NATURAL GAS IN COLOMBIA

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1. MOTIVATION

The development of the natural gas market in Colombia has grown rapidly since the implementation of the Natural Gas Mass Consumption Plan, which began 15 years ago looking for a fuel with low cost, high availability and low environmental impact.

At the beginning, the thermal generation of electricity encouraged natural gas consumption, but the energetic requirements of the country led to implement in other areas such as industry, vehicles and households. Among them, is important to emphasize the market of natural gas for vehicles, which increased its share from 2% to 9% in the last five years.

This growth places the natural gas as an essential energy source for the country, which raises the challenge of maintaining the supply over time. This approach creates a bleak outlook due to the fact that the relation between the proven reserves and the volume of consumption does not exceed 10 years, which shows the need for supply options in the short term.

2. METHODOLOGY

The understanding of the natural gas sector in Colombia requires a brief historical review, focused on the 90’s when the government developed the mass consumption plan, which extended the sphere of action, from small local venues mostly in the north to a developed structure, which entailed the growth of infrastructure and legal framework.

The description of the process analyzes the upstream and downstream structure; understood as the necessary steps from the exploitation, production, transportation, distribution and marketing up to the final consumer. Moreover, these approaches must be accompanied by an analysis of supply and demand in order to assess which were the engines of growth over time.

Finally, the projections were analyzed with particular emphasis on the threats that the system anticipates, which show the need for new alternatives on this energy market.
3. OUTCOME

3.1 Historical Development of Natural Gas

1970 - 1989

The development of the natural gas industry in Colombia is recent. There was just a limited use of hydrocarbon in the 50s, but the massive use began in the mid-70s with the launch of the pipeline Ballena-Barranquilla-Cartagena, which sought the replacement of exportable fuel oil that was consumed in the thermal generation of the Atlantic Coast.

In 1977 Barranquilla was pioneer of the natural gas connections to residential users, with 440 homes in the north of the city. Next year, a gas pipeline between the fields Neiva-Tello-Dina started its operation and the towns of Neiva and Bucaramanga entered the era of natural gas in the residential sector. At the same period were discovered large reserves of oil and gas in Apiay (Meta).

In 1986, the National Council on Economic and Social Policy (CONPES) developed the first energy policy in the country, "Natural gas for change", which incorporated the natural gas within the basket of national energy consumption, thus accelerating the extension of gas service to urban centers and the discovery of new fields.

In 1989, the exploratory process in Colombian brought good news: the discovery of Cusiana field, assuring oil and natural gas for the next 20 years to the country.

1990 - 2003

The decade of the 90 was marked by political, economic and energetic changes. The second economic crisis of the century occurred as well as an important energetic problem, which derived in emergency actions like electrical rationing. This led to the diversification of the offer, and the most important change was the inclusion of the natural gas. The rationing of electricity in 1992, due to El Niño phenomenon, determined a change in the generation system, significantly increasing the participation of the natural gas.

The next year, the reserves of the fields Cupiagua (Casanare) and Güepajé (Sucre) were discovered; it represented gas for the next 50 years. Because of the extent of natural gas benefits, the government decided to stimulate the supply and demand in this sector, publishing the Natural Gas Mass Consumption Plan ("Plan de Masificación del Gas Natural"). CONPES, through the resolution 2646 of 1993, defined the guidelines in order to construct the main network leaded by ECOPETROL, and the development of the regulatory frame of the industry. ECOPETROL signed and funded the construction of gas pipelines which are the backbone of the gas transport in the interior of the country.

The approval of the Constitution of 1991 and the creation of the Law 142 of 1994 marked a milestone in the modern history in the provision of public domiciliary services in Colombia, since by means of this law the fuel gas was defined as a public service and there were created the Superintendence of Public Domiciliary Services -
SSPD - and the Commission for Regulation of Energy and Gas - CREG-. (CREG is organized as a special administrative unit of the Ministry of Mines and Energy, replacing the CRE). The new law also established the mixed model of public services supply.

