DEVELOPMENT OF A COMPETITIVE
NATURAL GAS MARKET

Miguel Vazquez, Lívia Amorim, and Joisa Dutra

Preliminary Version. Please do not quote.
All comments are welcome and should be addressed to ceri@fgv.br.

The World Bank Disclaimer: The findings, interpretations, and conclusions expressed in this document are those of the authors and do not necessarily reflect the views of the Executive Directors of the World Bank, the governments they represent, or the counterparts consulted or engaged with during the study process.
The Center for Regulation and Infrastructure (CERI) from Fundação Getulio Vargas (FGV) has been collaborating with the World Bank to discuss some topics that are essential to the future development of the energy sector in Brazil. One of the topics is the proposed reform in the natural gas industry. The paper reflects the research efforts made by both teams and the debate with national and international stakeholders. On October 31st and November 1st of 2016, FGV CERI and the World Bank promoted the workshop ‘Establishing a Brazilian Gas Market,’ where government, companies, consumer representatives, and regulators had the opportunity to discuss with international and national experts what should be the key decision to be taken in the short term to put in place a target model that could be further developed in the future. The present Policy Paper is our contribution to this discussion. It provides an overview on the key features of the current structure of the natural gas, as well as the necessary elements to promote a sound natural gas market that is able to bring efficiency gains and competitiveness to the energy sector and the country as a whole.
Table of Contents

Table of Contents .................................................................................................................. 2
List of Illustrations ................................................................................................................ 3
ABBREVIATIONS AND ACRONYMS .................................................................................. 5
Executive summary ............................................................................................................... 6
1. Introduction ..................................................................................................................... 6
2. The market we have ........................................................................................................ 8
   2.1. Gas contracts in the Brazilian natural gas industry ...................................................... 9
      2.1.1. Commodity contracts .......................................................................................... 9
      2.1.2. Transport contracts ............................................................................................ 14
   2.2. Regulation and the logic for the organization of the industry .................................... 16
      2.2.2. The Gas Law (2009) ....................................................................................... 17
      2.2.3. Regulation at the distribution level .................................................................... 18
   2.3. Main challenges of the current situation ................................................................. 24
3. The market we seek ....................................................................................................... 25
   3.1. Who participates in the market? ................................................................................. 26
      3.1.1. Contract versus common carriage ..................................................................... 26
      3.1.2. Full retail competition versus regulated distribution ........................................... 28
   3.2. Defining coherent incentives for the market structure: unbundling ......................... 29
      3.2.1. Unbundling at the transmission level .................................................................. 30
      3.2.2. Unbundling at the distribution level ................................................................... 31
   3.3. Basic market designs ............................................................................................... 32
      3.3.1. Contract carriers and regulated distribution ....................................................... 32
      3.3.2. Common carriers and full retail competition ....................................................... 33
      3.3.3. Summary of basic market designs .................................................................... 35
4. Transitional arrangements ............................................................................................. 36
   4.1. Definition of the basic principles ............................................................................. 36
   4.2. Facilitation of trading arrangements ........................................................................ 36
4.2.1. Standardization of contracts ................................................................. 36
4.2.2. Legacy contracts .................................................................................. 36
4.2.3. Market institutions ............................................................................... 37
4.2.4. Taxation .............................................................................................. 37
4.3. The changing role of Petrobras .............................................................. 37
4.3.1. Sale of Petrobras' participation in Gaspetro ........................................ 38
4.3.2. Sale of Petrobras' transport pipelines .................................................. 39
5. Conclusion ............................................................................................... 40

List of Illustrations

Figures
Figure 1. Structure of the Wholesale Market in Brazil ........................................ 8
Figure 2. Basic Transactions in a Gas Market .................................................... 8
Figure 3. Existing Gas Transport Contracts ..................................................... 15
Figure 4. Internal Transactions by Petrobras .................................................. 16
Figure 5. Natural Gas Contracting Options in the Brazilian Wholesale Market ... 25
Figure 6. Distribution Unbundling Models ...................................................... 32
Figure 7. Basic Trade-offs in Natural Gas Market Design .................................. 35

Graphs
Graph 1. Production and Supply of Natural Gas and Number of E&P Players ........ 9
Graph 2. Percentage of Total Demand Supplied by the Retail Market ............... 10
Graph 3. Prices of Natural Gas in the Wholesale Market .................................. 11
Graph 4. Variable Cost of Gas-fired Power Plants in the System (R$ per MWh) ........ 12

Tables
Table 1. Volume of Gas Traded in the Long Term and in the Short Term in the Wholesale Natural Gas Market 10
Table 2. Final Retail Price to Industrial Consumers (US$ per MMBTU) .................. 11
Table 3. Local Distribution Companies in Brazil .......................................... 18
Table 4. Return on Capital Invested by Local Distribution Companies ............... 19
Table 5. Existing Distribution Concession Contracts ....................................... 21
Table 6. Capital Structure of the Distribution Companies .............................. 21
Table 7. Existing Distribution Network (km) ................................................................. 23
Table 8. States with Regulation of Free Consumers ...................................................... 23
Table 9. Characteristics of Types of Unbundling ............................................................ 30
Table 10. Capital Structure of the Local Distribution Companies before and after the Gaspetro Transaction... 38
ABBREVIATIONS AND ACRONYMS

ABRACE  Brazilian Association of Large consumers of Energy
ANEEL   National Energy Regulatory Agency
ANP     National Petroleum, Natural Gas, and Biofuels Agency
CADE    Brazilian Antitrust Regulator
CERI    Center for Regulation and Infrastructure
CVU     Variable Cost
E&P     Exploration and Production
EC      European Council
EU      European Union
FERC    Federal Energy Regulatory Commission
FGV     Fundação Getulio Vargas
GASBOL  Natural Gas Bolivian Pipeline
GPU     Gas Processing Unit
ICMS    Tax over merchandise and services
ISO     Independent System Operator
ITO     Independent Transmission Operator
LDC     Local Distribution Company
LNG     Liquefied Natural Gas
NPP     New Pricing Policy
NTS     Transport Pipeline Subsidiary – Southeast
ONS     National System Operator (Electricity)
OU      Full-Ownership Unbundling
PPT     Priority Thermoelectricity Program
RPI     Retail Price Index
TAG     Transport Pipeline Subsidiary
TBG     Transport Pipeline Subsidiary (Connects Bolivia and Brazil)
TCQ     Transportation Capacity Quantity
TCU     Federal Court of Auditors
TSO     Transmission System Operator
YPFB    Yacimientos Petrolíferos Fiscales Bolivianos
Executive summary

Since 1997, Brazil has been flirting with the idea of creating a market for natural gas. However, the industry requires a vision and solutions beyond engineering challenges: it requires a market design underpinned by a modern regulatory framework that is able to respond to those new challenges.

Implementing those goals involves trade-offs, some of which conflict with the goal of promoting a liquid market with a high volume of transactions/trades and a large number of players on both the supply and demand sides. Those goals may also confirm there is an uneven understanding of and contradictions to what a gas market really is. The international experience shows that no gas market is perfect at the moment of inception. There are alternatives and they deserve proper assessment.

We have identified three main ideas that guide our contribution to the debate. These contributions stem from the two-day discussion on the international experiences that are relevant to the challenges the government, Natural Gas agents, and stakeholders are about to face. Three points should drive our attention: (a) What market and level of competition do we really want? (b) Are we prepared to embrace this new market without resorting to political interference? and (c) Are we prepared to pay the price to implement this market?

Two elementary decisions need to be made:

- **Decision #1: Who participates in the market?** Two basic choices need to be made on this point: (a) contract versus common carriage; and (b) full retail competition versus regulated distribution.

- **Decision #2: What should be the level of unbundling?** The second group of choices is associated with the creation of coherent incentives for the market structure. One of the basic instruments to control perverse incentives in network industries is the prohibition of vertical integration of network owners and network users. This is often called unbundling. In that context, one needs to deal with (a) unbundling at the transmission level; and (b) unbundling at the distribution level.

Finally, we identify a set of drivers for transitional arrangements, including the definition of basic principles, the definition of measures to facilitate trading and the consideration of the new role to be played by Petrobras.

1. Introduction

The context for this position paper is given by the sale of Petrobras’ natural gas assets (participation of gas local distribution companies (LDCs), transport pipelines, liquefied natural gas (LNG) terminals, and thermal power plants). Specifically, Petrobras has already engaged in a divestment program of natural gas network assets and has decided to abandon its role as the coordinator of the Brazilian gas system. The sale of Gaspetro (gas distribution activities) in 2015, Nova Transportadora Sudeste (NTS) (gas transmission network) in 2016, and the expected sale of LNG terminals and power plants in the near future shows the change in the role played by Petrobras...
in the industry. Furthermore, Petrobras has announced its intention to stop aggregating gas demand to purchase gas from Bolivia in 2019.

This context has been perceived as an opportunity to advance the restructuring of the Brazilian gas industry by the Federal Government. In particular, the objective of transforming a Petrobras-centered industry into a market-based one has been put forward in several governmental initiatives, notably in ‘Gás para Crescer.’ Hence, the main question tackled by this position paper is, **Does the spin-off of Petrobras’ assets and activities suffice to create and develop a well-functioning market?** Several aspects need to be considered:

- The ongoing divestiture process faces the risk of an incomplete reform.
- The challenge of creating a market is bigger than coordinating operational activities.
- Economic, legal, financing, and tax issues cannot lag behind.

To deal with the challenges posed by the industry reform, we will pursue a three-step strategy.

The first step is to discuss the prevailing market structure of the industry in Brazil—framed as the market we currently have. The main objective in this stage is to identify the fundamentals of the market to describe the basic measures needed to implement a market-based reform. To that end, we analyze current contracting opportunities in the Brazilian market and the current regulatory framework. This allows us to provide a clear description of all the roles played by Petrobras.

The second step is to discuss which market we seek, meaning, a desirable outcome of the reform. This is the central part of this position paper. We aim to identify the requisite steps to implement a coherent set of market arrangements, describing the building blocks of a functional gas market design. Rather than pointing at a single ‘best solution,’ we aim to inform the market design process, helping it avoid incomplete or incoherent reforms.

The third step consists of identifying the transitional arrangements that could help achieve a feasible and desirable outcome. Instead of trying to work on the details of the market design, it is of essence to define the market’s building blocks.
2. The market we have

The analysis of this section is built on a general description of gas markets depicted in Figure 1 and Source and elaboration: FGV CERI.

