Natural gas regulation and policy in Brazil: Prospects for the market expansion and energy integration in Mercosul

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ABSTRACT

The study comprises an analysis of the most relevant oil and gas (O&G) legislation and policy, focusing on the development of natural gas (NG) infrastructure and market in Brazil. The paradigms for the study were the regulatory frameworks of the O&G industry in Brazil and Argentina, since they are relevant members of the Mercosul economic block. A comparative assessment was performed in order to better understand the bottlenecks and drawbacks for the NG market expansion in Brazil, considering successful examples of recent legislation advances of other countries. Also, the sanction imposed by ANEEL Resolution n. 583 of 2013 on natural gas suppliers, due to the lack of supply for thermoelectric utilities was evaluated. Since current calculations have introduced asymmetries concerning the indicators employed, while using parameters intrinsic to the electricity sector, an alternative formula was proposed, decreasing the sanction value on the supplier without compromising the contract neutrality. The regulatory framework analysis indicates that further strategic planning and investment, as well as adequate policy changes are required, in order to ensure a long-term energy policy aimed at the sustainable development of the NG industry in Brazil. This process is aligned with a transition towards a lower emission energy system, and should consider the expansion of energy integration in Mercosul to explore the potential of its members’ comparative advantages.

1. Introduction

The energy industry has played a major role in acting as driver of infrastructure investment since the 19th century, especially after the Industrial Revolution. Energy law scholars, policy makers, energy analysts, and researchers have been debating the issue concerning the exploitation and use of energy resources ever since. In the 1800s and early 1900s there was already legislation focused to manage energy sectors such as coal and oil (Heffron and Talus, 2016a).

Infrastructure investment and regulation discussions date back to the 1960s and there is no consensus regarding the effects of regulation on infrastructure investment (von Hirschhausen, 2004). Theoretical and empirical work has been developed about the dynamic nature of regulated investment, as in Hausman and Myers (2002) apud von Hirschhausen (2006), who suggested that relying on traditional regulation to establish competitive prices may lead to adverse effects on innovation and new investment.

In traditional liberal economic theory, the market is a self-regulated system, capable of achieving equilibrium on its own, without major deviations, in accordance with Adam Smith’s image of the “invisible hand” and Jean-Baptiste Say’s “law” that production creates its own demand given that the economy is in “perfect competition” (Piketty, 2014). In this case there would be no need for government intervention in the freedom of economic decisions of the agents, because the market would accommodate itself through the prices mechanism for resource allocation.

However, there are situations where the market alone does not lead to an efficient allocation of resources, where “market failures” involving externalities, information asymmetries, and market power held by one (monopoly) or some (oligopoly) agents, cause distortions in the market. In this situation, there is the need of action by means of government intervention through regulatory measures.

Heffron and Talus (2016a) stated that analogously to developments observed in upstream energy markets, downstream markets have also moved away from government, or monopoly controlled markets, causing energy law to become a need for downstream markets. The privatization and liberalization occurred in such markets around the world, departing from tightly state-controlled to markets driven by market forces, made their regulation necessary, as well as the nature of both markets and their regulation acquired an international nature.
The word “regulation” in Brazil has appeared with the movement of State reforms, especially when, due to the privatization of State companies and the introduction of the idea of competition between public service concessionaries, it was necessary to “regulate” the activities that were subjected to concession to private companies (Di Pietro, 2004). Levy and Spiller (1996) state that regulation is needed in the energy utility industry in general, because the mentioned monopolistic nature of its services normally gives a single local utility or a limited group of utilities (oligopoly) uncontrolled power over consumers or distribution.

Concerning specifically the natural gas infrastructure, Hopper et al. (1990) observed that most of the pipeline in Mercosul countries could be characterized as monopolies, similar to what were most the U.S and the European structures in the 1990s. This situation has not changed considerably after almost thirty years, especially in Brazil.

Gomes (2014), when discussing the issue, has concluded that Brazilian authorities need to change power auction rules in order to make natural gas projects compete more effectively and to develop policies to promote the development of domestic gas and encourage existing producers to sell their gas to the market. Thus, one important issue to address is how energy integration must be conducted and which regulatory framework has to be adopted to further ensure supply security, quality of services, and reasonable prices for the end-consumer.

In this context, Heffron and Talus (2016b) noted that the partial failure of economics and free market ideology has contributed to the main driver of energy law, which is the need for energy infrastructure development. In consequence, the next decade will be particularly important for the energy sector globally, in a way that energy infrastructure built and policy concerning future energy infrastructure development during the period will be determinant to the successful achievement of the climate change targets for signatory countries of the Paris Agreement.

A vital purpose of current energy law would be to foster and/or initiate new energy infrastructure, as happened through the U.S Energy Policy Act 2005, whose main aim was to invest massively in new energy infrastructure projects, resulting in almost US$ 30 billion of energy projects. Comparably was the UK Energy Act 2013 who planned to invest £ 110 billions in new energy infrastructure (Heffron and Talus, 2016a). Both governmental plans aimed to increase economic growth through public expenditure and supply chain development.

In Latin America, after the so called “economic lost decade” in the 1980s, result of the financial crisis that affected many of its economies, economic integration and energy law discussion regained popularity back in the 1990s, as means of promoting sustainable development in the developing world (Mares and Martin, 2012).

Also, several market liberalization and pro-market presidents proliferated in that decade, marked by administrative reforms introduced by Presidents Fernando Collor (1990–1992) and Fernando Henrique Cardoso (1995–2003) in Brazil and by Carlos Menem (1989–1999) administration in Argentina. Therefore, it is not a coincidence that the first attempt to regulate and promote the development of the natural gas industry occurred in the same period, since the first legal milestone of the oil and gas (O&G) industry legislation in Brazil was Law n. 9478 of 1997 (Petroleum Act).

The Petroleum Act was promulgated during the first Fernando Henrique Cardoso administration (1995–1999), in the context of ample administrative reforms initiated by the Plano Diretor da Reforma do Aparelho do Estado of 1995, which introduced a system of managerial public administration in the Brazilian government.

The increase of production and importance of the natural gas supply and final consumption in Brazil and throughout the world is expanding due to, mainly, increasing environmental issues regarding carbon emissions, since it is considered to be an efficient and clean energy source when compared to other fossil fuel alternatives (Leal et al., 2017).

This is particularly relevant to Brazil because its electricity matrix is mostly hydroelectric, which is reaching its operational limit, mainly due to geological, hydrological, and environmental factors, such as the limitation of concessions and low site availability (Leal et al., 2017). Thus, the exhaustion of elevated hydraulic potential basins in the South and Southeast requires current projects to be located mainly in the Brazilian Amazon, with large accumulation reservoirs, causing major environmental impact associated with flooding and deforestation, especially to biodiversity.

Demarty and Bastien (2011) and De Faria et al. (2015) reported that emission factors for the old tropical reservoirs of Balbina, Tucuruí, Petit Saut, and Samuel are higher than those of fossil fuel power plants, with mean emission factors of 2200, 480, 1300, and 2200 kg CO2eq per MWh, respectively. De Faria et al. (2015) assessed CO2 and CH4 emissions of eighteen reservoirs recently built, under construction, or planned in eight rivers in the Amazon basin, concluding that large hydropower plants located in tropical forested regions may lead to significant carbon dioxide and methane emissions.

