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INTEGRATION and electrical SECURITY in Latin America

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Integration and Electric Energy Security in Latin America

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Presentation EKLA-KAS

Dr. Christian Hübner[1]

Freedom, justice and solidarity are the basic principles underlying the work of the **Konrad Adenauer Foundation**. The KAS is a political foundation, linked to the Christian Democratic Union of Germany (CDU). With more than 80 offices abroad and projects in over 120 countries, our goal is to make a unique contribution to the promotion of democracy, the rule of law and a social market economy. To foster peace and freedom we encourage a continuous dialog at the national and international levels as well as the exchange between cultures and religions.

Alongside the country-specific programmes provided by the KAS country offices in Latin America, there are cross-border regional programmes with distinct thematic focuses. One of these is the **Regional Programme of Energy, Security and Climate Change in Latin America (EKLA)** which has its headquarters in Lima, Peru. The regional programme EKLA has been designed as a dialogue platform, in order to provide impetus for political decision-making processes. The programme understands itself as a consultative centre for the coordination of the individual KAS country projects on Latin America ,supporting these projects with its network and expertise on the subject. Assuming the role of an initiator and consultant, it aims at complementing the country programmes activities by means of regional networks and the provision of know-how, thus, enhancing their impact. The programme organizes events on the regional level where experts and participants from the Latin American countries have the opportunity to exchange ideas.

The global economy and society faces enormous ecological challenges. There is a need to react to climate change and the shortage of resources, as well as to the growing demand for energy, especially in emerging countries. Over the past years KAS has already embraced these issues, however, the enormous importance and the urgency of reacting to these demands led to the establishment of EKLA-KAS, which is able to focus on these subjects. The Latin American region is ideal for the implemen-

1 Head of EKLA-KAS

tation of environmental projects due to the great availability of green energy sources such as sun, water, geothermal energy, wind, and biomass. Exploring and developing this potential will help Latin America to satisfy its growing energy demand. In order to exploit the full ecologic potential of the continent, it is necessary to understand the current state of environmental policies in Latin America. Hence, the KAS supports this study, organized in cooperation with our partner, the **Electricity Sector Research Group (GESEL, in its Portuguese acronym) of the Institute of Economics of the Federal University of Rio de Janeiro (IE/UFRJ)**, aiming to facilitate the access to information. A better understanding of the peculiarities of the **Integration and Electrical Security in Latin America** opens up a whole new range of opportunities for cooperation and exchange of best practices. Within the framework of this project, an international seminar took place in Rio de Janeiro, Brazil, in which energy experts, politicians and businessmen from different countries could share experiences and opinions.

It is our understanding that a paradox lies behind the energy crisis the world is currently undergoing. On the one hand, greater energy supply is required to ensure continuous economic growth and social development on a global scale; yet, on the other hand, it is imperative to reduce greenhouse gases emission so as to mitigate their impact on global warming. Overcoming this dilemma requires a new global energy model, which in turn calls for a new emphasis on greater use of renewable and non-polluting energy sources. This will be a drawn out and costly process, requiring all countries to acknowledge their profound interdependence. Such a collective commitment will ensure the necessary financial resources to bring on stream the required projects. Even more important, this new understanding will enable the synergy required for meaningful scientific exchange and research on energy policies and planning in line with this new paradigm.

We hope that this book aids the process of further increasing electrical integration in the region, based on renewable sources. It is believed that this is a strategy that will bring security for the transition to a low-carbon energy mix, allowing mitigating climate change while promoting sustainable social and economic development. The main goal is to offer subsidies and proposals for the authorities responsible for energy policy and for the members of the legislative branch to formulate and implement public policies for the integration and electrical security in Latin America. We

would like to thank GESEL for the partnership in the composition of this document, as well as all the researchers and authors who contributed to this publication. We wish you all a pleasant reading!

Foreword

Brazilian electric sector institutional model allows for the development of projects related to binational hydro plants, and also treats the issue of energy imports and exports through interregional connections. We already have some successful examples, as in the case of Itaipu hydro plant, and the electric interconnections with Argentina, Uruguay and Venezuela. On the other hand, a great effort will have to be made in order to take full advantage of Latin Americas hydroelectric potential, as well as to enable firm energy interchange among the countries. This would provide benefits to consumers of the countries involved in the projects that would be developed.

The book addresses many alternatives created and the responsible institutions, with special attention to the legal, regulatory, technical and commercial aspects which should be considered. In addition this work also suggests the referrals necessary to turn binational hydro plants enterprises possible, as well as the achievement of energy exchange between neighboring countries, with special emphasis to those projects in which Brazil would be involved in.

However, I consider that regulatory, commercial and technical obstacles might be overcame, due to the different institutional frameworks of each country's power sector, which essentially, should be preserved.

Therefore, I have no doubts about the need of gradually developing the energy integration between the countries, taking advantage of the opportunities of already existing interconnections, initially developing exchange arrangements which respect the autonomy of each country, sharing benefits, in the sense of achieving a mutual trust climate, and then evolving towards full markets integration. All this done, through the definition of a set of rules and regulatory, technical and economical procedures, which have to be consolidated in documents in the response of the countries governments, for the process to be sustainable.

Hermes Chipp
Ex – Coordinator of ONS

Introduction

The theme Integration and Electric Security has been gaining strategic dimension in the international scenario, due to the concrete and successful experience of the European Union. The European experience is indicating the importance of building a common political basis, as it encourages many countries to accept collaboration and the electric integration. Since electricity is an essential good and input for the production of goods and services, in addition to guaranteeing the social well-being of families, only trust based on consistent policy can give the guarantees that countries need, to assume the inherent risk to energy security.

Having the political and diplomatic security of electricity supply between the countries, the integration allows for a quite important win-win process. From an economic perspective, there are great benefits directly associated to the possibilities of better exploiting energy resources, given the economic, climate, spatial and time differences and asymmetries. These are measurable benefits, allowing to calculate the gains for all the countries involved in the process, besides, of course, to stimulate and maximize the greater integration, that is the economic one.

Latin America already has very relevant experiences on electric integration, as it is the emblematic case of building, during the 70s and 80s, the biggest hydro plant in the world – Itaipu – facing challenges of all kind, particularly, the economic crisis which affected both countries. Nowadays Itaipu is a great example of success, for having allowed the generation of foreign exchange for the economic and social development of Paraguay and, on the other hand, enabled Brazil to have one of the most renewables electric matrixes of the world. This example must be a paradigm for new binational hydro plants projects, as it is the case of Rio Madeira project, between Brazil and Bolivia, and also Argentina and Brazil.

Considering these assumptions, KAS - Konrad Adenauer Stiftung – and GESEL – UFRJ Power Sector Research Group –held an important international workshop, on 25 and 26 August 2016, at the Economics Institute of UFRJ, aggregating experts from different countries, institutions and academic backgrounds, to analyze and examine distinct aspects related to the integration process and electrical security.

The most concrete result of the international workshop is materialized in this publication, composed of articles prepared by the participants of the event, systematizing and consolidating, in part, a mass of critical knowledge that was produced in the academic space of UFRJ. There are 8 articles written by 12 authors, turning this set of articles a reference work for scholars, policy makers and undergraduate and graduate students.

KAS and GESEL-UFRJ held this important initiative with the main goal of offering technical, economic and diplomatic knowledge about the electric integration process, in order to give consistent subsidies so that policy decisions can be made based on solid and consistent fundamentals.

Nivalde José de Castro
GESEL-UFRJ Coordinator

Itaipu Dam's Legacy
Inspiration for the Future

Marcel Biato[1]

1. Introduction

More than 40 years have passed since the Itaipu Treaty was signed[2] and 30 since the dam's first turbine came on stream.[3] The controversies surrounding the original project and, later, its execution, have largely faded. In contrast, the dam's unquestionable merits live on. In full operation since 1996, the Itaipu Dam has played a crucial role in ensuring a safe, cost-effective and sustainable power supply for both Brazil and Paraguay growing energy needs. Today, it generates 11% of Brazil's total electric power. It awes the world with its scale, rivalling China's Three Gorges Dam for the title of the world's largest electric power generator. Additionally, the Itaipu Treaty and the consortium that it established between the two countries offer a model of successful energy integration that is particularly relevant at a time when South America has taken up the challenge of accelerating regional integration.

The world has changed dramatically since the Treaty was signed in 1973. Our planet has become more volatile, fraught with increasing political and financial instability. More unpredictably still, it has begun to suffer the effects of major climate change and rising volatility in the global commodities and energy markets. As a result, the traditional economic fundamentals driving global growth are being brought into question. Most significant of all, the world has become more democratic, nowhere more so than in Latin America. Public opinion has become an actor in its own right and, thanks to contemporary social media, has become a powerful echoing chamber for the views and demands of previously silent segments of society.

1 1 Advisor on International Affairs to the President's Office (2003-2010) and Brazilian Ambassador to Bolivia (2010-2013). Researcher on Latin American, global governance, and military affairs; member of the Brazilian negotiation team during the Ecuador-Peru Peace Process (1995-1998).

2 April 26, 1973.

3 May 5, 1984.

In the midst of such profound sometimes radical change, the achievements associated with the construction of the Itaipu Dam continue to reverberate and inspire. Its legacy will go far beyond 2023, when the Treaty expires and the dam's construction will have been fully paid off. By generating vast amounts of clean, sustainable energy for many decades to come, the Itaipu Dam will not only help ensure the prosperity of Brazilians and Paraguayans; it will continue to provide a benchmark by which future hydroelectric power projects and their role in driving regional development and integration will be measured.

Accelerated economic growth over the last decade had boosted energy consumption exponentially in the region[4] and, as a consequence, endeavours to seek out new, more sustainable power generation sources. The 2001 power outage in Brazil underscored the risks of working too close to the operational margin in matters of energy production. The need for such a prudential policy was reinforced by signs of changes in global weather patterns, leading to an increase in extreme weather events, such as the drawn-out drought that hit much of Brazil in 2013-15. That regional energy integration is an efficient way to better husband and rationalise an increasingly valuable resource has been clear for a long time. Proof of this are the achievements of two landmark initiatives of the past. One is the Brazil-Bolivia Gas Agreement,[5] by which Brazil imports a natural resource allowing it to diversify its energy portfolio, why generating scare income for Bolivia to finance its development. The other is precisely the Itaipu Dam, which allows Brazil and Paraguay to jointly and rationally exploit a shared resource. The success of both agreements helps explain the launching of IIRSA[6] in the year 2000. IIRSA set up an inventory of varied infrastructure projects critical to fostering a truly integrated economic space in South America by reducing costs and maximizing synergies. It was expected that large-scale infra-structure projects, such as those agreed between Brazil and its two neighbours, would undergird long-held hopes for regional energy integration.

Though later incorporated into the UNASUL framework[7], this concept has been slow to be put into practice. If the Gas Agreement and the Itaipu

4 On average, an annual 4% rise is expected.

5 The Gas Agreement, signed in 1996, came into effect in 1999.

6 The South American Regional Integration Initiative was launched during the 1st Summit of South American Presidents, August 2000.

7 UNASUL incorporated IIRSA as one of its technical fora.

Treaty were so successful, why has their example not been replicated more often? It has certainly not been for a lack of funding and proposals, some of which were extremely ambitious, such as the imagined South Gas Pipeline, inspired by Venezuela. In fact, the teething problems suffered by many projects cannot be disassociated from a progressive slowing in political momentum throughout South America as enthusiasm for the integration agenda has ebbed in recent years. The regional economic downturn helps explain the drying up of funds and viable projects, but it really points to a mores structural issue: the fundamental lack of region-wide convergence on basic macro and microeconomic policies[8]. Unsurprisingly, the proposed Bank of the South has yet to be set up.[9]

But just as important, the energy integration agenda has encountered novel challenges, in particular in dealing satisfactory with the major social and environmental impacts resulting from large-scale infra-structure projects.

2. The Binational Itaipu Dam: a paradigm renewed

Although a half century old, the Itaipu experience can still be surprisingly fresh in the insights it provides. Its institutional design has survived the test of time with flying colours by successfully adapting over the years to the changing demands of contemporary society and to a ever challenging economic environment (Oxilia, 2009).

2.1 Giving priority to hydroelectricity

To begin with, the Itaipu Dam exemplifies, as no other project, the unequivocal benefits of investing in hydropower. Although new alternatives have arisen, including wind energy, solar energy, and biomass, hydro-generated electricity still offers a highly attractive source of clean, cost-effective and sustainable energy.

8 A good example is the collapse of Vaca Muerta project, set to explore a vast shale gas field in Argentina. The project was abandoned by Camargo Correa when investments costs quickly rose to over US$10 billion because, among other things, of the overvalued Argentinean peso.

9 The Bank was expected to provide soft loans for infrastructure investments and social programs, in contrast to the stringent funding policy of the International Monetary Fund and World Bank.

Of fundamental importance is the fact that it provides a renewable, yet constant, source of energy. Renewable alternatives, such as solar and wind, in addition to still being relatively expensive, are intermittent sources, given their dependence on highly fluctuating climactic conditions. The other main source of constant energy, thermal generation, is highly pollutant and relatively expensive.

Given the attractive nature of hydropower, it must be asked whether it makes sense for countries such as Brazil to embark on a model of hydro-generation based solely on run-of-river power plants. Because it significantly reduces the need for flooding and its associated socio-environmental side effects, this option has gained ground in recent years as an alternative to hydro plants with large reservoirs. This trend has been further reinforced by the fact the remaining hydropower potential in Brazil is largely concentrated in the Amazon basin, which offers an adverse flooded area/power generation ratio. Be this as it may, it must be recalled that the reduced storage capacity of run-of-river plants is not without its downside. In fact, this limitation aggravated the effects of the drought produced by exceptionally low rainfall levels over recent years and, consequently, the risk of power outages. Although seasonal drought events cannot be directly linked to climate changes, it cannot be ruled out that climate change is significantly altering hydrologic trends in Brazil and throughout the South American continent.

For all these reasons, it would appear prudent to reassess the cost-effectiveness of putting a total ban on new hydropower plants with reservoirs. This matter is especially relevant to Brazil, which generates more than two thirds of its electricity from hydropower. But it is also important to other countries sharing the upper Amazon basin, where the continent's and the world's largest hydropower potential is to be found. The importance of reservoirs is measured not only by the fact they are more technically reliable and less expensive to run than thermal power plants, but also because they offer energy generation guarantee and stability (Biato; Castro, 2011). The 2013/15 energy scare in Brazil threatened the country's then depressed economy and could jeopardise future growth. Energy shortage not only reduces productive activity, but also slashes future investments required for economic recovery, with highly onerous economic, social and environmental consequences. In weighing the pros and cons of alternative hydropower models, the wider benefits accruing to the entire social and economic hinterland of an artificial reservoir, such as can be seen in the Itaipu example, should not be overlooked.

Another advantage of hydroelectricity is the fact that its price is determined almost exclusively by domestic factors. In contrast, traditional sources of thermal power that are fuelled by oil and gas have their prices set by the notoriously volatile international market. Additionally, the "commoditification" of international petroleum prices and, progressively, of liquefied natural gas, LNG, has produced much speculative market uncertainty, making it difficult for countries to draw up adequate long term energy policy. As recently seen, major world producers such as Saudi Arabia will not hesitate to force down international oil prices if they consider it strategically desirable. They show minimal concern for potential harm to competitors, including Brazil, whose exploration of its "pre-salt" reserves has under question given the dramatic tumble in global oil prices.

2.2 Sustainability

One critical component in this debate about the role of hydropower in Brazil's future energy mix is heightened public awareness about the importance of environmental preservation, and the rights and prerogatives of local, especially indigenous, communities. In the past, poorly conceived and executed works, such as the notorious Balbina dam, have encouraged highly negative public perceptions of hydropower plants. Especially when extensive flooding is involved, dams are presented as a major threat to tropical biodiversity and its pharmacological and industrial uses. The risk is that resistance to large-scale projects will continue to grow precisely at a time when the hydropower generation potential outside of the Amazon region is close to exhaustion.

The Itaipu experiment offers valuable lessons on how to address the very real concerns about the social and environmental impacts associated with the imperative of increasing the availability of energy for economic development. At a time when environmental concerns were still minimal,[10] the Itaipu dam was already a model of power generation that fostered environmental protection. It provided more than a preservationist agenda, e.g. dramatically rescuing flora and fauna in newly flooded areas, local biodiversity studies, and environmental protection awareness initiatives. Itaipu created a truly sustai-

10 The Itaipu Treaty was signed just a year after the United Nations Conference on the Human Environment (Stockholm Conference), in 1972, where environmental protection for the first time was the object of an international conference.

nable management system that became an international benchmark. It combined well-tried technologies with a time-tested financial model.

One of its most notable innovations was to involve the local population from the start in dealing with the social and economic consequence of the creation of the Itaipu lake. Rather than simply compensate landowners and tenants for their flooded lands, these communities were trained to best exploit the new possibilities emerging in the fishing, tourist and agriculture industries. Above all, they were encouraged to organise in cooperative initiatives, for which Itaipu helped provide training and financing. Given its success, those benefiting were not just those populations relocated as a result of the flooding, but poor households and communities living within the wide swath of Itaipu's hinterland.

This experience was replicates in subsequent projects, though not always successfully. In the case of the BR-163 highway, the lack of private investment limited the benefits of opening up this new transportation route, while at the same time highlighting the risks of uncontrolled and unplanned land settlement. In an effort to maximise the synergy between public and private interests, recent large infrastructure undertakings in Brazil are developing new models of social governance.

This implies advance planning at different levels. On one level, it simply means better coordinating the different execution phases so as to avoid, for example, delays in issuing environmental licences that leads to construction work being held up and almost inevitably higher overhead costs. At another level, it means winning over, from the outset, the support of local communities, which are increasingly aware of potential risks posed by these large-scale projects to their livelihood and way of life. More important than simply engaging them through awareness campaigns, it is critical that the local communities be able to see up front the benefits to accrue from collaborating with the project. Otherwise they will be tempted to judge it only on the basis of the adverse social dislocation and environmental upheaval that is inevitably associated with large scale infrastructure works. When the potential benefits are made real, even before construction works starts, the risk of local conflict and resistance is starkly reduced.

The importance of such a preventive and strategic approach is reflected in the lessons learnt from infrastructure projects recently carried out in Brazil. They are no longer seen as stand-alone works, whose adverse local impacts

must be disguised or attenuated, but rather as "anchors" of wider integrated projects targeting the sustainable development of a given area. In the case of Belo Monte, in answer to mounting criticism of its expected impacts, its planning and construction model has evolved so that today it is no longer conceived as essentially a power plant. Rather is seen as an integral part of and the driving force behind the larger Xingu Local Sustainable Development Plan (PDRSX), for which it will provide energy and water resources.

3. Challenges to regional integration

If Latin America is to prosper under globalisation, improving production efficiency and technological competitiveness in global markets is critical. And this requires that local economic activity be integrated as much as possible into supra-nacional and transcontinental production chains. Unfortunately, even integration-geared support initiatives at the more compact South American level, such as Mercosul and UNASUL, have not shown themselves able to provide the economic and political institutional support to make this happen: regional infrastructure integration continues to be inadequate, including in energy. Major obstacles remain to consolidating an integrated continental-scale economic space capable of building on South America's well-known strengths: relative cultural and linguistic unity, lack of ethnic and religious conflicts, the world's largest disposable amount of farming land, and great availability and diversity of natural resources. Boasting vast amounts of water, sunlight, and energy resources, the region is well placed to become a global energy cluster (Castro; Rosental and Gomes, 2009).

The disappointing results of regional integration efforts in general over the last 50 years - ALALC, ALADI, the Andean Pact, Mercosur and, most recently, ALBA and CELAC – underscore the region's collective failures to overcome local differences, as well as a penchant to self-victimisation and other ideological excuses. Historical, social and economic factors directly associated with the relative underdevelopment of the region further enhance this trend. Regional integration in Latin America is still ofteh seen through 19th century lenses, when it was seen as in instrument for concerted action to repulse foreign threats. Even today, rather than being conceived as a motor of a common economic space, regional integration is still understood in terms

of fending off existential threats from overseas. The different sized railway gauges that traditionally held back the enemy at the border are largely gone, only to be replaced by a restrictive, defensive mentality that exalts economic autarky thereby effectively restricting regional trade. Additionally, the lack of agreement on the fundamentals of economic policies echoes underlying ideological divergences, as well as a continued reluctance to harmonise norms and standards between countries that fear ceding any degree of national sovereignty. Given this atavistic resistance to develop their abundant natural resources cooperatively, Latin America continues to be plagued by the consequences of the ineffective distribution and use of its resources: persistent poverty, economic vulnerability, power outages, etc.

Under the UNASUL umbrella, in the mid 2000's Brazil sought to draw up an innovative integration agenda under Brazilian political and economic leadership. In many ways, the electric power sector provides the ideal example of how Brazil can play a strategic role on the road to regional integration. In addition to Brazil's geographical location, sharing as it does a common border with 10 of its South American neighbours, the scale and sophistication of its electric power grid, within a solid institutional and economic framework providing for effective financing, offers a useful model for regional electric integration (Castro, 2010).

At the same time, a powerful countervailing force leads many of Brazil's smaller and less developed neighbours to resist attempts at developing common rules, procedures and regulatory frameworks. Nationalistic and xenophobic sentiment leads them to fear that Brazil might seek to exploit integration initiatives to impose its real or imagined hegemonic intentions. How can these complex challenges be overcome?

3.1. Paraguay

The major issues involved are illustrated in the relationship between Brazil and Paraguay. Having suffered a catastrophic military defeat at the hands of Brazil (and Argentina) in the 1860's, Paraguay still sees itself today as a victim of a concerted attempt by aggressive and greedy neighbours to reduce it to grinding poverty. Itaipu is an example of how energy integration can help overcome such deep-seated resentment. The dam made the continent's most ambitious energy integration project possible. More than that, it triggered a mutual, long-lasting commitment to put into effective use Paraguay's largely underused energy potential.

Itaipu developed a sophisticated governance model that has helped Paraguay to introduce government-wide institutional improvements. It avoids replicating the extremely asymmetrical relationship between the two countries, not only economically and demographically, but also politically and institutionally. Of special relevance, Itaipu provides opportunities for its Paraguayans operators to gain technical and institutional expertise[11], sharing as they do with Brazil all technical and administrative responsibilities associated with running the business.

Finding a solution to the inevitable issues underlying such an unequal partnership was critical in establishing a strategic, long-term partnership between Brazil and Paraguay. In light of the very different levels of development of South American countries, especially in technical, scientific and financial matters, the Itaipu example is very instructive.

Yet, no matter how substantial the mutual benefits may have been, they remain insufficient to avoid recurring Paraguayan allegations that the dam was somehow built at the Paraguay's expense. Lacking in economic dynamism, little job generation and constant power outages in Asuncion,[12] Paraguayans were historically encouraged to see the Itaipu Treaty as an instrument of Brazilian hegemony. Unsurprisingly such complaints continue, even after a 2007 renegotiation whereby Brazil substantially increased its annual payments for the right to use a large share of Paraguayan portion of Itaipu's electric power generation.[13] After all, Paraguay lived until recently under an essentially rentier economic mentality, the excess energy sold to Brazil being used to prop up an economic system based on contraband and illicit transborder trade. Only recently has Paraguay embarked on a "productive reconversion" of its previously rent-seeking economy by establishing an industrial sector based on affordable electric power.

3.2. Peru

A similar phenomenon plagued the Inambari hydropower project in the Peruvian Amazon. Activists were quick to question the fact that this ener-

11 Originally, some critical technical and administrative/financial duties were assigned exclusively to Brazil. More recently, Paraguay has been included in the rotation of these tasks.

12 Under the 2007 agreement Brazil is financing the construction of a transmission line connecting Asuncion to Itaipu Dam.

13 It came into effect in 2009, after approval by the Brazilian Congress.

gy, generated in Peru, would be mostly exported to Brazil. Furthermore, communities potentially most directed impacted by the construction were hardly consulted. The sense that the interests and rights of local populations had been neglected undermined all subsequent efforts to restore trust. To make matters worse, the project would affect indigenous tribes that had been historically marginalised within Peru, but that today have well-managed public relations campaigns to defend them. Unsurprisingly the local and international backlash eventually forced Peruvian authorities to abandon the proposed dam.

3.3. Bolivia

Similar factors undermined plans to develop the hydropower potential of the Madeira River basin, shared by Brazil and Bolivia. In the early 2000s, Brazilian construction companies negotiated an agreement with Bolivian authorities along lines similar to the Itaipu Treaty. As with Peru, however insufficient public debate made the project an easy target for nationalistic and environmental activists – especially after the election of Evo Morales in 2005 – and important sectors of public opinion soon turned against the proposal. Further delays became inevitable when Brazil resisted Bolivian wishes to favour the Cachuela Esperanza dam, set entirely in Bolivian territory, leaving for a later stage the larger binational project spanning the Madeira River favoured by Brazil.

In an attempt to overcome to jump start the project, in 2007 Brazil proposed the for joint development of the entire Madeira River hydroelectric potential. However, in the face of continued environmental concerns in Bolivia, Brazil eventually decided to move ahead on its own and started building dams on the Brazilian side of Madeira River.[14] Understandably, Bolivian worries were further heightened and despite the setting up of a bilateral technical commission in recent months, an atmosphere of mutual suspicion continues to bog down attempts to restart negotiations[15].