Note: Legislation lacks a clear definition if self-importers and self-producers can access the wholesale market to sell differences of the gas consumed.

Figure 2. In gas industries, markets need to coordinate the activities of all industry players (Figure 1). That coordination takes place through a set of transactions with different time scopes, both involving commodity and transmission services (Source and elaboration: FGV CERI).

Note: Legislation lacks a clear definition if self-importers and self-producers can access the wholesale market to sell differences of the gas consumed.

FIGURE 1. STRUCTURE OF THE WHOLESALE MARKET IN BRAZIL

Source and elaboration: FGV CERI.
Note: Legislation lacks a clear definition if self-importers and self-producers can access the wholesale market to sell differences of the gas consumed.

FIGURE 2. BASIC TRANSACTIONS IN A GAS MARKET

Source and elaboration: FGV CERI.
Note: LT = Long-term.
2.1. Gas contracts in the Brazilian natural gas industry

2.1.1. Commodity contracts

Overview of existing long-term commodity contracts

The supply of natural gas in Brazil is potentially competitive. In the market, it is handled by producers, importers, and traders. In 2016, the production represented 56.65 percent of total supply and imports represented 43.35 percent (81.22 percent Bolivian gas and 18.78 percent LNG).

- Supply side. Although there has been a growing number of players competing for gas production leases (see Graph 1), such diversity is still not reflected in the gas market. Petrobras continues to play a relevant role as a supplier of natural gas.

Graph 1. Production and supply of natural gas and number of E&P players

Source: National Petroleum, Natural Gas, and Biofuels Agency (ANP). Elaboration: FGV CERI.

Note: E&P means Exploration and Production.

- Graph 2 shows the evolution of the total demand for natural gas in Brazil, as well as the consumption of distribution companies compared to other players in the wholesale market. Distribution companies still negotiate a high percentage of the traded volume. Besides this, from the volume consumed out of the retail market, a significant amount is consumed by players related to Petrobras (under self-dealing transactions, either self-production or self-import). For instance, in the 2014 numbers, the total volume of gas demanded in those terms could go up to 42.07 MMm³ per day.
Table 1, approximately 97 percent of the volume of gas in the wholesale market is contracted in long-term contracts (more than one year). From 2009 to 2012, Petrobras entered into 186 short-term transactions to reallocate the volume of natural gas not consumed by the distribution companies, mainly due to the volatile demand of power plants. Also, when the volume demanded by the distribution companies was higher than the value contracted, Petrobras would supply the excess volume priced differently from the long-term contract (Abegas 2015). Hence, short-term adjustments were made through internal adjustments of Petrobras’ gas portfolio.

Table 1. Volume of Gas Traded in the Long Term and in the Short Term in the Wholesale Natural Gas Market

<table>
<thead>
<tr>
<th></th>
<th>Number of contracts</th>
<th>Contracted volume (valid in 20/09/14) (MMm3/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas at the well-head</td>
<td>13</td>
<td>14.37</td>
</tr>
<tr>
<td>Processed gas</td>
<td>77</td>
<td>94.6</td>
</tr>
<tr>
<td>Long term</td>
<td>76</td>
<td>91.85</td>
</tr>
<tr>
<td>Short term</td>
<td>1</td>
<td>2.75</td>
</tr>
</tbody>
</table>

Source: ANP. Elaboration: FGV CERI.

Pricing of existing commodity contracts

Prices of natural gas in the wholesale market in Brazil are freely negotiated between suppliers (producers, importers, and traders) and buyers (distribution companies or free consumers). Currently, there is little standardization of contracts, and hence, Brazilian prices are essentially a collection of pricing formulas associated with long-term bilateral contracts. Those bilateral contracts in the wholesale market need to be registered with the ANP. There are two basic commodity contracts—those signed with distributors and large consumers and those signed with power plants.

---

• **Contracts between Petrobras and distributors and industrial consumers (supplied by the retail market).** In the late 1990s, Petrobras offered Transportation Capacity Quantity (TCQ) contracts to sell the natural gas imported from Bolivia. In such contracts, the commodity price was linked to oil prices through netback pricing. Such price was unbundled from the transport price included in the contracts. In 2007, after persistent shortages of gas and the increased need to import LNG, Petrobras adopted a different pricing mechanism, known as the ‘New Pricing Policy’. This mechanism was intended to better reflect the more diversified mix of gas sources. Hence, the previous netback pricing was replaced by an index that combines a fixed and a variable portion. The pricing index was supposed to reflect the mix of national gas cost, LNG imports, and Bolivian gas that formed Petrobras’ portfolio. As gas prices are difficult to monitor, the index was contentious, aggravated by Petrobras’ dominant position. As international experience points out, lack of transparency poses a challenge when assessing eventual market abuse practices by monopolists. Nonetheless, all contracts signed after that followed this pricing mechanism.

**GRAPH 3. PRICES OF NATURAL GAS IN THE WHOLESALE MARKET**

![Graph showing prices of natural gas in the wholesale market]

**Source:** Ministry of Mines and Energy. **Elaboration:** FGV CERI.

**Note:** PPT means Priority Thermoelectricity Program and NPP means New Pricing Policy.

**TABLE 2. FINAL RETAIL PRICE TO INDUSTRIAL CONSUMERS (US$ PER MMBTU)**

<table>
<thead>
<tr>
<th>Consumption (m³/day)</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
<td>20,93</td>
<td>22,23</td>
<td>23,02</td>
<td>13,69</td>
<td>11,07</td>
</tr>
<tr>
<td>20,000</td>
<td>18,43</td>
<td>19,55</td>
<td>20,41</td>
<td>12,17</td>
<td>9,61</td>
</tr>
<tr>
<td>50,000</td>
<td>17,87</td>
<td>18,95</td>
<td>19,81</td>
<td>11,83</td>
<td>9,35</td>
</tr>
</tbody>
</table>

**Source:** Ministry of Mines and Energy. **Elaboration:** FGV CERI.

**Contracts between Petrobras and power plants** – The underlying prices can be inferred through the variable cost (CVU) of the power plants (cost declared by power plants in long-term electricity auctions). They show that existing power plants have different variable costs, ranging from R$38 per MWh to R$711 per MWh. Because the cost of gas is an important component of the variable cost,² it is reasonable to link such variability to a difference in gas prices.

---

² For instance, in Technical Opinion no. 067/2015/SGR-ANEEL, issued in June 2015, ANEEL assessed that the gas cost (including regasification and transport) represented 66.8 percent of the variable cost. ANEEL is the Brazilian Electricity Regulatory Agency. The acronym ANEEL stands for Agência Nacional de Energia Elétrica.
Graph 4 is that prices of power plants contracts are much more volatile than they are supposed to be. As in the long-term contracts with distributors and large industrial consumers, lack of transparency precludes assessing the rationale for such pricing practices.

**GRAPH 4. VARIABLE COST OF GAS-FIRED POWER PLANTS IN THE SYSTEM (R$ PER MWH)**

Source: Electric System National Operator - (ONS) and ANEEL. Elaboration: FGV CERI.

**ANALYSIS OF COMMODITY CONTRACTING OPPORTUNITIES**

Figure 1 (‘Suppliers’), only with regard to gas commodity contracts. Transport contracts will be analyzed in the next sections. We have shown that one of the main challenges is flexibility allocation and pricing.

- **Gas sale from a gas producer.** If a producer wants to sell its natural gas in the wholesale market, it would have four stylized potential transactions:
  
  - Sell to a distribution company at the city gate;
  - Sell to a free consumer;
  - Have the gas consumed in a vertical integrated facility ('self-consumption'); or
  - Sell to a wholesale gas trader.

In the first three options above, we note that producers need to access the market place, and to that end, they need to access the transmission infrastructure. However, it might be difficult for them to transport gas to a processing unit (GPU), at least in the near future, as Petrobras exclusively owns most of the facilities (both the upstream pipelines\(^3\) and the GPUs). The only

---

\(^3\) The upstream pipelines are a central issue to be further debated. Currently, such pipelines are regarded as private installations of the producer or of a group of producers. According to the Natural Gas Law, there is no third-party access to such facilities. Petrobras owns most of the existing upstream pipelines. Since regulation does not impose any restriction on who can own and build an upstream pipeline, this scenario could be seen as a result of other players having a lack of presence in the market. For associated fields, natural gas is the product of least value. Producers are normally interested in producing oil and would not engage in efforts to trade natural gas. Therefore, to meet the obligation of taking the natural gas produced, selling it at the oil platform becomes a convenient solution.
option that avoids this bottleneck is selling to a trader that already has access to the GPUs. In our case, the only viable trader is Petrobras.

Furthermore, most of the producers face limited options/alternatives. There are few free consumers in Brazil, limiting the potential counterparties. The third option (self-consumption) requires vertical integration with a flexible portfolio of consumers (for example, large volume of fertilizers). Otherwise, self-dealing would not be practicable. The integration of gas producers with power plants' output controlled by a third party (for example, the entity in charge of deciding output for all units in the power system, ONS) is a good example of the impossibility of self-dealing without the required flexibility.

Consequently, for most producers, the only two options available are either selling the gas to distribution companies at the city gate, in case they have access to GPUs; or selling to a wholesale trader before the GPU.

For the first option, as distribution companies currently purchase gas through long-term contracts, producers need access to short-term contracts for commodity (gas flexibility). Differently put, producers would be tied to a production curve that cannot be controlled. Imbalances between the quantity produced and demanded by the contract cannot be mitigated/handled in the short term. Therefore, the supplier has no mechanism to accommodate or to contract the flexibility required. As gas flexibility is difficult to buy in the market, the most viable option is to sell the gas to Petrobras before the GPU.

- **Gas sale from a gas importer.** The case of LNG imports is similar. Potential buyers are essentially the same. However, instead of facing the challenge of accessing GPUs, the importer faces the challenge of accessing regasification facilities. Similar to the previous case, the importer has to choose either to sell to distribution companies at the city gate, in case they have access to import facilities; or to sell it to a wholesale trader before the import facilities.

  The first option also requires access to short-term contracting options. Imports are often managed through take-or-pay contracts, where the producer bears the price risk and the buyer bears the quantity risk. In Brazil, however, the buyer will not have any means to manage such quantity risk, so the standard solution is not possible. For instance, since 2014, the power sector has experienced an increase in the number of gas-fired projects with a vertically integrated and dedicated supply of LNG not connected to the gas transmission network. The system contracted 3.99 GW of capacity under this business model, with delivery from 2020 on. The belief was that the increased LNG availability in the international market would provide the flexibility demanded by the power sector. However, it did not consider the differences in the scales of gas volumes transported in an LNG ship and the volume of gas used by a power plant, which faces extremely volatile

---

4 This refers both to LNG-related facilities and to international import pipelines, normally considered as facilities outside the national transmission system.
demand. Hence, there is great uncertainty about the way in which those power plants are able to manage the required gas.