Hence, natural gas could act as a bridge fuel for a sustainable transition to a low carbon electricity matrix in Brazil, in order to replace more polluting or inefficient technologies in thermoelectric generation such as fuel oil and mineral coal. It could be the backbone to sustain further solar and wind energy development in the Northeast, mitigating the intermittence associated to them.

This process would be aligned with the energy law principles of energy security and reliability, as well as the protection of the environment, human health, and combating climate change (Heffron et al., 2018), being inserted into a just transition context. Heffron and McCauley (2018) defined the just transition as “a fair and equitable process of moving towards a post-carbon society”. This developed through the application of distributational, procedural and restorative justice concepts.

In this sense, one of the concerns discussed at the 2018 Group of Twenty (G20) Buenos Aires Summit was the topic of energy transition and that G20 members should lead the process, working together to transform mutual energy systems into affordable, reliable, sustainable, and low GHG emissions systems in the short term, recognizing: “the key role that natural gas currently plays for many G20 countries, and its potential to expand significantly over the coming decades, supporting transitions towards lower emission energy systems” (G20, 2018).

Additionally, there is the shale gas boom occurred in North America and the Russian-Ukrainian conflict effects on decreasing supply to Europe, both events increased the importance of natural gas supply and destination studies. In this regard, Richter and Holz (2015) used a model-based approach to analyze the consequences of supply disruptions of Russian natural gas on the European market, concluding that Eastern European countries are the most vulnerable. The surcease of Russian supply could be compensated by an increase in domestic production, imports of LNG, and pipeline gas being brought from other regions, thus requiring further EU internal infrastructure integration.

Since 2010, the Brazilian pre-salt basins are increasingly producing oil and natural gas. The overall production has experienced a boost in the period, due to the recent discoveries of large gas reservoirs in the pre-salt layer, like the Sapinhoá Oil Field in the Santos Basin (Petrobras, 2016). The natural gas production has increased 85% from the 21,592.7 millions of m3 in 2008 to the level of 40,117.4 millions of m3 in 2017 (ANP, 2018a, 2018b).

Natural gas consumption in South and Central Americas has been increasing at average growth rates of 2.3% p.a. from 2006 to 2016 (BP, 2018). The Brazilian natural gas consumption has grown at a much faster pace in recent years of 5.8% p.a. in the same period, reaching 38.3 billions of m3 in 2017. On the internal demand side, the industrial

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demand for natural gas in 2016 increased 2.5% over the previous year, especially in iron and steel (18.1%) and chemical sectors (9.9%). The thermal power generation with natural gas, including self-producers and public service power plants, reached a level of 56.5 TWh (MME, 2017; ANP, 2018a, 2018b).

Considering this overall scenario, different laws and regulation concerning the natural gas industry in Brazil and Argentina were analyzed, focusing on understanding the effects of energy law and policy on the development of the natural gas market and infrastructure in both countries, as well as their impact on investment. The focus of such case study approach was to better understand the dynamics of each market, through the evidences provided by their main regulatory policies.

The paradigms for the analysis were the most relevant O&G industry related laws in Brazil and Argentina. Both countries were considered since they are relevant members of the Mercosul economic block. Then, a comparative assessment was performed in order to better understand the bottlenecks and other characteristics of the natural gas market in Brazil, also considering successful examples of recent legislation advances of other countries such as the United States (US).

Theoretical sampling was the basis for the discussion, which demonstrated to be the recommended approach to analytic induction, because it accommodates existing theories better. In collecting and analyzing data for this study, legal frameworks and diplomatic documents were the basis for the analysis.

This energy law sampling process culminated with the proposal of some suggestions for regulatory improvements in Brazil, especially a new formula to calculate supply cut-off sanctions to the natural gas supplier of thermoelectric utilities. This is performed through some changes of parameters in the current formula of ANEEL Resolution n. 583 of 2013, decreasing the overall value of the penalty, without compromising the contract neutrality.

Moreover, some conclusions concerning further legislation changes were provided, focusing on the development of competition in the natural gas market in Brazil, towards energy integration in Mercosul.

2. Discussion

2.1. Energy integration background

Energy integration in Latin America has been considered a key factor for the promotion of economic development at the region, ever since the issue was brought up in the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) and other multilateral discussion commissions inside the United Nations in the post Second World War (1945) era. One of the most relevant issues is which projects should be implemented in order to maximize the economic growth of Latin America, through the use of its countries comparative advantages and natural resources.

Calogeras et al. (2016), when discussing the matter, point out that the Mercosul area has a huge potential to create and stimulate the mutual cooperation between its members, including their relative power of bargain with other economic blocs. It also has the potential to mutual cooperation between its members, including their relative power of bargain with other economic blocs. It also has the potential to mutual cooperation between its members, including their relative power of bargain with other economic blocs. It also has the potential to mutual cooperation between its members, including their relative power of bargain with other economic blocs.

The continuous development of the Marcellus and Utica shales is fueled entirely by natural gas. The experience of regional integration in North America, between Canada and the US, presents some good examples of successful projects. TransCanada has long been one of the major natural gas transmission companies in North America, operating a 91,900 km network of pipelines, which supplies more than one quarter of the NG consumed daily across North America. Moreover, the recent expansion of the Northern Border Pipeline into Chicago and the development of the Alliance Pipeline, which delivers more than 1.6 billion cubic feet per day of natural gas from western Canada into the Chicago market.

The continuous development of the Marcellus and Utica shales is being supported by the extension of pipeline infrastructure from the Appalachian region to ship more gas to markets in the Northeast, Midwest, and Southeast regions of the United States and in Eastern Canada. The US gas output is expected to grow by 2.9% per year by 2022, adding around 140 billions of m³ to global production. Moreover, it is expected that by 2022, the US will produce approximately 890 billions of m³, or 22% of the total gas produced worldwide (IEA, 2017).

Although gas markets are approaching saturation in many parts of the developed world, consumption continues to grow in the US, the largest gas-consuming country in the world. Coal plants deactivation and NG switching in the power generation grid acted as the main driver of gas demand growth in the recent past (IEA, 2017). In the European market, where demand rose in 2016, due to lower prices and coal plant retirements, after four years of decline from 2010, natural gas relies heavily on large-scale infrastructure across several European Union (EU) Member States and outside the block as well (Fig. 1).

Regarding the EU situation, pipelines to other Member States trade a fifth of the internal production in the EU. Furthermore, pipeline supplies from Russia, Norway, and Algeria supply almost half of the Union’s gas consumption (Aalto and Temel, 2014).

Russia’s share of EU imports of natural gas has increased from 34.6% to 39.5%, between 2005 and 2016, as Norway remained the second largest supplier of European Union’s imports, with its share rising from roughly 20% in 2005 to 34.4% in 2016. In 2016, more than three quarters (89%) of the EU States’ NG imports came from Russia, Norway, or Algeria. When compared to the European or the North American market, where demand rose in 2016, due to lower prices and coal plant retirements, after four years of decline from 2010, natural gas relies heavily on large-scale infrastructure across several European Union (EU) Member States and outside the block as well (Fig. 1).

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This low-density market, which occurs in most of South American countries, is made of a series of monopolies at the national and regional levels. Indeed, there is virtually no competition anywhere within Mercosur between alternative gas suppliers, except mostly at local level in Brazil, where distributors of LNG compete for retail sales.