The Itaipu case study highlights the need for high level political will if legitimate environmental and political concerns and suspicions are to be overcome. Back in the 1970's, it took a decade of persistent negotiations for Brazil and Argentina to put an end to their dispute on how to harmonise their plans

14 Santo Antônio and Jirau hydropower plants have recently come into full operation.

15 Talks were taken up again in 2011, but with no practical consequences.

to use Paraná River hydropower potential.[16] Not only did these understandings open the way for the construction of binational dams between Brazilian, Angentina and Paraguay, they also allowed Brazil and Argentina to move forward on other ambitious integration initiatives.[17]

Yet even large undertakings that create strong mutual commitment and benefits, such as the Itaipu dam, will not alone ensure a smooth-running integration process. In fact, as illustrated by the Brazil-Bolivia case, the opposite could be argued. As with Brazil - Paraguay relations, the Gas Agreement between Brazil and Bolivia undergirds bilateral relations. Under this contract, Bolivia exports almost half of its natural gas production to Brazil, generating much of Bolivia's tax revenue and foreign-exchange reserves. At one time, these imports covered half of Brazil's total gas consumption, and helped diversified Brazil's energy mix away from expensive and polluting sources.

The success of the Gas Agreement should have encouraged both countries to extend their strategic partnership into the hydropower field. However, mutual dependency, when poorly dealt with, can have undesirable side-effects. This was the case when the Petrobras gas plant in Bolivia was "nationalised", in 2006. Evo Morales' decision was guided by a mix of nationalist populism and the desire to increase export revenues. Brazil did not contest this unilateral breach of contract - euphemistically called "contract migration" – given its major dependency at that time on Bolivian gas. Brazil has since diversified its sources of imported gas. More importantly, this breach in trust made it retarded attempts by transnational oil companies generally to negotiate agreements for prospecting in Bolivia. The upshot is that Bolivian gas reserves have fallen precipitously, threatening the renewal of the Gas Agreement in 2019 as well as Bolivian revenues. When President Lula decided to reduce Brazil's dependency on Bolivian gas he said "it's not good for Brazil or Bolivia to depend on each other that much". An energy integration initiative is only successful and long-lasting when interests are balanced and reciprocal,

16 Through the Tripartite Agreement between Brazil, Paraguay and Argentina, in 1979, water resource use is coordinated along sections of the Paraná River. This agreement successfully harmonized the construction of various hydropower dams along the Paraná River. The underlying issue concerning water usage on the Paraná and Madeira rivers is the same that led to a major controversy between Argentina and Uruguay over the construction of a cellulose plant on the banks of Uruguay river: the rights and responsibilities of neighboring countries concerning the usage of shared water resources.

17 The most recent case was in January 2015, when Brazil imported electric power from Argentina under the 2006 agreement.

ensuring legal predictability and stability.[18] In this context, the current uncertainties surrounding the planned hydropower plants on the Madeira River should not be surprising.

3.4. Chile

Chile has also suffered under this climate of distrust. An example of the impact of environmental concerns is the HidroAysén project in Chilean Patagonia, which provided for the building of five hydropower plants. In the face of powerful opposition to flooding a scenic region, the required Supreme Court authorization was not forthcoming (2012) and the project was eventually cancelled (2014). Unlike Peru and Bolivia, the power to be generated in Chile was not for export, but to cover growing local demand. By cancelling these dams, Chileans have shown powerful the opposition to environmentally questionable projects has become. They prefer to increase dependency on imported energy, despite its national security implications, rather than to go ahead with an environmentally controversial project.

Nationalistic mistrust was also a key obstacle in Chile's attempt to import gas from Bolivia. Bolivian resentment against Chilean refusal to revise the 1904 Treaty that robbed Bolivia of its coastal province, leaving it landlocked, has poisoned relations and led Bolivia to condition exports of its gas to Chile to a review of the treaty.

4. Building trust

How then to avoid this type of trap? How to determine whether dependency on imports/exports of energy has become political toxic? How to avoid or at the very least mitigate the risks and temptations involved in energy integration schemes?

Once again, the Itaipu experience is relevant and revealing. It is critical to understand that the mutually binding commitments derived from the Itaipu Treaty arose despite fundamentally divergent political and economic pers-

18 This legal breach led to deterioration in the business climate. In subsequent years, the unilateral suspension of a significant number of contracts involving Brazilian companies tarnished Bolivia's reputation as open to foreign investors.

pectives. Brazil and Paraguay did not share the same vision of the role of integration. When entering into this agreement, they had different – but compatible - objectives. For Brazil, it ensured a safe and profitable source of energy for its expanding industry. Paraguay in turn got access to an income flow it would never have obtained otherwise. As already explained, it was only much later that Paraguay began to give up this rentier mentality benefiting only a local elite and started to see what Brazil had seen from the outset: the strategic possibilities for using this abundantly cheap energy source to improve living conditions and to encourage electro-intensive plants to set up locally.

In increasingly democratic and mobilised societies, however, building durable trust between two partners must ultimately come from below. The success of Itaipu hinges fundamentally on the dam project helping to dispel the notion that large infrastructure works are necessarily negative from the point of view of the reality and needs of local communities. Itaipu shows that it is not enough to offer local communities shallow, short-term compensations, especially in the case of poor and vulnerable groups, clearly unable to cope with the drastic impact on the environment that provides their livelihood. Promoting an integrated approach means reinforcing in the population the understanding that they are both stakeholders in and beneficiaries of the project.

This global planning capacity is even more important in binational projects. To avoid the perception that one side – normally the most developed country – gets the lion's share of the benefits, it is critical to foster an integrated vision of the entire region or river basin. This means building up, on both sides of the border, local communities' technical and institutional capacity, so as to help mitigate the impact of the project as well as to help these populations overcome the disadvantages imposed by severe underdevelopment.

In this way, energy integration projects reinforce the border development integration agenda which Brazil already works on with its neighbours. These frontier programmes map out the needs of economically and socially marginalised regions. Itaipu has set up outreach tools that shape these commitments to local communities in even more ambitious terms. A good example is the Federal University for Latin American Integration - UNILA, headquartered in Foz de Iguaçu. By bringing together faculty and students from all neighbouring countries, it encourages a broader exchange between different peoples that share borders and the same continent.

Another example in mobilising the trust of local communities is the already-mentioned Xingu Local Sustainable Development Plan (PDRSX). It has set up an innovative proposal focused on front-loaded benefits aiming to provide demonstrable compensation for local populations that are the first and largest victims of the adverse impacts caused, often over a long period of time, by large scale infrastructure projects. After all, more often than not the promised compensation for the projects' negative socio-environmental side effects are only made available long after the immediate damage has become irreversible, especially when dealing with socially fragile and economically vulnerable communities. Just as important as mitigating socio-environmental impacts is the challenge of identifying opportunities to generate economic gains that will sustain environmentally-friendly development. As concerns hydropower plant projects, two critical factors deserve attention:

Firstly, to ensure more democratic access to electricity services. Nothing is more revealing of the unequal costs and benefits accruing from the building of a hydropower plant than the fact that communities often continue to live in poverty and darkness while the electricity locally generated lights up cities hundreds and thousands of miles away. The increased Brazilian payments for the Paraguayan portion of Itaipu energy generation, took this concern to heart. Additionally, Brazil committed to funding the construction of a transmission line that gave access to electricity to isolated rural communities in Paraguay and led a significant reduction in power outages in urban areas.

Secondly, locks can help make river systems into effective low-cost environmentally-friendly transportation networks critical to regional integration. They help drastically reduce transportation costs and bring economic activity to previously isolated and economically-depressed areas. However, locks are often left out of dam projects because of their high cost.[19] Installation costs make it almost impossible to justify economically putting in locks that would help backward regions overcome barriers to development. Itaipu is a case in point, given the limited river trade between Brazil and its neighbours. In this sense, legislation recently passed in Brazil that requires the construction of locks in future hydro power plants is very much welcome[20].

Electricity access and locks have a critical role to play in fostering the

19 Locks can lead to a 30% increase in the total construction costs of a hydro power plant.

20 The main obstacles to modernizing and broadening the Paraná River waterway are downstream. However, the issue also remains sensitive in the troubled relationship between Bolivia, Argentina and Uruguay.

integrated growth of the wider region surrounding hydropower plants. They can help ensure that large-scale infrastructure projects will act as veritable anchors for the sustainable development of the project's socio-economic hinterland. This integrated and rational approach to the multiple interconnected agendas and demands required for effective integrated regional development is also present in the PDRSX. Obtaining environmental licences, ensuring benefits and improvements are within the reach of local populations on both sides of the border, maximizing gains from outside investment and minimizing losses resulting from unwanted impacts: all these elements should be factored into a joint strategic plan. Given such a roadmap it becomes much easier to anticipate conflicts of interests and rival agendas, thus helping to overcome the suspicions, prejudices and fears that traditionally plague binational integration projects.

5. Governability and transparency

All these proposed innovations are welcomed, but insufficient. Across Latin America as globally, the revolution in information technology has given a voice to citizens. Informal, often self-empowered group action, emboldened by an increasingly informed and critical public opinion, questions the leadership and legitimacy of governments and their institutions. Citizens are increasingly aware of and determined to defend their rights and prerogatives. They not only expect more from government, but also demand greater participation and consultation in public decision-making.

The complexity and contradictory nature of contemporary society makes it inevitable that the building of large-scale projects such as hydropower dams be controversial and come under strict public scrutiny. Despite efforts and initiatives to promote dialogue and conciliation, this multitude of new players demands, above all, greater transparency. It wishes to feel actively engaged and consulted on all steps of the process, irrespective of the technical complexities often involved.

It could be argued that seeking such levels of democratisation in decision making is unrealistic, making as it would for a highly fragmented decision-making process that could ultimately lead to a form of collective social anomie. The fact however is that the power of public opinion, multi-faced as it may be, is backed

by today's 24/7 media. No matter however apparently marginal, all segments of the public now have access to the global debate. The claims of even the most isolated of communities, such as illiterate Indian tribes in the Amazon forest, can today easily gain the spotlight. Through social media their needs and claims are amplified, quickly making national and international headlines.

The need for more and better governance in the public sphere gives a particular twist to the current debate on regional integration perspectives in South America. The widespread disenchantment with the lacklustre results of decades of integration rhetoric can easily open the floodgates to the temptation of economic nationalism and autarky. Scepticism about ambitious government intentions is often reinforced by fear of opening up of the nation's natural resources to transnational companies and overseas interests, often seen as economically and environmentally exploitative.

These concerns gain even greater urgency and potency when it comes to bi-national initiatives. The impact of bi-national hydropower plant on the economy and society of less developed countries is hard to overestimate, involving as they do degrees of socio-environmental side effects and technical and financial complexity that these countries are ill-equipped to deal with. Limited technical capacity means that most of the work will be planned and executed by foreign companies, with local business being left no more than a cameo role. Local institutions are mostly left to deal with conflicting claims and requirements of a magnitude and complexity far beyond their experience or technical abilities (Santos, 2014). How are they to adequately respond to the enhanced requirements and expectations involved in technically, politically and socially challenging large scale construction projects?

5.1 Selection

Transparency should be encouraged from the very beginning. Binational or multinational projects should ideally be part of a wider holistic plan to integrate energy flows at the continental level rather than fostering competing subregional projects. This was the goal behind the launching of the previously mentioned IIRSA, partially inspired by the experience gained by Brazil in developing its own integrated logistics infrastructure and funded by the BNDES (Brazil's national development bank). IIRSA was a multinational, multi-sectorial and multidisciplinary initiative covering coordination mechanisms bringing together governments, multilateral financial institutions, and the

private sector.[21] Unfortunately IIRSA soon fell victim to a polarized debate. On the one hand were the radical environmental action groups and affected communities able to mobilize high profile international personalities.[22] On the other, stood advocates of large-scale infrastructure investment as powerful tool in eradicating poverty as well as fostering development generally. IIRSA was eventually placed under the UNASUL umbrella, but remained unable to bridge the gap between technical and governmental institutions and local communities, celebrity activists[23] and stakeholders. The necessary debate on how to promote large-scale infrastructure projects in tune with environmental and social concerns stalled.

5.2 Financing

Transparency in taking forward regional infrastructure projects is also critical in project financing. Credit lines offered both by national and multinational agencies play a crucial part in ensuring the success of any given project. In light of the central role of its public banks, in particular BNDES and Banco do Brasil, it is inevitable that Brazil's intentions and goals should be closely scrutinized.[24] This includes the means by which business projects are selected for public financing and the role of governmental contacts in helping Brazilian business in gaining access to export markets. Of even greater concern is the due diligence process by which compliance with Brazilian and third country legislation is ensured, especially as relates to socio-environmental impacts. This concern is all the greater given that BNDES has often considered itself constrained from enforcing full compliance with its own regulations.[25] Given its nature as a Brazilian public bank, more intrusive behaviour in requiring overseas projects to comply to BNDES' norms, it was

21 In addition to BNDES, IIRSA is also partially funded by the Inter-American Development Bank (BID), by the Andean Foment Corporation (CAF), and by the Financial Fund for River Plate Development (FONPLATA).

22 Including American filmmaker, James Cameron, a well-known environmental activist.

23 A further example of the risks involved was the agreement for the BNDES to fund ambitious infrastructure projects works in Ecuador, proposed by then Lucio Gutierrez. Soon after his forcible removal, the list of projects was drastically reviewed.

24 Brazil was criticized in Ecuador for funding projects considered to be political pet projects of Gutierrez. An example of such a politically motivated but economically unfeasible project was an airport expansion project at Tema, which opponents described as a Gutierrez electoral stronghold.

25 There is a provision for internal audits to evaluate potential socio-environmental impacts, but this recourse has rarely been used.

suggested, could be interpreted as tantamount to undue interference in the internal affairs of another country.

This argument is not plausible. By making a decision to fund (or not) the construction works, the bank is already interfering, in the strict sense of the word. Overseeing the execution of a project is the necessary and integral responsibility deriving from the decision to grant a loan in the first place, and not an option to weighed politically. Ensuring the faithful execution of the project is a critical task. Brazilian citizens who pay their taxes and ultimately authorise contracts entered into by the Brazilian government expect nothing less, especially when it comes to protecting human rights and the environment.

Failure to dutifully follow through with these responsibilities has led to inadequate monitoring of a number of international projects financed by BNDES. In extreme cases, this has resulted in halting construction midway, at a heavy political and financial cost. One of the most egregious examples involved the construction of highway in Bolivia crossing the TIPNIS[26] ecological sanctuary and Indian reserve. Although having met BNDES strict social and environmental guidelines as well as Bolivian (and Brazilian) requirements, the project quickly ran into controversy and was eventually suspended midway through. Local communities who had opposed plans for the road to cut through the park were aggrieved with the lack of effective consultation and dialogue on the part of the Bolivian government. They were further incensed following aggressive police repression when protests became more vocal. At this stage, BNDES decided to withhold financing for the project, eventually leading to the Brazilian construction company halting construction work. The Bolivian government in turn accused the firm with breach of contract. The aftermath was the worst of all possible scenarios: i) financial and political costs for BNDES; ii) aggravated social and political tensions in Bolivia; and iii) Brazilian companies having their image tarnished.

These failures can be largely traced to the original conception behind BNDES' financing mechanism. Initially, this credit line funded exports of relatively simple goods and services, such as motor vehicles and foodstuffs. The control and monitoring mechanisms required for this type of export are now clearly inadequate when the same tool began to be used to fund large infrastructure projects with drastically wider implications, both socio economic as well as political and environmental.

26 *Territorio Indígena y Parque Nacional Isiboro-Secure.*

More recently, BNDES has turned these lessons into effective action. It has translated this into valuable management experience in dealing with large scale projects domestically. The widespread critique of the Belo Monte dam project, as well, has challenged BNDES to review many of its previous operating methods. These procedural improvements are on show in the already mentioned Xingu Territorial Development project (ADTX). The need for major overall of supervision procedures is even more urgent when it comes to construction work overseas. The methodology being developed for ADTX is expected to be applied in future binational infrastructure projects. By adopting policy instruments consistent with the values and goals which it aspires to represent, Brazil has another opportunity to exercise effective regional leadership. If Brazil is to lead the struggle to make regional integration a reality in South America, a goal enshrined in the Brazilian Constitution, than this must be achieved in accordance with other fundamental principled also written into the Brazilian Magna Carta: the protection of human rights and of the environmental.

5.3 Costs and Benefits

Greater transparency is also crucial when assessing the potential costs and benefits of power plant projects. One of the most controversial aspects of the Itaipu Dam was the price Brazil agreed to pay for the right to use a large share of Paraguay's half of the energy generated. The formula adopted was calculated so as to generate the required revenue over a 50 year period to pay back Paraguay's half of the total cost of building the dam. The complex calculations involved, as well as fluctuating costs of financing the debt over so many years, made it difficult to sell politically to a Paraguayan public that profited little from the energy exports.

The apparently arbitrary nature of the tariff, reinforced by Brazil's willingness in 2007 to adjust it significantly in the absence of any technical justification, has ironically helped reinforce the urban legend current in Paraguay according to which Brazil's "monopolistic control" over the electricity market explains why Paraguay are paid so "little" for their energy. The best way to mitigate this charge is for Brazil to introduce a flexible regime of energy procurement whereby other potential regional buyers are given access to Paraguay's excess energy. This is today possible, in part, due to Brazil's reduced dependence on Itaipu's energy, as well as Brazil's greater capacity to finance itself internationally.

An additional means to reduce Paraguayan criticism about the price of energy exports would be to encourage Paraguay to continue to attract energy intensive industries, including Brazilian ones, to set up locally. This will not only reduce the amount exported to Brazil but would also help Paraguayan see the real benefits of Itaipu to them. As already suggested, instead of simply fostering rent-seeking for the benefit of a few, there are signs of an energy-intensive industry developing in Paraguay that generates far-flung benefits for the wider society in the form of added jobs and higher wages (Castro; Brandão, 2009).

Another necessary measure in fostering a sense of price-setting transparency involves ensuring full equality between Brazil and its partner(s) in the distribution of management roles and responsibilities within the administrative structure running the project. As with Itaipu, at first, it might be necessary to have mostly Brazilians running the more critical sectors. However this imbalance would soon be overcome as a result of Brazil's commitment to helping in capacity building of technicians of the other country. This would not only dispel allegations of Brazilian hegemony, but, once duly qualified, this technical staff will be among the most vocal advocates both domestically and overseas of the binational project.

At a time when corruption allegations in Brazil and throughout South America have highlighted complex governance issues involved in large scale projects, Itaipu continues to offer inspiration. Itaipu is largely autonomous and self-sufficient from national governments interference and has escaped largely unscathed allegations of corruption. This reduced room for political interference has come at a price: limited accountability [27].

6. Conclusion

Economic integration is fundamental for Latin America to effectively and competitively integrate itself into a world economic order increasingly governed by globalised production chains. Energy connectivity is a key ele-

27 Itaipu does not report to either the Brazilian or Paraguayan Treasury. In Paraguay, the income accruing from the export of Itaipu-generated energy is directly allocated to government-controlled programs without any legislative oversight. Understandably, opposition parties are highly critical.

ment in this process. The Brazilian energy model, of which Itaipu is a central pillar, still largely based on hydroelectricity and complemented by alternative renewable sources, offers insights into how best to take forward the long-delayed integration efforts across the continent.

Decades before the concept was coined, Itaipu put into effect the notion of using large scale infrastructure constructions as "anchor projects" to bring sustainable development to economically and socially depressed zones. In so doing, it had a double goal. On the one hand, it addressed the growing pressures to contain and redress social and environmental impacts of its activities on local communities. On the other hand, it answered growing expectations that, given its GDP and political clout, Brazil would take the lead in making regional integration a reality through technical and financial support for major infrastructure projects in the region.

40 years on, Itaipu's central challenge and achievement remain unaltered: promoting energy integration with a view to rationalising use and meeting both countries' growing energy needs. Yet, on the other hand, much has changed. We live in a world where democracy has increasingly taken roots and where citizens are focusing keenly fostering sustainable development agendas: climate change, biodiversity protection, human rights, social inclusion, and economic emancipation.

Nowhere is this truer than in South America. These recent trends have made Brazil's record come under greater scrutiny as Brazilian-financed and –executed infrastructure projects have generated growing controversy. Construction site invasions, project timetables delays, revoking of environmental licences. These are all expressions of a climate of adversarial scepticism and mistrust that have at their root lack of dialogue, communication and transparency in decision-making in the execution of many of these large scale projects. While there is ample room for criticism and improvement as concerns these projects, the backlash has been reinforced by chauvinistic nationalism, ideological disputes and political manipulation in neighbouring countries.

This toxic combination has left Mercosul and UNASUL largely paralysed, while the perspectives for integration at the larger, Latin American level, remain even more remote, pending the consolidation of its still incipient insti-

tutional arrangements[28]. Greater public opinion awareness about preservation of the environment, highly mobilised local communities, the persistence of political and ideological constraints on integration efforts; these are all challenges in bringing to life mega transnational construction projects, including hydropower plants.

There is no simple answer to this combination of obstacles. Greater institutional and especially regulatory uniformity throughout the entire continent is desirable; it would help forge procedures and tools with region-wide applicability and credibility. Mitigation and front-loaded compensation measures are useful tools, but hardly enough in the face of deep-seated distrust. Innovative means to disarm and engage many of the new actors and their agendas are required. Communities and groups traditionally without institutional representation must be more than simply heard. Consultations when decisions have already been made are both futile and counterproductive. All they achieve is blunt refusal or resentful consent. The new actors must not be driven to simply seek to extort some marginal short term gain; they must be made to feel effective stakeholders, sharing fully in the benefits and responsibilities of the entire project. Pro-forma consultation is not enough. Direct institutional participation of a greater number of different stakeholders in formal decision-making boards running these mega construction projects could be helpful if adequately managed.

In facing up to this complex array of interwoven issues, Itaipu does not provide a universal model, but it does offer an example and inspiration for intelligently pooling efforts and resources in a world order challenged by economic globalization, climate change and a mobilized citizenry.

Bibliographical References

BIATO, M.; CASTRO, N. J. **Integração regional na América do Sul e o papel da energia elétrica**. GESEL/IE/UFRJ, Texto de Discussão do Setor Elétrico n° 32, 2011.

28 The Community of Latin American and Caribbean States - CELAC is still not consolidated, while the Regional Energetic Integration Commission - CIER is a non-governmental entity focused on coordinating South American companies in the electric power sector, and counts on observers from Central America.

BERTINAT, P.; ARELOVICH, L.. Los desafíos de la integración energética: una introducción necesaria. **Energía y equidad**. Ano 2, nº. 3, 2012, pp. 5-14.

CASTRO, N. J. **O Papel do Brasil no Processo de Integração do Setor Elétrico da América do Sul.** Rio de Janeiro. GESEL – Instituto de Economia-UFRJ, Texto de Discussão do Setor Elétrico n.º 23, 2010.

CASTRO, N.J.; BRANDÃO, R. **Las Negociaciones con Paraguay sobre la Energia de Itaipu**. Rio de Janeiro. GESEL/IE/UFRJ, Texto de Discussão do Setor Elétrico n°2, 2009.

CASTRO, N. J.; ROSENTAL, R.; GOMES, V.J.F. **A integração do Setor Elétrico na América do Sul: Características e Benefícios.** Rio de Janeiro. GESEL/IE/UFRJ, Texto de Discussão do Setor Elétrico n°10, 2009.

CASTRO, N.J.; KLAGSBRUM, V.H. **O Processo de Integração Energética na América Latina - Perspectivas e Desafios Econômicos e Políticos**, Article submitted to the V Conferencia Nacional de Política Externa e Política Internacional - " O Brasil e o mundo que vem aí" - V CNPEPI. Ministério das Relações Exteriores do Brasil - Rio de Janeiro, October 28 and 29, 2010.

CEPAL – COMISSÃO ECONÔMICA PARA A AMÉRICA LATINA E O CARIBE. Physical Infrastructure and Regional Integration. **FAL Bulletin**, Issue nº. 280, nº. 12, 2009.

CIER - **COMISIÓN DE INTEGRACIÓN ENERGÉTICAREGIONAL**. Informações públicas. Available at: <www.cier.org.uy>. Visited on: September 15th, 2013.

MOREIRA, J. M. L.; PINTO, R. T. S. Integração energética ou integração de mercados: qual é a melhor solução para a comercialização de energia elétrica? **4º Congreso de la Asociación Lationamericana de Economía de la Energía – ALADEE**, Montevideo/Uruguay, 2013.

MOURA, G. N. P.; LEGEY, L. F. L.; PEREIRA JR., A. O. Diagnóstico do Sistema Elétrico de Transmissão Brasileiro Relacionado à Comercialização de Energia Elétrica com Países da América do Sul. **XIV Congresso Brasileiro de Energia (XIV CBE)**, Anais 2012, vol. 3, 2012, pp.1079-1100.

NUTI, M. R. **Integração Energética na América do Sul: escalas, planejamento e conflitos.** Doctorate Thesis in Urban and Regional Planning (IPPUR). Universidade Federal do Rio de Janeiro, 2006.