In summary, as in the producer’s case, because gas flexibility is difficult to buy in the market, the most viable option is to sell to a wholesale trader before the import facility. As there is only one wholesale trader with access to flexibility, this option amounts to selling the gas to Petrobras.

- **Gas sale from a wholesale trader.** A trader willing to enter the market in Brazil also has to tackle flexibility issues. The agent has to enter into long-term transactions with limited options to reallocate gas volumes in the short run. It is considerably risky to enter a market without effective access to mechanisms to adjust gas portfolios. This is especially so for a player that structures a position made up of a long-term contract (where it bears the price risk) and a short-term contract (where it bears the quantity risk).

In this case, there are significant entry barriers to wholesale traders other than Petrobras.

### 2.1.2. Transport contracts

The market players need to contract transportation capacity contracts to use the transmission systems. From the analysis of existing contracts developed above, we note that the use of the transmission system is dominated by Petrobras. Apart from self-deals, Petrobras purchases gas from producers at the GPUs and sells gas at the city gates. Consequently, Petrobras is effectively the only user of the transmission capacity in the network. Moreover, virtually all the capacity in the long run is already booked by Petrobras. There is no additional capacity available to be contracted on a firm basis in the market. Adding to this context, short-term products are scarce. Another relevant element that is missing is transparency in the available capacity in the short run (on either firm or interruptible basis).

**Figure 3** shows the duration of the existing capacity contracts.

---

5 There are proposals under discussion to grant LNG power plants the right to be dispatched for at least one week in a row, irrespective of the associated cost increase. This can be understood as an administrative measure that forces power consumers to provide flexibility without reward. Hence, it is an inefficient measure with unclear impacts for the gas market. Moreover, that administrative measure would not address the issue that contracts to sell gas to a single power plant in the long run are extremely difficult to find.
Pricing of Existing Transport Contracts

In the late 1990s, Petrobras offered TCQ contracts to market the natural gas imported from Bolivia. The transport tariff was unbundled from commodity prices and adjusted annually by the Regional Pricing Index (RPI). After 2007, with the introduction of the ‘New Pricing Policy,’ the logic for price formation changed. As Petrobras began pricing commodity gas based on an index that represented the mix of sources of its new portfolio, transport tariffs were subject to ‘system-wide’ considerations. The precise meaning of such considerations is far from clear, and it has been a persistent source of conflict between the ANP and Petrobras.

One way of looking at the problem brought by the diversified portfolio of Petrobras is to consider that the company commands all transportation capacity. Consequently, following a ‘system-wide’ rationale, Petrobras coordinates most of transport transactions required to manage the diversified gas portfolio internally. The main drawback is that those transactions are not transparent to the gas market, making it difficult to monitor the effective prices.
The lack of a clear definition of the capacity underlying transport contracts poses difficulties to
determine the corresponding prices. Currently, the ANP is reviewing the methods to define trans-
mission tariffs. One of the main issues under discussion is the separation of commodity and
transport prices in long-term contracts.6

2.2. Regulation and the logic for the organization of the industry


The Petroleum Law in 1997 sought to allow competition among potential gas sources, that is, a
type of competition for the market. The lack of liquidity in the short run made entry available
only through long-term contracting with Petrobras. This was the only mechanism available to
achieve the flexibility required to manage imbalances. Figure 4 schematically represents the
situation after the Petroleum Law.

**FIGURE 4. INTERNAL TRANSACTIONS BY PETROBRAS**

Source and Elaboration: FGV CERI.

From that point of view, three types of trading mechanisms were envisaged:

- Contracts between independent producers and Petrobras;
- Contracts between local distribution companies and Petrobras; and
- Petrobras’ control of the gas flow from the wellhead to the final consumer.

Signing contracts only with Petrobras was not necessarily perceived as a problem. At that point,
the market was based on what is called ‘competition for the market,’ that is, market forces would
be introduced by competition among gas sources. From this standpoint, gas lease auctions were
enough to guarantee the introduction of new gas sources. To understand the logic for the reform,
we can compare this situation to the contract-based market implemented in the United States.
Internalizing transactions was a natural solution for Petrobras because no unbundling was re-
quired between distribution and the other segments in the value chain.

From a different standpoint, the Brazilian market design after the 1997 Petroleum Law could be
compared to the rationale of the U.S. system: producers and consumers would sign long-term

---

6 This theme is under discussion at the ANP’s Public Consultation number 14/2016.
contracts, and the contracts would be typically between producers and local distribution companies. These market players would then purchase the rights to use the transmission network. It was believed that a secondary market to balance shippers’ portfolios in the short run would emerge in that context. However, in the Brazilian regulatory framework, a fundamental piece of the U.S. regulation since the Natural Gas Act in 1936 was missing: the total unbundling of local distribution companies from the other segments of the production chain (unbundling of production and transmission in the U.S. regulation came only in the 1980s). Such unbundling was not mandatory in the Brazilian case.

The incumbent player managed to enforce a different market design that served the same purpose that long-term contracts did in the coordination of industry activities. That is, Petrobras assumed a dominant position in the distribution business. Consequently, in most cases, the coordination between production and consumption was not done by long-term contracts and short-term balancing actions, as a result of hierarchical decisions within Petrobras. Hence, internal adjustments of Petrobras’ gas portfolio played the role of the wholesale market in the short-term adjustments. The result was an extreme lack of liquidity in the short run.

2.2.2. The Gas Law (2009)

The Gas Law enacted in 2009 was a new effort to promote the development of a natural gas market—this is the first piece of legislation specifically dedicated to the industry. One of the central points of the reform was to facilitate negotiations between independent producers and local distributors (gas transactions not involving Petrobras). To that end, a fundamental goal was to ensure access to the transmission network. Departing from the prevailing architecture, two kinds of solutions were proposed: (a) strengthening gas distribution unbundling to induce effective negotiations between gas buyers and sellers (similar to the U.S. Gas Act); and (b) regulating access to the transmission network to mitigate strategic behavior (more along the lines of the European Union [EU] reform).

The second option is favored in the Brazilian regulation. That option changes the rationale behind the market design implemented before the 2009 Gas Law. One of the consequences of the rationale change is that the amount of regulation required increases significantly. Besides determining the regulated price, it is necessary to determine which players have the right to use the network. As with all deep regulatory changes, the process is difficult and political negotiations among stakeholders take time. In Brazil, aligning stakeholders’ interests has been challenging especially considering the limited development of the new regulatory framework. So far, measures aimed at granting access to the transmission network have been modest (recently, the ‘operational swap,’ a measure similar to other systems’ ‘back-haul’ capacity, has been implemented).

---

7 The former regime, however, already established a negotiated access regime.
2.2.3. Regulation at the distribution level

Currently, there are 26 distribution companies in Brazil. As shown in Table 3, most of the distribution companies were formally established in the early 1990s as state-owned companies, controlled by the corresponding state government, with Petrobras having a minority stake.

**TABLE 3. LOCAL DISTRIBUTION COMPANIES IN BRAZIL**

<table>
<thead>
<tr>
<th>Local Distribution Company</th>
<th>Date of Legal Creation</th>
<th>Federative state</th>
<th>State Regulation</th>
<th>Network Length (Km)</th>
<th>Number of Clients (Thousands)</th>
<th>Demand (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algás</td>
<td>1992</td>
<td>AL</td>
<td>Arsal</td>
<td>415.91</td>
<td>42</td>
<td>1.14%</td>
</tr>
<tr>
<td>Cigás</td>
<td>1993</td>
<td>AM</td>
<td>Arsam</td>
<td>88.96</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Gasap</td>
<td>2002</td>
<td>AP</td>
<td>-</td>
<td>0.00</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Bahiagás</td>
<td>1989</td>
<td>CE</td>
<td>Agerba</td>
<td>839.54</td>
<td>41</td>
<td>6.07%</td>
</tr>
<tr>
<td>Cegás</td>
<td>1992</td>
<td>SE</td>
<td>Acre</td>
<td>425.95</td>
<td>9</td>
<td>1.50%</td>
</tr>
<tr>
<td>Cebégas</td>
<td>2000</td>
<td>DF</td>
<td>Amapá</td>
<td>5.02</td>
<td>0</td>
<td>0.02%</td>
</tr>
<tr>
<td>BR Distribuidora**</td>
<td>1993</td>
<td>ES</td>
<td>Amapá</td>
<td>434.04</td>
<td>7</td>
<td>5.06%</td>
</tr>
<tr>
<td>Goazógis</td>
<td>2000</td>
<td>GO</td>
<td>Amapa</td>
<td>0.10</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Gasmar</td>
<td>2001</td>
<td>HA</td>
<td>Amapena</td>
<td>0.44</td>
<td>0</td>
<td>7.39%</td>
</tr>
<tr>
<td>Gasimar</td>
<td>1993</td>
<td>MG</td>
<td>-</td>
<td>983.07</td>
<td>6</td>
<td>4.42%</td>
</tr>
<tr>
<td>Magés</td>
<td>1998</td>
<td>MS</td>
<td>Amapan</td>
<td>272.07</td>
<td>5</td>
<td>0.74%</td>
</tr>
<tr>
<td>Magás</td>
<td>2003</td>
<td>MT</td>
<td>Amapa</td>
<td>0.00</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Companhia de Gás do Pará</td>
<td>2006</td>
<td>PA</td>
<td>Amapa</td>
<td>0.00</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Phgás</td>
<td>1992</td>
<td>PB</td>
<td>Arpgo</td>
<td>306.40</td>
<td>11</td>
<td>0.49%</td>
</tr>
<tr>
<td>Copergás</td>
<td>1991</td>
<td>PE</td>
<td>Arpce</td>
<td>685.23</td>
<td>22</td>
<td>6.83%</td>
</tr>
<tr>
<td>Gasepá</td>
<td>2001</td>
<td>PI</td>
<td>Arpem</td>
<td>0.00</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Copagás</td>
<td>1994</td>
<td>PR</td>
<td>-</td>
<td>798.00</td>
<td>33</td>
<td>2.53%</td>
</tr>
<tr>
<td>Ceg Rio</td>
<td>1997</td>
<td>RJ</td>
<td>Arpens</td>
<td>551.00</td>
<td>946</td>
<td>15.57%</td>
</tr>
<tr>
<td>Ceg Rio</td>
<td>1997</td>
<td>RJ</td>
<td>Arpensa</td>
<td>551.00</td>
<td>946</td>
<td>9.79%</td>
</tr>
<tr>
<td>Potigás</td>
<td>1993</td>
<td>RN</td>
<td>Arpese</td>
<td>379.87</td>
<td>16</td>
<td>0.51%</td>
</tr>
<tr>
<td>Sulgás</td>
<td>1990</td>
<td>RS</td>
<td>-</td>
<td>975.64</td>
<td>29</td>
<td>3.81%</td>
</tr>
<tr>
<td>Scgás</td>
<td>1993</td>
<td>SC</td>
<td>Aresta</td>
<td>1111.10</td>
<td>10</td>
<td>3.05%</td>
</tr>
<tr>
<td>Sergés</td>
<td>1994</td>
<td>SE</td>
<td>Aresta</td>
<td>223.46</td>
<td>21</td>
<td>0.49%</td>
</tr>
<tr>
<td>Comgas</td>
<td>1999</td>
<td>SP</td>
<td>Arsemap</td>
<td>17310.38</td>
<td>1702</td>
<td>21.05%</td>
</tr>
<tr>
<td>Gas Brasileiro</td>
<td>1999</td>
<td>SP</td>
<td>Arsemp</td>
<td>17310.38</td>
<td>1702</td>
<td>1.32%</td>
</tr>
<tr>
<td>Gás Natural Fenosa</td>
<td>2000</td>
<td>SP</td>
<td>Arsemp</td>
<td>17310.38</td>
<td>1702</td>
<td>2.08%</td>
</tr>
</tbody>
</table>