A case regarding energy integration in the energy utility industry that deserves to be briefly addressed is the CIEN, or Energy Interconnection Company. It was founded in 1998 to be in charge of operating the power lines between Brazil and Argentina, since at that time the latter had an electricity surplus originated from its natural gas thermoelectric facilities, and Brazil already projected a deficit in generation at that time.

About US$ 700 million were invested in the construction of two converter substations, named Garabi I and Garabi II, and two power lines of 500 km each, with an overall capacity of 2200 MW. The first substation started to operate in the beginning of June 2000 and the second in the beginning of August 2002. The Brazilian National Agency of Electricity (ANEEL) issued Resolution n. 129 in 1998 and authorized the CIEN to import up to 1100 MW from the “Mercado Eléctrico Mayorista – MEM” in Argentina (Santos et al., 2002).

The confirmation by the Electricity Sector Monitoring Committee (CMSE), in the beginning of 2004, that there was risk of electricity shortage in the South Region of Brazil motivated the testing of real availability of the power line operated by CIEN. The National System Operator (ONS) and ANEEL conducted tests, together with the Companhia Administradora del Mercado Mayorista da Argentina (CMMES), that demonstrated the evident incapacity of CIEN to import the contracted energy associated to the enterprise, meaning the power line was “dry”.

This is an indication that the natural gas in Argentina, which is destined for electricity generation, is not able to produce a surplus able to sold to its neighboring countries. This might even be a demonstration that the power lines administrated by CIEN might eventually be used more often on the opposite way they were intended, with Brazil selling electricity surplus to Argentina.

American experiences, still remains a lot to be developed in transnational natural gas infrastructure integration in South America. As depicted in Fig. 2, the continent has little infrastructure of gas transportation, in such a way for internal supplying or regional interconnection.

From a technical perspective, the transportation system in Latin America is still a low integrated network. The Brazilian pipeline network total length is of about 11,732 km and primarily distributed along the Atlantic Ocean coastline. It has ramifications in the Center-West axis through the Bolivia-Brazil pipeline (GASBOL), which is 3150 km in length and transports about 33 million m³/day (ANP, 2018a, 2018b).

Currently, most pipelines in study would go from the South, interconnected with the hub in the city of Uruguaiana, border of Argentina and Uruguay, up to the city of Campo Grande, connecting to the GASBOL, aiming to reach the Northeast of Brazil (Figs. 2 and 3). The Bolivian natural gas exports to Brazil and Argentina were an average of 28.33 million m³/day and 15.50 million m³/day, respectively, in 2016, which represents more than ¾ of Bolivia’s production (Ministerio de Hidrocarburos, 2017).

Table 1
Proved natural gas reserves ranked by country for the 7-largest-resource holders in Latin America at 31st December 2015 (Source: BP, 2016).

<table>
<thead>
<tr>
<th>Country</th>
<th>Trillion cubic meters</th>
<th>Share of South America</th>
<th>Total Production</th>
<th>R/P ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>0.3</td>
<td>4%</td>
<td>36.5</td>
<td>9.1</td>
</tr>
<tr>
<td>Bolivia</td>
<td>0.3</td>
<td>4%</td>
<td>20.9</td>
<td>13.5</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.4</td>
<td>5.3%</td>
<td>22.9</td>
<td>18.5</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.1</td>
<td>1.3%</td>
<td>1.10</td>
<td>12.2</td>
</tr>
<tr>
<td>Peru</td>
<td>0.4</td>
<td>5.3%</td>
<td>12.5</td>
<td>33.1</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>0.3</td>
<td>4%</td>
<td>39.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Venezuela</td>
<td>5.6</td>
<td>74.7%</td>
<td>32.4</td>
<td>173.2</td>
</tr>
<tr>
<td>Other S. &amp; Cent.</td>
<td>0.1</td>
<td>1.3%</td>
<td>2.6%</td>
<td>24.0</td>
</tr>
</tbody>
</table>


b Natural gas production data expressed in billion cubic meters per day.

Table 2
Natural gas consumption ranked by country in 2017 (Source: BP, 2018).

<table>
<thead>
<tr>
<th>Country</th>
<th>Natural gas consumption per country (billions of m³)</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td></td>
<td>648.2</td>
<td>658.2</td>
<td>688.1</td>
<td>707.0</td>
<td>722.3</td>
<td>743.6</td>
<td>750.3</td>
<td>739.5</td>
</tr>
<tr>
<td>Russia</td>
<td></td>
<td>422.6</td>
<td>435.6</td>
<td>429.6</td>
<td>423.0</td>
<td>423.6</td>
<td>409.6</td>
<td>420.2</td>
<td>424.8</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td>108.9</td>
<td>135.2</td>
<td>150.9</td>
<td>171.9</td>
<td>188.4</td>
<td>194.7</td>
<td>209.4</td>
<td>204.4</td>
</tr>
<tr>
<td>Iran</td>
<td></td>
<td>98.9</td>
<td>110.4</td>
<td>122.4</td>
<td>122.3</td>
<td>120.5</td>
<td>118.7</td>
<td>116.4</td>
<td>117.1</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td>88.7</td>
<td>95.6</td>
<td>92.8</td>
<td>98.0</td>
<td>103.2</td>
<td>102.9</td>
<td>109.5</td>
<td>115.7</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td></td>
<td>83.3</td>
<td>87.6</td>
<td>94.4</td>
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<td>97.3</td>
<td>99.2</td>
<td>105.3</td>
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<td>Germany</td>
<td></td>
<td>88.1</td>
<td>80.9</td>
<td>81.1</td>
<td>85.0</td>
<td>73.9</td>
<td>77.0</td>
<td>84.9</td>
<td>90.2</td>
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<tr>
<td>Uk. Kingdom</td>
<td></td>
<td>98.5</td>
<td>81.9</td>
<td>76.9</td>
<td>76.3</td>
<td>70.1</td>
<td>71.8</td>
<td>81.0</td>
<td>78.8</td>
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<td>Arab Emirates</td>
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<td>63.4</td>
<td>71.0</td>
<td>72.5</td>
<td>72.2</td>
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<td>67.2</td>
<td>59.4</td>
<td>64.8</td>
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<td>61.3</td>
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<td>49.6</td>
<td>46.4</td>
<td>50.8</td>
<td>54.2</td>
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<tr>
<td>South Korea</td>
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<td>45.0</td>
<td>48.4</td>
<td>52.5</td>
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<td>50.0</td>
<td>45.6</td>
<td>47.6</td>
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<tr>
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<td>43.7</td>
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<td>Venezuela</td>
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<td>9.5</td>
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<tr>
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<td>5.4</td>
<td>6.0</td>
<td>5.9</td>
<td>6.7</td>
<td>7.1</td>
<td>7.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Chile</td>
<td></td>
<td>5.7</td>
<td>5.8</td>
<td>5.3</td>
<td>5.3</td>
<td>4.4</td>
<td>4.8</td>
<td>5.9</td>
<td>6.0</td>
</tr>
</tbody>
</table>

17/16 %
2.2. Regulatory framework of the natural gas industry in Brazil

Brazil is the largest country and economy in Latin America, therefore an interesting case study of successive attempts to integrate its gas distribution network. Despite Brazil’s substantial natural gas reserves and the great expectations surrounding the large amount of resources located in the pre-salt layer, the natural gas sector in the country is still relatively underdeveloped.