OLADE – ORGANIZAÇÃO LATINO-AMERICANA DE ENERGIA. **Energia y Minerales en Sudamérica,** Conferencia "La defensa y los Recursos Naturales". Buenos Aires, OLADE 2014.

OXILIA DÁVALOS, V. E. Raízes Socieconômicas da Integração Energética na América do Sul: análise dos projetos Itaipu Binacional, Gasbol e Gasandes. **Tese de Doutorado** – Post-Graduate Programme in Energy, Universidade de São Paulo, 2009.

SANTOS, T. **Integração Energética na América do Sul: desdobramentos do desenvolvimento institucional**. Rio de Janeiro, Master Dissertation – Instituto de Relações Internacionais, Pontifícia Universidade Católica do Rio de Janeiro, 2014.

SANTOS, T.; SANTOS, L.; MAHECHA, E. G. Integración Energética en Latinoamérica: breve historia y sus oportunidades en el siglo XXI. **4º Congreso de la Asociación Lationamericana de Economía de la Energía – ALADEE**, Montevideo/Uruguay, 2013a.

SUÁREZ, L.P.L.; GUERRA, S.M.; UDATE, M.E.M. **Os Fundamentos Institucionais na Integração Energética da América do Sul.** V Congresso Brasileiro de Planejamento Energético. May 31 to June 2, 2006. Brasília-DF.

VELEZ, J.A.O. **Condições Econômicas e Institucionais para a Integração Energética na América do Sul**. Master Dissertation at the Instituto de Economia/UFRJ, 2005

Legal and institutional energy integration models: Comparison between European Union and Mercosur

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1. Introduction

Energy is an essential political field for the economic and social development of any country. The same premise holds true for a group of countries holding hands for the common welfare of their populations, such as the European Union and Mercosur. However, such international organisations are challenged with the problem of defining the best way to integrate their sectors and energy markets. Should the power market regulation be prepared by supranational bodies? Or should such regulation be made with the signing of intergovernmental cooperation treaties in order to preserve States sovereignty over their power sources?

These matters evidence that the power is a problem of integration of the main contemporary economic blocs. Indeed, energy has always been considered a sensitive issue related to State sovereignty, to be seen as an asset of its property, vital for their development. This sense of possession described by Daintith and Williams (1987, p. 3), may give rise to the resistance of national governments to the participation in power markets unified with other countries.

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On the other hand, energy integration may have solutions for the contemporary global challenges, such as the growing energy consumption, scarcity of resources, pressure over prices, conflicts due to access to energy sources and environmental disasters. In fact "current reduction in global oil reserves, without the discovery of new ones, and increased demand by economies with intense growth rush the dispute for energy access" (Zanella, 2009, p. 18).

From this perspective, energy integration provides a potential for complementarity between producers and consumers in a region, which enables real opportunities for rational, joint and balanced use of available energy sources. Costs and benefits are shared, and energy research and safety investments are enhanced.

Both the European Union and Mercosur face peculiar difficulties in relation to their respective regional energy profile. The European Union has become dependent on imports of conventional energy sources from different regions of the world such as North Africa and the Norwegian sector of the North Sea. It should be noted that the role of Russia, main gas supplier in the European Union, which uses energy sources as an instrument for foreign policy (Ceia, 2008, p. 10). In turn, Mercosur is a region abundant in energy resources, but has not been able to achieve an integration project for energy able to guarantee improvements in social and economic conditions of its populations yet.

This article intends to analyse, in comparison, energy integration legal and institutional models adopted in the European Union and Mercosur. The choice of investigating the experiences of both economic blocs in the field of energy is justified by their importance in the global scenario and their close political, commercial and economic relationships, as well as the common challenges of scarcity they face and the competition for energy sources.

The article is organized as follows: the first section includes concepts and fundamentals of energy integration. Section two addresses energy integration in the European Union through its background and characteristics, as well as its standards and institutions. The third and last section introduces the same analysis; however, related to the energy integration in Mercosur. Lastly, the conclusion provides the comparative examination results between the energy legal and institutional models adopted by the European Union and Mercosur seeking to emphasise its similarities and main differences.

2. Energy integration

According to the globalisation perspective, internationalisation of markets and economies is an assumption for the economic growth of countries, which gave rise to a series of regional integration projects, especially as of 1980. Except for the European Union, these regional integration blocs have focused on increasing their commercial relations, passing over the discussions about political and social issues. It was the case of South American integration blocs.

> In South America, the 80s register a series of intergovernmental agreements that seemed to rekindle awareness of interdependence among countries in the region. However, the reformulation of old schemes and signature of new integration agreements were intended to organise the production structure to interconnect it to world markets, as a supplier of raw materials and primary products, than organizing institutions and economies in a regional cooperative system that would promote the balanced development of the countries involved (Zanella, 2009, p. 84-85).

Otherwise, since its beginning, the European Union proposed an integration project beyond economy seeking to concretise the coordination and unification of policies for several fields, including energy. In fact, energy boosted the evolution of the European bloc whose origin lies in energy agreements.

Energy integration can be defined as a foreign policy strategic option seeking to strengthen the relations between different States in the field of energy. Such deepening in interstate relations occurs through the integration of services, technologies, infrastructures, production, distribution and energy consumption.

Energy is directly related to social and economic safety and development and thus, ultimately, to the State sovereignty. As a consequence, any regional integration scheme seeking the growth of its economies and welfare of its populations should include energy the cooperation between its members. Therefore, sovereignty must be understood as the free activity of States pursuing integration and not the energy autonomy.

In this process, energy should be seen as a right and not a good. Mentioning that energy is essential for social justice is essential - due to its importance for job creation, provision of basic social services and better income

distribution - and not a mere raw material to be sold by large companies and offloaded to large industrial centres. In summary, the fruits of energy integration should be reverted for the benefit of common welfare promotion and reduced social inequalities. State presence and activity during the energy integration process is relevant (Zanella, 2009, p. 132).

Challenges of regional energy integration include the sector's regulation, that is, "solid legal instruments and strong institutional structure capable of supporting energy interdependence relations" (Zanella, 2009, p. 123). Several instruments are available to regulate energy integration among different countries. From the ratification of international treaties that create intergovernmental energy integration projects to the creation of supranational institutions that override the will of the States in the conduction of the integration process.

Whatever the path chosen is, adopting a common energy regulatory framework is essential between the countries involved in the integration scheme, in order to ensure legal safety for initiatives and common projects. Regulation mechanisms implemented in the European Union and in Mercosur will be examined on the following section in their respective energy integration processes.

3. Energy integration in the European Union

Energy security is a central theme on the European Union political agenda due to its problem of growing energy deficit. This is serious, especially because of the European bloc dependence on foreign energy sources. The solution proposed to face this framework was the energy integration between the European Union countries.

In this section, the energy integration legal and institutional model between the Union European countries is analysed whose main characteristic is the supranationality institute, as it will be seen here.

3.1 History

Since the beginning of the European integration project in the 50s, energy has always represented a relevant theme both politically and economically for

the evolution of the European bloc. To prove this statement just remember that the first integration schemes between European countries, post World War II, were about management, production and energy distribution, namely: the European Coal and Steel Community (ECSC) in 1951 and the European Atomic Energy Community (EURATOM) in 1957.

In fact, the history of the European Union starts in the beginning of 1950, that is, post World War II. The formation of the European Union is closely linked to this international conflict, as the process of European integration appears with the aim of maintaining peace among the peoples of Europe (Pfetsch, 2001, p. 19ss). Peace would only be achieved with the union of European States. The idea was that united in a single organisation, in which the sovereignty of all would be limited, no State would overlap each other.

CECA's creation was the European union integration initial milestone established by the Treaty of Paris in 1951. Such Community was created from the idea of having France and Germany reuniting their coal and steel production. The integration had economic and political purposes (Pfetsch, 2001, p. 31-32). Establishing the free circulation of coal and steel; ensure an orderly supply; ensure equal access to sources of production; and ensure lower prices were the economic purposes. Political purposes clearly included the strengthening of Franco-German solidarity; remoteness of war spectre; and opening of a way to the European integration.

At first, only France and Germany participated and later, Italy and the Benelux countries joined. CECA had a limited period of 50 years, expiring in July 2002 and the decision-making was entitled to the current European Union.

In 1957, the Treaties of Rome founded the European Economic Community (EEC) and EURATOM. EEC had the purpose of creating a common market among its Member States (which were the same members of CECA). Meaning, besides the elimination of commercial restrictions and the adoption of a common commercial policy with third countries, it longed for the free movement of capitals, labour and services.

In turn, EURATOM had the purposes of establishing a common market of nuclear products, the pacific development of nuclear power among its member countries (the same of EEC) and sharing of knowledge and infrastructure to ensure nuclear safety in the region. EURATOM is in force until nowadays.

These three European Communities (CECA, EEC and EURATOM), thanks to the signing of its Member States of the Merger Treaty (or Brussels Treaty) in 1965, had the same executive power and shared the same institutions and bodies from then on. These institutions were: Council of Ministers, Commission (supranational body), European Parliament and Court of Justice.

Due to its economic and political success, the European integration process received new members through successive rounds of enlargement since the 1970s, now totalling 28 Member States. Next to this, its main treaties underwent important reviews with the purpose of ensuring the bloc activity efficiency and its evolution during the economic integration phases. The Maastricht Treaty of 1992 is highlighted among these reviews, which created the European Union - supranational organisation with the incorporation of three communities (CECA, EEC and EURATOM) - and the Economic and Monetary Union, which provided for the adoption of Euro.

Another prominent review should be noted: the Treaty of Lisbon, which entered into force in 2009 and was the result of the reflection period after the failure of the Constitutional Treaty in 2005. Its main purpose is to provide more efficiency and coherence to the European Union relationship with the international society and bring it closer to European citizens.

With the Treaty of Lisbon, the European Union acquires unique legal personality when the duality between the European Community and the European Union ceases to exist. It is worth mentioning that the new European Union, holder of an international legal personality replaced the former European Union without legal personality, as well as the European Community. It stopped existing as an autonomous institution and all of its activities will be transferred to the Union.

In 2008, the European Union faces a serious financial crisis that divides the European bloc in Beck's vision (2012, p. 20-21):

> The crisis and programmes to save Euro reinforced the contours of another Europe, a divided Europe, separated by new moats and new frontiers. One of these moats passes between countries of the North and South, between creditor and debtor States. Another border separates States from the Euro zone, forced to act, of UE member States that did not join the Euro and are forced to watch the decision-making of fundamental decisions for the future of the Union without their participation. During elections in debtor countries, a third essential moat emerged with long-term political consequences: governors vote in favour of the austerity packages, the peo-

> ple vote against them. This process shows the structural tension between an European project presented and managed *from above* by political and economic elites and the resistance *from below*. [...] Not only in Athens but throughout Europe, resistance for a political resolution of the crisis that paves the way for a redistribution from the *bottom up* grows - according to the maxim: "State socialism for the rich and banks, neoliberalism for the middle class and the poor."

Such crisis affects especially Greece, Spain and Portugal, which are being forced to adopt drastic fiscal adjustment measures to receive financial help from the European Union and the International Monetary Fund. As shown, this crisis gives rise to a debate on the crisis of the European democracy as a result of market emphasis over the protection of fundamental social rights.

3.2 Characteristics

The European Union is an example of supranational organisation characterised by the fact that the sovereignty of Member States is limited. The fact that the European Union adopts the supranationality as a legal integration model is not by chance. There is a reason for this. As explained before, the European Union emerges after World War II in which the traditional sovereignty concept becomes relativized.

Precisely, the serious violation of human rights perpetrated by the Nazi during World War II spurred the creation of international standards and institutions capable of ensuring respect for human dignity, as well as the accountability of States at international level.

With this, the relativization of the traditional notion of state sovereignty is clear, which started to incorporate international commitments and obligations related to the protection of human rights in its concept. Meaning that sovereign States are not subjected to the power of any other State; however, on the other hand, they are subjected to the rules of international law on behalf of the protection of human rights.

The European Union arises exactly after World War II and its formation is naturally influenced by this idea of mitigation of the State sovereignty concept favouring the protection of humans, especially because Europe was the main stage of the atrocities committed during World War II.

Thus, the European Union incorporates the mitigated concept of sovereignty and makes it even more flexible. This because States accept delegating compe-

tences to higher community institutions and begin to submit to their decisions within the scope of the European bloc. They are called supranational institutions.

As a consequence, the European Union enshrines a shared sovereignty model among its Member States and their community institutions. Those ceding part of their sovereignty (part of their state competences) in favour of these. The result is that the European Union political system has different governance levels, which is called by the multilevel governance doctrine, which would correspond to the complex decision-making process adopted by the Union with several layers developed within and above the State (Machado; Del'Olmo, 2011, p. 151).

The European Union is characterised as a supranational *sui generis* international organisation as it does not fit in any form of State or existing conglomeration of States. It is an international organisation different from the others with certain peculiarities. Its differential is exactly the sharing of sovereignty in which States delegate part of their State competencies to be exercised by supranational institutions, which are fit to conduct the interests of the bloc.

European states agreed to delegate part of their sovereignty to mitigate the State sovereign figure of unlimited action and ambition that produced wars on the continent. Institutions above States should contain and somehow control their ambitions and conducts.

Not only institutions of the European Union are supranational, but also standards produced by them. Such sources comprise the so-called Community Right, which is an autonomous branch of law that is associated to the supranationality institute.

Sources of Community law enjoy precedence over national standards, that is, they cannot be revoked or amended by subsequent national law. And, in case of contradiction between community standard and national standard, the community has precedence, even when it comes to national standard of constitutional hierarchy (Machado; Del'Olmo 2011, p 182.).

In addition, the sources of Community Law are immediately applicable, that is, their standards do not need to be internalised as the standards of ordinary international treaties. They immediately acquire the status of national law upon enactment by community bodies. Therefore, Community standards come into force in all Member States at the same time and from then anyone can directly invoke such a standard before its national judiciary (Machado; Del'Olmo 2011, p.179.).

The immediate applicability of community law is a clear proof of limited sovereignty within the UE. This because the immediate applicability implies that a State accept standards edited by external bodies, which become effective at the time of its external publication.

In short, the European Union Right is a proper legal order independent of the national legal systems characterised by the immediate applicability and primacy of its standards. Such a set of characteristics shows the unprecedented type of supranational organisation that proposes a deep level of integration among its members, empowered with bodies and own executive, legislative and jurisdictional powers, functional independence of its Member States, financial autonomy and decision-making system based on the majority.

3.3 Regulatory framework

The first integration legal standards in Europe were international energy integration treaties as: treaties that established CECA (1951) and EURATOM (1957). CECA's purpose was the collective control of two main raw materials for the industrial sector's growth and therefore to rebuild the continent after World War II.

Despite this promising start, the energy cooperation policy development among the European countries in the following decades was slow. On one hand, this is explained by the loss of CECA's relevance due to replacement of coal for oil as the main source of power; and, on the other hand, for the divergence of interests among member countries regarding energy combinations, transport routes and markets structure. This last reason obstructs the plans of the European Commission to consolidate a common energy policy in Europe (Langsdorf, 2011, p. 2).

> In 1968, lack of integration in the energy sphere was considered to be a 'dangerous trend' which could be changed only through a 'Community energy policy which fully integrates the energy sector into the common market', counterbalancing 'risks arising from the great dependence of the Member States on imports and from insufficient diversification of the sources of supply' (European Commission, 1968, p. 5 *apud* Maltby, 2012, p. 437).

The project of founding a common energy policy has always been centrally focused on the conclusion of the internal energy market of the European Union. The relevance of such project was emphasised by the Commission

during the 1973 oil crisis, which demonstrated the vulnerability of energy supply sources for Europe. However, next of this strictly economic purpose, environmental protection became an important axis to the European Union energy policy after including this issue in the Single European Act of 1986 (Langsdorf, 2011, p. 5).

Member countries of the European Union were always against the creation of an energy internal market, especially the ones that hold their own rich energy reserves. In this context, member countries vetoed the European Commission proposal of including its own chapter to the subject of energy in the Maastricht Treaty (1992). Similarly, in further treaties - the Treaty of Amsterdam (1999) and the Treaty of Nice (2003) - the regulation of a common energy policy in a separate chapter was not achieved. Thus, the alternative was to make progress in the energy legislation through directives and regulations in the fields of environmental policy and internal market (Langsdorf, 2011, p. 5).

Such a scenario is changed when the climatic change and thus the energy matter is a relevant problem in the global agenda. Beside it, energy security has become a central concern of the European Union because of the bloc dependence on energy imports from unstable regions of the globe.

It took some time until the Heads of State and the Government of the European Union approved the first "Energy Action Plan" of the bloc in 2007. The Plan was prepared based on the strategy paper of the European Commission named "An Energy Policy for Europe" listing the three main lines of the European energy policy, namely: sustainability, supply safety and competitiveness. To achieve these goals, the European Commission and the Council defined specific goals including the "20-20-20" goals to be reached by 2020. They are: i) reducing the levels of greenhouse gas emissions by 20%; ii) increase the volume of renewable energies to 20%; and iii) reduce energy consumption by 20%.

The Action Plan was complemented by important legislative innovations as the inclusion of Title XXI on energy in the Treaty of Lisbon (2007) whose article 194 provides for:

> Within the scope of establishment or operation of the internal market and bearing in mind the requirement of preservation and improved environment, the energy policy of the Union, in a spirit of solidarity between Member States, has the purpose of: a) Ensuring the energy market operation;

> b) Ensuring the Union energy supply safety; c) Promoting energy efficiency and energy economies, as well as the development of new and renewable energies; and d) Promoting the interconnection of energy networks.

As per this device, energy security became the competence of the Union, while the energy combination, the energy external policy and exploration of energy sources continue under the responsibility of Member Countries (Langsdorf, 2011, p. 6).

In addition to such legislative progresses, it is worth mentioning the edition of several strategy documents by the European Commission in the field of energy, such as the "Energy Script for 2050". In short, this document proposes combined decarbonising goals with energy security and long-term competitiveness purposes after 2020.

> The advantage of the Roadmap is, however, that the Commission makes a clear stating detailing what it wishes to achieve by 2050: a largely decarbonised society in the EU. It stresses that it can be done and that it will not cost considerably more that the current strategy. A decarbonised energy system will lead to high energy security, lower import dependency, lower energy prices and CO2 reductions. Furthermore it will provide benefits, such as better air quality and favourable health conditions (Langsdorf, 2011, p. 8).

As a result, it is noted that the energy security recognition as a problem of the European Union, and not of its Member Countries alone, has contributed to a greater participation of supranational institutions, especially the European Commission, in the conduction of the bloc's energy policy (Maltby, 2012, p. 436).

3.4 Institutions

As seen in the previous section, the European Commission performs an important role in the European energy policy development. Indeed, the European Commission has significant powers in setting the energy agenda of the European Union. In this sense, it has the right to legal initiative; monitors the implementation of legislation in the field of energy as the executive body of the European Union; and lastly sometimes receives the mandate from the Council to draw up certain legislative projects on energy (Langsdorf, 2011, p. 3).

> The Commission is then able to propagate its policy recommendations and contribute towards the shift in norms and perceptions of energy security through interaction with Council Working Groups and through

> acting as a useful partner to Member States. The Commission can then offer a channel of influence for Member States; providing expertise, advocacy and leadership before and during negotiations (Maltby, 2012, p. 436).

Alongside the Commission, the Council (formed by the respective Ministers of member countries) plays important roles in relation to the energy policy of the bloc. Before the changes brought by the Treaty of Lisbon related to the competencies of member countries and the European Union in the field of energy, the Council had the decision power by unanimity over all energy legislation. In contrast, today most of the energy policy issues are decided by qualified majority by the Council alongside the European Parliament, which shall decide by simple majority, according to the so-called "ordinary legislative procedure" (Langsdorf, 2011, p. 3).

In parallel to these European institutions, member countries have significant influence on the future of European energy policy through the work of their ministers working in the Council. Furthermore, their Chiefs of State and Government define the general European energy policy guidelines within the scope of the European Council. Mentioning that member countries have competence on energy combination and energy external policy as per rules of the Treaty of Lisbon is important.

Lastly, the so-called "national champions", large national energy companies, perform a significant role in the European energy industry. The liberalisation of the energy sector as a form of ensuring better prices and greater efficiency is part of a project to create an internal energy market in the European Union. Since the liberalisation process of the energy sector has suffered considerable delays, the "national champions" gained influence over their economic power. Within the liberalisation process, it is also worth mentioning the role of national regulatory agencies whose activities are coordinated by the Agency for the Cooperation of Energy Regulators (Langsdorf, 2011, p. 4).

4. Energy integration in Mercosur

Contextualising the energy integration progress in Mercosur is primarily necessary. Energy cooperation initiatives between the countries of the aforementioned bloc are included in the energy integration process in South

America. This region has a highly diversified and rich energy potential; however, uneven between its countries. Supply crises are frequent and investments in energy infrastructure are limited. The result is "the relation between natural resources and the energy available is not direct" (Desiderá Neto *et al*, 2014, p. 74).

In this section, the energy integration legal and institutional model between the Mercosur countries is examined, which is essentially based on binational agreements and not supranational institutions, as it will be shown.

4.1 History

Negotiations that preceded the creation of Mercosur have always been directly related to the interests and goals of external policy of Brazil and Argentina, especially due to the historic rivalry between these two countries. The strategic and safety concern regarding southern borders, as well as the unceasing struggle for regional hegemony have always been sensitive issues and a major barrier. However, Paraguay and Uruguay occupied marginal roles in relation to such events.

The 1980s brought changes to this competition framework, giving rise to an approaching trend between Brazil and Argentina. This change can be explained by two main factors: the economic crisis faced by Latin America in this period; and the process of redemocratisation, due to the remoteness of the military governments in both countries. Specifically regarding reasons that influenced Brazil's decision, it is worth mentioning:

> This change was driven by domestic scenario of reconstruction of democratic institutions and the crisis of the development model, anchored in protectionism and import substitution policy. The problem was not restricted to the internal economy, but on how to stabilize the political system amid international pressures and honour the commitments of external debt, within a context of little growth, soaring inflation and loss of technological and productive competitiveness. [...] For Brazil, the approach with Argentina consisted of an international insertion strategy combined with a process of internal transformation in the pursuit of democratic stability and alternatives for economic development. Use comparative and competitive advantages of both countries was a quite reasonable way of reducing costs during the global competitive adaptation process (Desiderá Neto *et al*, 2014, p. 22-23).

Then, the desire to strengthen democracy, followed by anxieties in economic development and greater international participation resulted in the signature of several cooperation agreements between Brazil and Argentina with emphasis on: the Declaration of Iguaçu of 1985; the Economic Cooperation Integration Programme of 1986; the Integration, Cooperation and Development Treaty of 1988[3]; the signature of Buenos Aires Act of 1990; and lastly, the ratification of the Treaty of Asuncion in March 1991, which consolidated the creation of Mercosur[4], with an invitation for Paraguay and Uruguay to participate[5].

4.2 Characteristics

Unfolding of the goals, principles and foundations definition process for Mercosur regional integration demonstrate the centralised protagonist role of governments in the exercise of diplomatic negotiations among the Presidents. This characteristic is very peculiar in the relations between South America countries and is called "Presidential diplomacy".

"Presidential diplomacy" is considered essential in Mercosur's political dimension due to its flexibility to contribute to the bloc coordination during periods of conjunctural difficulties commonly faced by member countries.

For Malamud (2003, p. 66), this movement, also called "inter-presidentialism" produces some type of spill over effect different from the one expected in neofunctionalist theories, since it comes from above; that is, the central activity of Presidents.

3 Regarding the Declaration of Iguaçu; the Economic Integration and Cooperation Programme; and the Integration, Cooperation and Development Treaty, Desiderá Neto *et al* (2014, p. 23-25) stated that the integration model in construction presented goals surpassing the simple increase of commercial flows. The strategy was to take advantage of regional instruments for the promotion of national development under a logic of growth of the two economies in a balanced and gradual manner. However, with the election of the President Fernando Collor de Mello, the Brazilian external action logics underwent a massive change influenced by the dominant liberal hegemonic thinking, which concentrated the understanding of opening of the domestic market and the search for means for a competitive insertion in the international market. Such an understanding was reflected in Buenos Aires Act, with the abandonment, in a way, of the principle of gradualism and the acceleration of the opening of markets and timing of the integration process.

4 For a complete analysis of Mercosur creation history, please read SEITENFUS, 2012, p. 292ss.

5 Member States of Mercosur are currently the following: Brazil, Argentina, Paraguay, Uruguay and Venezuela. Bolivia is in the process of adhesion since 7 December 2012. States associated to the bloc are: Chile, Peru, Colombia, Ecuador, Guiana and Suriname.

In fact, the presidential protagonism in the conduction of Mercosur incorporated notions of delegation to the presidential authority that, once elected, acquires power to conduct the integration process as it deems appropriate; a phenomenon called by the specialised doctrine as "delegation integration" (Malamud, 2000).

Unlike the European Union integration model, within the scope of MERCOSUR, private sectors report directly to national Executives which are cores that hold the decision power to present their demands, regardless - as such under the domestic relations of countries - of institutional channels.