Source: Ministry of Mines and Energy and Abegás. Elaboration: FGV CERI.

Note: *Demand percentage over the total National Demand. Data from April 2016 **The concession was declared null and void in 2016

The participation of the states in the distribution companies is a critical issue from the perspective of the governance of the industry. Combined with the fragile level of regulation on the states, the distribution tariffs are often subject to political interference.

First, the state plays multiple institutional roles potentially related to the distribution or consumption of natural gas. Such roles are (a) the taxation of natural gas sales (through the Imposto Sobre Circulação de Mercadorias e Serviços (ICMS), a state value-added tax); (b) environmental licensing of new projects in the state (for example, power plants, pipelines, and other facilities that might be necessary for the supply of natural gas); and (c) regulation of gas distribution. Furthermore, although most states have an agency to regulate the distribution of natural gas, there is lack of transparency of the criteria adopted to set and review the distribution tariffs. As a result, the state can have conflicting interests, such as to raise the revenues of the distribution company, simultaneously increasing its own tax revenues.
In some of the states, such as Amapá, Rondônia, Pará, and Mato Grosso, a company has been established and is entitled to a concession (ranging from 30 to 50 years). However, some states have not been able to develop a distribution network (see Table 7).

There is no legal definition of the level of unbundling (either legal, accounting, or ownership) that must be observed for distribution. It is necessary to perform a careful assessment of the concession contracts and of the related regulations. Evidence shows that the contracts lack incentives to expand the network, improve performance, and induce efficiency gains.

In most of the concession contracts, the local distribution companies have been granted exclusive franchises for a certain period. For instance, in São Paulo, the concession contract establishes a 12-year period of exclusive franchise for consumers other than residential and commercial. For those consumers, the local distributor is the exclusive supplier during the entire concession period.

Regarding tariff setting and return on the capital invested, Table 4 summarizes the applicable values for local distribution companies.

**TABLE 4. RETURN ON CAPITAL INVESTED BY LOCAL DISTRIBUTION COMPANIES**

<table>
<thead>
<tr>
<th>State</th>
<th>BA, PR, PE, PR SC, RS, SE</th>
<th>Alagoas and Ceará</th>
<th>Minas Gerais</th>
<th>Espírito Santo</th>
<th>Rio de Janeiro</th>
<th>São Paulo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rate of Return on Capex</strong></td>
<td>20%</td>
<td>20%</td>
<td>Not reported in the contract</td>
<td>15%</td>
<td>WACC</td>
<td>WACC</td>
</tr>
<tr>
<td><strong>Rate of Return on Opex</strong></td>
<td>20%</td>
<td>20%</td>
<td>Not reported in the contract</td>
<td>15%</td>
<td>Not reported in the contract</td>
<td>Not reported in the contract</td>
</tr>
</tbody>
</table>

Source: Associação Brasileira de Grandes consumidores de energia (ABRACE).

- **Existing concession companies and concession contracts.** Another aspect to emphasize is that most of the existing distribution concession contracts were awarded in the early 1990s and are valid for periods ranging from 30 years to 50 years, depending on the state.
- **Table 5** shows the total duration of the existing concession contracts.
### TABLE 5. EXISTING DISTRIBUTION CONCESSION CONTRACTS

<table>
<thead>
<tr>
<th>State</th>
<th>Local Distribution Company</th>
<th>Duration</th>
<th>Shareholder #1</th>
<th>Shareholder #2</th>
<th>Shareholder #3</th>
<th>Shareholder #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Algás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td>Cigás</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP</td>
<td>Gasepe</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA</td>
<td>Bahia Gás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE</td>
<td>Cegás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DF</td>
<td>Cebgás</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES</td>
<td>BR Distribuidora</td>
<td>50</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GO</td>
<td>Goianáis</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>Gasmar</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MG</td>
<td>Gasmig</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS</td>
<td>MGás</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MT</td>
<td>MTGás</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA</td>
<td>Gas Pará</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>PB Gás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>Capergás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI</td>
<td>Gas Pia</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>Campogás</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RJ</td>
<td>CEG</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RO</td>
<td>Rongás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS</td>
<td>Sul Gás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>SC Gás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>Sergás</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>Gas Neutro-Franca</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>Canga</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>Gas Brasiliense</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source and elaboration: FGV CERI.

**Note:** * Renewal for the same period of time **Was declared null and void in 2016 ***The conditions for renewal of the contracts could not be found

Moreover, it is important to observe that most of these companies are controlled by the respective state government, that has at least 51 percent of the voting shares (see Table 6). The privatization of some of these companies is challenging and would possibly require a different concession contract.

### TABLE 6. CAPITAL STRUCTURE OF THE DISTRIBUTION COMPANIES

<table>
<thead>
<tr>
<th>State</th>
<th>Local Distribution Company</th>
<th>Shareholder #1</th>
<th>Shareholder #2</th>
<th>Shareholder #3</th>
<th>Shareholder #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Algás</td>
<td>51% State of Alagoas</td>
<td>24.5% Gaspetro</td>
<td>25.5% Mitsui</td>
<td></td>
</tr>
<tr>
<td>AM</td>
<td>Cigás</td>
<td>17% State of Amazonas</td>
<td>83% Manaus Gás S.A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP</td>
<td>Gaspe</td>
<td>51% State of Amapá</td>
<td>24.5% CS Participações</td>
<td>24.5% Gaspetro</td>
<td></td>
</tr>
<tr>
<td>BA</td>
<td>Bahia Gás</td>
<td>51% State of Bahia</td>
<td>24.5% Gaspetro</td>
<td>24.5% Mitsui</td>
<td></td>
</tr>
<tr>
<td>CE</td>
<td>Cegás</td>
<td>51% State of Ceará</td>
<td>24.5% Gaspetro</td>
<td>24.5% Mitsui</td>
<td></td>
</tr>
<tr>
<td>DF</td>
<td>Cebgás</td>
<td>51% CEB</td>
<td>28% Brasiliagás</td>
<td>21% Gaspetro</td>
<td></td>
</tr>
<tr>
<td>ES</td>
<td>BR Distribuidora</td>
<td>100% Petrobras</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GO</td>
<td>Goianáis</td>
<td>51% State of Goiás</td>
<td>29.5% Gasgolana</td>
<td>19.5% Gaspetro</td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>Gasmar</td>
<td>51% State of Maranhão</td>
<td>21% Gaspetro</td>
<td>28% Termogás</td>
<td></td>
</tr>
<tr>
<td>MG</td>
<td>Gasmig</td>
<td>99.6% CEMIG</td>
<td>0.4% County of Belo Horizonte</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

21 | DEVELOPMENT OF A COMPETITIVE NATURAL GAS MARKET
Different from what is happening in Espírito Santo (see Box 1), where a new contract will be awarded, in this case, the sale of a state’s participation in the distribution company would not necessarily mean another concession contract. Therefore, if the existing contract is poorly designed, the state would still be bound by such terms when regulating the rendering of the service.

**BOX 1. THE CONCESSION OF BR DISTRIBUIDORA IN ESPÍRITO SANTO**

Since 1993, BR DISTRIBUIDORA has been entitled to explore gas distribution services in the State of Espírito Santo. In 2016, the State enacted a law proposed by the Executive (Law 10,493/16) declaring null and void the concession contract. The main ground for this was the inexistence of a previous public auction to allocate the contract, which is required by the Federal Constitution. It is expected that BR Distribuidora will keep exploiting the services until a bidding process is conducted.

The bidding process to take place in Espírito Santo could work as a test case for other states that want to privatize the local distribution companies and/or award a concession to a private party.