Since demand for heating is almost nonexistent, due to mostly tropical and under-tropical predominant climate, most of demand is primarily located in industrial facilities and thermoelectric generators. There is also demand for transportation, commercial, and residential consumers (Fig. 4).

The average national daily production in 2017 was of 109.86 million m³/day, and the average volume of imported natural gas, including the regasification of LNG, was of 29.37 million m³/day. The Brazilian transportation network is about 11,732 km in length, if considered both transport and transfer pipelines, while the distribution network, still primarily concentrated in the Southeast States, has about 27,320 km in length (ANP, 2018a, 2018b; MME, 2016a, 2016b).

The Petroleum Act has shown to be unable to foster the natural gas industry development, especially due to limitations intrinsic to the lack of power in coordinating the market agents and somehow failed to attract investment, especially from private companies. Under this first regulation occurred the construction of the 3200 km Bolivia–Brazil pipeline in 2000, the longest gas pipeline in South America, to serve both the industrial sector and the planned natural gas-fired thermoelectric demand.

Changes in the federal government that occurred in 2003 modified the reform process and instead of pursuing a more open market, focused on reinforcing the planning role of the Ministry of Mines and Energy (MME) in the energy sector. Also, the Energy Research Company (EPE) was created in the period, with the main objective of technically assisting the MME in strategically oriented decisions and mid-term expansion strategies.
Historically, the Brazilian natural gas industry’s growth was not based on consumption to generate electricity, as occurred in several other countries, but on commercial and especially industrial use. Since the industrial demand is relatively stable and the volumes are enormous, this segment is the main drive for projects to build network infrastructure, for both transportation and distribution (Mathias and Szklo, 2007).

The thermoelectric power plants in the country were originally intended for emergency response, in case of occasional severe droughts that would impact adversely the electricity supply, such as the ones occurred in 2001 and more recently in 2014–2015, which culminated in unwanted electricity rationing.

Later, the second regulatory milestone established by Law n. 11,909 of 2009 (Gas Act), under intense political debate between the different participants of the gas industry, contributed to the development of regulatory coordination through the National Agency of Petroleum, Natural Gas and Biofuels (ANP). However, the extensive influence of state giant Petrobras throughout the entire gas chain still made it difficult to other agents to enter the market (Colomer Ferraro and Hallack, 2012).

Under the establishment of Law n. 11,909 of 2009, some issues that were not addressed appropriately in the Petroleum Act were then more adequately approached. Firstly, the role of the government in the gas sector was substantially changed, allowing further liberalization of the natural gas transportation network, and creating a mechanism of coordination to reduce the perception of risk from private investors.

Campos et al. (2016) stated that along with this new configuration brought by the Gas Act, is the draft of a new commercial model...
arrangement, allowing the entry of new actors (self-producers, self-importers, and free consumers) and therefore new possibilities of contractual relations. However, they observed that the actual expansion of the grid remains much smaller than expected under the Gas Act.

Such inability is credited to some particular factors concerning regulatory uncertainties and inadequate resolutions among which: the uncertainty concerning the classification of pipelines (transfer, transportation, production flow, and distribution pipeline), the controversy surrounding the definition of what would be considered a “free consumer”, third-party access to existing pipeline infrastructure, period of contract exclusivity, and PEMAT (Expansion Plan of the Natural Gas Transportation) network expansion planning.

In this case, the associated risks with pipeline deployment can be many, going from leakage control, operation and maintenance issues, to costs with pressure loss along the pipelines. Concessions of natural gas transportation under the Gas Act were in charge of ANP and supposed to last for a thirty-year period, with permitted prorogation.

The Gas Act promoted a partial unbundling of the natural gas transport segment, through Article 32th which stated that the access of any third party to transport pipelines is guaranteed. However, it relegated the access rules and use of transfer pipelines and re-gasification facilities to further regulation (Colomer Ferraro and Hallack, 2012). An important aspect ostensibly established was the exclusivity period for initial gas carriers of ten years, counted from the beginning of the commercial transport pipeline operation.

Further, ANP Resolution n. 11 of 2016 improved legislation and established more defined terms and rules for the access to transportation and transfer facilities, including the reclassification of transfer pipelines to transport pipelines, and the guarantee of non-discriminatory third party access to any transportation network through applicable transport tariffs.

Law Project n. 6407 of 2013, or the Gas PL, still under discussion in the Congress, is supposed to innovate through the creation of a Secondary Natural Gas Market, to meet gas demand required by final users willing to purchase gas that is already being contracted, but is temporarily not being used by the primary consumer. It also considers the adoption of federal tax incentives and the creation of an integrated transport system through a private non-profit organization called Natural Gas Transport System Operator (ONGAS).

Table 3 presents the overall panorama of the latest most relevant regulatory instruments in Brazil, divided by aspects such as granting system for gas transport pipelines or production regimes, degree of market liberalization, state presence, etc. It includes a brief analysis of the intrinsic contingencies contained in each legal text. Since electricity generation is one of the primary destinations for natural gas in Brazil, it is important to analyze recent changes in regulatory legislation and its impacts.

As can be noticed, there is still the need to better deal with the gas transportation deregulation issue, since it was not adequately addressed in previous legislation. In this matter a brief digression is of importance, especially concerning a much more developed market, the North American.

Busby (1999) observed that the greatest impact of federal regulation in the natural gas industry came as result of Federal Energy Regulatory Commission (FERC) orders implementing the Natural Gas Policy Act, FERC's Orders n. 436 in 1985, n. 500 in 1987 and n. 636 in 1993. Such orders allowed local gas distributors and large customers to "by-pass" the pipeline and purchase gas directly from producers, marketers, and brokers.

This implied that pipeline companies had to transport any purchased gas, resulting in a drastic change in the supplier-customer relationship. By 1993, FERC orders had covered several relevant issues, among which fully comparable transportation services for gas, whether sold by the pipeline company or by other third party, and separation of purchase and transportation services by interstate pipelines ("unbundling").

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Granting system for production regimes</td>
<td>Authorization granted by ANP</td>
<td>Authorization granted by ANP</td>
<td>Authorization granted by ANP</td>
<td>Authorization granted by ANP</td>
</tr>
<tr>
<td>Granting system for natural gas transport pipelines</td>
<td>Authorization granted by ANP</td>
<td>Authorization granted by ANP</td>
<td>Authorization granted by ANP</td>
<td>Authorization granted by ANP</td>
</tr>
<tr>
<td>Granting Duration</td>
<td>Variable, Art. 66-A, § 4o limited to 50 (fifty) years, extendable to additional 30 (thirty) years</td>
<td>30 (thirty) years</td>
<td>30 (thirty) years, extendable up to additional 30 (thirty) years</td>
<td>30 (thirty) years, extendable up to additional 30 (thirty) years</td>
</tr>
<tr>
<td>State presence Degree of liberalization</td>
<td>Strong</td>
<td>Strong</td>
<td>Medium</td>
<td>Strong</td>
</tr>
<tr>
<td>Contingency</td>
<td>No regulation</td>
<td>No regulation</td>
<td>No regulation</td>
<td>No regulation</td>
</tr>
<tr>
<td>Import and Export Conditions</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
</tr>
<tr>
<td>Oil &amp; Gas Trading</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
</tr>
<tr>
<td>Oil &amp; Gas Quality</td>
<td>Established by ANP</td>
<td>Established by ANP</td>
<td>Established by ANP</td>
<td>Established by ANP</td>
</tr>
<tr>
<td>Oil &amp; Gas Exploration</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
<td>Authorized by ANP</td>
</tr>
</tbody>
</table>
Campos et al. (2016) presented a subdivision regarding the major ongoing strategies for the expansion of the natural gas industry in Brazil as: to expand the natural gas supply (production in pre-salt layers and of unconventional gas resources) and importation (projects of international pipelines and of regasification infrastructure). Laws n. 12,351 of 2010 and n. 13,365 of 2016 foster these particular aspects.