In 1995 began the operation of the pipeline Ballena - Barrancabermeja to send gas from La Guajira to the interior of the country. The construction of the pipeline from the West, Mariquita - Cali, also began. This allowed ECOPETROL the construction of more than 2000 kilometers of gas pipelines.

Through the law 401 and Decree 2829, both in 1997, was established the Colombian Company of Gas ECOGAS, which was aimed at planning, organization, extension, maintenance, operation and exploitation of transport systems of natural gas. It meant that ECOPETROL left the responsibility for implementing the massive natural gas.

The same year, supported on the law 142 of 1994 and the law 226 of 1995, began the process of privatization of gas companies; the government decided to sell ECOPETROL participation in Gas Natural de Colombia and Promigas.

Five years later, the National Hydrocarbons Agency (ANH) was created to have the administration and integration of hydrocarbon reserves of the nation. It generated higher level of confidence for foreign investment to Colombia and positioned as an attractive country for exploration and exploitation of hydrocarbons.

In 2007, the company Transportadora de Gas del Interior S.A. (TGI) replaced ECOGAS, which was purchased by the company of energy of Bogotá (Empresa de Energía de Bogotá –EEB1–) through public auction.

### 3.2 The Structure

The production and distribution of natural gas in Colombia can be divided into two components: Upstream and Downstream.

**Upstream** includes exploration, production and transportation of natural gas to the main pipeline. The Colombia structure is mainly composed for more than 44 explorers and 12 producers, which include ECOPETROL.

**Downstream** consists of transportation, distribution, marketing and demand. We can find 8 transportation companies and more than 23 distributors.

The distributors are the suppliers to the final users (residential, vehicles, industry and thermoelectricity), but the transporters can also make contracts with the industrial and thermoelectricity sector. Those contracts use to have long terms conditions and mandatory requirements over the other customers.

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1. Empresa de Energía de Bogotá S.A (EEB S.A.) works under a mixed scheme, with public and private capital, being the principal shareholders the capital district of Bogota (81,5 %), Ecopetrol S.A. (7,3 %) and Endesa LatinoAmericana S.A (4,7%). Its main businesses are electricity (generation, distribution and transmission) and natural gas (transport, distribution and commercialization).
The most important segments are the producers and the transporters:

**Producers**

The main producing areas are located in Guajira (Chuchupa and Ballena) and Cusiana (Cusiana and Cupiagua), which cover about 90% of national production.

Guajira wells are operated by ECOPETROL and ChevronTexaco (57% and 43% respectively), and cover 62% of the country's production, although the volume of reserves is less than Cusiana. Natural gas prices\(^2\) are regulated and are determined according to the oil price. (Between August 2008 and January 2009 the price is 4.72 USD/TJ). In Cusiana, unlike Guajira, natural gas production is associated to oil production, which means that most of the gas is reinjected in the fields to keep the oil recovery. Cusiana is managed by ECOPETROL and BP and the wellhead price is determined by auction.

**Transporters**

Transportation in Colombia, although is carried on by 8 companies, is a natural monopoly. By design consists of two markets, which are defined by property transaction: Atlantic Coast and the Interior. The major carriers are TGI and Promigas with nearly 95% of the volume transported and pipelines in Colombia.

On the north side of the country is the subsystem of the Atlantic Coast with the line Ballena-Barranquilla-Cartagena-Cerromatoso, which has a length of 2039 km and belongs to Promigas, a private company with foreign capital participation by AEI (Ashmore Energy International).

In the region of the Andes, is the subsystem of the Interior, which includes mainly the lines Ballena-Barrancabermeja-Vasconia-Cali, Cusiana-Apiay-Bogotá and Cusiana-La Belleza-Vasconia-Cali, which have a total length of 3702 km and are owned by TGI S.A.

The other transport companies are Transorient, Transmetano, Gasoducto del Tolima Progasur, Transoccidente and Transcogas.