Winter (2003, p. 116) that criticises the discretion given to Presidents in Mercosur defends that the discretion power ends redounding in significant distortions the institutional model, *a priori* making the decision of the ruling, the decision of the country; which, ultimately, characterises an individualistic system.

According to the author, the maintenance of presidential tradition in Mercosur prevents any progress in the regional integration process, given the incompatibility of such action with the creation of supranational structures. In this sense, he states:

> Presidentialism, with its implementation of powers does not allow, given its own structure, the delegation of powers without a close supervision by the Head of State and Government and, therefore, generates significant deviations that should be analysed (Winter, 2003 p. 124).

However, it should be recognised that one of the main factors for Mercosur's progress and development was the choice of not applying, not even planning to apply, a community institutional structure within the model of the European Union.[6] Over time, it is noted that the essential characteristics of South American central presidentialism determined the progress and strengthening of integration in the bloc as they assured, among others: (i) predictability and security due to the fixed President mandate; (ii) direct access of the relevant domestic players to decision-making power cores, providing them quick response to demands; and (iii) autonomy and scope of manoeuvre necessary to Presidents in the conduct of the negotiation process without institutional and political constraints (Malamud, 2005, p. 159).

6 Unlike the European Union, Mercosur emerges without having an economic interdependence among member countries as a pre-condition. However, the movement towards integration drove the interdependence among them.

Therefore, the regional integration among the countries of the bloc is driven by a legal intergovernmental model comprising, from the realistic view, States as the main actors of the international system with the option to participate in regional cooperation arrangements as they correspond to their interests.

The doctrine specialised in Integration Law has two qualifying aspects of intergovernmentalism, which are: classic and liberal. Classic intergovernmentalism is the integration of States in an essentially anarchic environment. Cooperation schemes are welcome; however, any proposals tending to the dissolution of the State through the creation of post-national governance institutions should be discarded. Thus, States are seen as selfish players and only participate in arrangements if they are interested.

On the other hand, the liberal side comprises the participation of States in regional integration organisations as a toughening tool of States through the projection and meeting the interests of domestic social agents in the international environment. Malamud (1998, p. 139) argues that the liberal adjective reflects the understanding that, in this model, are the interests of domestic social agents and not purely strategic political interests of states that feed regional integration.

Lastly, it is worth mentioning that regional integration schemes structured based on the intergovernmentalism legal model - specifically the case of Mercosur - the low degree of legal institutionalisation; coordination of policies in specific sectors; and the conduction of proceedings by political leaders in a protagonist-centralist way in the definition of economic integration and the objectives and principles that guide it are, among others, the basic characteristics of this integration model.

4.3 Regulatory framework

The main power plant projects for energy integration within the geographical sphere of Mercosur have been negotiated before the very creation of the bloc in 1991. As an example, the following binational plants can be mentioned: Itaipu; Salto Grande and Yacyretá.

Itaipu binational power plant was built after signing the Itaipu Treaty in 1973 between Brazil and Paraguay to use Paraná River hydroelectric potential.

In 1974, the Itaipu Binacional entity was created as an international company[7] in order to administer the venture and manage the construction. The first generation unit started to operate in May 1984 and the 20 generation units reached full operation in May 2007. The entire project has 14,000 MW of installed power.

One of the Salto Grande binational power plant, located in Uruguay river, first normative acts of the Uruguay River Act, was the signature by the Argentine and Uruguayan governments, in January 1938, through which both countries have consolidated their intentions for the common use of the region's hydroelectric potential.

On 30 December 1946 the countries signed an agreement and decided to reaffirm their intentions to build the venture; therefore, designating the Joint Technical Commission, which would be responsible for the coordination and economic development of the plant.[8]

Yacyretá binational plant, located at Paraná River, was constituted after the signature of Yacyretá Treaty in 1973, represented by the Paraguayan Administración Nacional de Electricidad – ANDE; and the Argentine Emprendimientos Energéticos Binacionales Sociedad Anónima – EBISA. The plant has almost 3,100 MW of installed capacity.[9]

As it can be noted, the decades of 1970 and 1980 were marked as a period of intense negotiations between Southern Cone countries, formalised through treaties signed by States and ruled by Public International Law standards for the binational exploration of hydroelectric potential in neighbour-

7 Regarding the Itaipu legal structure, the jurist Miguel Reale, in a summary of a lecture given at the Technical Economy, Sociology and Politics Council of São Paulo Federation of Commerce, on 07/04/1974, considers: "[.. .] after analysing the objectives pursued, and in the light of the powers that would be granted to various projected bodies, it was noted that most of the provisions of the law governing 'corporations' would have very little application. Hence, I made a proposal to constitute a 'binational public company' upon a Treaty once, after approved by Legislative Decree of the National Congress, it acquires force of law, thus prevailing its special standards about any other previously belonging to the matter; [...] First, the transfer of a legal model prepared by the Internal Administrative Law was made for International Law with all consequences inherent to such implementation, which shall colour or give a different meaning to administrative, commercial, criminal, labour schemes, etc." (Reale, 1974, p. 256-258).

8 However, it is worth mentioning that such an Agreement only came into force on 27 August 1958 upon its ratification by the Uruguayan Parliament.

9 Further details on Yacyretá binational plant can be seen on the project's website, available at: <http://www.ebisa.com.ar/comercializacion_energia>. Visited on: 30 Aug. 2016.

ing areas. The motivation behind these understandings was the search for economic growth and strengthening of States. In this sense, Vainer and Nuti (2008, p. 14) consider:

> [...] the integration as a bilateral relation between countries in order to enable common interests as the exploration or receipt of power focused on specific projects located close to national borders was a major concern.

In parallel to the creation of binational, the energy interconnection process was also intensified between countries[10]. At first, as a mechanism for the flow of energy produced by plants; and, in a second moment, to meet the demands of energy exchange contracts. The 1990, in particular, marks the proliferation of electrical interconnections between the countries of the region.

Negotiations for energy integration of the natural gas industry also follow the same normative logic of hydroelectric integration models, especially due to the lack of a multilateral institutional framework to rule and coordinate energy integration processes.

> In South America, infrastructure constructions interconnecting the network industries of different countries were historically based on bilateral (binational) commitments. Thus, bilateral commitments can be considered as the basis of the institutional framework of the construction of infrastructures existing in South America (Hallack, 2014, p. 354).

Among the countries involved in Mercosur's integration process, the main exporters of gas are: Bolivia and Argentina. The table below provides interconnections between the member countries of the bloc:

10 However, the first international interconnection of South America electrical systems dates back to 1960 after an agreement signed by the state companies Companhia Estadual de Energia Elétrica (CEEE) and Usinas Eléctricas y Teléfonos del Estado (UTE) - respectively administrated by the Brazilian and Uruguayan governments - for the exchange of energy in four points of the border. The connection points were: Livramento-Rivera; Quarai-Artigas; Jaguarão-Rio Branco; and Chui-Chuy. Later, in 1969, delegated by Petrobras, Companhia Paranaense de Energia Elétrica (COPEL) would sign the first energy interconnection and supply agreement with the Paraguay company Administración Nacional de Electricidade (ANDE).

Interconnection gas pipelines in the geographical sphere of MERCOSUR (countries-part)				
Gas Pipelines	**Outputs**	**Incoming**	**Start of Operation**	**Connected regions**
Yacimientos Bolívian-Gulf (YABOG)	Bolivia	Argentina	1972	Rio Grande (Bolívia) to Salta (Argentina)
Juana Azurduy	Bolivia	Argentina	2011	From field Margerita (Bolivia) to field of Duran (Argentina).
Gasbol	Bolivia	Brazil	1999	From Santa Cruz (Bolivia) and Porto Alegre (Brazil) via São Paulo
Lateral Cuiabá	Bolivia	Brazil	2001	From Ipias (Bolivia) to Cuiabá (Brazil)
Transportadora de Gas del Mercosur	Argentina	Brazil	2000	From Brazilian Aldea (Argentina) to Uruguaiana (Brazil).
Gasoducto Cruz del Sur	Argentina	Uruguay	2002	From Buenos Aires (Argentina) to Montevidéu (Uruguay)
Gasoducto del Litoral	Argentina	Uruguay	1998	From Colón (Argentina) to Paysandú (Uruguay)

Source: Prepared by the author based on HALLACK (2014, p. 367).

However, it must be noted that such bilateral generation agreements, as well as interconnection agreements, are not exempt from the changes in national and international policy and the effects of market dynamics. For better

exemplification, just resume the historical cases of: (i) change in conditions of sale of natural gas from Bolivia in 2006; and (ii) renegotiation of Itaipu power plant contract requested by Paraguay (Ceia, 2008, p. 10).

Political and economic weaknesses of some countries accentuated the sense of insecurity and mistrust among countries; therefore, resulting in barriers to the development of energy integration projects multilaterally. In short, the region still lacks of robust legal and institutional framework to coordinate and control projects and initiatives in the energy sector.

4.4 Institutions

Mercosur's institutional structure is comprised by intergovernmental forums addressing subjects that comprise the several negotiation agendas of the bloc. Regarding the energy sector's agenda, some matters are addressed in the meetings of Ministers in the framework of the Common Market Council (CMC), and others, in the Common Market Group (GMC) structurally organized under the CMC.

GMC is comprised by several work subgroups, *ad hoc* groups and other institutions. Specifically regarding the energy sector, discussions are handled in the Work Subgroup no. 9 (SGT-9), created in the period of restructuring of energy sectors in 1990; and the *ad hoc* group of biofuels (GAHB), created to discuss and promote the implementation of the Mercosur Action Plan, pursuant to Decision CMC No. 49/07. Despite its broad purposes, SGT-9 - to optimise energy production and harmonise the environmental legislation, among others - has developed a limited role for the preparation of inventories of the energy sector and the analysis of financial, legal and tax aspects of the same sector (Zanella, 2009, p. 87).

The relevance of both Memorandums of Understanding prepared by SGT-9 and approved by CMC through Decisions no. 10/98 and 10/99 should be emphasised, specifically including, respectively: (i) electrical exchanges and energy interconnections in Mercosur; and (ii) gas interchanges and gas integration among Member States of the Mercosur.

Such instruments externalise the will of States to facilitate the bureaucratic transactions required in the energy import and export authorization process; as well as highlight the interest of States in the effectiveness

of measures to complement their natural resources[11]. However, they are criticised for forgetting the relevance of power as a mechanism for social transformation.

> Thus, it is noted that the main political coordination body in Mercosur, responsible for dictating integration characteristics, abstained from establishing the necessary relationship between the energy issue and the social issue, for a balanced development in the region. Instead, it chose to open free competition markets and promote simple interconnections, as well as the basis of energy strategies for the bloc (Zanella, 2009, p. 86).

In terms of initiatives for cooperation and energy integration, it is worth mentioning some South American organisations that count on the participation of Mercosur members to develop this agenda, namely: the Latin American Integration Association (ALADI), successor to the Latin American Free Trade Association; Organization of American States (OAS); the Union of South American Nations (Unasur), as well as the South American Energy Council of

11 The main understandings contained in the memorandum approved by Decision no. 10/98 are: (i) ensuring competitive conditions for the electricity generation market without imposing subsidies that may change normal competition conditions at prices that reflect efficient economic costs, thus avoiding discriminatory practices with respect to demand agents and supply of electricity between states parties; (ii) allow utility companies, traders and large users of electricity to freely hire their supply sources, which may be located in any State Party of Mercosur; (iii) allow and respect the signature of purchase and sale contracts freely agreed between sellers and buyers of electricity pursuant to the legislation in force in each State Party and with treaties in force between State Parties with the commitment of not establishing restrictions to their physical compliance, different from those established for internal contracts of the same nature; (iv) ensure regulations in their power markets allow for the guarantee of supply purchase agents requires from sellers from another State Party, regardless of the supply origin market requirements; (v) not discriminate producers and consumers, whatever their geographical location is; (vi) enable, inside each State Party, the supply of demand result in economic dispatch of loads, including offers of energy surpluses in international interconnections. Therefore, the communications infrastructure should be developed and links enabling exchange of data and information on markets, including real time, necessary to coordinate the physical operation of interconnections and the accounting for trade; (vii) respect the open access to the surplus capacity of transport and distribution facilities, also including the access to international interconnections without discrimination as to nationality, (internal or external) destination of energy or public or private companies, subjected to the regulated tariffs for their use; (viii) respect the general security and quality criteria for power supply of each State Party already defined for the operation of its own networks and systems; (ix) ensure open access to electrical systems, markets and energy transaction information; and (x) establish the conduction of studies through competent bodies, aiming the joint operation of markets of States Parties, as well as the identification of the necessary adjustments to enable energy integration. Available at: http://dai-mre.serpro.gov.br/atos-internacionais/bilaterais/1997/b_126_2011-09-01-14-10-35/. Visited on: 30 Aug. 2016

Unasur; the Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (Arpel); the Latin American Energy Organisation (OLADE); the Initiative for South American Regional Infrastructure Integration (IIRSA)[12]; and the Energy Integration Commission (CIER).

Despite the attempts of such institutions to facilitate and propel the process of regional energy integration, it is possible to note limitations to the execution of some proposals, mainly due to the intergovernmental model adopted to coordinate relations between the States and the overlay of some goals. Today, some of these institutions perform another secondary advisory role to energy integration projects in the region (Zanella, 2009, p. 92).

Thus, it can be considered that the effective development of the energy integration process in countries member of Mercosur is essentially derived from the binational integration initiatives without promoting a harmonisation of regional legislations, or the construction of an institutional framework. Furthermore, it is a process targeted to the private sector and not for the integrated social and economic development of the region. This because its goals are focused on the flow of raw materials to industrial centres and in connection with major consumption centres.

Despite the diversity and abundance of the energy potential to be explored in the Mercosur, the institutional deficiency and lack of energy cooperation policies targeted to common welfare still hinder a uniform and consistent performance of countries in the promotion of multilateral initiatives that benefit the region as a whole.

5. Conclusion

Both in the European Union and in Mercosur, the energy industry liberalisation was established as the primary goal among countries of the respective regions. Indeed, the private sector participation is relevant in energy integration schemes for investment in research and technology, as well as competitiveness purposes.

12 Iirsa proposes a physical integration project aiming at the development and integration of energy, transport and communication in the South American region. However, it is criticised that such an initiative directly benefits large private enterprises than populations of the countries involved (Zanella, 2009, p. 91).

However, energy should be seen as a social and economic development factor for countries and, consequently, any energy integration scheme should be mainly targeted to national economic growth and improvement in life conditions. This results in the importance of the presence of the State to ensure that the course and outcome of energy integration are defined on behalf of social and economic welfare.

Mercosur has been failing in this matter by choosing an integration model that sees energy as a good to be freely used by the market based on the belief that this, combined with free competition, would ensure product quality at the lowest price. However, this option lacked efficiency in solving social inequality problems affecting the region.

Mercosur's energy integration legal and institutional model differs completely from that implemented in the European Union. While the first one is guided by intergovernmentalism, the second one is guided by increasing supranationality.

Mercosur's model is characterised by the conclusion of a series of isolated interconnection projects in energy infrastructure based on bilateral international treaties. Therefore, a real energy integration plan involving producers, distributors and consumers was not adopted.

In turn, the European model aims to create an internal energy market, whose creation has always been advocated by the European Commission and resisted by member countries. This changes when energy security and climatic changes become a central theme among European countries that realise the supranational integration as the most proper solution to deal with such challenges. In this sense, the European Commission is transformed into an essential body in the conduction of the European energy policy given its competencies established in the Union treaties, guidelines and regulations, in addition to their own strategy documents.

Regardless of the legal and institutional model to be adopted by the economic bloc, its energy integration initiatives should go beyond the strictly economic and commercial criteria in order to contribute to the social transformation of the region in which it is inserted. Finally, the legal framework and institutions are only instruments to achieve the goal of integration, which should be always committed to the welfare of populations involved.

References

BECK, Ulrich. **A Europa Alemã**. Lisboa: Edições 70, 2012.

BRASIL. Memorando de Entendimento entre a República Federativa do Brasil e a República Oriental do Uruguai sobre o desenvolvimento de Intercâmbios Elétricos e Futura Integração Elétrica. Available at: <http://dai-mre.serpro.gov.br/atos-internacionais/bilaterais/1997/b_126_2011-09-01-14-10-35> Visited on: 30 Aug. 2016.

CEIA, Eleonora Mesquita. How can Brazil's leading role in South America contribute to boosting security cooperation between the EU and Mercosur? **Working Paper of the Observatory of European Foreign Policy**. n. 78. Jul. 2008. Barcelona: Institut Universitari d'Estudis Europeus. Universitat Autònoma de Barcelona.

COMISIÓN TÉCNICA MIXTA DE SALTO GRANDE. Documentos Fundacionales, Leyes, Decretos, Notas Reversales, Actas, Acuerdos, Convenios. República Argentina, Ciudad Autónoma de Buenos Aires. Junio 2013. Available at: <https://www.saltogrande.org/pdf/libro_DOCUMENTOS_Y_ANTECEDENTES.pdf>. Visited on: 30 Aug. 2016.

DAINTITH, Terence; WILLIAMS, Stephen F. **The legal integration of energy markets**. v. 5. New York/Berlin: Walter de Gruyter, 1987.

DESIDERÁ NETO, Walter Antonio *et al*. Relações do Brasil com a América do Sul após a Guerra Fria: política externa, integração, segurança e energia. In: DESIDERÁ NETO, Walter Antonio (Org.). **O Brasil e novas dimensões da integração regional**. Rio de Janeiro: Ipea, 2014, p. 19-100.

HALLACK, Michelle Carvalho Metanias. A integração da indústria de gás natural na América do Sul: desafios institucionais no desenvolvimento de infraestruturas de interconexão. In: DESIDERÁ NETO, Walter Antonio. (Org.) **O Brasil e novas dimensões da integração regional**. Rio de Janeiro: IPEA, 2014, p. 353-413.

LANGSDORF, Susanne. **EU Energy Policy**: From the ECSC to the Energy Roadmap 2050. Brussels: Green European Foundation, 2011.

MACHADO, Diego Pereira; DEL'OLMO, Florisbal de Souza. **Direito da Integração, Direito Comunitário, Mercosul e União Europeia**. Salvador: Editora JusPodivm, 2011.

MALAMUD, Andrés. Jefes de Gobierno y Procesos de Integración Regional: las experiencias de Europa y América Latina. In: LOMBAERDE, Philippe de et al (eds.), **Del regionalismo latinoamericano a la integración interregional**, Madrid: Fundación Carolina, 1998, p. 137-162.

_____. **Mercosur**: from 'delegative democracies' to 'delegative integration'? Paper preparado para o Encontro da Latin American Studies Association, Miami, 16-18 de Março, 2000.

_____. Presidentialism in the Southern Cone. A framework for analysis. **EUI Working Papers**, n. 1, Florença: European University Institute, 2001.

_____. Presidentialism and Mercosur: a hidden cause for a sucessful experience. In: LAURSEN, Finn (ed.), **Comparative Regional Integration**: theorical perspectives, London, 2003.

_____. Presidential diplomacy and the institutional underpinnings of Mercosur: an empirical examination. **Latin American Research Review**, v. 40, n. 1, 2005, p. 138-164.

MALTBY, Tomas. European Union energy policy integration: A case of European Commission policy entrepreneurship and increasing supranationalism. **Energy policy**, v. 55, 2013, pp. 435-444.

PFETSCH, Frank R. **A União Européia**: história, instituições, processos. Brasília: Editora da Universidade de Brasília, 2001.

REALE, Miguel. A estrutura jurídica de Itaipu. **Revista da Faculdade de Direito da Universidade de São Paulo**, São Paulo, v. 69, n. 1, p. 255-266, jan. 1974. Available at: <http://www.journals.usp.br/rfdusp/article/view/66724>. Visited on: 30 Aug. 2016.

SEITENFUS, Ricardo Antônio Silva. **Manual das organizações internacionais**. 5. ed. Porto Alegre: Livraria do Advogado, 2012.

VAINER, Carlos; NUTI, Mírian. **A integração energética sul-americana**: subsídios para uma agenda socioambiental. Brasília: INESC, 2008.

WINTER, Luís Alexandre Carta. **Crise do modelo presidencialista no âmbito do MERCOSUL.** Curitiba: Juruá, 2003.

ZANELLA, Cristine Koehler. **Energia e integração**: oportunidade e potencialidades da integração gasífera na América do Sul. Ijuí: Ed. Unijuí, 2009.

Constraints and Perspectives of the Energy Integration in South America

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1. INTRODUCTION

Maximizing South America's competitiveness in a globalised economy means to value its comparative advantages, the abundance of natural resources and lack of insurmountable physical barriers. This requires setting the basis and material structures that allow to consolidate, in practice, an integrated economic space able to leverage these productivity factors. This is to enable a new economic rationality capable of inducing and accelerating the process of unification of regional markets as a whole. Otherwise, the classic economic logic of centripetal nature that was - and still remains - imagined for the reality of colonial times shall prevail. Definitely overcoming a heavy legacy of societies physically against each other as they are historically focused on the former metropolises. There will be no practical feasibility for continental integration; therefore, expressive efficiency gains without first redesigning the axes through which production vectors travel. A large market and production park shall not be shaped on a regional scale without first prioritising the infrastructure sector, creating synergies and competitive production scales.

When shaping a competitive economic space, having abundant energy at affordable prices is essential to ensure scale economies and synergies needed to enable efficient production chains. Out of the different energy sources, the most promising one from a regional viewpoint is electricity. It provides mul-

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tiple comparative advantages: tariff modicity, employment of consolidated technologies and other innovative ones (wind and solar) and environmental sustainability. Its largely technologically and technically dominated characteristics favour the installation of integrated transmission networks capable of guaranteeing continuous and uninterrupted supply of energy over long distances. Additionally, electricity favours the inclusion of large social segments, distant from development benefits and opportunities. Both factors explain the replacement of non-renewable and pollution-generating sources in the region since market reforms of years 1980-90. Its financial, economic and environmental advantages show that clean and renewable energy is efficient and profitable. It means affordable, sustainable and continued prices so that people, countries and regions achieve their full potential as economic players.

Thus, this work seeks to analyse opportunities and challenges to the power integration process in South America. At first, some constraints to building this process are presented. Below, some comparative advantages of the region are analysed to move forward with the integration process. The third part presents its challenges and potentialities and the fourth part shows the importance of the Brazilian leadership in this process. Lastly, conclusions show that electricity infrastructure integration allows to multiply the integration benefits for the continent: income generation; guarantee of safe, renewable and cheap power supply.

2. INTEGRATION BACKGROUND

Countries of continental dimensions generally with plenty natural and human resources are self-sufficient in strategic inputs for the development of a national security priority and strategic target. In the case of energy resources, the Brazilian experience is no exception, especially in regards to diversity, broad offer and low cost of energy sources available in the country - conventional and non-conventional. Such a predisposition was reinforced by physical barriers and economic and political distances that historically separated Brazil from its neighbours.

Therefore, no wonder Brazil has faced many challenges and shows largely frustrating results in the Latin American regional integration process. Starting with ALALC (1960), going through ALADI (1980) and to the sub re-

gional experiences, integration efforts have managed to significantly expand inter-regional trade, but contributed little to the effective industrialisation of most countries, which is a central objective of the development agenda. In fact, little has changed to the historic dependence of such countries in relation to the export of primary products with low added value and high price volatility (Castro; Leite and Rosental, 2013). Results, mostly disappointing, of these regional integration initiatives over the last half century attest to the difficulty in capitalising on the remarkable strengths of the region already favoured with relative cultural uniformity and lack of ethnic and religious conflicts:

1. having large renewable and non-renewable energy reserves. Notwithstanding, several countries have faced shortages living with an endemic energy crisis that adversely affects the quality of life and slows the economic development;
2. having an expressive agricultural production, but significant portions of the population still suffer from malnutrition; and
3. having abundant natural resources and a sizeable economically active population, yet coupled with high levels of poverty, income concentration and a low Human Development Index (HDI) are the norm in almost all countries (Castro, Rosental and Gomes, 2009).

The conclusion is inevitable: mere reduction of customs barriers, initial focus on the integration agenda have limited dynamic impact on the whole economy. Of more concern, as it does not include structural constraints of the production activity, the constitution of a continental customs union reproduced to a certain extant, in Latin America the asymmetrical relationship which already characterizes the changes in the region as a whole with the developed countries. As a symptom of this perverse dynamic in times of downturn in trade and international investments - such as during the post-2008 recession - flows between the countries of Latin America have fallen into even greater rhythm than the rest of the world, helping to strengthen - rather than reduce - the recessionary impact of the global crisis.

The consequences of the lack of competitiveness and productive complementarity are even more serious in cases of smaller economies, frustrated in their main objective to adhere to regional trade arrangements, namely favoured access to the consumer market of the largest partners in the region.

Exactly the opposite is often noted - the overwhelming predominance in smaller markets of businesses and investments from the most vigorous economies. It results in the consolidation of a structural surplus in commercial accounts, especially in Brazil, with most of its Latin American neighbours. The Brazilian "invasion" in these markets ends up feeding resentments and nationalist fears that militate against the very integrationist project.