Also, to expand the network of transport pipelines, based on a stable regulatory framework, which plans PEMAT in compliance with other planning instruments of the national energy sector, such as the PDE (Decennial Plan of Energy Expansion), PNE (National Plan of Energy), and National Zoning of Oil and Gas Resources.

Finally, to encourage the use of natural gas in thermoderectic generation to complement hydroelectric generation and mitigate intermittence related to renewable sources (wind and photovoltaic). In this particular aspect, natural gas-fired utilities present several advantages linked to the quality of the electricity generated such as: reliability, dispatchability, time of answer, and predictability of generation.

The total thermoderectic generation participation in the National Interconnected System (SIN) has increased from 25,210 MW in 2006–42,861 MW in 2017 and NG power plants contributed to about 30% of thermal generation (ONS, 2018).

In this context, ANEEL Resolution n. 583 of 2013 introduced a major asymmetry concerning the penalties for contracted distributors cutting off NG supply to thermoderectic utilities, while using parameters intrinsic to the electricity sector, one of the main concerns targeted by the Gás para Crescer initiative resolutions.6 It employs a linear equation to calculate the penalty amount:

\[
V_{\text{sm}} = \left[ \text{PMED}_{\text{m}} + j \left( \frac{\text{PLD}_{\text{max}} - \text{PMED}_{\text{m}}}{4} \right) \right] \text{ENP}_{\text{m}}
\]

Where, \(V_{\text{sm}}\) corresponds to the sanction value, in month \(m\), in which the NG supply cut off occurred, expressed in US$; \(\text{PMED}_{\text{m}}\) is the average monthly liquidation price of the differences (PLD – spot market price), as publicized by the Chamber of Electric Energy Commerce (CCEE) and expressed in US$/MWh.

The variable \(j\) refers to the number of months in which the natural gas supply cut off has occurred, varying from 1 to a maximum of 4, after which it remains constant. \(\text{PLD}_{\text{max}}\) is the maximum current regulated liquidation price of the differences in US$/MWh, annually homologated by ANEEL. Finally, \(\text{ENP}_{\text{m}}\) which corresponds to the amount of electricity that was not generated due to the lack of fuel for the facility, in MWh.

The daily fine imposed on the natural gas supplier in each month, considering market data for 2017, is demonstrated both in Fig. 5 and Table 4. It is important to notice that \(V_{\text{sm}}\) depends on values and indicators derived from the electricity market.

This implies that the penalty clause not only transfers risks from the electricity market to the NG industry, but also links them to parameters intrinsic to the Free Contract Environment (ACL, Brazilian Acronym), which is subjected to price fluctuation.

In order to soften these effects, the study proposes a change in the way the sanction value is calculated \((V_{\text{sm}}^{*})\), employing more accurate parameters, as the current formula, with an analogous linear format:

\[
V_{\text{sm}}^{*} = \sum_{i=1}^{n} \left[ \text{PLD}_{\text{w}} + j \frac{\text{PLD}_{\text{w}} - \text{PMED}_{\text{m}}}{4} \right] \text{ENP}_{\text{w}}
\]

Where, \(V_{\text{sm}}^{*}\) corresponds to the mitigated sanction value, in month \(m\), expressed in US$; \(\text{PLD}_{\text{w}}\) is the weekly liquidation price of the differences (PLD).8

The coefficient \(w\) for week varies from 1 to a maximum of 5. \(\text{ENP}_{\text{w}}\) corresponds to the amount of electricity that was not generated due to the lack of fuel for the utility, in MWh, in the corresponding week.

The difference between the weekly and the monthly averages are the new proposed parameters, within a module, since its value might occasionally be negative, which would diminish its penalizing effect unintentionally.

The proposed sanction value calculation does not penalize the electricity generator, since it considers more precise parameters, instead of the monthly averages and the \(\text{PLD}_{\text{max}}\). Moreover, it considers the same increasing penalty, through the variable \(j\), for recurrent supply cutoff. Therefore, the contract neutrality of the proposed calculation is ensured.

It also mitigates the influence of averages and the \(\text{PLD}_{\text{max}}\) use, therefore decreasing the sanction value for the NG supplier, when compared to the current formula (see Table 4). The annual decrease of sanctions value would be of –12.13%, when compared to the current ANEEL Resolution n. 583 of 2013 formula, for non-recurrent suppliers.

Thus, the supplier still has to account for the generator’s income losses due to lack of fuel. However, the indemnity is now slightly smaller, and more adhered to the actual prices of differences liquidation of the ACL. Fig. 6 demonstrates the difference between the two calculated daily fines during 2017, for non-recurrent supplier (Table 4).

2.3. Legal aspects of the O&G production chain

When referring to the pre-salt regulation, Article 10th of Law n. 12,351 of 2010 demanded that Petrobras had a mandatory participation in every contracted block of exploration with a minimum share of 30%. Moreover, Article 20th stated that the company had to be the operator of all operational activities related to the production of oil and gas in the blocks contracted under the shared production regime.

This mandatory participation and more restrictive operational rules, made it difficult for the expansion of production sites, especially given the scenario of financial difficulties that Petrobras has been experiencing in the last five years, making it unable to endorse new prospecting and production projects in the pre-salt layer.

The fact is that Petrobras controlled 51% of the shares of its subsidiary Gaspetro, the other 49% belonged to Mitsui, the large Japanese conglomerate.9 This subsidiary detained over 7000 km of gas pipelines in Brazil, through the Transportadora Associada de Gás (TAG) which incorporated all regional natural gas transport subsidiaries in a process of management centralization that began in 2006.

It was later divided into two companies, Nova Transportadora do Sudeste S.A. (NTS) and Nova Transportadora do Nordeste S.A. (NTN), macro segments of distribution in the South and Northeast of the country.

In the second semester of 2016, as part of Petrobras recovery program and its business strategy plan PNG 2017–21, the company announced the sale of 90% of the shares of NTS for the amount of US$ 5.19 billion, the equivalent to 35% of the target of US$ 15.1 billion aimed at the sale plan between 2015 and 2016.10 This operation was

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6 The Gas para Crescer initiative, launched in June 2016 by the federal government, has the objective of studying and elaborating resolutions and proposals to maintain the adequate operation of the gas sector in face of a Petrobras’ participation reduction scenario. It studied several relevant themes concerning regulatory risks, infrastructure, and increase of competition, among others. See more at: http://www.mme.gov.br/web/guest/gas-para-crescer.

7 Positive or negative differences between the electricity that was produced or consumed and the electricity that was contracted are liquidated on the spot market and valued at the liquidation price of the differences (PLD), which is determined weekly by each load level and for each submarket based on the marginal cost of operation of the subsystem. The PLD is limited by minimum and maximum prices. In this market, the price does not conform to the economic relationship between supply and demand of the agents. Rather, it is determined by a set of computational models operated by the ONS and the CCEE.

