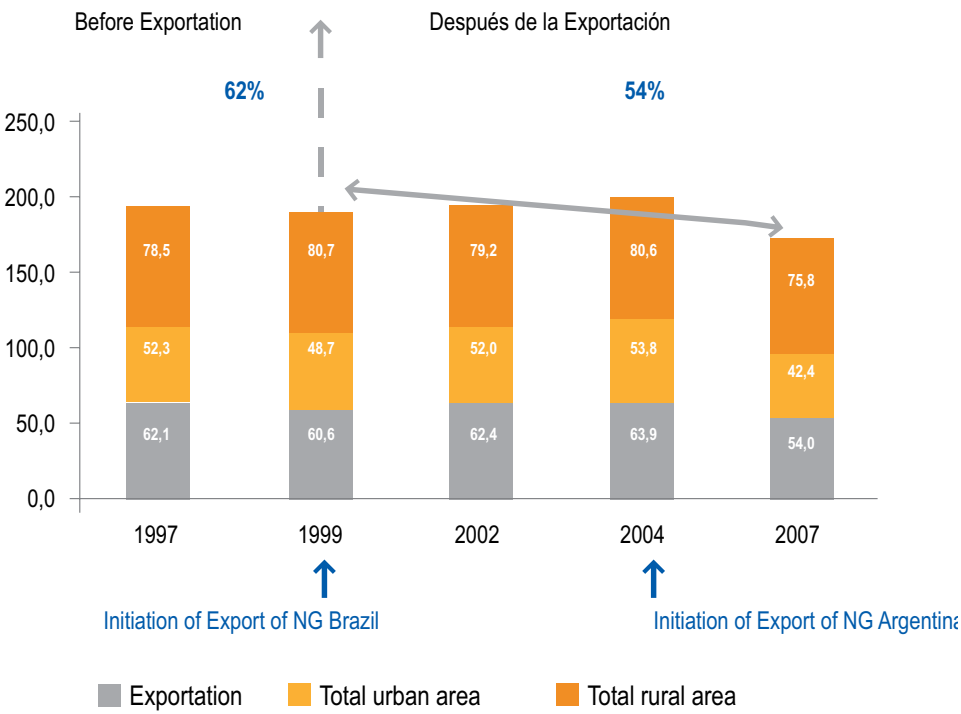


Source: ECLAC, 2010

Finally, the percentage of poverty (urban and rural) before exportation was 62%, while after it fell to an average of 54%.

Figure 40.

Poverty Rate in Bolivia Before and After Exportation



Source: INEB, 2010

Although exportation is highly favorable for Bolivia, it is still especially rentier. The accession of basic petrochemicals can be considered an important step, but not fundamental due to technological, scale, and other previously mentioned aspects.

5.3 Argentina

The development of the natural gas sector in Argentina began in 1946. Throughout the years, and with strong development of the natural gas industry, it has produced the opening of markets, initiating exports of natural gas to Chile, Brazil, and Uruguay, and has invested in various development poles with its principal example being the petrochemical hub in Bahia Blanca, generating benefits for the country.

Additionally, it encourages the use of natural gas in its domestic market, becoming one of the most natural gas based countries in the world, with a high percentage of participation in its energy matrix.