Table 7 shows the evolution of the distribution network. Although no data are available for the whole concession period, it shows that in most of the states there was very small expansion of the distribution network in this period.
TABLE 7. EXISTING DISTRIBUTION NETWORK (KM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Algás (AL)</td>
<td>1993</td>
<td>177</td>
<td>234</td>
<td>349</td>
<td>370</td>
<td>383</td>
<td>394</td>
</tr>
<tr>
<td>AM</td>
<td>Cigás (AM)</td>
<td>1995</td>
<td>0</td>
<td>0</td>
<td>48</td>
<td>48</td>
<td>84</td>
<td>88</td>
</tr>
<tr>
<td>AP</td>
<td>Gasap(AP)</td>
<td>2002</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BA</td>
<td>Bahiagás (BA)</td>
<td>1993</td>
<td>450</td>
<td>552</td>
<td>689</td>
<td>726</td>
<td>771</td>
<td>816</td>
</tr>
<tr>
<td>CE</td>
<td>Cegás (CE)</td>
<td>1992</td>
<td>210</td>
<td>264</td>
<td>319</td>
<td>343</td>
<td>388</td>
<td>424</td>
</tr>
<tr>
<td>DF</td>
<td>Cebgás (DF)</td>
<td>1993</td>
<td>0</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>ES</td>
<td>BR Distribuidora (ES)</td>
<td>1993*</td>
<td>66</td>
<td>134</td>
<td>270</td>
<td>399</td>
<td>443</td>
<td>451</td>
</tr>
<tr>
<td>GO</td>
<td>Golar (GO)</td>
<td>2000</td>
<td>0</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>MA</td>
<td>Gasmur (MA)</td>
<td>2001</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>MG</td>
<td>Gomig (MG)</td>
<td>1993</td>
<td>336</td>
<td>428</td>
<td>832</td>
<td>863</td>
<td>927</td>
<td>955</td>
</tr>
<tr>
<td>MS</td>
<td>Magás (MS)</td>
<td>1998</td>
<td>139</td>
<td>152</td>
<td>193</td>
<td>203</td>
<td>214</td>
<td>258</td>
</tr>
<tr>
<td>MT</td>
<td>Migás (MT)</td>
<td>2003</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PA</td>
<td>Companhia de Gás do Pará (PA)</td>
<td>2006</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PB</td>
<td>Pbgás (PB)</td>
<td>1994</td>
<td>210</td>
<td>248</td>
<td>279</td>
<td>282</td>
<td>294</td>
<td>305</td>
</tr>
<tr>
<td>PE</td>
<td>Copergás (PE)</td>
<td>1992</td>
<td>267</td>
<td>397</td>
<td>555</td>
<td>588</td>
<td>602</td>
<td>666</td>
</tr>
<tr>
<td>PI</td>
<td>Gaspolo (PI)</td>
<td>2002</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PR</td>
<td>Campogás (PR)</td>
<td>1994</td>
<td>448</td>
<td>499</td>
<td>602</td>
<td>646</td>
<td>726</td>
<td>778</td>
</tr>
<tr>
<td>RJ</td>
<td>Ceg (RJ)</td>
<td>1997</td>
<td>3,510</td>
<td>3,986</td>
<td>4,300</td>
<td>4,307</td>
<td>4,316</td>
<td>4,320</td>
</tr>
<tr>
<td>RJ</td>
<td>Ceg Rio (RJ)</td>
<td>1998</td>
<td>549</td>
<td>881</td>
<td>727</td>
<td>738</td>
<td>870</td>
<td>1,079</td>
</tr>
<tr>
<td>RN</td>
<td>Parigás (RN)</td>
<td>1995</td>
<td>208</td>
<td>280</td>
<td>323</td>
<td>338</td>
<td>351</td>
<td>367</td>
</tr>
<tr>
<td>RS</td>
<td>Sulgás (RS)</td>
<td>2000</td>
<td>400</td>
<td>473</td>
<td>607</td>
<td>730</td>
<td>805</td>
<td>947</td>
</tr>
<tr>
<td>SC</td>
<td>Szigás (SC)</td>
<td>1994</td>
<td>624</td>
<td>769</td>
<td>1,009</td>
<td>1,048</td>
<td>1,084</td>
<td>1,104</td>
</tr>
<tr>
<td>SE</td>
<td>Sergás (SE)</td>
<td>1993</td>
<td>110</td>
<td>136</td>
<td>172</td>
<td>188</td>
<td>205</td>
<td>223</td>
</tr>
<tr>
<td>SP</td>
<td>Comgás (SP)</td>
<td>1999</td>
<td>3,837</td>
<td>5,533</td>
<td>9,360</td>
<td>11,014</td>
<td>12,558</td>
<td>14,099</td>
</tr>
<tr>
<td>SP</td>
<td>Gas Brasiliano (SP)</td>
<td>1999</td>
<td>625</td>
<td>694</td>
<td>842</td>
<td>871</td>
<td>897</td>
<td>989</td>
</tr>
<tr>
<td>SP</td>
<td>Gás Natural Fenosa (SP)</td>
<td>2000</td>
<td>787</td>
<td>1,229</td>
<td>1,308</td>
<td>1,364</td>
<td>1,405</td>
<td>1,756</td>
</tr>
</tbody>
</table>

Source: Associação Brasileira de empresas distribuidoras de Gás (ABEGÁS). Elaboration: FGV CERI.
Note: *The concession was declared unconstitutional

• Free consumers and the commercial bypass of the LDC. As mentioned in the previous section, the states are responsible for setting the conditions under which a consumer can buy directly in the wholesale market and, thus, commercially bypass the distribution companies.

Table 8 summarizes the states that already set such conditions. Despite that, it is important to mention that since there are no products in the market to adjust volumes, and there is only one supplier for practical purposes, there are limited possibilities for a consumer to buy natural gas from players other than Petrobras. One of the main concerns raised is that there is no security of supply, because if the supplier fails to deliver the gas, there is no alternative means of supply in the short term and the consumers will face shortages.

TABLE 8. STATES WITH REGULATION OF FREE CONSUMERS

<table>
<thead>
<tr>
<th>Local Distribution Company (LDC)</th>
<th>Minimum Demand required to Free Consumers (m³/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazônia</td>
<td>500,000</td>
</tr>
<tr>
<td>Espírito Santo</td>
<td>35,000</td>
</tr>
<tr>
<td>Maranhão</td>
<td>500,000</td>
</tr>
<tr>
<td>Minas Gerais</td>
<td>10,000</td>
</tr>
<tr>
<td>Mato Grosso do Sul</td>
<td>1500000 (I), 500000 (T), 1000000 (P)</td>
</tr>
<tr>
<td>Mato Grosso</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Pará</td>
<td>500,000</td>
</tr>
<tr>
<td>Rio de Janeiro</td>
<td>100,000</td>
</tr>
<tr>
<td>São Paulo</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Source and elaboration: FGV CERI.
Note: (I) Industrial, (T) Thermal Plants, (P) Consumers who use NG as Primary resource (Large Consumption)

Some of the states are rushing to implement the possibility to attract power plant projects to their territory. However, the limits set are very high (in some, it can go up to 500,000 m³ per day). As a result, the number of eligible players to buy from other suppliers is very restricted.
In other words, such regulation represents a barrier by having different players accessing the wholesale market. A greater number of players with access to the wholesale market could enhance the number of transactions in the market.

Since the 2009 Gas Law, the local distribution companies have been entitled to a levy from all consumers (including those with right of choice), even in cases when the LDC distribution network is not being used by the consumer. In this case, the consumer needs to pay an Operation and Maintainance O&M-tariff to the distribution company. The criterion to set this tariff also lacks transparency. Only refineries and fertilizer plants existing at the time of the Gas Law are exempt from payment of such tariff. Therefore, they are the consumers that have an ad hoc regime and can both commercially and physically bypass the local distribution companies.

2.3. Main challenges of the current situation

All the examples above converge to the general diagnosis that the current structure of the gas market in Brazil lacks contracting options, and therefore, liquidity. There are no flexible and short-term products easily available to the market. Petrobras does not provide such products on a consistent basis, and there is no transparency of the criteria used to decide whether to provide the products. The basic available contract is a long-term contract. In it, parties specify the price and quantity of the gas purchased, the duration of the contract, and the delivery point. Its basic structure is the following:

- **Price.** As shown earlier, although Petrobras offered contracts priced on the take-or-pay basis with Bolivia, nowadays, the only pricing option is the New Pricing Policy (NPP), which is an index of a Petrobras’ internal gas contract basket.

- **Duration.** The contract duration is about 10 years.

- **Delivery.** In all previous cases, the delivery point is at the city gate (for distributors) or at the exit point (for other customers). This means that Petrobras, in all contracts, is in charge of bringing the gas from the GPU to the consumption point.

- **Flexibility.** Petrobras provides the short-term flexibility required by customers. Flexibility services are provided using its gas portfolio. The resource allocation is an internal, non-observable process performed by Petrobras.

As for transport services, contracting options are long-term contracts associated with the commodity contracts. That is, transmission capacity contracts are often ship-or-pay contracts that allow long-term commodity trading.

As represented in Figure 5, the Brazilian gas industry is characterized by a significant lack of contracting options, both for commodity and transmission services.
Besides this, it is important to pay attention to the parties that transact in the industry. Again, the traditional structure in Brazil was based on vertical integration of all those transactions. As Petrobras’ role is changing, the Brazilian industry needs to be concerned with these parties. In case Petrobras remains a main player in the distribution business (as in the case of its sale of Gaspetro, where Petrobras remained as a controlling party after the sale), the number of retailers acting as counterparties in gas contracts (both for commodity and for transmission), may be limited. In turn, if the market design does not favor unbundling from distribution companies and gas retailers, Petrobras’ dominant position would be less harmful to competition. We have discussed these issues in the next sections.

### 3. The market we seek

We need to define what the objectives of our design are. We assume that, at least, one would expect the following:

- A market with a large number of traders (buyers and sellers);
- A market that allocates risk properly; and
- A market that functions in a non-discriminatory manner.

Distinct institutional designs have been implemented in other contexts. We have reviewed their main elements, aiming to provide a (restricted) menu of market designs. This approach follows a sequence of steps/stages:

- **Step #1.** Decide which activities are organized under competition. This includes deciding whether transmission services will be coordinated by market players or by regulation, and whether delivery to end consumers will be organized around retail competition or through regulated companies.

- **Step #2.** Implement coherent incentives for the selected market structure—unbundling requirements.

- **Step #3.** Decide on the characteristics of the products (commodity and transport) that will be traded, the contracting mechanisms (including pricing), and the expansion mechanisms.
3.1. Who participates in the market?

3.1.1. Contract versus common carriage

We consider that restructuring essentially consists of transforming former vertically integrated industries into market-based industries. Some (but not all) of the activities in the supply chain are to be opened to competition. This objective drives the redesign of rules to keep the monopoly characteristics of infrastructure from becoming entry barriers in the resulting market. That is, the use of the same infrastructure by different players is at the core of the reform. Nonetheless, the way in which this is done varies depending on the context.

The Rationale Behind Different Carriage Systems

- The logic for a market based on contract carriage. The typical example is the U.S. gas sector. It is organized around private companies that are in charge of deciding on upstream production, transportation, storage, and downstream delivery of gas (while distribution to consumers can be regulated or public). In this context, market participants manage both investment and operation of the transmission network. The central elements of the U.S. market design are bilateral, long-term contracts between producers and suppliers. Additionally, transmission rights are also contracted long in advance. In such transactions, producers and suppliers sign contracts that provide the right to use the (vast) network to transport gas from one point to another. The counterparties are the owners of the infrastructure involved in the path between both points. In this regard, shippers decide on the physical path that the gas will follow and pay for the use of the associated infrastructure.