**3.3 The Market**

The supply of natural gas in Colombia until 2007 covered only the domestic demand, mainly determined by industry and thermoelectricity. Since 2008 exports to Venezuela are also performed for a period of 4 years and then they will be replaced by imports over 16 years.

\(^2\) Natural gas prices at the wellhead are regulated according to different regulations. There is a basic division according to the year that the well was found (before 1995 and after 1995). In the first case the prices are regulated by the CREG Resolution 119 of 2005 as indexing becomes the rate New York Harbor Residual Fuel Oil. The second group has free prices, set by auction. Although Cusiana was discovered before 1995, in accordance with resolution 018 of 2002, its price was released for the construction of treatment plant with a capacity greater than 180MCFD.
Reserves

According to figure 1, it is possible to notice that the reserves have not kept a constant trend throughout the years, with two strong changes on the nineties. However, since 2000, the data shows that the reserves have remained almost constant around 130 billion cubic meters.

Between the years 1991, 1992 and 1993 appears the biggest increase in reserves, which reflects the entry of Cusiana and Cupiagua fields on the east, Güepajé on the Atlantic coast, and with small capacity Opón and Volcanera.

In 2000, ECOPETROL changed the system for reporting proved reserves of the country, dividing them into developed and not developed reserves, so for the data between 1999 and 2000, it meant an apparent decrease. However, if we look at reserves in December 2000 the total level was 203 bcm, which exceeded the 155 bcm of gas reserves in the year 1999, amounting to 188 bcm.

After updating the balance of reserves, the remaining volumes of gas to December 31, 2000 are classified as follows:
- 129 bcm developed (73%). They are reported as total reserves in 2000.
- 75 bcm of reserves not developed (27%). They do not have a defined marketing plan.

The reported reserves in December 31, 2007 by the National Planning Unit of Mines and Energy (UPME), reached 131 billion cubic meters, which include commercial gas (58 bcm), remaining gas (48 bcm) and gas for their own consumption (25 bcm).

Production

Natural gas production in Colombia has had an increasing trend since 1994, reflecting the entrance of the mass consumption plan and the strong influence exerted by the energy rationing in 1992 caused by El Niño phenomenon.
There are three dramatic changes in the trend. The first is an increase in production between 1996 and 1997, which reflects two events, the entry into operation of the pipeline from the West and increasing the capacity of Guajira with the entry into operation of the platform Chuchupa II.

The second change is due to the severe 99 recession, showing a decline in production of 1.03 billion cubic meters between 1998 and 1999. Although the level of production increased, it does not reach the 1998 level until 2004.

The third change corresponds to a raise in production since 2003, which shows the increase of Cusiana capacity with Cusiana III.

At the end of 2007 the production was 7,70 billion cubic meters.


Figure 2: Production vs. Year

Consumption

As the graphic shows, the natural gas consumption raised from 631 TJ/day in 2003 to 940 TJ/day in 2008, with two main components: industry and thermoelectricity. In recent years the market has been driven by natural gas vehicles and industry, but also the residential sector has grown.

The vehicle industry is showing stronger growth, increasing its share from 2% in 2003 to 9% in 2008. In 2002, 18,300 vehicles traveled with natural gas for vehicles and in June 2007 more than 202,000. This shows that the country could reduce its dependence on traditional fuels and reduce the environmental impacts with respect to emissions of CO2, NOX, SOX and particulates. This behavior reflects the influence of two factors:

- The first is the increase in oil prices and therefore gasoline
And the second is the support of government and business promoters with VAT exemption for the conversion kits, cylinders firing and discount tickets for the installation.

Although consumption by the thermoelectricity sector has declined, it is still a factor in the behavior of demand, which shows a high volatility in certain periods of the year. The reliability charge also plays a role in encouraging long-term contract to afford the mandatory gas supply to the thermoelectricity. This phenomenon was clearly showed in 2008, when there was rationing of natural gas for vehicles and industrial centers in the south and west of the country, as the supply capacity was absorbed to bring into operation two thermoelectricity plants in the Middle Magdalena.