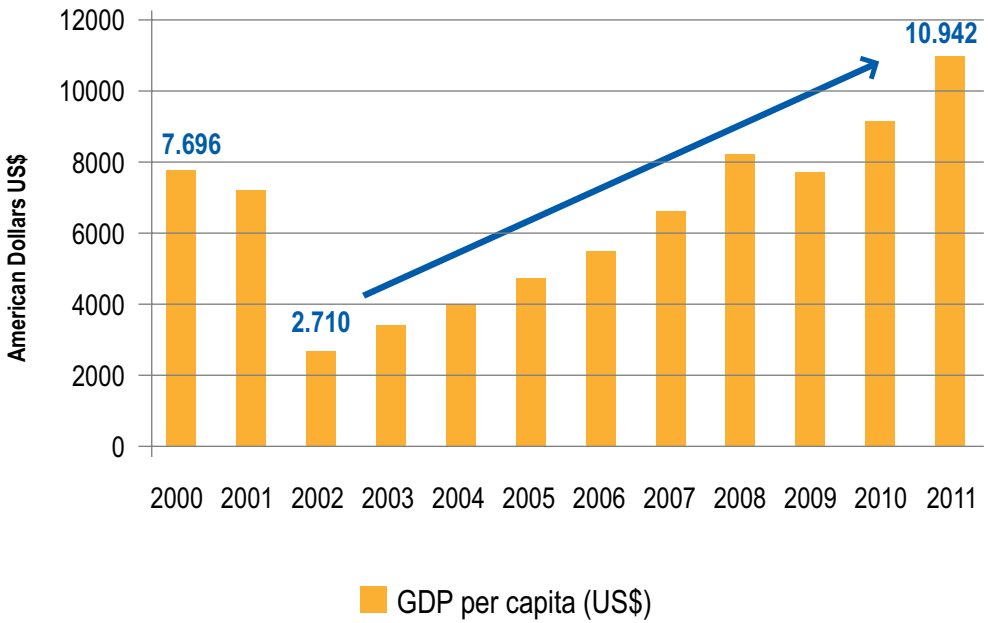
However, since 2002, domestic market prices have frozen which has discouraged investment in exploration and has generated a drop in reserves and production. The previously mentioned, as well as the increase in domestic consumption, generates an imbalance between supply and demand that puts an end to the exportation of natural gas and has made the country a net importer.

It's important to remember that the vision of Argentina has been different than that of Bolivia and Trinidad and Tobago, being that this country has developed some products and technological services. Concurrently, with the given growth of the natural gas sector, it has trained human capital and has begun exporting service companies within the hydrocarbons sector. The case of CNG and NGV are of particular relevance, as well as the technology and fabrication of machinery and accessories for the natural gas and petrochemical industry.

Economic growth has increased quite a lot during the first phase of development of the natural gas industry (plants, gas pipelines, petrochemistry, and machinery). From there, Argentina fluctuates constantly with highs and lows in its economy, but always maintains a stable range. From 2002, Argentina creates an economic growth based on low energy prices that did not end up being sustainable and is affecting its economy in the present day.

Figure 41.

Evolution of GDP per Capita in Argentina



Source: World Bank, 2012

5.4 Canada

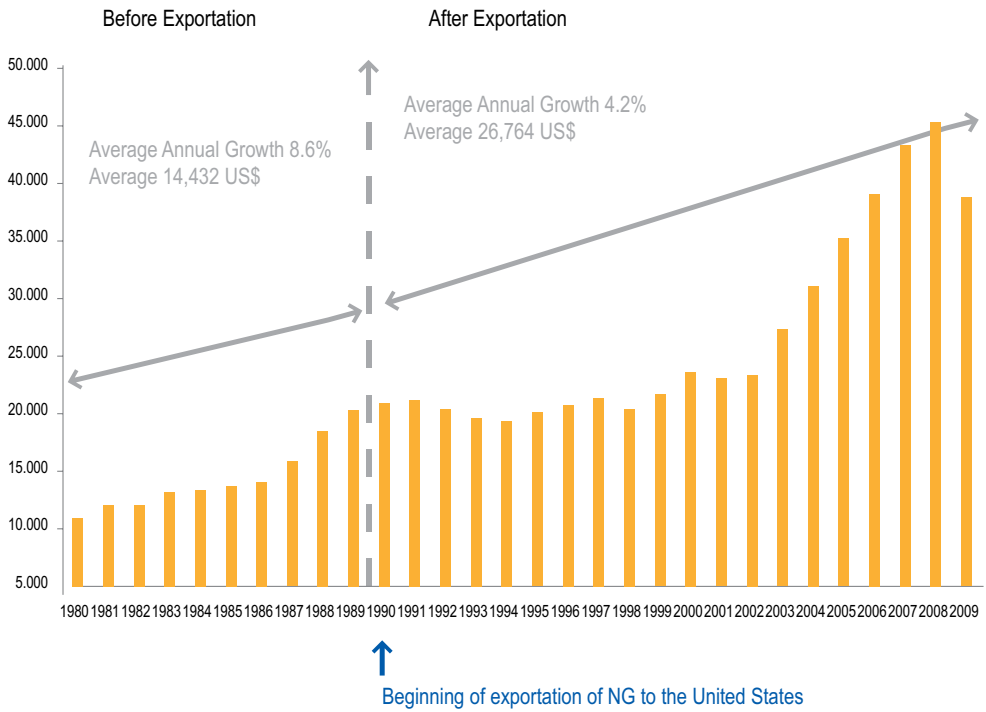
Canada's natural gas industry has a long history in its domestic market, and it initiated exportation of natural gas to the United States in 1990.