  Under this design, investment in network infrastructure is largely driven by those long-term contracts. Nonetheless, gas supply and demand patterns are highly volatile, and the balance of flows in the gas system must be coordinated in shorter terms. Hence, in the short run, shippers will face frequent imbalances, which must be dealt with through complex combinations of gas trading arrangements and the associated changes in transmission rights. Consequently, the wholesale markets are typically associated with the definition of a place where the physical delivery of the commodity takes place—the physical hub (the most important one is the Henry Hub). Serving as marketplaces, hubs have often been seen as a prerequisite for gas pricing through gas-to-gas competition.

  Therefore, contract carriage systems are based on the idea of pipe-to-pipe competition. Differently put, competition plays a relevant role in the coordination not only of commodity-related activities but also of transmission activities.

- The logic for a market based on common carriage. Typical examples are the EU or the Victoria market. The basic idea is to consider that networks are public goods, contrary to the view of contract carriage in the United States. The logic for this decision might have been that gas network activities have the structure of a natural monopoly or are an overly concentrated oligopoly and thus, were recognized as the main barrier for opening the commodity market. In such a situation, as in the electricity sector, production and supply are considered as open businesses that can benefit from a market arrangement, whereas
network activities must remain subject to public regulation, regarding their operation and investment.

From a different viewpoint, it might also be possible to support regulation of network activities arguing that overly decentralized decisions in the operation of the network would lead to inefficiencies. The efficient option is then to design a centralized operation by means of a Transmission System Operator (TSO), coordinating the gas system interactions as effectively as possible.

**Implementation of Carriage Systems: Definition of Open Access**

- **Implementation of Contract Carriage: Open access in the United States.** In the United States, open access to network services has also been claimed to be one of the main elements of the gas market liberalization and development. However, the meaning of open access in the United States is different from the one in the EU. In 1985, the Federal Energy Regulatory Commission (FERC) announced Order No. 436, which introduced voluntary open access to interstate gas pipelines. Pipeline companies could choose to be only a transporter of the gas (open access) or carry their own gas (remaining private carriers but keeping their gas price regulated). In 1992, the FERC issued Order No. 636, which required pipeline companies to fully unbundle gas trading from pipeline operation activities and to set up separate transportation and trading affiliates. In other words, pipeline companies were forbidden to carry their own gas and forced to carry the gas of third parties. The key consequence of Order No. 636 was the complete separation between the ownership of the infrastructure and the services provided. The FERC regulates many aspects of interstate pipeline operation, including approval and siting for new pipeline facilities, as well as transmission rates that pipelines are allowed to charge for interstate shipments. The rules of access, however, are negotiated between pipeline owners and shippers. So, different from the European regulation, the rules of infrastructure use are defined by negotiation between the players (for instance, park and loan contracts), and a third party (FERC) plays a role in case there is no agreement.

- **Implementation of Common Carriage: Open access in the EU.** In the EU, open access was established in Directive 98/30/EC from the European Parliament and of the European Council (EC) on June 22, 1998 (the First Gas Directive). The first directive only defined that pipeline access shall be provided in a manner determined by the Member States, with the objective of fair and open access, achieving a competitive market in natural gas and avoiding abuse of dominant positions. In this first directive, the meaning of open access was vague and allowed varied interpretations. The second directive, EC 2003, defined the implementation of regulated third-party access. The interpretation of this directive led the EU member states to define an ‘ex ante’ set of rules for infrastructure use. The definition of these rules depends on a third party (frequently a regulatory body but also may include other governmental bodies such as a ministry). The third directive, EC 2009, did not change the main concept of regulated third-party access, but it set the need to establish common (or harmonized) rules in the EU countries. It meant that every shipper could access the network following a regulated set of procedures and pay a regulated tariff. According
to article 35 of EC 2009, the refusal to grant access would be possible when there was lack of capacity and/or this could bring safety risk. However, duly substantiated reasons must be given for any such refusal. In the long run, the member states may take the measures necessary to ensure that the necessary enhancements are promoted to avoid refusals. That is, there is a strong effort to make it harder to exclude players from accessing network services, because network access is seen as a key element to promote the wholesale gas market.

3.1.2. Full retail competition versus regulated distribution

Historically, distribution companies were responsible for delivering gas to end consumers. Such companies were monopolies with responsibilities over their concession areas. In that sense, delivery of gas to end consumers involved two different kinds of services:

- Sale of natural gas (often referred as commodity service): the service of buying and making arrangements for the delivery of natural gas at the delivery point.
- Distribution of natural gas (often referred as the network service): the service of transporting the gas through the distribution network to final consumers.

In that context, there is wide agreement that distribution activities (network activities) are a natural monopoly and, hence, regulation should assure there is just one firm in charge of each distribution area.

One can find less agreement with regard to the best way to organize commercialization activities. For instance, the United States has traditionally opted for regulated distribution companies, protected from competition by regulation, which are responsible for both commercialization (commodity) and distribution (network services). On the other hand, one of the main pillars of many reforms in the EU, including the seminal reform in United Kingdom, is full retail competition.

The choice between the two market designs for retailing activities (retail competition versus regulated distribution) cannot be seen as isolated from the rest of the market design. In particular, the choice is related to the previous choice between contract and common carriage. For contract carriage systems, the central element is the long-term transmission contract. Consequently, much of the success of the market is associated with the success of pipe-to-pipe competition. Therefore, having a strong counterparty for pipeline companies is extremely relevant. That is, two or three pipelines competing to serve several small retailers subject to competitive pressures can result in dominant positions for pipeline companies. On the contrary, with strong distribution companies that are protected from retail competition, pipelines face stronger competitive pressures.

For common carriage systems, the transmission contract is significantly less important for the functioning of the market. On the other hand, the ability of shippers to find customers is a key element of the liquidity sought by the common carriage systems. In that respect, strong retail competition is a key measure to obtain a competitive wholesale market.
Therefore, full retail competition would be relevant if the choice is common carriers. Regulated
distribution may be an interesting option if contract carriers is the preferred choice to organize
the market.

3.2. Defining coherent incentives for the market structure: unbundling

One of the basic instruments to control perverse incentives in network industries is to prohibit
the vertical integration of network owners and network users. This is often called unbundling.
Table 9 reports possible unbundling requirements in gas industries, followed by a brief typol-
ogy of different kinds of separations of activities.
### TABLE 9. CHARACTERISTICS OF TYPES OF UNBUNDLING

<table>
<thead>
<tr>
<th>Type of Separation</th>
<th>Characteristics</th>
<th>Pros and Cons</th>
</tr>
</thead>
</table>
| **Accounting**     | Separation of the accounts corresponding to potentially conflicting activities. | (+) Relatively light intervention in previous company structures, as it only requires the creation of separate accounts.  
|                    | Objective: To avoid cross-subsidies among those activities. | (-) It has difficulties in avoiding strategic behavior associated with the integration of activities. It is also difficult to monitor the separation of resources. |
| **Managerial**     | Separation of operation and management. | (+) It increases the potential of real accounting separation.  
|                    | Objective: Relative to legal unbundling, it facilitates cost separation. | (-) As before, it has difficulties in avoiding integrated strategies. |
| **Legal**          | Creation of separate legal entities. | (+) It facilitates the control of entities according to the specific purposes defined for them.  
|                    | Objective: To have entities with specific purposes. | (-) The potential still exists to create coordinated strategic actions aimed at optimizing joint profits. |
| **Ownership**      | There is no common property. | (+) Two firms with separate incentives.  
|                    | Objective: To eliminate the incentives to coordinate actions. | (-) Relatively hard intervention in the company structure, hence creating costs for restructured firms. |

Source and elaboration: FGV CERI.

### 3.2.1. Unbundling at the transmission level

Both contract and common carriers rely on unbundling at the transmission level. This comes from the fact that the main difference between the two carriage systems is whether the transmission operator is a market player or a regulated one. But in any case, the transmission operator (whether a pipeline operator or a system operator) would face incentives to preclude access under vertical integration with network users that compete in markets (frequently called shippers).

Although the need for unbundling in both types of carriage systems is recognized, the particular unbundling requirement can vary. Historically, the United States opted for ownership unbundling models. This choice can be justified by the central role that pipe-to-pipe competition has in the contract carriage model and, hence, the need to eliminate possible perverse incentives. In the EU, those incentives have been a relatively less important concern. Historically, unbundling requirements began by accounting unbundling and gradually evolved to three kinds of unbundling models.

- **Model A - Full-Ownership Unbundling (OU).** This model establishes conditions of human resources (financial, technical, and so on). The same agent cannot be part of two directive bodies or be responsible for nominating someone for the position. A frequent solution is to determine that the owner of the assets (unbundled) must be the network operation (ensuring complete unbundling). The same solution can also be implemented through transporters and network operators that are independent and not vertically integrated. This requires the establishment of strong conditions. Therefore, other options are available.

- **Model B - Independent Transmission Operator (ITO).** The most frequent model in the EU is the ITO, which is a type of legal separation. The model establishes that the owner of the transport network, which is also the operator, must be independent of companies with vested interests in other segments of the natural gas chain. This model requires strong regulatory intervention. In particular, the investment plan (expansion) needs to be closely monitored and approved by the regulator.
• **Model C - Independent System Operator (ISO).** The ISO model requires the separation between the ownership and the technical operation of the transmission assets. This model, which also needs to be closely monitored, can pose problems of coordinating investments, because it needs to harmonize two entities with different business models.

From this point of view, the EU experience shows that policy makers and regulators see legal unbundling as sufficient in the case of common carriers. This is possibly motivated by the fact that common carriers require the definition of network rules, which can also be seen as a tool to monitor unbundled companies.

3.2.2. Unbundling at the distribution level

As shown earlier, delivery of gas to end consumers involves two different kinds of services:

- Commercialization of natural gas (often referred as commodity service): the service of buying and making arrangements for the delivery of natural gas at the delivery point.
- Distribution of natural gas (often referred as the network service): the service of transporting the gas through the distribution network to final consumers.

Unbundling at the distribution level will mean the separation of these two activities. The necessary unbundling requirements vary depending on the organization chosen for the retail market. If there is no competition in the retailing activities, then unbundling will not be possible (what we call Model I). On the contrary, if retail competition is to be implemented, then unbundling of distribution and commercialization activities is a relevant piece of the design (what we call Model II).