Historic structural limitations to the effective industrialisation, namely the lack of access to technical and technological qualification and ability to attract long-term productive investments remain in force for most countries in the region. In response, the most ambitious sub regional mechanisms (MERCOSUR, the Andean Pact, the Central American Common Market) started to develop embryonic programmes of supranational arbitration of commercial disputes and of promotion to the integration of local production chains. However, such an institutional deepening attempt has not been proved sufficient to break the known barriers to the consolidation of production scale and competitiveness necessary to truly unleash the process of productive integration. Facing this challenge becomes even more urgent in the contemporary world, made up by large economic and trade blocks dominating global value chains by virtue of their extremely high levels of vertical and horizontal integration. How can Latin America be qualified as a global player in this new scenario?

3. THE SOUTH AMERICAN OPTION

When the role of electricity infrastructure is considered in the formation of an integrated economic space, South America is naturally an option as a field of analysis and action. In contrast to Latin America as a whole, it consistis, firstly, in a compact geographical and physically contiguous unit, which minimizes costs and maximizes benefits related to the implementation of physical infrastructure projects (Neves, 2007).

Secondly, the region has extensive reserves of both renewable and non-renewable power that can be transformed into electricity:

1. Non-renewable sources: 22% of global oil reserves (Venezuela, Brazil and Ecuador), 4% of natural gas (Venezuela, Bolivia, Argentina, Brazil and Peru), fracking, mineral coal (Colombia);

2. Renewable sources: hydroelectric energy: greater potential in the world (Venezuela, Paraguay, Colombia and, above all, Brazil), agrofuels: Brazil produces 45% of bioethanol; Argentina first producer of soy oil; and
3. Alternative sources: great potential in wind and solar.

Third, South America has successful background in the field of energy infrastructure integration. There is an important collection of works done, whose benefits are vital for the countries and region. They are divided into three categories.

A first group includes binational hydroelectric projects. It is the case of Guri (Brazil and Venezuela) dams, Corpus (Argentina and Paraguay) projects, Yaciretá (Argentina and Paraguay) and the electric interconnection between Rio Grande do Sul and Uruguay. Benefits of which the Itaipu plant (Brazil and Paraguay) is emblematic example. With its help, Brazil ensured a safe and profitable source of power to feed a production park in expansion, thus currently representing 17% of the national consumption. On the other hand, Paraguay ensured access to financial resources with every condition to promote the structural transformation of its economy along with the availability of cheap power. The country is ceasing to depend on an unstable and vulnerable profit-seeking to leverage an incipient process of industrialisation by installing a park of electro-intensive processing businesses. After settling the debt from work financing after 2023, each country will own half of the entire power produced at a cost of around U$ 4 per Mwh.

A second group only involves power purchase and sale agreements on the spot market. It does not establish synergies capable of levering more ambitious projects or initiatives, thus being limited to meet emergency needs and demands with flexibility, which otherwise could result in the disruption of economic activities and shortage of population sectors.

The third group of projects does not involve joint ventures, but aim to export electricity from a country to a consumer market in other country through medium and long-term contracts. Countries with surplus power generation availability can thus meet supply imbalances in neighbouring countries. This model's progress will consolidate the power integration process as it will support the necessary investments through medium and long-term contracts (Castro *et al*. 2015).

There is no doubt regarding the strategic importance of these power integration projects to optimize the employment of available resources and; therefore, realise the economic potential of the region. However, the reality is that the use of this potential power would remain largely underdeveloped. Despite the vast potential, no binational venture remotely comparable to Itaipu or even Yaciretá was developed in recent decades. How can it be explained?

4. POWER INTEGRATION: CHALLENGES AND POTENTIALITIES

Ultimately, such a paralysis comes from the same set of inertial factors that slow down the integration process in general, and it includes the following challenges:

1. Economic asymmetries: development and technical and technology power differential between Brazil and its neighbours, especially the smaller ones. This still nourishes defensive visions of alleged expansionist intentions of the "pioneers of the 21st century". It is impossible to underestimate sensitiveness in these countries for any real or imagined perception of hegemonic pretension by the main shareholder;
2. Lack of institutional convergence: divergences in macro and micro economic policy[4] hinder the adoption of actions and projects on compatible technical and legal bases illustrating the emptying of a Banco do Sul project.[5]At the same time, incompatible legal and regulatory schemes hinder the joint equation of new challenges, the matter of mitigation of social and environmental impacts is especially evident; and
3. Political instability and bilateral rivalries: tensions and mistrust between neighbours still persist; sometimes, they are linked to territorial disputes easily manipulated by nationalist rhetoric. Efforts to develop

4 An emblematic example was the collapse of Vaca Muerta project designed to explore the gigantic shale gas field in Argentina. The project was abandoned by Camargo Correa when the necessary investments quickly doubled from US$ 5 to almost US$ 20 billion per account, among other factors, of the Argentine Government refusal to admit the impact on overvaluation investment costs of Argentine peso resulting from the refusal of the Argentine Government to recognize the high levels of inflation in the country.

5 The Bank would have to finance infrastructure works and social programmes in favourable conditions. It was an alternative to the mostly strict loan standards of IMF and the World Bank.

supranational coordination mechanisms and controversies solution are thus hindered; neither the uniformisation of standards and [6]technical norms are advanced due to feat in making grants that may involve sovereignty unilateral transfer.[7]One consequence is the temptation to resort to nationalisation policies, driving away both local and foreign investments.

Thus, a framework of political and institutional difficulties is characterised by arbitrary scale disputes and complexities way beyond the experience or even technical capacity of local institutions from many countries.[8] Consequences include a notable lack of new electricity integration projects in South America, thus giving rise to high generation costs, insecurity in supply, unsatisfactory coverage and damage to the broader effort of economic integration (Castro and Biato, 2011).

The imperative to address and overcome these barriers to power integration is much greater in the light of the following factors: scenario of growth in electricity demand; need to diversify sources, particularly sustainable and renewable according to costs and emission of greenhouse gases and the structuring role of energy integration for any regional economic integration project.

How to resume initiative in the power integration agenda?

A first step involves recognising the enormous costs referred to above of not carrying out efforts to harness the huge potential of electrical integration still available in the continent: South America has huge reserves of power resources and, paradoxically, of unmet demand, which inhibits development.

A second step includes identifying and deepening power generation and distribution infrastructure integration projects, so as to join potential offer with repressed demand. It is about integrating Brazil and other large consumer markets with countries that have great hydroelectric potential and re-

6 Gauge differences between the respective rail parks of countries, as well as roads ending a few miles from the border: all measures originally prepared to prevent invasions of foreign troops, but that today continue to restrain another invasion, the invasion of imported goods that threaten national industries

7 No wonder that even after renegotiating the clause in the Treaty on payment for excess of power in 2007 with the multiplication for three of the amount reimbursed annually by Brazil, the contestation spirit remains. The undoubted benefits earned by the Paraguayan people for decades do not obviate the nationalism of natural resources spectrum, which begin to incorporate components of the social and environmental rhetoric.

8 Failure of projects sometimes extremely ambitious, notably the Southern Gas Pipeline, but poorly designed help reinforcing the scepticism about the integration process perspectives.

duced domestic market; however, that face problems in the supply and quality of electricity, that is, non-renewable generation matrix. Within this synergy of interests, some projects with great potential deserve priority attention: North Arch (power integration from Brazil with three of its neighbours to the north: Venezuela, Guiana and Suriname); and the binational UHE with Bolivia, at Madeira River.

A third step includes developing a strategy to administer political, economic and regulatory injunctions involved. After UNASUL's launching (2007), South America took the initiative to try to break this inertia through an ambitious agenda of structural projects in sub-regional scale. The South American Council of Infrastructure and Planning UNASUR (2009) provides a high level institutional and political framework for infrastructure integration strategies.[9] Although still at an early stage, this forum has been addressing urgent challenges, especially:

Funding: have long-term funding instruments, thus encouraging the formation of strategic partnerships between the state and the private sector in countries of the region. Only then the vicious circle in which the lack of infrastructure discourages productive investments and *vice versa* in a vicious circle will be broken; and

Social and environmental impacts: public opinion awareness on the importance of preserving the environment and respecting the rights and prerogatives of local communities, especially indigenous, grows. Such sensitivity is easily transformed into resistance to large projects as the progressive exhaustion of hydroelectric potential out of environmentally sensitive areas, especially the Amazon region. Poorly designed and poorly executed dams give rise to claims, amplified in the popular media, that power plants, especially those that have a reservoir, would be a threat to the preservation of the huge Amazon biodiversity and potential pharmacological and related industrial benefits.

5. BRAZILIAN LEADERSHIP

Brazil has all conditions to be an inducer of this collective power integration effort. It is located in the geodetic centre of the continent; it shares a bor-

9 Such duties were previously performed by the Initiative for the Integration of the Regional Infrastructure of South America - IIRSA, which is now integrated to the Council as a Technical Forum.

der with 10 of its 12 continental neighbours; it has expertise in the generation and transmission of electricity over long distances; it is the largest electricity market of the continent and has a consistent economic model of expansion of the production capacity through auctions with efficiency, affordability and safety. Due to its scale and complexity, the Brazilian electric system has a consistent and dynamic model with very solid institutional and economic basis, and a funding standard that is being adapted to new challenges including the exceptional water crisis of recent years. The rich diversity of its generating matrix should also not be ignored, which is capable of combining and integrating alternative and mainly renewable sources (Castro, 2010).

Brazil also enjoys favourable conditions to ensure funding for infrastructure works in the region, including in the power sector. Significant amounts of resources are available through BNDES and Proex Programme of the Bank of Brazil to enable high cost and long-term profitable investments. Brazil is also contributing through favourable funding within FOCEM (MERCOSUR Structural Convergence Fund). Resumption of negotiations to create the Banco do Sul should also be supplemented, which could multiply the resources already available for this purpose in the Inter-American Development Bank (IDB) and the Andean Development Corporation (CAF).

Equally as crucial is to find means to reconcile legitimate concerns about the social and environmental impact of works of this magnitude with the need to increase the supply of power for development. In the past, Itaipu Binacional project provided valuable lessons in this regard. However, new challenges related to the need of going beyond the simple mitigation of works' social and environmental impacts grow. Recent projects in Brazil, such as the Regional Sustainable Development Plan of Xingu *(*PDRSX), seek to identify opportunity and needs to generate structuring economic gains, on one hand, capable of catalysing local development. The work is no longer seen as an isolated project, whose adverse impacts should be mitigated, to be understood as an "anchor" of a greater sustainable development project covering the whole area of influence of the work.

Within the same logic, on the other hand, programmes for democratisation of access to electricity services are also emphasised.[10] Nothing can be

10 "Light for Everyone" Programme focused on expanding the access to electricity in the most remote corners of Brazil is an example. Many local communities started to benefit from basic public services for the first time now.

more emblematic to the exclusion of a power plant construction gains than continue living in the dark while the electricity generated in the region is taken away for the benefit of individuals and economies from far away. An innovative proposal focused on adopting anticipatory measures has been developed in this effort of gaining trust and the engagement of local communities. It is about recognising that local populations suffer, in many cases, for years, the harmful effects of a construction before being contemplated with the announced compensations. In most cases, the benefits did not outweigh the adverse environmental impacts of the intervention, as they often arrive too late when damages are already irreversible, especially for socially fragile and economically vulnerable communities.

6. CONCLUSION

At a time when globalisation radically reorganises global economic relationships and launches new environmental sustainability challenges, South America is given the exceptional opportunity to redefine the terms of its inclusion in the global economy. Maximising its competitiveness in the global economy also means to maximise its comparative advantages, especially from the abundance of natural resources and their relative linguistic and cultural homogeneity. Electricity infrastructure integration allows multiplying the integration benefits for the continent: income generation; guarantee of safe, renewable and cheap power supply. Thus, the best conditions to consolidate an integrated economic space capable of realising the productive potential of the South American population are offered.

For its physical characteristics and experience in the electricity field, Brazil has every reason to be a solidary leader providing its resources and capacities for a project that will be of benefit for all. On one hand, power integration shall facilitate the access of the Brazilian production park to broader and diversified sources of power in the future. This is mainly important at a time in which concerns associated to the climatic change and demands for a greater democratisation in the control of environmental collective natural resources have been progressively constraining the regional hydroelectric potential, and especially, the Brazilian one. On the other hand, but not less important, the economic development the abundant power shall provide will turn South

America into a more efficient platform for Brazil to recover its competitive inclusion capacity in the global economy.

BIBLIOGRAPHICAL REFERENCES

ALZAMORA, Iván la Rosa. *Energy Context and Perspectives in Latin America: state of the art and challenges for EU-LAC Cooperation*. In: EU-LATIN AMERICA AND THE CARIBBEAN EXPERTS' SEMINAR ON ENERGY, 2006, Brussels: European Commission, 20-21 April 2006.

CASTRO, Nivalde José; BRANDÃO, Roberto; ROSENTAL, Rubens; DORADO, Paola. *Integração elétrica internacional do Brasil: Antecedentes, situação atual e perspectivas*. Texto de Discussão do setor Elétrico n. 64. Rio de Janeiro. August, 2015.

CASTRO, Nivalde José; ROSENTAL, Rubens; GOMES, Victor José Ferreira. *A Integração do Setor Elétrico na América do Sul: Características e Benefícios.* Texto de Discussão n. 10. Rio de Janeiro: Gesel/IE/UFRJ, 2009.

CASTRO, Nivalde José. *O Papel do Brasil no Processo de Integração do Setor Elétrico na América do Sul.* Texto de Discussão n. 23. Rio de Janeiro: Gesel/IE/UFRJ, 2010b.

CASTRO, Nivalde José; BIATO, Marcel. *Integração Regional na América do Sul e o Papel da Energia Elétrica*. Texto de Discussão n.32. Rio de Janeiro: Gesel/IE/UFRJ, 2011.

CASTRO, Nivalde José; LEITE, André Luis da Silva; ROSENTAL, Rubens. *Integração Energética: Uma análise comparativa entre União Europeia e América do Sul.* Texto de Discussão n. 48. Rio de Janeiro: Gesel/IE/UFRJ, 2012.

CIER. *Síntesis Informativa Energética de los Países de la Cier:* Información del sector energético em países de América del Sur, América Central y El Caribe. Datos del año 2013. CIER, Uruguay, 2014.

DÁVALOS, Victorio Enrique Oxilia. *Razões Socioeconômcas da Integração Energética na América do Sul: análise dos projetos Itaipu Binacional, Gasbol e Gasandes*. 569 f. Dissertação (Doutorado em Energia) – Universidade de São Paulo. São Paulo, 2009.

NEVES, José Antônio Moreira das. *O Setor Elétrico na Integração da América do Sul: O Desafio da Autonomia Energético.* 92 f. Dissertação (Mestrado em Ciências Políticas) – Universidade Federal do Rio Grande do Sul. Porto Alegre, 2007.

NUTI, Mírian Regini. *Integração Energética na América do Sul: escalas, planejamento e conflitos. 3*04 f. Dissertação (Doutorado) – Programa de Pós Graduação em Planejamento Urbano e Regional, Universidade Federal do Rio de Janeiro. Rio de Janeiro, 2006.

OLADE**.** *Energía: Uma Visión sobre los Retos y Oportunidades en América Latina y el Caribe*. Caracas: CAF, 2013.

RUIZ-CARO, Ariela. *Cooperación e integración energética en América Latina y el Caribe.* Santiago de Chile: CEPAL, 2006 (Recursos Naturales e Infraestrutura, 106).

SANCHEZ, F. *Integración Energética* In: Congreso de integración energética, 3, 2006. Buenos Aires. *Anais eletrônicos CEPAL.*

SANTOS, Romário de Jesus. *Fontes energéticas no âmbito da América do Sul: uma breve análise do potencial regional e sua capacidade de integração***.** *C@LEA – Revista Cadernos de Aulas do LEA*, Ilhéus, n. 2, p. 32 – 45, nov. 2013.

SILVA, Milko Luis González. *Nuevas Perspectivas de la Integracion Energética.* Caracas: Instituto Latinoamericano de Investigaciones Sociales, 2007.

TEIXEIRA, Rodrigo Alves; NETO, Walter Antonio Desiderá. *La Recuperación del Desarrollismo em el Regionalismo Latinoamericano* Brasília: Ipea: CAF, 2012 (Perspectivas para la Integración de América Latina).

VÉLEZ, Jaime Alfonso Orjuela. *Condições Econômicas e Institucionais para a Integração Energética na América do Sul.* 2005. 151 f. Dissertação (Mestrado em Economia) – Instituto de Economia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2005.

Electricity Markets Regional Integration: Conceptual Basis, Potential Benefits and Opportunities for the Southern Cone.

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1. Introduction

Latin America has a huge energy integration potential due to its abundance of natural resources and complementarity of several sources among countries; however, this potential has been historically underused. The reasons for not making use of the potential for gains from more comprehensive integration between countries can be identified in a very precise way and can be traced back to a wide range of constraints and / or constraints that need to be removed or at least circumvented.

The moment experienced nowadays, specially in Southern Cone countries, is emblematic with an urgent need to promote a necessary adaptation and transformation of the power matrix, in order to massively incorporate new resources that have been gaining economic competitiveness in the face of technology development and global scale gain.

Making progress in the improvement of existing market architectures is absolutely essential considering the possibility of encouraging and economically enabling interconnections between electrical systems of neighbouring countries taking into account the reality unfolded and including:

i. the growing and large scale participation of renewable sources, especially the intermittent ones, in each country's production matrix with frequent important generation of offer surplus; with
ii. contingency of the power source due to environmental restrictions; and

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iii. the strong presence of distributed generation, including leveraged by Natural Gas penetration in the electricity market commercial segment, as well as the massive insertion of solar photovoltaic generation in the low tension segment, but not least;

iv. the advancement of Smart Grids in distribution systems.

Despite the unquestionable view that energy integration can leverage major efficiency gains for all parties involved, obstacles to this integration still remain and can be summarised:

i. in the possible lack of political will proportional to the technical and financial challenges to be faced;

ii. lack of adequate perception that interconnections must be observed in the focus of a strategic and long-term vision;

iii. lack of a regional planning activity systematisation that provides the necessary support to Policymakers and;

iv. difficulties in legitimising bilateral International Treaties. Lastly, in the implementation practice, the challenge of measuring, building and operating a large transmission system must be faced, which allows flexible interchanges among integrated countries, thus meeting strict robustness and reliability requirements.

In this perspective, the central purpose of the Chapter is the proposal of measures to create a favourable market environment for a strong Regional Integration with special focus in the electricity market.

Section two presents the importance of Regional Integration. The following section describes the situation of a still reduced Regional Integration level. Subsequently, section four addresses integration modalities usually considered in Electricity Markets Architecture studies. Section five includes recommendations that could be adopted from the Brazilian point of view in order to promote a broader Regional Integration. Lastly, the final Chapter presents the Conclusions of this state-of-the-art critical analysis effort for energy integration in Latin America focused on the Southern Cone.

2. Regional Integration: Potential Benefits and Relevance

2.1. Potential Benefits of Regional Integration between Countries

Regional Planning studies involving the countries of a certain region or subcontinent are focused on energy resources integration (electricity, gas, oil, etc.) of each country, so that the energy synergy and complementarity can be intensely explored, which generally persists when resources stratified in a very extensive territorial area are noted.

In technical analyses to be prepared to capture the possibility of maximising the use of resources, the most recent technology progresses in equipment, methodologies and computational models should be considered in order to provide the best indication possible for "decision-makers" in view of the formulation of policies and strategies to ensure the coherence of interests of the countries involved with investors' decisions.

In turn, Regional Planning studies should also comprise, as a key element, the allocation of benefits for Consumers respecting the autonomy of energy policies from each country. Within the scope of considerations, **structural** benefits that can be identified and quantified for a proper economic valuation for collation purposes of implementing alternatives are fundamentally:

1. reduced operational costs;
2. increased supply reliability; and
3. reduced emission of CO_2.

In the sequence, the gains allocation strategy from energy interconnections among countries should be emphasised in order to ensure the sharing of such benefits with consumers of the countries involved (reduced tariff).

In addition, it should be established that the flexible commercial schemes design to preserve the energy autonomy and policy of each country, consolidating decisions from planning studies and obtaining the due institutional support through Treaties and International Agreements at the Government level.

2.2. The importance of Regional Integration

Electricity Markets Regional Integration have repercussions that can be assessed from the viewpoint of different dimensions, being worth noting the political, economic and electro energy dimensions.

Regional Integration is emphasised in the political dimension in order to allow countries involved to gain force in multilateral political and economic negotiations. In fact, since the complementarity of supply sources shall raise the level of energy security, which consequently provides a more favourable business environment for investments, not only in the electricity industry as in other economic activities as a whole.

In turn, in the economic dimension it is noted that the interconnection between countries allows obtaining scale economies and a more efficient allocation of scarce resources and often with growing costs for electricity generation over time. A more efficient resource allocation positively affects the social and economic development. Also in the economic dimension perspective, it can be stated that a successful Market Integration providing more accessible energy prices would allow a better competitiveness level of the industries of member countries in the global economy [1].

Lastly, the electro energy dimension analysis allows to highlight that the Integration entails the possibility to take advantage of production complementary of energy sources from different countries, which increases the medium and long-term supply security. On the other hand, interchanges may help in the short-term grid management in stress situations, in addition to provide more flexibility for system operators.

Thus, it can be intuited that, without a doubt, this integration is extremely important in the three underlined dimensions and, more than that this, it presents the opportunity for Brazil to act as a broad integration promoter, using not only agreements between countries, but also decisively contributing to the construction of a favourable market environment for supply security and economic and social development with solid companies that operate in a competitive environment, with fulcrum on maximising the welfare of those involved, thus allowing consumers of countries to have access to reliable electricity at competitive prices.

3. Reduced Regional Integration level

Despite the complementarity of energy sources mentioned and the lack of major geopolitical conflicts between Latin America countries, it can be said that the level of Regional Integration is still relatively low, particularly in what regards to markets integration, despite the progress of recent years, being specially interesting the discreet evolution that happened between South America countries.

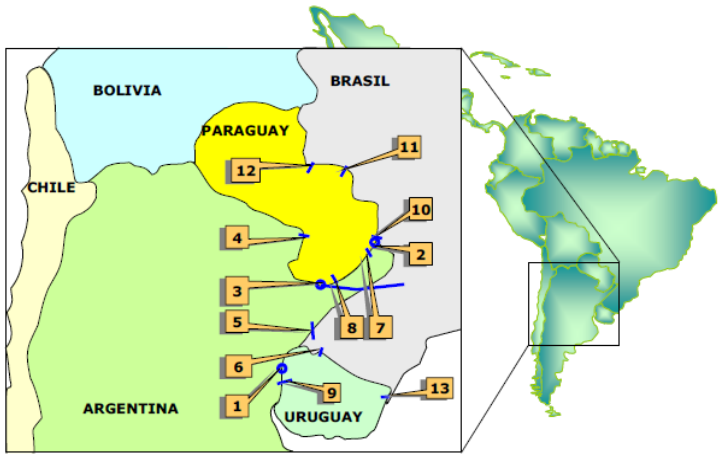
In this perspective, it is worth mentioning that when analysing the Brazilian case with its neighbours, for example, it is noted that regional interchange relation are usually restricted to electricity exchange operations at critical times through agreements between Governments, with the lack of a market approach.

Binational power plants should be an exception as Itaipu (Brazil-Paraguay), Salto Grande (Argentina-Uruguay) and Yacyretá (Argentina-Paraguay), noting that despite being a long-term relationship the decision support was the vision of a geopolitical agreement and national strategies rather than the focus of a Regional Integration based on market aspects. This is so true that conflicts about the prices of electricity sold by the exporter are not rare or problems regarding the effective payment of operations arise.

Figure 1 shows Southern Cone power interconnections [2]. If considered the Brazil-Uruguay connection that had its commercial operation started by the end of 2015, Brazil could possible conduct electricity interchanges of 2.8 GW.

When observing in greater detail the operation of Southern Cone regional interconnections, there is a clear perception that these interconnections are being used only in extreme situations, which characterises a significant spare capacity to be exploited.

Such a underuse is seen as a serious problem to be addressed by the countries involved, since (i) it makes the cost of electricity more expensive for all countries due to the cost of capital recovery allocated in assets already available, as well as (ii) there is no longer a more intensively exploration and use of the strategic character of electricity markets for the whole economy and society.



[1] – Hidroeléctrica Salto Grande 1890 MW (1979)
[2] – Hidroeléctrica Itaipú 14000 MW (1984)
[3] – Hidroeléctrica Yacyretá 3000 MW (1994)
[4] – Interconexión Clorinda – Guarambaré 220kV (1994)
[5] – Interconexión Paso de los Libres 132kV – Uruguaiana 230 kV – 50 MW(1995)
[6] – Interconexión Rivera 150 kV – Livramento 230 kV – 70 MW
[7] – Interconexión El Dorado – Mariscal López 132kV
[8] – Interconexión Posadas – Encarnación 66kV
[9] – Interconexión Concepción del Uruguay – Paysandú 150kV
[10] – Interconexión Acaray 132kV – Foz de Iguazú 230 kV – 50 MW
[11] – Interconexión Pedro Caballero – Ponta Pora 69kV
[12] – Interconexión Vallemí – Puerto Murtinho 23kV
[13] – Interconexión Chuy – Chui 15/13.8kV
[14] – Interconexión Rincón de Santa María – Itá 500 kV (2000 MW)
[15] – Interconexión Paso de Sico – Atacama 345kV (1999)

Figure 1 - Southern Cone Interconnections

Source: CIER 15 Report [1]

More explicitly, it is no longer in line with an irreversible global trend, which is the electrical systems interconnections execution trend with the benefits and complementarity of power matrices from integrated countries; also allowing the expansion of power security and mitigation of certain environmental impacts, such as those caused by flooded areas and servitude areas in the main corridors of transmission once integration between countries can reduce the need for expansion of power plants and transmission lines.