The development of the natural gas industry has given high revenues to the country, not only through exportation, but also through industrialization of natural gas, generation of national service companies that provide technology not only to Canada, but also at the world level, and the training of human capital. As a result, Canada is a successful case study for its development of natural gas and its process of industrialization.

The average annual growth rate of GDP per capital the decade prior to exportation of natural gas was 8.6%, representing an approximate value of 14,000 dollars per citizen. In the following decade, at the commencement of exportation, growth was 4.2%, but the value had doubled to 26,764 dollars per citizen.

FIGURE 42.

Average Annual Growth and Value of GDP per capita in Canada Before and After Exportation



Source: World Bank, 2012

Canada is an example of how strong pushes to natural gas for its domestic and export markets, together with very vigorous industrialization and the provision of technological goods and services, has resulted in strong economic and social development.

It's also very interesting to analyze that Canada maintained a constant exploratory cycle various decades in order to underpin its domestic demand for natural gas, its growing export market, and the petrochemical industry. This situation doesn't occur with many countries in Latin America and the Caribbean. From what we have been able to observe, through various methods, the exploratory cycle to encourage development has been short.

Definition of case studies in Latin America and the Caribbean, as of the analysis of the supply of natural gas in the region

CHAPTER VI

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

The countries of the region considered for the definition of case studies are those that have the production potential and reserves to cope with industrialization plans in the next five years. In accordance with the evaluation in point seven, Gas Energy considers Peru, Bolivia, Mexico, and Brazil as the countries with plans to industrialize their natural gas.

On this point, a detail of the plans and a summary of the regulatory and trade framework under which they plan to develop those plans are presented.

The plans and projects for the industrialization of natural gas in Latin America and the Caribbean have become complicated in their development since the growth of the shale gas industry in the United States, which has now expanded to Canada. These low prices of raw materials will be a reference marker for the prices of petrochemistry in Latin America for many years. This complicates the exploratory projects and the development of the natural gas chain in the region's countries.