• **Model I – Network unbundling without competition.** A significant part of the U.S. states chose not to allow competition in the distribution area. The main concern in this case is related to setting up conditions for independent interaction between the local distribution activities (commodity and network) and the rest of the chain (transmission and production). The same considerations made about the unbundling regimes apply in this case.

• **Model II – Network unbundling with competition.** The typical process of introducing competition in the natural gas market (observed both in the EU and in the U.S. states that chose this model) consists of offering end consumers the following choices:
  - Buy the commodity service at regulated prices and pay for the services associated with the regulated tariff
  - Buy the commodity service from a market supplier and pay for the services associated with the regulated tariff

It is necessary for tariffs charged by the local distribution companies to unbundle the commodity and the network service costs. Thus, besides the separation between distribution and transmission (and production), it is also necessary to set the unbundling of gas distribution and supply.
3.3. Basic market designs

3.3.1. Contract carriers and regulated distribution

The typical instance of this model is the U.S. model. As this market design relies on negotiations between market participants to coordinate industry activities, the requisite number of rules is smaller than in other options. Actually, we have already seen the basic requirements of this model—unbundling at the transmission and the distribution levels. The rationale behind this model is that once perverse incentives are eliminated through unbundling, negotiation between producers, transporters, and distribution companies will determine most of the decisions required to coordinate the industry.

In that sense, as seen, retail competition might not be a desired feature of the market. Actually, most U.S. states have chosen not to open retailing activities to competition. Hence, there will not be, in general, unbundling of distribution from commercialization activities. One of the most important arenas for regulation is the determination of pipeline tariffs (even if pipelines are not seen as a system, they enjoy significant dominant positions).

The definition of capacity contracts and the different services offered by pipelines are defined through negotiation among market players. In that sense, one of the most important elements of the contract carriage system is the role played by antitrust authorities. As the coordination of all activities relies on negotiation, anticompetitive behavior can hamper efficient results. In particular, the energy regulator, FERC, has considerable antitrust activity.

To avoid entry barriers, this market design requires (enough) liquidity in short-term transactions. It is possible to enact measures to promote liquidity. In general, these measures aim at increasing contract homogeneity, so that the number of players trading the same good increases as well. Some possible measures are the following:

- Standardization of gas delivery points. Ideally, it is possible to choose one physical hub to serve as the reference for all prices in the system (to work like the Henry Hub in the U.S.)
- Standard transport contracts to make short-term commodity trading possible
- Creation of an organized exchange
3.3.2. Common carriers and full retail competition

The main ingredient is simplification of the transmission contracting. There are several methods to simplify the contracting of transmission. For instance, the Victoria system relies on the implicit allocation of the transmission network according to commodity prices (in a methodology very similar to nodal pricing in power markets). This is an extreme case of simplifying contracting, in the sense that there is no possibility of contracting transmission capacity. A shipper will only obtain capacity if the corresponding bid for short-term commodity purchase or sale results in capacity allocated to the shipper.

The other popular approach to transmission contracts is the entry-exit regime. As in all common carriage systems, the seller of transmission rights is a regulated player (the TSO). This means that the entry-exit regime requires a minimum level of unbundling. Entry-exit regimes also define conditions to allocate transmission rights. The system defines in advance a set of entry points (zones that represent where the gas can be injected into the system) and a set of exit points (zones that represent where the gas can be withdrawn from the system). In that context, market participants agree on a set of gas commodity contracts, in principle with a variety of durations, from less than one day to several years. For the point-to-point regime, it is important to establish the delivery point of these contracts.

Entry-exit regimes provide liquidity precisely in that dimension—the delivery point is anywhere within the system. The allocation of network capacity, or equivalently rights to use the network, is implemented by the following procedure: entry rights give the right to carry gas from the specific entry point to any exit point, while exit rights give the right to withdraw gas from the exit point regardless of the origin of the gas withdrawn.

By doing that, a market is created where players trade gas in a virtual hub. Actually, entry and exit rights provide the rights to trade gas at the virtual hub (anywhere within the system). In this virtual hub, gas cannot be differentiated by its origin, thus representing a homogenous commodity. The traditional example of a virtual hub is the National Balancing Point in United Kingdom.

- **Capacity allocation.** In the entry-exit regime, the first step to allocate network capacity among shippers is to calculate the available capacity at each entry and exit point. To that end, besides knowing the physical properties of the pipeline system, it is necessary to calculate expected flows for each entry and exit point. Based on scenarios for injection and withdrawal (typically scenarios of system stress), the TSO calculates available capacities to be offered to network users. Hence, the basic required mechanisms are the following:

  o **Capacity definition.** This is the definition of standard capacity contracts. It is necessary to set contract duration, firmness (whether the right is interruptible), resell rights, and so on.

  o **Capacity allocation mechanisms.** There are several possibilities. Among the very simple ones, the market can use ‘first-come-first-served’ or ‘pro-rata’ mechanisms. They make it relatively easy for entrants to obtain network capacity and work relatively well when there is no congestion. One may also use auctions (now
mandatory in the EU). They are typically more efficient mechanisms when there is congestion, but they can complicate obtaining capacity for entrants.

- **Congestion management mechanisms.** The three basic options for entry-exit regimes are (a) overbooking and buy-back, (b) use-it-or-lose-it, and (c) implicit auctions.

- **Balancing systems.** Entry and exit capacity gives shippers the right to trade gas at one virtual point of sale the virtual trading point. In practice, however, the virtual trading point does not consist of a set of pipelines bringing gas to and disseminating gas from a central point. Pipelines connect specific routes for gas flow. Hence, there is no technical difference between infrastructure dedicated to entry capacity and infrastructure devoted to exit capacity. Therefore, a demand for entry or exit capacity does not correspond directly to a demand for access to any particular pipelines.

Furthermore, the virtual hub definition implies the definition of a period when the gas is a homogenous commodity—the balancing period. Differently put, within the balancing period (frequently, a day), gas does not have different values; that is, it is not economically differentiable. That does not mean that gas has the same price, because players may change their preferences. However, prices depend on the contracting time and not the time of injection or withdrawal.

Hence, entry-exit regimes create an implicit flexibility (both spatial and temporal flexibility) with the aim of promoting market liquidity. This strategy, however, comes at a cost. Entry-exit regimes create a gap between commercial and physical flows. Balancing systems are the mechanisms designed to bridge that gap. To design balancing systems, the basic required definitions (besides nomination and re-nomination processes and incentives to balance gas portfolios) are the following:

- **Definition of the balancing zone**

- **Definition of the balancing period** (possibly a day, but hourly balancing systems are also an interesting alternative, as was the case of the old Dutch balancing market)

- **Definition of balancing services.** Entry-exit regimes require the specification of the set of network resources that remain under the TSO’s control to guarantee system integrity. In almost every system, line-pack storage is used by the TSO to balance the system. In most cases, on the other hand, the LNG terminals are not part of the balancing services (Spain is an exception to that rule). In some cases, the TSO may use part of the underground storage capacity for balancing purposes (Italy is an example of this strategy). In that view, deciding which resources are used by the TSO to provide balancing services is not independent of the decisions on balancing zone and period: the larger the flexibility given by the system (the larger the zone and/or period), the larger the quantity of resources required by the TSO to guarantee system integrity.
• **Tariffs.** The procedure to implement entry/exit tariffs requires first defining the allowed revenue for the network owner. Then, once the expected network demand at each entry/exit point is estimated, the costs to be recovered at each point are defined. But complete cost reflectivity may not be possible, because tariffs are non-path-dependent. In other words, limitations in cost reflectivity do not come from the simplification of network nodes, but from the need of setting a single tariff regardless of the path followed by the gas. Consequently, path-based tariffs result in more efficient pricing, even if the physical network is simplified to a relatively simple set of nodes (as in ‘zonal pricing’ in electricity).

• **Network expansion.** The relatively weaker long-term signals that can be sent to market participants is a relevant challenge associated with entry-exit regimes. On the one hand, entry-exit systems weaken property rights over transmission capacity. On the other hand, tariffs are not completely (in general) cost-reflective. Consequently, additional methodologies must be put into place to expand the transmission network. This typically involves some degree of central planning, even if combined with open seasons.

3.3.3. **Summary of basic market designs**

We have seen that, depending on the way access is granted, one may differentiate among several market designs. The elementary decision in the gas market design is whether access is regulated or negotiated. This can be related to the idea that gas contracts delivery points can be standardized, and the way in which delivery points are standardized is through the open access mechanism. Figure 7 shows a first decision in the tree—whether the market design relies on regulated or negotiated access. In the latter option, the system will be a point-to-point system as in the United States.

Furthermore, Figure 7 shows that if access is regulated, there is a first choice—whether the market design is based on explicit allocation of network capacity (as in the entry-exit system of the EU) or on implicit allocation (as in Victoria, Australia). Once the entry-exit system is chosen, the concrete level of flexibility granted needs to be defined. For instance, depending on the level of spatial flexibility given by the definition of balancing zones, it is possible to distinguish between regional (as in France) and single-zone (as in United Kingdom) markets.

**FIGURE 7. BASIC TRADE-OFFS IN NATURAL GAS MARKET DESIGN**

Source and elaboration: FGV CERI.
4. Transitional arrangements

4.1. Definition of the basic principles

To guide the transition to the desired market design, the objectives sought by its final implementation need to be clear from the outset. This is relevant not only because it allows selecting the preferred model but also because it allows making coherent choices. Typical examples of objectives of the restructuring process are the following:

- Large number of traders (buyers and sellers)
- Non-discrimination
- Proper allocation of risks

The idea is that the choices that follow will be coherent with these objectives.

The three basic questions that need to be answered at this point are (a) What market and level of competition do we really want? (b) Are we prepared to embrace this new market without resorting to political interference? and (c) Are we prepared to pay the price to implement this market?

4.2. Facilitation of trading arrangements

4.2.1. Standardization of contracts

One of the most basic standardization measures is the harmonization of contracts duration. That is, it might be useful to specify several standard contracts to facilitate trading, for example, contracts with durations shorter than a day, daily contracts, monthly contracts, and so on.