8 Weekly PLD prices data are available at: www.ccee.org.br/portal/faces/pages_publico/o-que-fazemos/como_ccee_atua/precos.

closed in April 2017 with the Canadian Brookfield Asset Management for the amount of US$ 4.23 billion. These facts are indication that the monopolistic structure of the natural gas industry is beginning to change its core, admitting more players, in pursuit of a more competitive environment, favorable to the entry of additional investment in the market, and to the sharing of infrastructure costs.

In the same direction, the Special Commission for Petrobras and the Pre-salt Exploration of the Chamber of Deputies made the first step to flexibilize these rules. The approved text of Law n. 13,365 of 2016 changed Law n. 12,351 of 2010 configuration, where the presence of Petrobras is no longer mandatory. However, as stated by Article 4th it still has preference to be the operator of blocks to be auctioned under the production share regime. If for any given reason the company chooses to not participate in an eventual auction, Article 2nd indicates that the same rules under the Pre-Salt Act will apply to the other block operator awarded.

Another innovation is contained in Article 4th § 2nd, implying that all choices made by the state company regarding the participation in exploration projects will be submitted to the National Council of Energy Policy (CNPE), which will forward it to the Presidency of the Republic, who pronounces ultimately about which blocks Petrobras participates. This is intended to give room for more investment in the Pre-salt layer development and production, and it is likely to enable the expansion of related infrastructure.

Such changes imply that Petrobras may no longer be the operator of all blocks contracted under shared production regime. It modifies the Article 30th of current Law n. 12,351 of 2010, in a way that the name Petrobras is replaced by the definition "operator of the shared regime contract". Another important issue is that the auction winner, that is awarded the block of exploration in the Round of Bidding, is no longer obligated to constitute a consortium with Petrobras, without such, the awarded operator would find barriers to explore the block, if the state company chose not to participate in the production shared regime.

This legal maneuver was intended to release the state company from

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Table 4
Calculated daily sanction values per month in 2017 for the average natural gas-fired power plant (Source: author elaboration).

<table>
<thead>
<tr>
<th>Month (2017)</th>
<th>PMLDI/SE $/MWh</th>
<th>PLODmax $/MWh</th>
<th>Vsm [$]</th>
<th>V*sm [$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>121.44</td>
<td>533.82</td>
<td>709,499.24</td>
<td>1,274,376.46</td>
</tr>
<tr>
<td>February</td>
<td>128.43</td>
<td>533.82</td>
<td>748,231.83</td>
<td>1,304,130.92</td>
</tr>
<tr>
<td>March</td>
<td>216.24</td>
<td>533.82</td>
<td>1,259,171.46</td>
<td>1,677,913.40</td>
</tr>
<tr>
<td>April</td>
<td>371.47</td>
<td>533.82</td>
<td>2,152,197.00</td>
<td>2,338,683.85</td>
</tr>
<tr>
<td>May</td>
<td>411.49</td>
<td>533.82</td>
<td>2,427,546.40</td>
<td>2,509,037.73</td>
</tr>
<tr>
<td>June</td>
<td>124.70</td>
<td>533.82</td>
<td>766,427.89</td>
<td>1,288,253.36</td>
</tr>
<tr>
<td>July</td>
<td>280.81</td>
<td>533.82</td>
<td>1,625,864.37</td>
<td>1,952,769.73</td>
</tr>
<tr>
<td>August</td>
<td>505.95</td>
<td>533.82</td>
<td>2,896,725.49</td>
<td>2,911,127.39</td>
</tr>
<tr>
<td>September</td>
<td>521.83</td>
<td>533.82</td>
<td>2,997,865.13</td>
<td>2,978,724.08</td>
</tr>
<tr>
<td>October</td>
<td>533.82</td>
<td>533.82</td>
<td>3,029,762.14</td>
<td>3,029,762.14</td>
</tr>
<tr>
<td>November</td>
<td>425.17</td>
<td>533.82</td>
<td>2,507,445.01</td>
<td>2,567,269.65</td>
</tr>
<tr>
<td>December</td>
<td>235.07</td>
<td>533.82</td>
<td>1,365,521.32</td>
<td>1,758,067.41</td>
</tr>
</tbody>
</table>

Fig. 5. Calculated daily sanction value for NG suppliers.

Fig. 6. Comparative calculated daily sanction values (Vsm, V*sm).

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10 More information regarding the purchase process is available at: https://www.ntsbrasil.com/blog/venda-da-nts-petrobras/.
a burden it could no longer carry, since under Law n. 12,351 of 2010 and previous legislation, it was obliged to participate in every block under the production shared regime with a minimum percentage of 30%. Another important aspect is that Petrobras is able to manifest interest to participate in the consortium of a given block.

Specifically referring to the natural gas supply and distribution, the panorama changes a little from the prospected situation in the oil and gas production (Fig. 7). Cordeiro et al. (2012) observed that although many advances were achieved with the new natural gas regulatory framework, mainly after the Gas Act, some aspects of the industry organization which demanded regulatory action where left untouched by the most recent law, while others were treated without the proper regard for isonomy principles.

The first aspect is that no additional limits on vertical relationships of the natural gas chain were established so far. Also, Petrobras corresponds to practically all of the natural gas injected into the transport network in the current market structure. Moreover, until recently, it had relevant shares on other links of the chain, so this vertical integration yields considerable market power to the mixed capital state company.

According to Schoots et al. (2011), “The ability to value flexibility and identify bottlenecks in the system is also of importance due to the large value created by the production of natural gas”. Consequently, when compared to the most usual global gas model, the Brazilian market is still strongly monopolistic. Producers and traders in Fig. 7 generalization could be the most usual global gas model, the Brazilian market is still strongly monopolistic. Producers and traders in Fig. 7 generalization could be subject to the presence of a major company throughout the entire chain, up to the city gates in the States. There local companies are in charge of distribution to the end-consumer.

In this context, the recent disinvestment program that includes the sales of many assets and downsizing of activities began an inevitable process of change in this market structure. This is due to the fact that the Brazilian government can no longer afford to be the primary driver of infrastructure expenditure.

Colomer Ferraro and Hallack (2012) observed that in less developed NG markets, such as the Brazilian case, the reduced level of competition in the production and trading of the commodity creates obstacles to the entry of new players in the industry. In the natural gas industry, infrastructure investment analysis is crucial due to the large costs associated to construction, compression, and other infrastructure elements.

It is evident that such strong presence of a monopolistic position in the transport link leads to significant barriers to the entry of new shippers, willing to compete in the supply market. The concession granting system reforms were intended to diminish access barriers, but it is going to be a while until a new set of pipelines is developed without Petrobras' former subsidiaries taking relevant part into the process, unless some proactive legislation reform is undertaken.

This is more prominent since the company actually does not possess the necessary available capital to successfully develop the remaining of national pipeline infrastructure, required to satisfactorily deliver the natural gas produced at the pre-salt basins to their final destinations. The purchase of NTS's shares by another international conglomerate, as happened with Gaspetro, indicates that major investment groups are aware of the current status of the Brazilian natural gas supply chain.

3. Regulatory framework of the natural gas industry in Argentina

In 2014, Argentina was the largest dry gas producer and the fourth largest oil and derivatives producer in South America, being an interesting case study of successful and failed attempts to integrate its gas network, including from a transnational point of view with Chile.