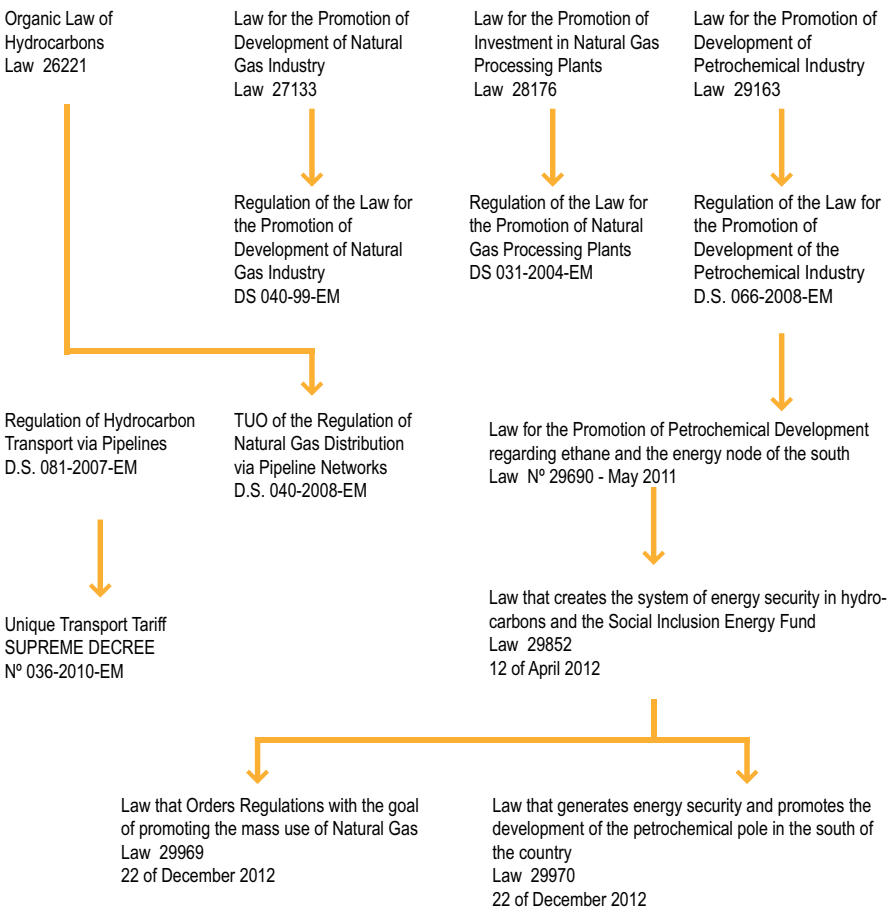
6.1 Peru

Peru has great potential and natural gas reserves to date. The infrastructure is under development and the country is quickly moving toward a natural gas matrix.

It's a policy of the Peruvian state, given these reserves and infrastructure development, to support various projects of natural gas industrialization. To this effect, Peru has created a series of laws so that international capital can develop the petrochemical industry on the coasts.

Figure 43.

Active Regulation Framework in Peru



Source: Ministry of Energy and Mines, 2013

Peru, in the last five years, has had one of the highest economic growth rates and one of the lowest inflation rates in Latin America, as well as an open economy and diversification of exports, maintaining legal security in order to continue attracting investments. Everything shows that this tendency will continue through successive governments and it's possible to predict that the prior is almost a policy of the Peruvian state.

The regulatory framework for natural gas controls downstream activities and has free-market characteristics for on-site production. OSINERGMIN undertakes the regulatory activities regarding costs, tariffs, and quality of service.

Investments and development plans for petrochemistry all come from international capital due to the incentives provided in the laws and regulatory frameworks. Four projects exist in this context, each one with different levels of progress toward trying to industrialize the natural gas of Peru. All have private international capital.

The first two projects are pending some price conditions and the capacity to transport via a gas pipeline that runs from Camisea to Lima.

The final two are awaiting construction of the South Andean Gas Pipeline that is currently in the licensing process.

- C.F. Industries (Ammonia and Urea) - Ica

The ammonia and urea plant will be located in San Juan de Marcona, Ica. It will process 90 Mcf/d of natural gas in order to produce 0.9 MMT/year of ammonia and 1.4 MMT/year of urea. The investment is approximately 2 billion USD. Even though there have not been great advancements, Perupetro has not discarded this project.

- Nitratos del Peru (Ammonia and Nitrates) - Ica

Located in the Paracas district of Ica, the ammonia and ammonium nitrate plants process 72 Mcf/d of natural gas in order to produce 0.8 MMT/year of

ammonia, 0.3 MMT/year of nitric acid, and 0.38 MMT/year of ammonium nitrate. They have a scheduled investment of 650 million USD. The associates of the endeavor are the Peruvian group Brescia (51%) and the Chilean group Signdo Koppers (49%).