If countries with complementary resources and production diversity are not integrated, increased economy efficiency is not obtained, which is translated by lower energy production costs, and the opportunity to broaden the country/region competitiveness in the world is also lost.

Finding a way to Integrate Electricity Markets is necessary to solve this problem, so that operations occur with greater dynamism and naturally without being limited to the construction of binational power plants (which undoubtedly should be recommended) or opportunities interchanges.

4. Possible Market Integration Modalities

After analysing the possibilities of Markets Integration, two approaches can be summarised as follows from the macroscopic point of view:

1. Construction of binational plants;
2. Markets Integration.

Below is presented the concept of each of these approaches [3].

4.1. Construction of binational plants

This is the most well-known approach and even used in some opportunities in South America, consisting in an integration solution in which two countries build a project materialised by a binational plant for economic, geopolitical and strategic purposes, usually located on the border of both countries with a contractual arrangement providing for the sharing of investments, profits and electricity production. Usually the country with the largest consumer market tends to leverage the project and often works as an economic enabler by obtaining funding for the work construction, for example, often receiving compensation for its greater contribution to the Project in the form of energy.

Currently, there are three large binational power plants in South America [2]: Itaipu (Brazil-Paraguay) with 14 GW of power, Salto Grande (Argentina-Uruguay) 1.9 GW and Yacyretá (Argentina-Paraguay) 3.1 GW. Other projects are being studied with the same binational logic with emphasis for the construction of a power plant between Brazil-Bolivia, at Madeira River and a joint wind use between Brazil-Uruguay.

Regarding its economic and financial attractiveness and feasibility from the environmental point of view, these projects are at a slow pace due to the

lack of feasibility mechanisms duly agreed between countries, and it is worth mentioning that the approach usually used still today consists in a geopolitical agreement rather than a need for electricity market.

The construction of binational projects can and should be encouraged; however, the lack of a more assertive political direction in this direction and a legal compliance accepted by both parties involved, prevent the acceleration of the implementation of these projects. Also, it is worth mentioning the case of a joint development, entirely located inside a country's territory whose market does not have sufficient scale to ensure the economic feasibility of the project, even considering extremely interesting unit costs since it would take long to be absorbed by the market of the Country holder of the potential.

This possibility has a concrete materialisation example in case of extremely economic uses in Peru, but that do not have scale for the Peruvian market individually, while the Brazilian market may ensure the exact market scale enabling the use. Another example is the Bolivian power potential called Cachuela Esperanza, which is only enabled when adding market on the Brazilian side. Thus, the possibility to add markets to ensure scale favouring the absorption of a use with compatible time for its economic feasibility, a variant of the alternative to integrate markets via construction of binational uses, seen here in the most commonly used sense, which would be the development of border potentials with sharing of costs and benefits.

4.2. Markets Integration

A more permanent and long-term approach would be the constitution of regulatory and market mechanisms between two countries with attractive integration, where the main guidelines and regulatory rules for energy trading between these countries would be set, valid for an indefinite period and that, therefore, provided comfort for investors interested in developing energy integration projects.

In other words, it would be necessary to have a technical and commercial arrangement previously approved at the Government level and, possibly, supported by a Treaty not focused on a specific project, but in any energy interchange opportunity between signatory countries, thus allowing Agents to see a sustainable technical and regulatory framework that provided the leverage of opportunities to (i) improve the operational reliability of electrical system; (ii) increase the flexibility of energy planning; and (iii) ensure an economic

and financial sustainability of the parties involved with shared gains. The different stages possible for markets integration is presented below [3].

4.2.1. Opportunity Interchange

This stage is characterised by the interruptible supply of volume and electricity price on the country's border. Such type of offer is usually established by the countries' policy-makers (in the Brazilian case the Ministry for Mines and Energy) for a determined period with very specific conditions related to the source to be provided and pre-established commercial conditions (thermal not dispatched, poured wind hydroelectric power, etc.).

As the name suggests, since it is an Opportunity Interchange it is characterised by a conjunctural energy integration defined according to the casual will of the countries involved.

Which implies negotiations and economic and regulatory discussions during each time of exchange, thus reducing operations' dynamism. Therefore, each country's operators exchange information for electricity delivery/receipt coordination on the border for each opportunity interchange. Given the conjunctural and exceptional nature of this mechanism, such interchanges do not have a price in the system operation and are not backed for consumers, as well as do not affect the structural shape of the energy balance of countries.

4.2.2. Firm Energy Contracting

Firm energy contracting involves bilateral contracts conducted directly between the parties. In Brazil, contracting could be made in the Free Hiring Environment (ACL) or the Regulated Hiring Environment (ACR). In ACR the transaction would be mandatorily made through centralised auctions aiming to serve Utility Companies.

Auctions can be for new energy with longer terms (usually 30 years for hydro and 20 for other sources) or existing energy with shorter terms (at least 1 year and a maximum of 15 years; the most common are contracts of up to 5 years). In this case, the interchange amount is limited by the buyer through a specific Clause in the contract. Such an amount of firm energy ends up influencing pricing in the short-term market (MCP) of each country; however, each party involved remains with methodological autonomy to define price in MCP and how the operated amount will be considered in its formation.

Most commercial rules are defined by the purchasing country, that is, the exporter uses the environment of the buyer's market and should adhere to its design, structure, regulation and autonomy. This implies meeting contractual requirements, financial guarantees and liability for any penalties. Non-delivery of the amount hired implies automatic exposure to the short-term market and the seller shall settle it in the buyer market. For example, if Brazil is the importer, the volume hired represents generation and may ballast sales. The company performing commercial import procedures will be accountable for all the effects of a non-delivery or short sale. Now, if Brazil is the exporter, the export shall be considered a load on the border and shall present a contractual coverage.

This mode is already more advanced than the opportunity interchange and any financial surpluses by congestion of transmission lines that interconnect countries can be allocated in proportion to the investment of countries in the interconnection. It should be also emphasised that this integration mode already requires a higher degree of coordination in countries' Energy Planning as despite the autonomy that each country still maintains, minimum agreements are necessary to consider such an energy amount a reliable resource, at least in the supply period established in Agreement.

4.2.3. Market Coupling

As suggested by the name, the countries involved present market coupling that shall demand at least a minimum regulatory harmonisation when considering the energy volumes and short-term price formation of each country, as well as volumes offered and demanded, and energy planning. There are basically three coupling modes: (i) loose volume coupling; (ii) tight volume coupling; and (iii) price coupling.

(i) Loose volume coupling

Each country defines its curve relating the Marginal Cost of Operation (CMO) and interchange (export or import curve) with price and quantity offers. A single and common algorithm between countries crosses export and import offers and sets the interchange flow. Thus, each country shall be entitled to internalise the results of this singly algorithm in the short-term market pricing, as well as commercial and regulatory discounts in its models.

Common access to electrical energy data from all countries involved is required in this coupling mode in order to conduct coordinated generation and transmission expansion studies. So that the relationship can be reliable and lasting, the countries involved should act without discrimination among the companies that make up the coupling, and methodologies to define import and export curves should be transparent and reproducible.

(ii) Tight volume coupling

Tight volume coupling implies a coordinated dispatch among countries, and the interchange is defined through a single computational model based on simplified systems information. Each operator internalises the interchange flow in its model and sets prices for the short-term market in this approach.

Transactions occur in each country's short-term market and, obviously, respect the commercial rules of the country in which the amount is being settled. This allows national energy policies to remain autonomous; however, it requires a balance of the structural balance of those involved so that short-term interchanges actually mean an optimisation of systems and not an undue appropriation of income or even a supply allowance from one country to another. In case of a structural balance, the short-term interchange can even overcome the volume of the amount hired generating differences that would be settled in the short-term market. A successful example of this approach is Nordpool's coupling with CWE (France, Germany, Belgium, The Netherlands and Luxembourg).

(iii) Price coupling

Price coupling requires a single computational model to calculate the Marginal Cost of Operation - CMO of member countries and interchange flow occurs based on detailed information of countries' electrical energy systems. National operators internalise interchange flows established by the model and calculate short-term prices with the same computational model.

So that this mode works, the coordination level should be extremely high and countries lose autonomy in their policies, thus requiring an Integrated Energy Planning comprising not only electricity but generation sources that shall be used and how this is related to other energy markets, such as the gas market. The most advanced example of this mode is CWE (France, Germany, Belgium, The Netherlands and Luxembourg) involving the operators of these countries and the electricity exchange EPEX-SPOT.

4.2.4. Market splitting

Market splitting would be the last phase of markets integration as it would only count on one operator for countries of the bloc being integrated, and each country or region would be treated as a submarket similar to what Brazil conducts internally in the National Interconnected System (SIN) operation. For example, it would be as if the SIN operation model was replicated on a larger scale, encompassing all countries that wish to be integrated where each country represents a submarket or zone.

There would be a single algorithm to define the dispatch and to form the CMO and the short-term market price. Given this integrated operation, almost full harmonisation in countries' regulation, generation and transmission expansion criteria and commercial assets remuneration rules is necessary. The most controversial point, particularly for Latin America, would be the definition of a single operator, which implies a loss of countries' autonomy and the fear that this operator acts in a discriminatory manner benefiting the countries with the largest consumer market. The two most advanced examples are MIBEL (Portugal and Spain) and Nordpool (Norway, Sweden, Finland and Denmark).

4.3. Attention points for Markets Integration

Electricity Markets Integration is more complex than it can be imagined at first as it involves a special and strategic product. As Ruben Chaer from ADME Uruguay declared [4]: *"Countries should focus more on electricity than currencies as its emission is much more complex"*.

Figure 2 summarises the different integration stages presented and allows us to reflect on focus points that should be noted by Brazil in order to leverage Markets Integration in Latin America and particularly with South America neighbouring countries.

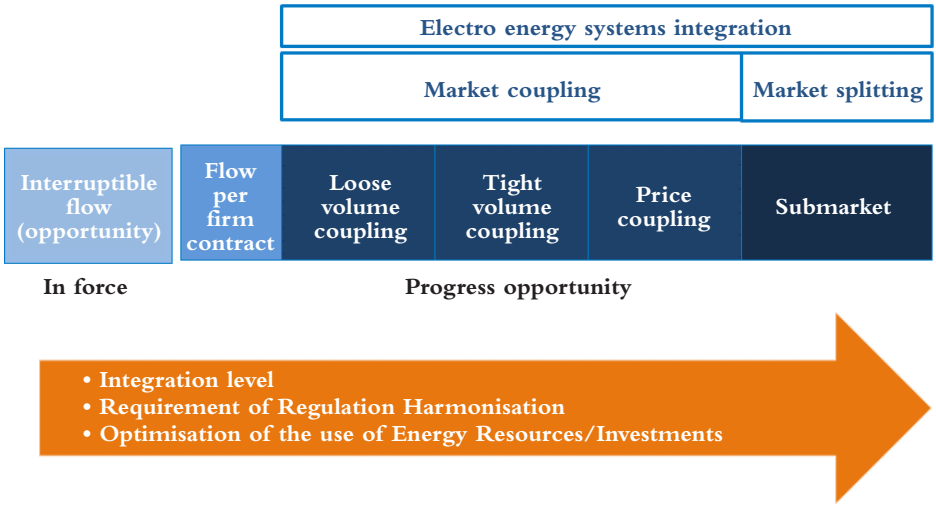


Figure 2 - Different Markets Integration stages. Source: Altieri [3]

Annex 1 also helps analysing the theme with greater detail of the operation, interchange, short-term market price and commercialisation rules. As points to be observed and/or negotiated by the countries wishing to establish electrical interconnection between them, we can mention:

1. reduced energy self-sufficiency (energy interdependence);
2. Reduced operational autonomy;
3. Complexity in legal frameworks, treaties, agreements and rules construction;
4. Expansion of risks due to changes in agreed conditions through governments interventions (for example, expropriation of assets, new laws and taxes);
5. Possible impacts on diplomatic relations between countries;
6. Definition of projects of common interest and financial viability.

The following can be listed as attention points that must be observed:

- An adaptation of commercialisation rules for the process of export and import is more dynamic and comprehensive.
- Analysing regulatory definitions related to several aspects of the Brazilian institutional model operation, such as thermal dispatch out

of the merit order and resulting charges, thus artificially affecting pricing in the short-term market and causing an impact on costs of several agents so as to identify cases in which regulatory rule may give rise to relevant obstacles for integration with neighbouring countries.

- Financial guarantees and commercial aspects as exchange rate and risk-taking.
- Tax framing of agents that will trade energy from interchanges between countries.
- Specific allotments of the trade rules system that can derail a commercial interchange process by adding costs affecting the economic feasibility of the energy interchanged.

During an integration process between countries, majoritarian winners should always exist, but in general, at least in localized terms, there are agents losers. Agents or Players anticipating potential losses are tempted to delay or prevent changes. For example, in a region that counts on more abundant power, consumers may reject integration which would be seen as desirable by generators/sellers. On the other hand, in a region with potential scarcity, generators have incentives to reject integration and import of foreign power fearing to see their margins reduced, thus characterising a situation in which, on the contrary, consumers would be favourable as they would be benefited.

Despite the complexity of the above attention points, Brazil can and should address these matters considering the strategic aspect of an Energy Markets Integration and benefits that could be obtained for the countries involved both in supply security dimension and the social and economic dimension [5].

As an example of rules and guidelines to support an activity designed to facilitate the addressing of integration difficulties already mapped today of Regulatory Frameworks of the Southern Cone countries, we can mention:

- Direct bilateral contracting between the parties, which in the Brazilian case can be both enabled in the ACL - Free Hiring Environment and in ACR - Regulated Hiring Environment, in the latter case through new and/or existing energy auction.

- Interchange can be defined by the buyer and limited to the contracted value.
- Pricing should follow the rules of each country.
- Trade rules should be defined in each country.
- Bilateral contracting resulting from the energy trade agreement between the country forms a ballast (physical guarantee) and therefore requires contractual coverage.
- If Brazil is the importer, the volume hired represents generation and may ballast sales and, on the other hand, generation charges must be paid.
- If Brazil is the exporter, export should be represented as load and shall present contractual coverage with the payment of consumption charges.
- Non-delivery of energy hired implies purchase at MCP and payment of penalties.
- Allocation of financial surplus generated through LT congestion interconnecting countries can be made in proportion to the investment of the countries in the interconnection.
- As far as possible, rules should provide fair appropriation from the economic and financial point of view, consumer integration gains, thus shielding the immediate transfer of price changes resulting from integration processes to the rate for captive consumers.
- Energy Planning should include partial coordination in order to safeguard an important level of independence for countries signatory of agreements/treaties for energy integration, under penalty of resistances preventing the initiative.

Figure 3 below presents a commercial arrangement proposal for binational project involving Brazil, considering that the model adopted for Itaipu will be hardly used again [3].

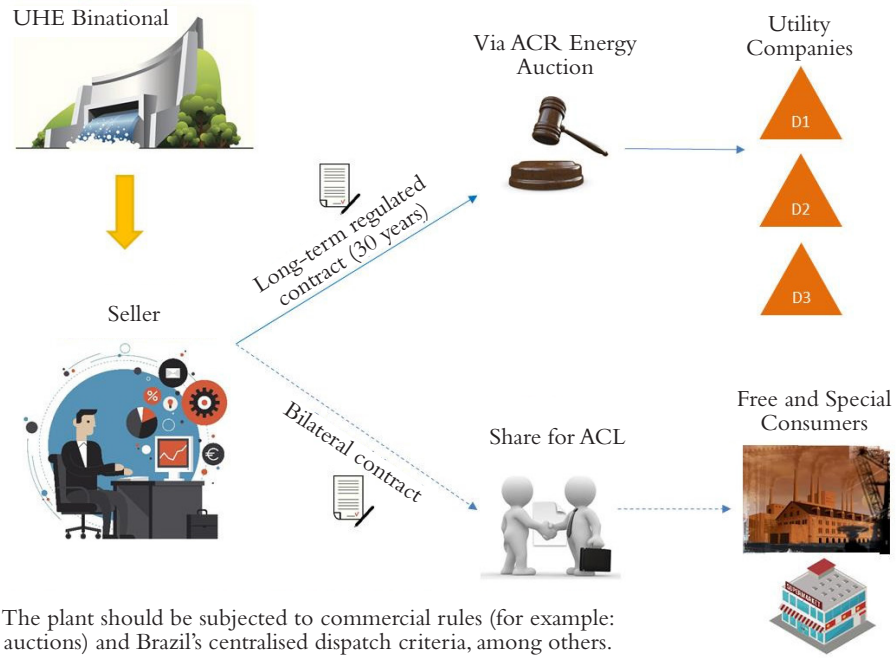


Figure 3 - Commercial Arrangement for binational project energy trade

Source: Altieri [3]

It can also be said that a significant progress in new interconnections feasibility may occur if proper procedures are adopted in integration costs and benefits analyses and decision process, such as size and financial viability of investments to expand plants and transmission lines associated with the interchange agreement being formatted, quantifying the resulting tariff impact of both sides as well as the conditions for infrastructure financing and rules to be passed on for Market Agents about the perception of legal security.

Short, medium and long-term integration modes should be defined considering specific planning, operation and trade aspects for each interchange modality, making progress in the construction of a plan for the implementation of the necessary projects (Plants, Transmission Lines and Substations), also preparing legal and commercial frameworks that allow for the integration with consistent and attractive basis for Agents, including international treaties among the countries involved for the sake of legal security also supporting the financial and operational safety of transactions to be conducted in the markets of each Country involved.

The Agreement to be signed should additionally include the explanation of treatment to be adopted in exceptional situations that may occur, such as shortages and/or energy crisis situations.

The main Agreement should also support the preparation of cooperation and agreements and procedures, and the respective competences for electricity system Planning and Operation Bodies and the markets of the countries involved, which contribute to promote the integration among markets and remove obstacles that are frequently noted due to gaps and insufficiency in the established rules.

5. Recommendations for Brazil to start the Integration process

Future progress perspectives for the Brazilian system show that projects with controllable generation (dispatchable plants requested by the Operator) tend to be relatively scarce in the interconnected system offer expansion path. Considering that new power plants are most run-of-the-river with little generation in the next semester is important; therefore, the new thermal generation is necessary to regulate the system and Brazil depends on gas and coal imports.

The main motivations for integration with neighbouring countries from Brazil's point of view can be summarised in (i) access to new firm energy sources; (ii) use of shared water resources (binational plants); (iii) reinforced supply of gas/coal or even import of thermal power; (iv) business/time exchange opportunities; (v) increased economic integration.

Brazil, as the main market in South America and Latin America should act intensively to promote the Regional Integration of electricity markets. A market splitting logic and coordinated physical operation is usually discussed, which is understood as very hard to reach at first. In fact, the reality that building an energy market similar to the European model in South America is unlikely cannot be ignored due to (i) incompatible regulatory models; (ii) several countries practice subsidies and/or prices administered in generation; (iii) greater Southern Cone market, Brazil has a commercial model that hinders an European-style integration with peculiarities that prevent the assimilation of an European model since (a) the commercial model is for physical

guarantee purchase and sale and not for energy; (b) the physical guarantee can only be calculated in a modelled system as being "closed in itself". Therefore, these obstacles put restrictions on the type of electrical integration, as an integration to the European style, considering that the energy and power market where the main "player" has a market architecture grounded in the concept of "ballast" (Physical Guarantee), is not viable.

From discussions on the recent Markets Integration Workshop promoted by BRACIER (CIER Brazilian Committee - Comisión de Integración Eléctrica Regional), it is believed that Brazil can work as an inducer of this integration complementarily, that is, by establishing regulatory mechanisms so that neighbouring countries wishing to offer and buy electricity in the Brazilian market may have free access and clear and non-discriminatory rules [7].

It is worth mentioning that Brazil has plenty renewable natural resources for generation, but with a large block of intermittent sources remaining. Therefore, energy integration with the import of firm energy can be interesting for Brazil. In this sense, a list of timely recommendations that could be adopted in Brazil to create a favourable marketplace for Regional Integration is provided below:

- **Clear regulatory mechanisms for the import and export of electricity:** Creating a regulation for companies to be established in the Brazilian market in order to import and export power. In this sense, the approached used by Colombia towards Ecuador can be a good example [1] since the country with the largest market promoted economic and regulatory incentive mechanisms to promote integration. Such a regulation should comprise matters about in which conditions the Brazilian market accepts the conduction of operations, what are the technical and commercial criteria to be observed and how the company should act and be accountable for the market operator (CCEE), system operator (ONS) and the Regulatory Agency (ANEEL).
- **Participation in electricity auctions:** Allowing importers to participation in electricity auctions to supply for the Brazilian regulated market (ACR). Considering the always sensitive nature of electricity supply in the long-term, contracts should have a shorter term (for example, 5 years) with Brazil's commitment of automatic purchase for an equal period, if the interested party shows interest one year before,

so as to give the Seller the perspective of at least a ten-year period of traded energy, important to obtain guarantees (PPA – Power Purchase Agreement) supporting the necessary financings to enable projects. This would leverage a Regional Integration, would provide guarantee of receivable for sellers who wish to build new plants and would have flexibility for the supplier to change strategy over time, considering for example the domestic market growth and the smaller space to export energy. However, a mechanism of financial guarantees and international arbitration in case of disruption of supply.

- **Construction of projects for export:** There are many power plants construction opportunities in the Amazon (binational - that is, border - or not) as well as wind and thermal projects in the Southern Cone region, which can be targeted to export and, therefore, encouraged. Despite being an integration methodology considered as a State one [6], it is understood that if conducted complementarily to market mechanisms it can be successful (examples: interruptible surplus power supply for the operator, contracts in auctions, etc.).
- **Implementation of regulatory and economic incentives:** Brazil could grant regulatory and economic incentives to attract new investments in transmission lines in order to increase interconnections available and thus reduce interchange restrictions, particularly when the country has abundant resources and another have shortage.

6. Conclusions

A new, not only commercial, but especially energy integration trend is consolidated in several parts of the world as a way of optimising existing generation projects and, as a by-product, minimise the need to expand new plants harming the environment to meet the growing demand of countries that participate in this integration. This movement already exists between Canada and the US, Germany and Austria, Norway, Sweden, Finland and Denmark and is developed in the European Union, in Austral Africa and MERCOSUR.

It is justified, since Electricity Markets Integration is undoubtedly very important both in the political dimension and economic and electro energy

dimensions. Integration provides members with greater political weight in multilateral negotiations, and enable economies of scale in electricity production and transmission, also resulting in increased supply security. Notwithstanding, there must be a strong political will to make intention become a reality assuming a competition environment as a solution for fair prices for end consumer (European common market decision in the 90s).

Market designs can even be different (and this shall occur for a long time...); however, some common characteristics are essential for successful international markets integration initiatives as (i) credibility, (ii) transparency and (iii) legal safety. Adapting modern tools and solutions of the European market to markets of Southern Cone countries, each in its time, yet pursuing a goal of gradual evolution and convergence in the long run is a recommended agenda to achieve the minimum requirements of mature markets.

In this sense, it should be emphasised that energy integration of Southern Cone countries is a positive agenda that should be faced objectively, remembering that the power market will not be complete if it continues to be seen as a purely national matter. Also worth mentioning is that the impact of international relations is not entirely incorporated in South American integration planning; therefore, making efforts for a joint agenda among governments with this purpose is recommended.

Currently, South America has a relatively low Regional Integration level given the existing potential. Integration started with binational plants anchored in international treaties aiming at mitigating the political and economic risk as they are strategic projects with long maturation term.

Experiences working in MERCOSUR are summarised to Itaipu power plants (Brazil and Paraguay), Yaciretá (Argentina and Paraguay) and Salto Grande (Argentina and Uruguay); and gas pipelines of Argentina with Brazil, Chile and Uruguay; and Bolivia with Argentina, Brazil and Chile. Growth of electricity demand could lead to the structuring of an "energy pole" including Brazil, Argentina, Paraguay, Bolivia and Uruguay. Another example would be Garabi and Panambi (2,700MW), at Uruguay River (Alto Uruguay) which, in addition to solving Argentina's supply problems could operate harmoniously with other upstream river projects and provide great energy optimisation.

Paraguay, a small consumer, is a large energy exporter. And the same happens with Bolivia whose major contribution is the supply of natural gas, but

with inventoried hydroelectric potential of over 30 GW. Therefore, there are conditions for an excellent complementarity and synergy for a strong motivation around the implementation of an "energy pole", after adaptations to existing differences in cycles without technical impediments and absorbable costs. Projects known that can be easily integrated to existing transmission networks include the use of Corpus Christi (3,000MW) at Paraná River, for example, located in the triple border between Paraguay, Brazil and Argentina, and it is relevant to stress that the project is situated near highly developed basins and thereby generates benefits to the Brazilian preservation system and thermal complementarity to Argentina. In addition to binational plants, the case of integration in the "opportunity interchange" mode should be highlighted as it happens quite often, usually conducted to meet State policies, with visible lack of consistent market mechanisms.