![Consumption](image)

**Source:** UPME, Boletín estadístico 2008

**Figure 3: Consumption by sector vs. Year**

### 3.4 The Future Scenarios

The required supply of natural gas, with the current production and the projected increases, may be enough according to some studies until 2012 with high demand or 2020 for low gas consumption. One of the most recent and complete studies was published in 2008, by the National Planning Unit of Mines and Energy (UPME) and the Colombian Association of Natural Gas (Naturgas), which involves an analysis of probability of the projected supply and demand by sectors and regions in Colombia. The study is divided into three stages:

- The P10 is a scenario with the highest probability of occurrence.
- The P50 is the middle likelihood scenario.
- The P90 is the scenario with the lowest probability of occurrence.

The projections were made taking into account the natural gas production profiles from the existing fields and their extensions according to ECOPETROL. Besides, each scenario was complemented with the expected imports from Venezuela starting on 2012.
As a result of the study, the domestic supply and imports from Venezuela would make possible to meet domestic demand on scenario P50 until 2018, on P10 until 2020 and P90 until 2016. It is important to note that the methane gas associated to coal, already announced by the Drummond Company, has not been considered into the projections.

However, the imports from Venezuela can even be delayed until 2014 according to recent Venezuelan government reports. The supply of gas from that country is constraint by the development of the non-associated gas production fields and the infrastructure to transport it to the point of interconnection with Colombia.

Therefore, Colombia needs alternatives not only in long but also in the short term. The first and most important is the increase on domestic production as well as transport capacity, for which the country needs to increase exploration. (By the end of 2007, the National Hydrocarbons Agency ANH offered 13 exploration blocks, of which 7 have participation of ECOPETROL).

Other alternatives would be: ensuring, in a legal and/or political way, the already arranged gas supply from Venezuela and if it is possible, increase the volume and duration of such provision; searching alternative sources of imports like Central America or Bolivia, which has large natural gas reserves; building the infrastructure facility for storage of natural gas to cover consumption peaks and, a less viable alternative, is the installation of regasification plants, which would ensure the provision, but would require large initial investments and a guaranteed demand.

4. IMPLICATIONS OF THE CORE MESSAGE

It is important to highlight the positive effect of the Natural Gas Mass Consumption Plan, which brought important changes, like the new vision of the natural gas as a good alternative energy source, the construction of the main pipelines, the legal framework creation and also the modification of the government entities.

The gas impact can be seen through its raise in the energy market share from 6.8% in 1998 to 16.8% in 2007; and also because, at the end of 2007, 40% of the total population had access to this service, where 85% of the users belong to the low and middle economic class, which shows that the use of energy resources is not longer a privilege for rich people.

The market of natural gas in Colombia will continue growing, first of all due to the industry sector, which has already shown the potential of consumption with an increase from 29% in 2003 to 41% in 2008. The most important reason for this growth is the price in relation with other energy sources, making easier a cleaner production with lower cost.

2008 shows that the system has some problems based on wrong management decisions. At that year there was a supply crisis, which brought a rationing and the publishing of new laws; however, according to the distributors and transporters, the new rules do not even look for a solution just put more barriers to the transport system. The production scheme is highly dependent of the two explorers and
transporters, and it is also focused in not many regions as the coast and the center of the country. This means that currently the system is not completely reliable.

Fortunately Colombia has advantages, for example it is still self-sufficient with its own production, and an excellent geographical location, which allows the country to make strategic business with big producers like Venezuela and Bolivia, and not just for our supply but also as an interconnection point, for example with Central America. But we should also consider that Latin American countries exhibit high levels of instability, mainly within its borders but also in their regional relations. South America for example could be divided in two groups according to its political point of view, and this division locates Colombia in the opposite side of the future partners like Venezuela, Ecuador and Bolivia.

5. LITERATURE