• Orica (Ammonium nitrates) – Ilo Province

The plant will be located in the "Lomas de Ilo" zone, in the Moquengua department. It will produce 0.3 MMT/year of ammonium nitrate with an investment around 500 million USD. At this time, the project awaits approval from the Environmental Impact Assessment.

• Braskem (Ethylene and Polyethylene) – Southern Peru

It involves the construction of a petrochemical complex that will require an approximate investment of 3 billion USD to produce 1.2 MMT/year of ethylene.

6.2 Bolivia

Bolivia is also taking concrete steps forward for the industrialization of natural gas. It is achieving this under a completely different model than is Peru, where the government is the sole investor in establishing plans and projects.

Because of this, there are no laws or regulations that promote international investment in this sector.

The two projects that are envisaged in Bolivia are:

• YPFB (Ammonia and Urea) – Bulo Bulo

The ammonia and urea plant will be located in the Department of Cochabamba and will process 50 Bcf/d of natural gas with a production of 1,925 MTD (metric tons a day) of urea. The cost for this plant is approximately 1

billion USD. It is estimated that the beginning of its operations will occur in the second half of 2015 and that the basic engineering, detail engineering and construction is being performed by the Samsung Engineering Co.

- YPFB (Ethylene and polyethylene) - Yacuiba

The ethylene and polyethylene plant will be located in Tarija in southern Bolivia. The raw material is ethylene, which comes from another project that is being constructed in Bolivia: the Gran Chaco Liquid Separation Plant (planta de Separación de Líquidos Gran Chaco). The estimated cost is 1.9 billion USD and Tecnimont is the company heading the conceptual engineering study. The processing of 2,030 MTD of ethane and the production of 600,000 metric tons a year of ethylene is expected.

6.3 Mexico

As demonstrated in section seven, Mexico will have an abundant supply of natural gas for its own production and for the area integrated with North America.

Despite its petrochemical production, the country continues to import these products. The government owned oil company, PEMEX, does not have a budget sufficient enough to modernize or expand its productive capacities (Complejo Cangrejera, Cosoleacaque, Morelos, Pajaritos, Independencia, Tula, Escolín and Camargo). The private sector, in association with PEMEX, is developing petrochemical projects. In order for this to happen, Mexico has a procedural and regulatory framework that ensures investment as well as these types of associations in the petrochemical industry.

This is to say that Mexico has a hybrid regulatory and commercial framework that supports and allows for public-private investments in the industrialization processes of natural gas.

The following is an already approved petrochemical plan in Mexico:

- Pemex-Braskem-Idesa (Ethylene and polyethylenes) - Nanchital

The Petrochemical Complex "Ethylene 21" ("Etileno XXI") will be located in the Nanchital Municipality, in the State of Veracruz. Varied amounts of ethanol, 66,000 BPD on average, will be provided by PEMEX PGPB (PEMEX's participation is limited to the sole provision of raw material) in order to produce 1 million tons per annum (MTA) of ethylene and polyethylene in three polymerization plants whose initial operations are expected to begin in the second trimester of 2015. The cost of the complex is approximately $2.5 billion USD. The basic engineering, details and construction is being performed by Odebrecht (40%), Technip (40%) and ICA Fluor (20%). Between six and eight thousand jobs will be created during the construction phase and approximately 800 direct and 2,200 indirect permanent jobs will be created.

6.4 Brazil

Despite being a country with a deficit in natural gas, it continues to develop industrialization projects based on raw material, as it is also short in several petrochemicals, especially urea. It develops these projects under Petrobras, which can arrange and/or compensate for national production with imports in order to supply competitive raw material for petrochemical projects.

The public oil company, Petrobras, is also very inclined to form partnerships with the private sector in order to develop petrochemical projects. In Brazil, the petrochemical industry is also supported by private capital.