Integrating electricity markets is not a simple task and there are many ways of promoting this integration. Europe is the most advanced continent in this sense, having examples of integration by coupling methodology (volume and price) and examples of full integration, which is also known as market splitting.

Attention points include that SIN operation in Brazil is a sophisticated technique created and developed for a certain situation, now greatly changed and, therefore, that must be adapted to the new reality of Brazilian generation using diversified primary energy sources and in different regions. Besides, the Brazilian SIN operation system should be adapted to fit the case of integration of different countries and different dispatch structures, including eventual seasonal exchanges of electricity from one country to another.

In this context of assessment Brazil should promote a favourable marketplace for countries wishing to export or import electricity from the country through clear and non-discriminatory rules. Thus, four actions that could be adopted by Brazil to promote region integration are recommended: (i) clear regulatory mechanisms to import and export power; (ii) allow the participation of importers from electricity auctions to meet ACR; (iii) encourage the construction of binational projects through market mechanisms; and (iv) facilitate new investments in interconnections.

It is also worth noting that, except for the case of binational use that should have a case by case rule due to each country's participation in the plant investment, integration level already existing among markets, etc., Bra-

zil's integration with other Southern Cone markets with which it has borders should be established as "Loose Volume Coupling" where each country calculates its Marginal Cost of Operation independently and is free to continuously set purchase and sale prices by adding the margin it deems appropriate in relation to the pure marginal cost in electricity connection point(s) (addition of congestion costs, for example). The Operator of each system shall make a simulation to define the amount to be interchanged economically respecting the amount limitations that should be informed by the Operators of the markets of each country coupled.

Electricity Integration Markets can be strategic for Latin America to increase its weight in geopolitical negotiation, especially South America, increase competitiveness of its industries in the global market and promote supply security for its societies.

References

[1] MAYA, Cecilia. XM - Integrácion de Mercados: Caso Colombia. In: **Workshop de Integração de Mercados**, Rio de Janeiro 17 e 18 de setembro de 2015.

[2] Comisión de Integración Energética Regional – CIER**. Proyecto CIER 15 Fase II: Informe Final**. Montevideo, 2010.

[3] ALTIERI, Rui. Câmara de Comercialização de Energia Elétrica - A comercialização de energia elétrica no Brasil e possíveis avanços nas fronteiras. In: **Workshop de Integração de Mercados**, Rio de Janeiro, 17 e 18 de setembro de 2015.

[4] CHAER, Ruben. ADME - Integración de Mercados: Caso Uruguay. In: **Workshop de Integração de Mercados de Energia**, Rio de Janeiro, 17 e 18 de setembro de 2015.

[5] MELLO, João Carlos. Thymos Energia – Integração de Mercados: Overview sobre experiências internacionais. In: **Workshop de Integração de Mercados de Energia**, Rio de Janeiro, 17 e 18 de setembro de 2015.

[6]BRANDÃO, Roberto. GESEL – A integração elétrica do ponto de vista

do Brasil. In: **Workshop de Integração de Mercados de Energia**, Rio de Janeiro, 17 e 18 de setembro de 2015.

[7]DUTRA, Joisa. FGV CERI - Integração Energética na América Latina no século XXI. In: **Workshop de Integração de Mercados de Energia**, Rio de Janeiro, 17 e 18 de setembro de 2015.

[8] PRAIS, Marcelo. ONS - A experiência brasileira com interconexões e as perspectivas do Operador. In: **Workshop de Integração de Mercados de Energia**, Rio de Janeiro, 17 e 18 de setembro de 2015.

Annex I – Summary of Markets Integration modalities

			Market coupling		Market Splitting
Model	Interruptible flow (opportunity)	Flow per contract	Volume coupling	Price coupling	Market splitting (submarket)
Operation	**Coordinated (one or more operators)**				**Integrated (single operator)**
Interchange	**Agreed by countries**	**Defined by contract**	**Defined by separated models**	**Defined by the single model**	**Defined by the single model**
MCP Price	**No**	**Calculated by country**	**Calculated by country internalising the interchange defined in a coordinated manner**	**Determined by the same model that determines the interchange**	**Defined by the single model**
Contract	**Interruptible**	**Firm**			
Ballast	**No**	**Yes**			
MCP	**Net energy in MCP**	**Accounts contract on border and calculates ballast**	**Yes (structural balance needs to be ensured and the transmission capacity needs to be proper)**		
Commercialisation rules	**Agreed**		**Similar**		**Equal**
Energy Planning	**No**		**Coordinated**		**Integrated**
International experience	**Central America (MER)**	**LP contracting in Europe**	**Nordpool + CWE**	**CWE**	**Nordppol**

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BRAZIL-PERU ENERGY INTEGRATION: HISTORY, CHALLENGES AND FUTURE PERSPECTIVES

Paula Franco Moreira[1]

1. INTRODUCTION

Driven by the then projection of increased demand for power and the growth and internationalisation of large Brazilian companies, Brazil started negotiations with the Peruvian State to sign an Energy Cooperation Treaty in 2006, which was finally signed in 2010, by the respective ministers of the Ministry for Mines and Energy of each country providing for the construction of power plants (UHEs) in the Peruvian Amazon to generate approximately 7,200 MW/h of electricity to Peru and export the surplus to Brazil.

During negotiations, it was noted that such works would be built by Brazilian companies as Odebrecht, Construtora OAS, Furnas, Andrade Gutierrez, Engevix and Eletrobrás. This is an "umbrella" agreement that supports the establishment of at least five power plants to export electricity to Brazil. Projects of power plants that would bar Inambari, Urubamba, Junín, Ene, and Tambo rivers are located in remote areas of the Peruvian Amazon, near the border with Brazil. They are inhabited by indigenous people, traditional communities, farmers, coca growers, miners and other local populations, and have high biodiversity and endemism index. These rivers in Peru flow into Madeira river located in the Brazilian territory. Peru is considered strategic for Brazil once it is positioned upstream in relation to the other Amazonian riverside countries. In this context, preparing a form of agreement on the use of its river waters becomes relevant for Brazil in geopolitical terms. The additional benefit of buildings these dams on upstream rivers is also evident to allow better control of Madeira river flow (downstream) and thus better

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planning and control of Santo Antônio and Jirau do Rio Madeira power plants operation.

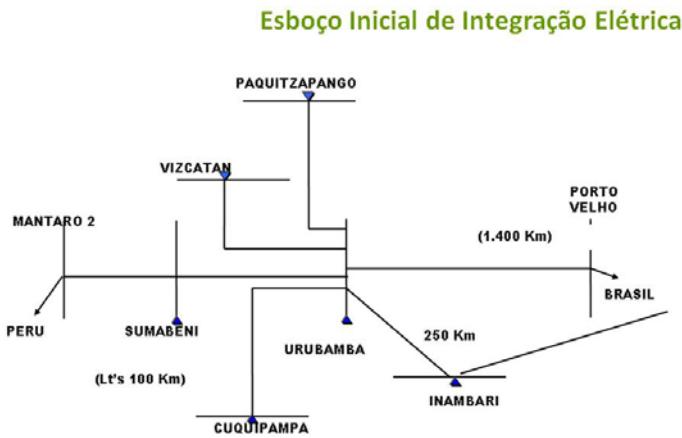
The agreement, involving various stakeholders and impacted players (indigenous groups, peasants, coca growers, Peruvian Amazon miners, local governments, academy, non-governmental organizations, among others), was and remains ample debated by the Peruvian society, and also, a sophisticated campaign opposing the construction of power plants supported by this treaty and against their own ratification. As a consequence of these social manifestations and socio-environmental, political, economic and regulatory barriers, as well as situational factors to be discussed in this article, the agreement ratification process is suspended in both national congresses and the five planned works[2] are paralysed. In Peru, the National Congress Foreign Relations Committee decided not to approve the project that proposed the approval of the Brazil-Peru Energy Agreement on 23 May 2014, determining the project archiving. In Brazil, the agreement was returned by the Staff to the President to Itamaraty where it is filed.

The map below shows the location of planned power plants:

2 Paquitzapango (2,200 MW), Inambari (2,000 MW), Tambo 40 (1270 MW), Tambo 60 (579 MW), and Mainique 1 (607 MW). (ELETROBRÁS 2013).

Map 1. Location of power plants for the export of electricity to Brazil; these will be built by Odebrecht, OAS, Furnas, Andrade Gutierrez, Engevix, and Eletrobrás with indication of place for interconnection. Source: Adapted from Eletrobrás, 2012.

According to the Electric System National Operator (ONS), transmission lines from Peru to Brazil would be initially built as follows:



Source: CHIPP, 2009.

Figure 1 Electrical Systems and Energy Integration.

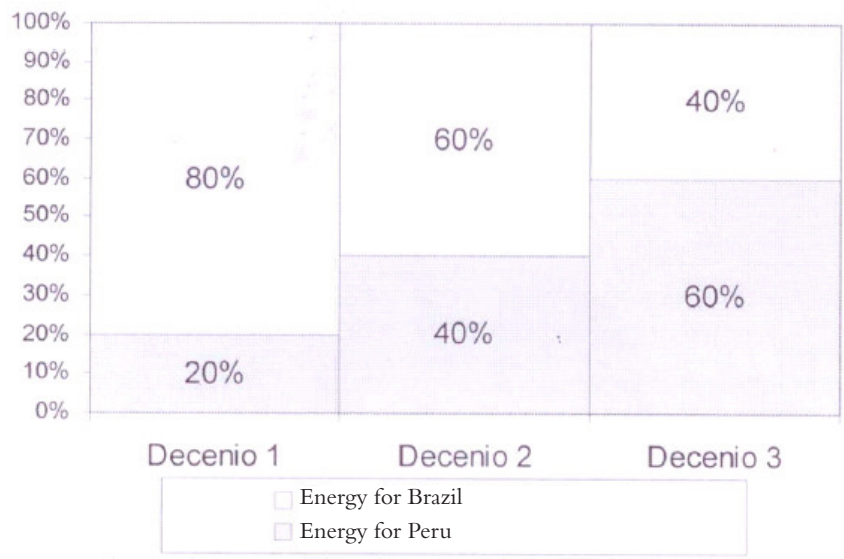
In this context, this work has the main purpose of analysing a brief history of Agreement (item 1) negotiations and the most relevant barriers that led to the suspension of planned power plants projects (item 4) within the page limit established for this chapter. Therefore, the relevance of regional planning for the integration process will be presented on item two. Item three will show some of the relevant aspects of the Brazilian and Peruvian power industries, differences and complementarities that justify the integration and also make it a challenging process to be put in place. In item four, the main situational factors and barriers to the social, environmental, political and regulatory progress of this integration will be analysed. Lastly, possible paths to be followed in order to succeed in Brazil-Peru energy integration are suggested.

2. Brief History of Negotiations and the Agreement

The first record of negotiations between Peru and Brazil on energy issues was around 2006. A *Memorandum of Understanding* was signed this year in Brasília in order to established a Permanent Joint Commission on Energy,

Geological and Mining Matters among the Ministries for Mines and Energy of both countries. This memorandum already provided for a permission for Brazil to study, fund, build and operate up to six large power plants in Peru in order to meet its power needs, thus buying most part of the electricity produced from Peru.

MINEM's first proposal to MME on the quantity of electricity to be exported in Peru-Brazil energy integration was presented in 2009. Such a proposal determined that power plants electricity inside Peruvian territory would be sent to the Brazilian market in stages: 80% of the production of each central during the first ten years, 60% during the second decade and 40% during the last ten years (Figure 2). The difference would be destined to the Peruvian market when after completing the 30 years concession term, 100% of the production would be intended for the Peruvian market, which is the time the country would need to expand consumption and generate such a demand for electricity. Additionally, the Official Letter shows that effective powers of all power plants developed within Peru-Brazil agreement framework would be at least 2,000 MW and maximum 6,000 MW.



Source: MINEM. 2009b.

Figure 2. Peruvian proposal of electricity percentages for Brazil throughout three decades (light Brazil and dark Peru).

However, such decreasing percentages were questioned by Brazil as the electricity trade model for the Brazilian regulated market (hiring of new energy by utility companies) requires a constant quantity of firm power for 30 years (AVANZINI, 2010, p. 49). It was undoubtedly one of the greatest diplomatic battles to be won to sign the agreement. Without reaching a consensus, the Agreement signed does not mention a minimum or maximum quantity of electricity to be exported to Brazil over time. The signed version does not mention a minimum or maximum quantity of electricity to be exported to Brazil over time; however, it sets a sequence of supply priorities. Clause 3, "b" of the agreement establishes that from generation, electricity supply will be offered according to the following priority order: 1) Offers to the Peruvian regulated market. In case there is electricity remains, it passes to priority 2: 2) Offers to the Peruvian free market. In case there is still electricity remains, it will be offered in priority 3: 3) Offers for export to Brazil *for 30 years*[3].

In 2010, before Peru-Brazil Agreement was signed, three documents in this negotiation process were checked: Note no. 5-2-M/055 dated 17 February, Proceso de Negociación Perú-Brasil no. 144 dated 12 March and Revisión dated 3 May. Lastly, the *Acuerdo para El Suministro de Electricidad al Perú y Exportación de Excedentes al Brasil* was signed on 16 June 2010 by the ministries for mines and energy from both countries[4].

3. THE POWER INDUSTRY IN BRAZIL AND PERU

3.1. The Peruvian hydroelectric potential

The last decades were characterised by a rapid process of occupation of the Peruvian Amazon through the implementation of road infrastructure, oil exploration and gold mining, and strong expansion of agricultural and forestry activities. During this process, the opportunity to explore a hydroelectric potential of the Peruvian Amazon was noted through studies developed in the 70s by the company Lahmeyer-Salzgitter and funded by the German cooperation (then GTZ) and the World Bank. The studied showed that there

3 To deepen the regulatory differences and discussion of the Agreement clauses, see chapter 3 of MOREIRA, P.F. 2015 and item 4 below.

4 Unlike the pictures in newspapers, the agreement was not signed by the President, but its ministries. (CASTRO, MARIANO, 2014)

is approximately 200 thousand MW summing the basins of the Pacific, Titicaca and Atlantic, according to information from the then Deputy Minister for Mines and Energy of Peru Daniel Camac during negotiations (MINEM, 2009a). Since 2010, it is noted that the Ten-Year Energy Expansion Plan (PDEs) prepared by the Brazilian EPE (MME Energy Planning Company) already consider electricity to be generated in Peru mentioning the inventory and feasibility studies "indicating the possibility to export exceeding energy to Brazil by interconnecting the electrical system in the State of Rondônia" (MME/EPE, PDE 2019 (2010) and PDE 2024 (2015, p. 74)[5].

Given the potential magnitude of low electricity demand in Peru (an average of 7,000 MW per year) and significant use of gas for electricity generation, whose deposits are far from exhausted, it became clear that the country would not use this hydroelectricity potential anytime soon. According to the open economy model aimed at the market and with little intervention from the State, reinforced in the presidential managements of Alan Garcia and Ollanta Humala, such a potential of energy natural resource was broadly seen by Alan Garcia's government and also in Humala's management as a commodity. And in this sense, a commodity can be sold to any interested parties provided that the operation is made with expertise and provides financial resources and taxes to the country.

3.2. Brazilian and Peruvian power industry regulation

The Brazilian and Peruvian power industry, as in other South American countries, underwent sector reformulations and faced problems with their new regulatory models despite having chosen different paths. Brazil has the configuration of a hybrid model with a very meaningful participation of the State, especially in what regards to sector planning (for example: PDE, the Ten-year Energy Plan and PNE, National Energy Plan annually updated by EPE). On the other hand, Peru has a greater opening of private capital in all segments (generation, transmission and distribution) and, especially, the lack of long-term energy plans by the Government by 2014, which was a a reason for concern in discussions for the development of the power integration

5 Regarding energy integration, the last PDE 2024 states that: *"There are projects to build six power plants in Peru totalling almost 7 GW of installed capacity. Use of 2.2 GW from Inambari is the most advanced one, located at approximately 260 km from the border with Brazil (…) indicate the possibility to export exceeding energy for Brazil interconnecting the electrical systems in the State of Rondônia"*. PDE 2024 (2015, p. 74).

agreement with Brazil[6]. This major differences between the planning level and regulations of countries makes integration even more challenging.

In addition to regulatory and institutional differences, the electricity market in Brazil has an installed power fourteen times higher than the Peruvian one[7], and has its water basis. In the Peruvian case, it is noted that hydraulic power participation was 52% in 2013 while the thermal power was 46% (MINEM, 2014-a). This was because the thermal park had a more substantial increase than the hydroelectric park, especially for the increase in natural gas proved reserves and, consequently, use in thermal generation. Taking into account the Camisea gas pipeline vulnerability, the greatest gas provider of the country, it is important to emphasise that there are sectors of the Peruvian society concluding that there will be a growth in hydroelectricity demand in order to reduce the reliance on Camisea gas. In this sense, the debate on the Agreement's non-ratification by the Peruvian congress is extremely important to a potential energy supply crisis in 2016 and beyond due to the lack of hydroelectric projects' entry.

In this context, the Brazil-Peru hydro energy integration could bring benefits to both countries at first, thus enabling Peru to produce more power, acquire technology and infrastructure and gain revenues with the export of the electricity surplus to Brazil. In Brazil, integration would help to meet part of the power demand[8]. However, the reality showed that ideas for real regional energy integration face enormous difficulties to become a reality until today, and require a deeper and regional planning, fulfilment of social and environmental conditions and favourable situational factors, as it will be discussed below.

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6 The *National Energy Plan 2014 - 2024*, published on November, 2014 comprised the projection of final power consumption and increased power demand in Peru for the first time, and how to heal it according to power and electricity sources in the country. According to the plant, demand is expected to grow from the current 5,800 MW to around 9,500 MW and 12,300 MW by 2025, according to both GDP growth scenarios from 4.5% and 6.5%, respectively.

7 To get an idea of the significant difference between electricity markets: The installed power of electricity generation in Brazil was 124,000 MW in 2013. In Peru, it was 11,051 MW. Electricity consumption was 40,000 GWh in Peru, in 2013, while it was 481 TWh in Brazil, in 2014. Maximum electricity demand is expected at 12,300 MW for Peru, in 2025 (in case of GDP growth of 6.5%) and the Brazilian forecast is 689 TWh in 2023. For further analysis and comparisons, see chapter 1 of MOREIRA, P.F. (2015).

8 Although in the current scenario of economic crises in Brazil with an estimated negative growth of -3.2% of the GDP for 2016 and an increase of only 1.36 for 2017 (BCB, September, 2016), it should be reminded that the country's power demand should be adjusted to the GDP forecast.

4. CLIMATE CHANGES, REGIONAL PLANNING AND ENERGY INTEGRATION PROCESS

Proper regional planning between countries involved in watersheds is a fundamental aspect of the hydro energy integration process supported by legal and institutional instruments. *Energy integration for full, sustainable and solidary use of regional resources* (article 3, "d" of Decree 7.667/2012 that enacted Unasur Constitutive Treaty) is one of the goals of the Union of South American Nations (UNASUR). The South American Council on Infrastructure and Planning (COSIPLAN[9]) was created in 2009 within the scope of UNASUR, and it was comprised by ministries of planning, energy, transports and communications from twelve South American countries with the purpose of enabling and monitoring the implementation of projects with great impact for physical integration and regional development. COSIPLAN prepared two instruments that aim at structuring its work over the next decade: the Strategic Action Plan (PAE) 2012-2022 and the Integration Priority Projects Agenda (API) with 31 projects (IIRSA/COSIPLAN, 2011). However, only one project entered the API within the Peru-Brazil-Bolivia integration axis, which is called land "*Porto Velho - Peruvian Coast Connection*". Energy integration works between Peru and Brazil **are not** included in the API. In this regards, many authors criticise the API once it does not prioritise the region's energy integration (Oliveira 2010), which ended up making room for countries to submit the integration at bilateral level[10].

However, regional power integration prepared with due supranational planning of the use of natural resources in an integrated way in the South American continent and compliance with social and environmental conditions may bring a series of benefits for the continent, such as: (1) hydrologic complementarity; (2) higher level of reliability and efficiency from the economic point of view; (3) possibility to exchange surpluses of electricity between countries; (4) optimisation and guarantee of power supply in the region; (5) avoid changes

9 COSIPLAN included the Initiative for the Integration of Regional Infrastructure in South-America (IIRSA created in 2000) as its technical infrastructure forum.

10 This is the case until the energy integration in South America, as it occurred upon binational projects in which each country held half of the installed capacity and production, being able to negotiate or not the surpluses of electricity generated (for example, Itaipu Binacional). These works do not express an energy plan or a multilateral integration, but punctual motivations between two countries (Castro *et al.* 2009).

in direction during the execution of works and, consequently, waste of money; (6) reduction in social and environmental impacts of watershed works as Andina and Amazon; and (7) Advances in the construction of a supranational governance necessary to resolve local and frequent cross-border conflicts such as the initiative for Brazil-Peru energy integration. According to Castro *et al.* (2009), the Amazon Basin, the largest river basin in the world, extends through the territories of Brazil, Bolivia, Peru, Ecuador, Colombia and Venezuela and is crossed by the Equator, which causes double capture of summer floods: from November to April in the southern hemisphere and from May to October in the northern hemisphere. This double regime of rains in the Amazon Basins provides an important hydrological complementarity to South America. In this regard, we agree with Pedro Bara (2014) that in the current context of climatic changes with change in rainfall patterns, the most attractive measure of climate adaptation is the Amazon energy integration, a region of the so-called last "great South American hydroelectric border." Recent studies already modelled the impacts of climatic changes on rainfall indices for the South American region and, therefore, the energy planning sector of the Brazilian government has given signs that other renewable sources besides power plants must be considered. The study "Brazil 2040: Scenarios of Adaptation to Climatic Change", coordinated by the then SAE (Secretariat of Strategic Affairs of the Presidency of the Republic) made an exercise of regionalisation of global climate models made by IPCC (Intergovernmental Panel on Climate Change), the United Nations climate panel. Maps from this study indicate that the Southeast and Midwest will be drier in 25 years; flow of rivers in the Amazon may be reduced. Such climatic regionalised scenarios refer to the period from 2010 to 2100 and are comparable to the weather observed since 1969 until now, showing the trend of extreme weather indicators, temperature frequency distribution and precipitation in temporal clippings 2011 to 2040; 2041 to 2070; and 2071 to 2100. The final purpose of this tool is to provide the necessary support to dimension the climatic risks in the country's planning and development. Brazil is able to learn the scenario and prepare itself in time and increase its resilience before projects impacts of climatic changes through this tool[11].

11 Climatic maps are a result from the partnership between the Secretariat for Strategic Affairs of the Presidency of the Republic (SAE/PR) and the Ministry of Science, Technology and Innovation (MCTI) and today, after the extinction of SAE, are in the National Infrastructure Spatial Data website (INDE). Information available on the institutional website of http://www.inde.gov.br/noticias-inde/8274-saiba-como-acessar-os-mapas-climaticos-do-brasil-na-inde.html visited on 20/09/2016.

Another advantage of markets integration indicated by Castro *et al* (2009) is the greater level of reliability and efficiency from the economic viewpoint once the integration would allow for the compensation of eventual disparities and water shortcomings with the exceeding energy from other countries.

4.1. Hydropower planning instrument for Amazon-Andean Basin

Although supra regional official governance and planning institutional bodies of the region that includes the Andean-Amazon basins have not developed until now a participative planning mechanism for the advancement of hydropower in these basins, it is worth remembering that there is a tool with this goal developed by the international environmental NGO World Wildlife Foundation, WWF, since 2008. According to WWF, the tool is a system to support the decision mainly focused on conservation priorities. It aims at developing hydropower in the region, taking into account ecological factors in order to have more sustainable projects. The "Hydrological Information System; Amazon Region Assessment (HIS-ARA)" uses studies already modelling the impacts of climatic changes in the pan-Amazon region rainfall indices and was made based on terrestrial physical and aquatic, biological and hydrological information. The tool enabled the preparation of a long-term view to respond to the following question: how to ensure the most cost-effective representative, functional, efficient and resilient sample of the Amazon biodiversity in the future? (RIVEROS, 2008). In a simplified summary, the tool involves combining six parameters, ecological risk index, conservation opportunities based on conversation areas and indigenous territories already titled, terrestrial ecosystem, types of terrestrial habitats, marked by the parameter of the need for conservation of a minimum of 30% of each habitat type (as per global UN biodiversity convention targets). This calculation generated a score of areas that would be irreplaceable. The planned instrument used a conservation systematic planning approach obtaining a prioritisation based on the principles of representation, connectivity among rivers, possibility of replacement, functionality, flexibility and vulnerability (MARGULIS & SARKAR, 2007).

Considering over 60 large dams planned for the Brazilian Amazon (FEARNSIDE, 2015), this tool uses hydropower planning in the Amazon in a watershed perspective as a whole and not by sub-basins as it has been done by the National States and the Amazon and Andean basin alone. For

example, for Inambari power plant of 2,000 MW provided for on treaty, the tool showed that since this river is already very polluted due to mining and other human actions, this river would be passed over for other conservation purposes.