The natural gas consumption in Argentina for the past five years is depicted in Fig. 8, also approximately eight million consumers are connected to the gas distribution grids (MEM, 2016).

Natural gas consumption is broadly disseminated in Argentina, which has the most comprehensive network of transportation and distribution pipelines in Latin America. It constitutes of around 15,984 km in pipeline for transportation and of 146,506 km destined to distribution (ENARGAS, 2016). It is also expected that NG will gradually increase its market share and replace substantial amounts of liquid fuels, such as fuel oil, resulting in better overall performance of thermo-electric utilities (MEM, 2016).

The gas sector in Argentina is assumed to be more mature than the one in Brazil and has undergone profound changes as a result of regulatory and structural reforms launched by the end of the 1980s. Recent regulatory changes are related to giving absolute priority to domestic supply of gas at stable prices in order to sustain economic recovery.

Such reforms were part of an overall program of economic restructuring, aiming at improving economic efficiency and increasing investment through the liberalization of the market and the involvement of more private capital (IEA, 1999), as has been occurring in the last five years in Brazil.

The design of the legal reforms in the 1980s and the 1990s was inspired heavily on experiences and lessons learnt from other countries, notably Canada, the United States, and the United Kingdom. At the core of these reforms, were the privatization of the downstream gas company, Gas del Estado (GdE), and the upstream oil and gas company, Yacimientos Petrolíferos Fiscales (YPF), with the division of GdE into two transmission companies and eight distribution companies.

Moreover, the removal of wellhead and wholesale price controls and the establishment of an open-access regime to the distribution, along with the creation of an independent regulatory authority, called Ente Nacional Regulador del Gas (ENARGAS), were some of the major changes in the natural gas market to achieve better efficiency.

These measures have demonstrated to be reasonably successful to foster competition throughout the gas supply chain. This was one of the main objectives of Law n. 24,076 of 1992, the Natural Gas Act. However, despite the removal of exclusive rights prior to privatization, YPF still remained as the dominant producer and supplier of gas to the Argentinian market (IEA, 1999), as happens to Petrobras in Brazil.

After the economic crisis that struck Argentina in 2001, legislation and regulations, including the Economic Emergency Act n. 25,561, were enacted, limiting the 1990s regime and imposing additional government controls over prices and use of natural gas.
Further on, under the establishment of Law n. 26,197 of 2007, differently from what occurs in Brazil where concession is centralized by the federal government, the Argentinian provinces assumed the ownership and administration of the hydrocarbon deposits within their boundaries. Hence, receiving the right to grant concessions on inland exploration blocks. Regarding offshore reserves, they were divided between provinces and the federal government (IEA, 1999).

The reduced infrastructure limiting the natural gas market development outside of Argentina is derived largely from past policies in the region, as in Brazil, which strongly encouraged energy self-sufficiency and the development of state-owned O&G monopolies.

As well observed by (IEA, 1999), with the advent of more open, market-oriented policies, in particular the encouragement of private sector investment and reduction of governmental price controls, interest in expanding the use of natural gas in Argentina’s neighbors has increased accordingly.

This has been more evident in the last decade, with the construction of new transnational pipelines, especially involving Brazil, Argentina, Bolivia, and Chile.

Concerning this matter, Renou-maissant (2012) discussed the recent regulatory changes undergone in European countries energy policies and how they targeted a single European gas market. The objective of deregulating energy markets was to offer real choice to all consumers in the EU, by creating new business opportunities and enlarging cross-border trade, in order to increase the efficiency and competitiveness of the EU energy sector. Moreover, there is indication of strong integration of natural gas markets in continental Europe, except for Belgium, being the process more successful between Italy and France.

Bondorevsky and Petrecolla (2001) observed that the Article 33th of the Natural Gas Act in Argentina established a separation between gas transportation and distribution systems. The idea of building a high capacity pipeline that would connect the macro region the consumer is situated.

Another important issue was the one contained in Article 26th of Law n. 24,076 of 1992, which stated that carriers and distributors were obligated to permit indiscriminate access of third parties to any transportation and distribution utility of their respective transportation systems.

Such legal commandment implies the freedom of consumers to choose a trader of their willing, something that does not occur analogously in the Brazilian market, where consumers are obligated to purchase from the company that detains the concession in each State, in each specific macro region the consumer is situated.

In the 2000s, these market friendly reforms, introduced by President Menem’s Administration in the 1990s, were somehow put aside and strong government controls began. In 2001, Argentina went through one of the most turbulent economic crises in its history, when the fixed exchange rate convertibility system that had supported the Argentinian Peso to the U.S. Dollar since 1991 ended abruptly. This caused major depreciation of about 70% of its relative value, forcing the government to adopt extensive austerity measures.

Due to the deteriorating fiscal and energy situation, the Argentinian government was forced to loosen some of the restrictions to make the hydrocarbons sector once more attractive to private investors. It happened through two Decrees aiming at investment promotion and capital goods, since export controls were relaxed and attractive wellhead gas price incentives were adopted.

Vásquez (2016) emphasized that during the twelve years of the Kirchner-Fernández administrations, the ENARGAS was relegated to a secondary role, while a new government department was created in 2012. The Commission for Strategic Planning and Coordination of the National Hydrocarbons Investment Plan, the enforcement authority of the so-called "Régimen de Promoción de Inversión", was created to regulate hydrocarbons investments, with functions that overlapped and sometimes exceeded those of other agencies that the two administrations sought to supplant.

The government of President Macri, whose office started in 2016, has begun with the goal to correct some of the economic and political problems inherited from the previous governments and one of its first measures was the prompt dismantling of the controversial Commission mentioned above (La Nación, 2016). It is evident that Argentina is also struggling with regulatory issues to pursue regional energy integration and natural gas market expansion.

4. Infrastructure assessment and energy integration in Mercosul

The most important debates of the new millennium are focused on globalization and sustainable development for nations. Therefore, transnational energy integration in Latin America has been receiving increasingly attention from researchers and policy makers (BID, 2001; OEA, 2015). The 2018 G20 Summit meeting of energy ministers considered the investment in infrastructure as essential and emphasized the importance of diversification of energy sources, suppliers, and routes.

Also, it was reinforced the need to stimulate the continued and increasing public and private investment to ensure sustainable, affordable, reliable, resilient, and cleaner energy systems (G20, 2018). This is particularly relevant to the natural gas sector, because in this kind of market the costs associated to contractual reestablishments or changes are substantially high, especially in infrastructure.

Nowadays, most of the gas pipeline infrastructure in the Mercosul region is distributed along the South; from Bolivia departs four major pipelines that target exportation, two to Argentina (Rámos – Bermejo and Campo Durán – Madrejones) and two to Brazil (Bolívia – Brasil, or GASBOL and Lateral Cuiabá). There are just a few modern projects in actual construction (See Figs. 2 and 3).

The idea of building a high capacity pipeline that would connect Venezuela’s production fields to Brazil and Argentina, that arose in the midst of the 29th Mercosul Summit in 2005, has not gone much further than the Memorandum of Understanding signed at the occasion (Mercosul, 2005). It seems even less likely to occur in the mid-term with the recent suspension of Venezuela, officially announced in the beginning of December 2016, and the deepening of its economic and political crisis in 2017.