The set (portfolio) of durations should be chosen to grant enough possibilities for most trades. Furthermore, it is important to specify a common starting time. For instance, daily contracts can be standardized to day-ahead contracts, meaning that all those contracts are nominated the day before gas delivery. In that view, one would create common nomination deadlines, which allow standardization. By doing that, the main elements of a (short-term) gas contract would be price, quantity, and delivery conditions. The last component (delivery conditions) is more complex than it would appear at first glance. The main reason for this is that it involves tight coordination with the transmission network. Consequently, the standardization of delivery point and flexibility conditions is a crucial step of any market design. Hence, one crucial step of the standardization process is definition of the ‘transmission capacity’ that can be contracted.

4.2.2. Legacy contracts

Regardless of the sale of Petrobras’ participation on the assets, a key point yet to be addressed by the reform is what should be done with the existing capacity contracts. Such contracts have mostly been made with Petrobras. Often the contracts signed have Petrobras’ own subsidiaries, owners of the infrastructure, as counterparts. They preserve (or at least stretch) the position taken by the incumbent company in the context of a vertically integrated industry.
These are mostly long-term contracts and waiting for them to end could substantially postpone the entrance of new agents in the market.

In practice, despite the divestment of the asset itself, for a long period, Petrobras (as a shipper) will still be exclusively entitled to use the existing pipeline capacity. Therefore, unless part of the existing capacity is released to be accessed by different agents, there is no clear message that the divestment and a new regulatory framework will unlock capacity to be used by third parties.

The general view provided above means that access to transmission and distribution networks is a necessary condition for the implementation of any market model. In that context, one of the main problems that needs to be addressed is how it will be possible to create effective third-party access to the existing pipelines.

4.2.3. Market institutions

A market operator to provide transparency to gas trading is often welcomed. The basic responsibility of the market operator would be to collect data from short-term trades and publish them aggregately. More sophisticated tasks depend on the level of organization chosen for the short-term market. In the most organized option, the system would rely on a gas exchange.

4.2.4. Taxation

The tax system will also need to be adjusted to encompass different players in the market. Currently, one of its underlying assumptions is to tax transport transactions based on the physical flow of natural gas. This is possible mainly because the contracts also adopt a point-to-point structure, identifying a starting point and a destination to the transport service. The tax is calculated considering the value of the tariff of a bundled product (the right to inject and to withdraw gas) and the revenues go to the origin state.

However, if the regulatory model shifts to an entry-exit regime, the object of the transport service also changes. First, what was previously a bundled product will now be traded and priced differently, the right to inject and the right to withdraw gas from the system. Therefore, it can reduce the taxable values in the origin state. Additionally, the entry-exit regime lacks a reference for physical gas flow. To track the pathway of the gas, it will be necessary to build a reference of its contractual relations, the ‘contractual flow.’

4.3. The changing role of Petrobras

One of the main concerns being raised with the expected change in the role played by Petrobras in the industry is the security of supply of natural gas. Petrobras has historically acted as the supplier of last resort. Recently, it publicly announced that it has no intention of continuing this. The approaching end of the Bolivian supply contract in 2019 is bringing uncertainties about who will negotiate the future contracts with Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), and if the supply arrangement will be able to offer the flexibility and security of supply to the consumers currently supplied by Bolivian gas.
One last aspect worth addressing is the conduction of the divestment process being carried out by Petrobras. The sales of Petrobras’ participation in strategic assets without the establishment of a regulatory model that suits the new reality of the sector could continue to hinder the development of the market and the security of supply.

On our perspective, therefore, such transactions should be regarded as an opportunity both to establish a coherent regulatory model and foster its results, because there is an ongoing change of property rights in the chain.

The following sections comment on the status of the sale of Petrobras’ participation in the distribution companies and the Transportadora Associada de Gás TAG.

4.3.1. Sale of Petrobras’ participation in Gaspetro

Gaspetro is a Petrobras subsidiary that holds the equity stakes in the distribution companies. Apart from BR Distribuidora (the former concessionaire in Espirito Santo), all the shares held by Petrobras in the distribution companies are detained through Gaspetro.

For the gas midstream and downstream assets, this was the first divestment transaction announced and closed by Petrobras. Petrobras sold 49 percent of its participation to Mitsui, a strategic partner of Petrobras in other ventures that already held stakes in other distribution companies. The stake was sold of R$1.9 billion.

CADE (the Brazilian antitrust regulator) approved the transaction in December 2015. However, a series of lawsuits were filed against the conclusion of the transaction, mainly arguing the lack of transparency. The existence of preferential rights of the other shareholders of the distribution companies in which Gaspetro has participation is also under dispute.

As of this paper, the effects of the transaction are still suspended by an injunction issued by a Federal Court in Bahia in January 2016. Petrobras appealed the decision before the Federal Court of Appeals for the First Region (TRF1), but no decision has been rendered yet. Table 10 summarizes the stakes of Gaspetro and Mitsui in the distribution companies before and after the transaction.

**Table 10. Capital Structure of the Local Distribution Companies Before and After the Gaspetro Transaction**

<table>
<thead>
<tr>
<th>Local Distribution Company (LDC)</th>
<th>Federative State</th>
<th>Date of Legal Creation</th>
<th>Network Length (Km)</th>
<th>Number of Clients (Thousands)</th>
<th>Demand (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algás</td>
<td>AL</td>
<td>1992</td>
<td>416</td>
<td>42</td>
<td>1%</td>
</tr>
<tr>
<td>Cigás</td>
<td>AM</td>
<td>1995</td>
<td>89</td>
<td>0</td>
<td>6%</td>
</tr>
<tr>
<td>Gaspal</td>
<td>AP</td>
<td>2002</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Bahiagás</td>
<td>BA</td>
<td>1989</td>
<td>840</td>
<td>41</td>
<td>6%</td>
</tr>
<tr>
<td>Cegás</td>
<td>CE</td>
<td>1992</td>
<td>426</td>
<td>9</td>
<td>1%</td>
</tr>
<tr>
<td>Ceolgás</td>
<td>DF</td>
<td>2000</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>BR Distribuidora</td>
<td>ES</td>
<td>1993</td>
<td>453</td>
<td>39</td>
<td>5%</td>
</tr>
<tr>
<td>Goiasgás</td>
<td>GO</td>
<td>2000</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Gasmar</td>
<td>MA</td>
<td>2001</td>
<td>0</td>
<td>0</td>
<td>7%</td>
</tr>
</tbody>
</table>

---

* Case no. 0000131-24.2016.4.01.3306, being conducted in Paulo Afonso, Bahia.
Contrary to what happened in the sale of the southeast transport network, in this transaction, Petrobras did not sell control of the company. Also, there is evidence that as part of the deal, Petrobras negotiated to maintain full control over technical and investment decisions.

4.3.2. Sale of Petrobras’ transport pipelines

As a part of the divestment process, Petrobras is selling its participation in NTS (a TAG subsidiary that owns the transmission network assets located in the southeast). The transaction does not involve Transportadora Brasileira de Gás (TBG), and hence, the GASBOL pipeline is not included in the deal.

According to public information, the deal is designed as a 10 percent Petrobras and 90 percent buyer model. This is a consequence of the ANP Resolution 51/2013, which defines that for new pipelines, shippers cannot control the transporter in charge of the new pipeline.

Even though in this case, the ANP Resolution 51/2013 is being complied with, some concerns still exist: (a) all the capacity of existing pipelines is controlled by Petrobras and (b) all capacity is contracted under ship-or-pay contracts, so Petrobras will continue paying for the pipeline capacity even if it is not used.

In that respect, it is important to note that the NTS transaction involves selling the cash flow associated with the existing pipelines. From the buyer’s point of view, the transaction involves 90 percent of the cash flow that currently does not depend on the physical flow. If the new regulatory framework involves a new method to calculate the allowed revenue where the transporter’s position is riskier, the assets’ value will change. Consequently, the buyer will expect the basic

Source and elaboration: GGV CERI.  
Note: *Demand percentage over the total National Demand. Data from April 2016

---

GASBOL is the natural gas pipeline connecting Bolivia and Brazil.
principles of the new regulation to be defined before the transaction takes place. This is an important role for the basic coherent model. The timely decision of the future developments in the legal framework lowers regulatory uncertainty, adding value to the assets.

- Value of the existing assets. The value of such assets is closely related to the gas transport contracts in place. For instance, the value to be potentially paid for the NTS considers the expected returns associated with the capacity that is already booked in the long term.

The potential value of such contracts is what orients the investment decision of prospective buyers. Thus, the new transporter, the buyer of Petrobras’ assets, might expect the value to be preserved even if there is a change in the regulatory framework. For instance, if the capacity allocation regime changes to an entry-exit regime, the new transporter might expect the allowed revenue to affect the amount paid in the transaction.

After the signature of the contract in September of 2016, the Petrobras General Assembly approved the sale in November. On December of 2016, the Federal Court of Auditors (TCU) suspended the signing of many Petrobras sales contracts because of irregularities on the procedures. The suspension ended in March 2017, and now the transaction only waits for some conditions to be concluded.

5. Conclusion

The aim of this paper was to analyze the process of creating a well-functioning gas market in Brazil. To that end, we have described a strategy based on three pillars: (a) characterizing the market we have; (b) identifying the market we seek; and (c) developing transitional arrangements to migrate from the current situation to the desired one.

We identified a nested decision-making process where we first defined the basic principles of the reform. Several fundamental questions need to be decided in this step: (a) What market and level of competition do we really want? (b) Are we prepared to embrace this new market without/not resorting to political interference? and (c) Are we prepared to pay the price to implement this market?

Once these decisions are made, a target model needs to be defined. The decisions required for the definition of a target model can be grouped under three broad headings:

- Who participates in the market? We have seen that two basic choices that need to be made at this point: (a) contract versus common carriage and (b) full retail competition versus regulated distribution.

- Unbundling. The second group of choices is associated with the creation of coherent incentives for the market structure. In that context, one needs to deal with (a) unbundling at the transmission level and (b) unbundling at the distribution level.

- Once the previous options are made, the details of the market design need to be defined. We have shown the process to implement an entry-exit regime with four
steps: (a) product definition (What to contract?), (b) contracting mechanism (How to contract?), (c) pricing mechanism (How to price?), and (d) investment decision (How to build?).

Several measures to facilitate trading in the new market are often required, such as the standardization of contracts, creation of new market institutions, dealing with legacy contracts and tax challenges, and so on.

One of the main lessons to be drawn from the above analysis is that there is a sequence in the decision-making process associated with gas market design. For instance, it is not possible to define ‘transmission tariffs’ (a pricing mechanism) without having defined ‘transmission capacity’ (what is going to be priced). In turn, it is not possible to define ‘transmission capacity’ before defining who is going to define capacity (the decision on whether to implement contract or common carriers).