In this context, Brazil has a procedural and regulatory framework that ensures private investments and public-private associations in the petrochemical industry.

Brazil is a country with a growing economy, a solid business structure that contributes technology to its projects leaving a value-added product and has legal policies that favor investment.

There are three new projects in place for the production of needed fertilizers, which will be connected to future lines of the gas pipeline, GASBOL:

- Petrobras. (Urea and ammonia) – Tres Lagoas

The Nitrogenous Fertilizer Unit III (Unidad de Fertilizantes Nitrogenados III) will have its headquarters in the city of Tres Lagoas, in the state of Mato Grosso do Sul. It will have the capacity to produce 1.2 million metric tons/year (MMT/year) of urea and 761,000 MTA of ammonia. The cost comes to $1.2 million USD. It would begin operations in September of 2014.

- Petrobras (Urea and ammonia) – Linhares

The Nitrogenous Fertilizer Unit IV (Unidad de Fertilizantes Nitrogenados IV), in Linares, in the state of Espírito Santo, is expecting to invest $3 million USD in order to produce 1 MMT/year of urea and ammonia, methanol and acetic acid, as well as formic acid and melamine. Foster Wheeler will lead the basic engineering, detail engineering and construction. The plant would be operating by 2017.

- Petrobras (Ammonia) - Uberaba

The Nitrogenous Fertilizer Unit V (Unidad de Fertilizantes Nitrogenados V), located in Uberaba in the state of Mina Gerais, will produce .54 MMT/year of ammonia. Haldor Topsoe and Technip will develop the basic engineering design. Concrete details are not yet known with regard to its cost. The complex's operations are expected to start in the second half of 2015.

Conclusions and Recommendations

The Role of Natural Gas in the Economic and Social Development of Latin America and the Caribbean

Natural gas will be the energy source of the 21st century due to the various qualities it holds, but above all because of its abundance, cleanliness, combustion and efficiency.

Latin America and the Caribbean do not have significant amounts of reserves, demand or production of natural gas compared with other regions on a global scale.

Many countries in the region have a great potential for natural gas, but the region is not self-sufficient because continued exploration is not encouraged for several reasons, which have turned the region into an importer of LNG. These supply restriction have not favored investments in infrastructure development and natural gas industrialization processes.

The report analyzes how it is possible to increase economic growth and social development by way of industrialization processes and the role that technology and other conditions play in its development. The report reviews the cases of the United States, Taiwan, and South Korea in this context and compares them with Latin America and the Caribbean

This report also explores how natural gas has been used to generate economic benefits and social improvements in countries. Excluding Canada, the cases of Trinidad and Tobago, Argentina and Bolivia were analyzed under this context even though they have basic industrialization processes.

Lastly, four countries in the region were analyzed that in the opinion of Gas Energy, have short and medium-term (5 years) industrialization plans. Primarily, access to raw material and regulatory and commercial conditions

under which these processes expect to be developed will be analyzed. It is important to emphasize that some processes are developed solely by state investment, others are driven solely by the private sector, and others by hybrid models where the state agencies play a very active role.

Gas Energy recommends the following in order to encourage more development in the natural gas industry and in industrialization processes:

Maintain continued explorations in a way that does not interrupt service provision of gas or without having to import despite having great geological potential.

Adding value to natural gas is something that the region should continue aiming for, but this should be achieved through parallel processes of technological investigation and development, which allow for more and improved economic resources of investments and higher paying employment in these in demand services and products. The cases of South Korea and Taiwan may very well be examined with greater detail.

It is very important for these industrialization processes to be monitored and developed in petrochemical complexes, and not in private plants, because of the benefits they offer.

The scale of these complexes must also be at a maximum in order to lower per-unit production costs and to be globally competitive.

The complexes and/or plants should be located in preferred strategic areas or as close as possible to the raw material and its markets.

In sum, all of the mentioned points will allow for the economic and social benefits to be of much greater value in the countries that initiate development of their natural gas resources and industrialization processes.

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