In this particular matter, the only instrument signed by state parties of Mercosul was MERCOSUL/CMC/DEC N’ 10/99, a Memorandum of Understanding concerning gas exchange and gas integration between its members (Mercosul, 1999). As part of such agreement, the countries agreed to “develop a competitive gas supply market in the short and long term, by offering to the agents of supply and demand of the sector in each state party, conditions of nondiscriminatory treatment and the possibility of access to the market of the region.”

Moreover, the memorandum specified that open access to remaining capacity of transportation and distribution facilities must be respected, including access to international interconnections and that companies would not discriminate on the basis of nationality or destination of natural gas supply, respecting regulated usage rates and contracts, and ensuring that prices and fees would include all the associated costs, particularly environmental and social.

It moved on to establish protection against monopolistic practices and abuse of a dominant position for all users of natural gas, to ensure that the same mistakes made during the experience between Bolivia, Argentina, and Brazil were not committed again. In the mentioned experience, two companies, YPF and Petrobras, either prevented or
obstructed the participation of rival companies in forming a competitive natural gas market. Despite the intended reforms, the memorandum remains as a theoretical guideline not being observed.

It is widely recognized that the costs associated to the development of pipeline infrastructure are several and relatively high. Colomer and Hallack (2012) observed that this is related to the fact that natural gas pipelines consist of a series of ducts, valves and stationary compression stations that cannot be redeployed for other purposes easily, at least not without elevated costs with decommissioning the network.

However, the gradual expansion of Mercosul members’ network, with the increase of hubs and interconnections, would make the access to other sites far easier, enabling more potential consumers to connect to the network, as happens analogously to electricity grids at the national levels.

Such development would bring more efficiency and better economical allocation of the resources in the region. Hence, energy integration along with the comparative advantages of each country would ultimately result in better market conditions, such as natural gas price and availability.

In this context, the Protocol of Montevideo on Trade in Services entered into force in 2005, following the diplomatic rounds of negotiation in Mercosul, providing a regulatory framework for trade in services inside the economic block, demonstrating that the traditional focus on the trade of goods has been shifting towards creating a more competitive environment.

The Protocol compelled each state party to participate in a program of liberalization based on rounds of negotiations of specific commitments on market access. Additionally, the Mercosul Trade Committee must be updated on each member regulatory changes that may affect significantly trade in services.

The fact is that the recent changes in the O&G regulation in Brazil and Argentina, as well as the latest tendencies of multilateral dialogue in Mercosul, signalize that the regulatory framework is moving towards a higher degree of liberalization and mutual cooperation, although at a slight pace.

5. Conclusion and policy implications

Taking into account the concept of energy justice, in face of the economic policy perspective, policy makers should consider the urgency that is inherent to GHG mitigation efforts, especially considering the recent international pressure to maintain average global temperatures within 1.5 °C of the pre-industrial era average (Masson-Delmotte et al., 2018).

Under these circumstances, natural gas can play a major role in the transition process to a low carbon electricity matrix in Brazil, through the gradual deactivation of fuel oil and coal-fired thermal power stations, and their consequent replacement for gas-fired utilities. This process would be aligned with the energy law principles of energy security and reliability, as well as the protection of the environment, human health, and combatting climate change, being part of a just transition context.

Imbued with the challenge of the ‘energy trilemma’, which is balancing mutually competitive aims of energy security, environmental sustainability, and energy equity (Heffron and Mccauley, 2017), there is the need to improve natural gas current legislation in Brazil to permit advances towards a low-emission energy system, through the expansion of natural gas infrastructure, increasing network capillarity and reach.

Despite the achievements and further development of the Brazilian regulatory framework, designed to promote a better integration of the gas network, the actual system integration has been minor so far. Further modifications in regulation and adequate policy are required from the government to attract investment and expand pipeline infrastructure.

Although recent changes in both Brazilian and Argentinian regulations have been thought to further liberalize the O&G industry, in order to promote a more competitive environment, so far they have not succeeded completely in changing the core of the market structure. This is more prominent given the fact that the existing monopolistic structure does not contribute to the expansion of the pipeline network and gas production.

The analysis of the latest regulatory changes and reforms occurred in Argentina and the US permit some recommendations for the Brazilian case, as to further increase the liberalization of the market, since the lack of power of investment by Petrobras will make it difficult to the company, which faces a deep and thorough recovery program, to develop natural gas pipeline infrastructure alone.

The current separation of natural gas production from transportation is just a legal aspect, since no legal restriction is made on market agents’ cross holding of a transportation company. Thus, one important measure would be the effective separation of production from other activities such as trading, transportation, and distribution. If implemented, it is very likely to have a positive impact on the development of market competition, in every segment of the industry, since it would prevent the creation of market barriers to the access of new producers and traders.

It is also necessary to create or modify regulatory structures that would ultimately reduce the overall risk of deploying natural gas transportation infrastructure, since it is not easily redeployed. This would encourage the entry of new carriers. Some potential carriers are those other producers, importers, and local distribution companies, which nowadays do not have many incentives to manifest their willingness to transporting natural gas.

The reduced capillarity of transportation and distribution networks continues to be one of the major drawbacks for the expansion of the natural gas market in South America, among with other significant weaknesses related to short-term supply conditions. This is more important since the status quo of energy integration in South America faces uncertainty because of recurrent concerns about security of supply from Bolivia.

Law n. 13,365 of 2016 encourages additional suppliers by decreasing some producer entry barriers. This process could be complemented through incentives for producers to negotiate sales independently, and encouraging new supply sources and alternative logistic routes. In this context, market indicators will show if the rules for indiscriminate access of third parties to any transportation pipeline in Brazil, as established by ANP Resolution n. 11 of 2016, are likely to stimulate market agents to sell their natural gas supply directly to distributors or large customers.

The study proposed another calculation method for sanctions imposed on suppliers due to the lack of gas for thermoelectric utilities. The new formula was thought to mitigate the influence of electricity market parameters, decreasing the sanction value on the NG supplier when compared to the current calculation prescribed by ANEEL Resolution n. 583 of 2013, without compromising the contractual neutrality. The comparative calculated annual decrease of the daily sanction value was of = 12.13% for non-recurrent suppliers. This implicates a relevant improvement, especially considering all the controversy concerning the current formula’s fairness.

The regulatory framework analysis indicates that further strategic planning and investment, as well as adequate policy changes are required from the market and governmental agencies, in order to ensure a long-term energy policy aimed at the sustainable development of the natural gas industry in Brazil. This process is aligned with a transition towards a lower emission energy system and should consider the expansion of energy integration in Mercosul, focusing on the use of its members’ comparative advantages.

Despite the fact that the multilateral agenda in Mercosul included indeed some discussions concerning energy integration, especially in the last two decades, there is the need to establish more defined roles for each state party. Also, following the example of the electricity
sector, there is the prominent need to expand infrastructure, financed most likely through tariffs and usage charges, and to incorporate open market rules into future legislation.

It is patent that policy makers have to deal with these regulatory and structural problems pragmatically. By observing the experience of other economies, one can encounter points of conversion between them, making this sampling process a fertile ground for alternatives, bearing in mind that each economy has its own particular dynamic. Ultimately, energy law principles should act as guidance throughout this process, especially when attempting to balance the conflicting interests of the energy trilemma.

Nowadays, the environmental concerns surrounding climate change demand a look beyond the ordinary cost and efficiency analysis. The exchange occurred between energy and the environment must be dealt with through an energy justice perspective. In this sense, natural gas poses as a means, along with complementary renewables, to support a sustainable energy matrix.

References