We argue that this tool is exactly the kind of instrument a regional governance organisation as Cosiplan, UNASUR, CIER, Olade or OTCA could develop to provide guidance to countries in the region, since economic and social benchmarks are added as the identification of economic activities and local communities to the environmental already provided. In addition, if developed with a diversified participation of countries in terms of civil society, States representatives, companies and academy, this tool would have the necessary legitimacy and thus greater capillarity.

Despite the evident benefits from an energy integration, dealings now analysed reveal numerous social, environmental, political, regulatory and conjunctural obstacles in this process, which are not allowing the hydropower integration to enjoy such benefits. Some of the obstacles will be analysed in the following item, making it possible to build some recommendations exposed in the end.

5. BARRIERS TO BRAZIL-PERU ENERGY INTEGRATION

5.1 Social and Environmental Factors

Evidently, in case Peru makes progress with electricity generation through power plants, greenhouse gases will have decreased emission than the use of natural gas in thermal plants. However, other environmental barriers for the implementation of hydropower projects planned in the Andean and Amazon basins were raised by the Peruvian and international society. One of the barriers determined is the break in connectivity between both river basins for the first time.

Recent studies show that the Amazonas river is intrinsically linked to the Andes mountains for over 10 million years, so that sudden breaks in this connectivity by building power plants on rivers that connect such basins can bring severe and unpredictable impacts on all South American species (Finer y Jenkins, 2012). Authors noted that the Andes provide sediment,

nutrients and organic matter to Amazonian rivers supplying raw material to the ecosystem considered the most productive on the planet. It was the first study to measure the impacts of all power plants planned in Andean-Amazon basins, including five of the six major Andean flows of the Amazonas river, and noted that the most threatened rivers connectivity is precisely those originating in the Andean Peru and Ecuador falling into the Amazon basin[12]. On the analysis of all power plants expected for both basins, researchers noted that 151 new power plants with power above 2 MW are planned over the next 20 years, thus reflecting an increase of over 300% in relation to 2012. The analysis showed: (1) that 60% of power plants would cause the first major break in connectivity between Andean sources protected and low Amazon; (2) that 47% of the ecological impact from new power plants is classified as high and only 19% as low; (3) that over 80% of these works would cause deforestation due to new roads, transmission lines and flooding; and (4) that 40 out of 151 dams planned for the Amazon basins over the next 20 years would be built immediately upstream or downstream in an Indigenous Land[13].

In addition to environmental concerns, negotiations for this agreement were handled with great discretion by governments until the signature of the Treaty in 2010. For this reason, according to sectors of the Peruvian society, these dealings had a long history, unknown and not transparent to the Peruvian and Brazilian societies (Dourojeanni 2010), which collaborated to awaken the feeling of distrust of the dealings.

The main demands of the civil society institutions contrary to the Peru-Brazil Agreement are as follows: (i) prioritisation of supply to Peru before exporting the potential energy of natural resources for another country (for energy safety); (ii) greater regional, social participation and transparency of the energy sector (LA ROSA, 2011); (iii) protection of Indigenous Lands and environmental reserves; and (iv) coherence between conservation of biodiversity, extraction projects and climatic change.

12 In this sense, researchers developed a conceptual framework based on planned power plants, roads and transmission lines from power plants in government portfolios to estimate relative impacts of all power plants in tributaries of Amazonas river (Caqueta, Madeira, Napo, Marañon, Putumayo and Ucayali) involving five countries (Bolivia, Brazil, Colombia, Ecuador and Peru) in order to estimate relative impacts of all power plants and define their level as high, medium or low.

13 These results led the study authors, Finer & Jenkins as well as other authors, to question the UHE classification as a clean energy source and also as a reason for requests of carbon credits.

Regarding item (iii) above, the indigenous nongovernmental organisation (NGO) *Central Ashaninka do Río Ene (*CARE) sued the Peruvian State and submitted letters to the Inter-American Commission on Human Rights, among other recipients, questioning Brazil of the negotiation and compromising their ancestral Indigenous territories, demanding respect for the *"right to live in peace and according to their traditional way of life"* (CARE 2010)[14].

For geopolitical reasons, social and environmental, and economic arguments, among several others, which are not addressed here due to limited space, the Brazil-Peru energy cooperation agreement is target of a campaign built by a transnational advocacy network of the Peruvian, Brazilian and American civil society[15]. The author of this article collected a series of newspaper articles of Peru and society manifestation transmitting the image created from Brazil and Peru since the revelation of signature of the Agreement with Brazil, such as *"The energy fever of Brazil shall flood the Peruvian jungle (El mundo, 2010)"* among others (see Attachment I a paradigmatic example). Such manifestations evidenced the operation of Brazilian companies (named champions) supported by the Brazilian government and the then Government of Alan Garcia caused outrage by local populations potentially affected by the works.

5.2 Bagua and Conga Political and Electoral Factors, and Social Conflicts

In Peru, the election of Ollanta Humala in 2011 changed the direction of how to solve the country's energy demand, which also collaborated to stop efforts for energy integration with Brazil. Humala has been focusing political efforts to build a gas pipeline to transport gas from Camisea fields in the Andes to supply for thermal plants on the south coast, thus providing, electricity

14 CARE acted along with other national and transnational NGOs members of the campaign articulated by the transnational network of advocacy of "*Colectivo Hidrelectrica Amazonia*". These manifestations made Odebrecht give up on the UHE Paquitzapango Project and motivated the receipt of the international environmental award by the president of CARE, Ruth Buendia, granted by Goldman Foundation in April, 2014. Information at: http://www.goldmanprize.org/recipient/ruth-buendia. See some campaign documents on the Attachment of this article and further information on MOREIRA, P.F. 2015.

15 Mapping of the transnational campaign players against the Agreement and power plants, its strategy, arguments, instruments, successes and failures, as well as the analysis of conjunctural factors are widely discussed in the doctoral thesis of the author of this article. See MOREIRA, P.F. 2015.

for this region and fulfilling the campaign promise for the first time[16]. In addition to these plants, Humalla plans to build a petrochemical complex in this region, which should be supplied through the pipeline.

In addition, the violent conflict with Bagua started in the Amazonas department in 2009 contributed substantially to destabilize the end of Alan Garcia government also causing effects in the government of Ollanta Humala. The indigenous protested to avoid the implementation of policies in Alan Garcia's Government to ratify the Free Trade Treaty with the USA in this national conflict, including the exploration of oil and sale of lands where the indigenous worked and lived (SILVA, T. L. A. 2010). The motto of the Peruvian Indigenous Movement was "*La selva no se vende, la se defiende*!". News say that there was a confrontation between the police and the indigenous resulting on the death of at least 33 people. Such a confrontation caused a deep institutional crisis in both Governments, but in Ollanta's Government the conflict repercussion led to exoneration of many representatives of the Executive Power.

Both conflicts, widely reported in the international media, made the Peruvian government take a step back in the implementation of any project in the Amazon with impacts on local people, fearing further loss of popularity and governance.

As a response to the criticism on the enormous freedom to foreign private capital to the detriment of the quality of life of populations, the Peruvian government has sought to change the institutional arrangement of infrastructure projects to give more space for the participation of national players. In this sense, the name of Electroperu in the construction of Inambari over Egasur, with 100% of Brazilian capital emerged in 2014[17].

Furthermore, the violent conflict in Conga mining (2012) in Cajamarca's region in the high Peruvian Amazon (high jungle) made Humala's Government to step back its rhythm to implement any other project in the Amazon with impacts on local populations fearing greater popularity losses. The project intended to explore gold, silver and copper, thus generating a great

16 The Peruvian Government now also mentions the electricity export to Chile using Inambari or Camisea, but does not consider export to Brazil as feasible, as it will be read further at "Reapproximation with Chile".

17 "Peru wants to retake the plant project of US$ 4 bi with OAS". Reuters, Brasil Econômico - Mundo 14/03/2014. Available at http://www.bracier.org.br/noticias/brasil/4924-peru-quer-retomar-projeto-de-usina-de-us-4-bi-com-a-oas.html Visited on 20/09/2016.

environmental impact on the region, destructing four lagoons connected to river sources, especially used by the local population to supply agriculture. (DAFFÓS, 2012 *apud* ALMEIDA, 2014). In addition to the certainty in environmental degradation, one of the main disagreements of farmers is in the territorial domain that the project represents. In Cajamarca, concessions are of over 40% of territories, and in other regions it reaches almost 60% of concession of the territories in the region. The argument that mining generates wealth for the population is also rejected since it is estimated that less than 1% of the wealth will effectively stay in Cajamarca. Given the divergence, the local Government summoned the population for a general strike against the project. During three days of manifestations, five protesters were killed and many others were arrested: the event was known as "the massacre of Cajamarca". Despite the opposition of the local Government, the mining company has the support of the national government to facilitate the company's plans. Given the difficulty to implement a project that will cause major irreversible environmental damages and the local population resistance, Conga's project is currently paralysed in the search for a conciliation of interests (ALMEIDA, 2014, p. 105).

On the Brazilian side, the election of Dilma and the fact that the necessary attention to economic problems and the country's infrastructure drove away the priority of Brazil-Peru energy integration from the President's agenda. The agenda becomes even less of a priority during the impeachment and the interim mandate of Michel Temer as of September 2016. No effort was seen in this matter until now to rebate the negative image of Brazil as a *neo-exploiter of natural resources* left in the Peruvian society's sectors. Lack of alignment between practice of the Brazilian external policy still persists often perpetrated by national champions and BNDES on behalf of Brazil (incentive and prioritization of internationalisation of Brazilian companies) with the speech of Itamaraty and the principles of UNASUR - South-South Cooperation, solidarity and prioritisation of the South American integration to strengthen the region according to AMORIM (2010). Such values do not seem to be noted by the Peruvian civil society and the newspapers of this country from negotiations to sign this energy agreement. A small part of the Brazilian society that studies this topic also criticises the need for Peruvian power plants, and the lack of transparency in the decision-making process (Rodrigues, Hernandez y Bermann 2011; Dourojeanni 2010).

5.3 Differences between Regulations of the Electrical Sector

An important note in terms of difference of regulation of the power sector between both countries should be made here. On one hand, for long-term energy safety purposes, Brazil has developed a Power Concessions Law that requires the guarantee of supply by the utility company for a period of 30 years for a given dealer; on the other hand, the Peruvian Power Concessions Law and the Political Constitution let the free market determine the recipient of that electricity and the concession period.

This way, the Peruvian State does not have the legal competence to determine whether a certain amount of electricity generated in projects within the Agreement will be destined to the Brazilian electricity market. To implement this agreement, this difference requires a *legal reform in Peru and/or Brazil*, which is hardly fulfilled in the current political state of both countries.

According to the above clauses[18], it was agreed that the surplus of electricity should be pre-established at each power generation. Pre-establishing the amount of electricity for export is one of the main obstacles for ratification in the Peruvian Congress. Congressmen of the *Comission de Relaciones Exteriores,* chaired by Martin Belaunde, argue that the Peruvian legislation does not force a company, in the rules of free market, to sell its product for a certain buyer, let alone for 30 years. They argue that such a pre-establishment hurts the Peruvian constitution and the fundamental principles of the economic order of the State. This represents a potential problem for Peru as it limits its potential in case of demand. If the Peruvian demand grows during the period in which the amount of electricity surplus for export is already determined, Peru can be "stuck" with 30 years of electricity export to Brazil with a pre-established amount. If this happens, the Agreement has no clause providing for a solution for the Peruvian Government. There is only one emergency clause in case of water crisis, in which the parties will decide how to act[19].

The need *for possible changes to the Peruvian regulatory milestone to fit the Brazilian one* in case of sale of electricity surplus for the Brazilian regulated

18 Especially in item "v" of section "c" of clause 3 of the Agreement.

19 Inconsistencies between the texts of the Energy Agreement and the national legislation and the Peruvian Constitution and arguments used by the opinion of the Committee of Foreign Affairs of the Peruvian Congress, which decided in May 2014 to file the Legislative Resolution Project proposing the approval of the Brazil-Peru Energy Agreement, can be read in MOREIRA, P.F. (2015).

market is one of the questionings of such Agreement in Peru. Sectors of the Peruvian society questioned the real need of these projects for the Peruvian power market, once Peru still does not have such a demand of electricity. Until the Agreement signature, a proper projection of electricity demand had not been established and there are other possibilities of generation with lesser impact on the environment and local societies.

Today, *all* hydroelectric projects provided for in the Agreement are interrupted, which evidences the Agreement legal insecurity and the major risk of investment that Brazilian companies the Brazil incurred since the beginning of negotiations.

5.4 Conjunctural Factors

In addition to social and environmental, political, economic and regulation factors, bearing in mind that a series of conjunctural factors influencing the Peruvian society since the Energy Cooperation Agreement signature that help to explain the suspension of its ratification, as well as the power plants provided for in it is necessary.

The Pacific Alliance

The Pacific Alliance, created in 2013, is a Latin American trade block founded by Chile, Colombia, Mexico and Peru. Even though there are goals related to the free circulation of people, goods, services and capital, improved well-being of its populations, development and construction of a political platform, the Alliance intends to allow the trade liberalisation among its members in order to attract more foreign investments and be included in the global value chains with a "clear orientation toward Asia". To fulfil these goals, countries are negotiating a joint policy for an aggressive reduction of the export rate between its borders, comprising the totality of products, and should be entirely eliminated by 2018. The participation of the corporate sector through the Alliance Corporate Council may confirm the greater purpose of this agreement.

Bearing in mind that the Energy Agreement was signed in 2010 over the last days of Alan Garcia and Lula's management, who had a closer relationship, it can be said that the Pacific Alliance, under the management of Ollanta Humalla, established two years after the signature of the Agreement with Brazil,

contributed to strengthening of ties between the member countries of the Alliance and with Asia and consequently helped to diminish the importance of relations between Peru and Brazil. It can also be said that the establishment of the Pacific Alliance was a conjunctural factor that influenced the political, diplomatic and commercial separation between Peru and Brazil. Anyway, we cannot forget that Brazil's involvement in the construction of Brazil-Peru railway with Chinese investment is an indication that Brazil wishes to participate in the fruits that this Alliance will provide, as already expressed in Itamaraty's public speech.

Approximation with China

China's commercial global growth over the last decades is no longer new. China changed from minor investor to a central player from 2000 to 2013 in Latin America. The trade of goods between both parties has multiplied by 22 in this period, passing from US$ 12 billion to US$ 275 billion in 2013. Particularly in Peru, investment was US$ 9.3 billion in 2014, which was above Argentina, Brazil and Venezuela, thus representing 50% of the Chinese foreign investment. Surely, the Pacific Alliance will facilitate even further the progress of this investment. China is not only investing in mining, but also in the extraction of oil such as the purchase of Petrobras in Peru and infrastructure works.

Thus, Peru is glimpsing great opportunities in trade relations with China. And that's why it has been devoting efforts to strengthen its relations with the eastern country on a priority basis and possibly to a greater extent than with Brazil. As a consequence, Peru no longer sees the strengthening of relations with Brazil as a priority and consequently the implementation of its bilateral Peru-Brazil Energy Agreement.

Whereas to implement the Energy Agreement with Brazil requires numerous development efforts of complex regulatory detail and facing the local population and civil society sectors with high potential for conflict, this agenda clearly would have to be treated as a priority by the Peruvian government.

Reapproximation with Chile and Gas Pipeline

Surprisingly, despite the signature of the Energy Cooperation Agreement with Brazil in 2010 with expected forecast of electricity surpluses, the current reality between the Peruvian Government shows us that there is a more

political, commercial and diplomatic will to export electricity to Chile than to Brazil. Such an export could be even easier after finishing the gas pipeline being built by Odebrecht to expand the access to electricity to the South of Peru (Figure 3). According to interviews with representatives of the Ministry for Mines and Energy, the export of power could be made with the following sources: 1) gas export of Camisea whose reserves are of approximately 14 TCF already proven and up to 80 TCF expected, that is, for supply by Peru over the next 40 years or through gas of new licensed batches for exploration; 2) export of electricity to be generated by the construction of Inambari, which would need another consumer besides Peru.

Also regarding the positive points to approach Peru and Chile for the export of electricity, bearing in mind that the electricity rate in this country is the most expensive in South America is important. With the lack of energy resources in Chile, the dependence of import from other countries is large. Seen as a commodity, the Peruvian Government desires to raise economic funds with the possible sale. With the progress in the construction of the gas pipeline running 1,080 kilometres to the south (which will extend from the Camisea field in Cuzco to the Ilo port on the coast) by Odebrecht, it will be even easier to perform such operation with an extension of this gas pipeline to the border with Chile.

Figure 3. "Andean South" Pipeline. Source: Odebrecht Projects in Peru. Institutional website

With the Pacific Alliance, Peru-Chile and Peru-China relations tend to be strengthened even further.

The new president of Peru (2016-2021), the conservative economist Pedro Pablo Kuczynski, former finance minister of Toledo, former Wall Street banker, proposed an economic stimulus program for private investment, tax reduction, facilitation of administrative bureaucracy, thus supporting a series of mega-projects ranging from hydroelectric dams in airports to mining sites, which, in spite of declaring himself against Inambari power plant and against the Pacific-Atlantic railroad[20], makes fear the escalation of conflicts with local populations.

Final Considerations and Perspectives

First, taking into account the results indicated by Finer y Jenkins (2012), a superregional planning for two river Andean and Amazon basins for long-term use of natural resources and potential hydro power is necessary. Even considering the difficulties imposed by a dominant nationalist mind, regional governors must prepare regional plants and policies, thus overcoming the limit of "Sovereignty" of the twentieth century, *in favour* of a governance responding to the challenges of the 21st century which includes ensuring natural resources and socio-biodiversity for future generations. The tool of support to "Hydrological Information System; Amazon Region Assessment decisions was mentioned as an example and a major step in this sense.

Moreover, to resolve social conflicts arising from the integration and to propose solutions, it is necessary to build a bilateral or supranational governance mechanism or to further strengthen existing international organisations such as UNASUR, COSIPLAN, OTCA, OLADE, CIER. However, this mechanism must be transparent and have the participation of the civil society - representatives of indigenous communities potentially affected by the works, private sector, academy and NGOs - and that its deliberations are

20 http://losandes.com.pe/Politica/20160810/98915.html and http://www.dar.org.pe/noticias/tres-razones-por-las-cuales-ppk-hace-bien-en-dudar-del-tren-bioceanico/

part of decisions[21]. In this sense, at least a bilateral governance forum with transparency and participation of the civil society may have a more feasible and intermediary solution. Transparency in the decision-making, as well as the participation of the local community since the start of interconnection planning shall cause greater legitimacy shall bring rich inputs and in the end, greater facility to build the possible works finally approved by the collective.

Regarding the drafting of the Energy Agreement, if there is not a negotiation of a new treaty with the effective participation of the society from the beginning, it is necessary that at least a minimum of amendments are made including, for example, additional social and environmental clauses as the use of stricter environmental legislation between both countries, the obligation regarding Convention 169 of the International Labour Organisation (ILO) on free, prior and informed and consent and the United Nations Declaration on the Rights of Indigenous Peoples.

Social, environmental, regulatory, political and electoral, and conjunctural barriers analysed above showed that having a broad range of favourable conditions for a regional energy integration is necessary. Otherwise, the integration will take much time and effort to be accomplished.

Finally, regarding the Brazilian foreign policy in Peru, it turns out that it is essential to update and align the guidelines of the Brazilian foreign policy focused on the internationalisation of Brazilian companies in the light of the paradigms agreed at UNASUR, since the increased internationalisation of companies without guidelines in line with the objectives of UNASUR will be directly proportional to the intensification of distrust between Peoples and South American States in relation to the Brazilian reasons for regional integration. Thus, any possibility of Brazil becoming a major player in defining the directions of the 21st century in South America will depend on its ability to build credibility and trust in the region and articulate a dynamic, democratic and sustainable polo of development in South America.

21 An example of successful governance with participation with decision power of the civil society can be illustrated by the formation of the Legislative Council of the composition of the UN Programme on Reducing Emissions from Deforestation and Forest Degradation, the UN-REDD, that Moreira wrote and helped build (2009 to 2011).

BIBLIOGRAPHICAL REFERENCES

ALIANZA DEL PACIFICO. 2013. **Declaración de Cali.** Available at: http://alianzapacifico.net/documents/cali.pdfVisited on 28 May 2013.

ALMEIDA, C.S.D.M.D. 2014. **Conflitos na Exploração de Recursos Naturais em Terras Indígenas: Um Estudo de Caso nas Américas**. Revista Política Hoje, v.23, 1. ed., p. 93-111.

AMORIM, C. 2010. **Brazilian foreign policy under President Lula (2003-2010): an overview.** Revista Brasileira de Política Internacional, v. 53, n. especial, p. 214-240.

AVANZINI, R.E.B. 2010. **Comunicación Social sobre la Integración Energética Perú-Brasil en La Amazonía Peruana**. Rio de Janeiro: GESEL, Junho de 2010. (Monografia de Pós-graduação em Análise Econômica do Setor Elétrico – Integração Energética da América Latina).

BERMANN, C. 2007. **Impasses e controvérsias da hidroeletricidade.** In: Estudos Avançados. v. 21, n. 59 São Paulo jan./apr. 2007.

BCB. 2016. Boletim Focus - Relatório de Mercado, Banco Central do Brasil, Gerin, 20/09/2016. Available at: https://www.bcb.gov.br/pec/GCI/PORT/readout/R20160916.pdfVisited on 20/09/2016.

CAF (Corporación Andina de Fomento / Banco de Desarrollo de América Latina) & CIER (Comissión de Integración Energética Regional). 2012. **Nuevas Oportunidades de intercnoxión eléctrica en América Latina.** Bogotá. CAF & CIER.

CAMPOS, A.F. 2011. **A Importância dos Aspectos Regulatórios E Institucionais Para o Processo de Integração Sul-Americano: O Caso da Integração mediante Hidrelétricas entre o Brasil e o Peru.** Monografia apresentada para Instituto de Economia – Grupo de Estudos do Setor Elétrico, Programa de Pós- Graduação *Lato Sensu* em Análise Econômica do Setor Elétrico - Integração Energética da América Latina, GESEL/IE/UFRJ.

CARE (Central Ashaninka del Rio Ene). 2010. **Informe apresentado à Comissão Interamericana de Direitos Humanos na 138ª seção.** Preparado pela La Central Ashaninka del Rio Ene (CARE) e Centro

Amazonico de Antropologia y Aplicacion Practica em 23 de março de 2010.

CARVALHO, C. 2012. **O Protagonismo do BNDES no Financiamento Da Infraestrutura Sul-Americana Durante O Governo Lula: Interface Entre Interesses Domésticos e a Política Externa**. Seminário Anual de Relações Internacionais da Associação Brasileira de Relações Internacionais (ABRI) Seminário de Política Externa.

CASTRO, N. J., ROSENTAL, R.; GOMES, V. 2009. **A Integração do Setor Elétrico na América do Sul: Características e Benefícios**. In: Texto de Discussão do Setor Elétrico nº 10. Rio de Janeiro: GESEL/UFRJ.

CASTRO, N.J. 2010. **O Papel do Brasil no Processo de Integração do Setor Elétrico da America do Sul**. In: Texto de Discussão do Setor Elétrico nº 23. Rio de Janeiro: GESEL/UFRJ, Agosto de 2010.

CASTRO, N.J. et al. 2011. **Formação de uma Campeã Nacional: O Processo de Internacionalização da Eletrobrás**. In: Texto de Discussão do Setor Elétrico n.º 38, TDSE 38 – Rio de Janeiro: GESEL/UFRJ, Julho 2011.

CG/LA INFRASTRUCTURE. 2014. **Strategic Top 100 Latin American Infrastructure 2014 Report.** Cartagena. CG/LA Infrastructure.

CHIPP, H. 2009. **Sistemas Elétricos e Integração Energética.** In: Seminário Internacional De Integração Energética Brasil – Peru. Rio de Janeiro. Apresentação em PowerPoint datada de 15.05.2009, elaborada pela Diretoria Geral Operador Nacional do Sistema. GESEL / UFRJ Rio de Janeiro.

COES-SINAC [Comité de Operación Económica del Sistema Interconectado]. 2012. **Propuesta Definitiva de Actualización del Plan de Transmisión - Período 2013-2022. Informe DP–01–2012.** Lima. COES-SINAC.

COMISIÓN DE RELACIONES EXTERIORES, CONGRESO DE LA REPÚBLICA, REPÚBLICA DEL PERÚ. 2014. ***Dictamen recaído el Proyecto de Resolución Legislativa n. 391/2011-PE que propone aprobar el Acuerdo entre el Gobierno de la República de Perú y el Gobierno de la República Federativa del Brasil para el Suministro de Electricidad al Perú y Exportación de Excedentes al Brasil.*** Lima. 23/05/2014.

COSIPLAN (Conselho Sul-Americano de Infraestrutura e Planejamento). 2011. **Plan de Trabajo 2012** In: II Reunión del Consejo Suramericano de Infraestructura y Planeamiento, COSIPLAN/UNASUR, Brasilia, 30 de novembro de 2011. Acesso em 11.11.2012.

DAR [Derecho, Ambiente y Recursos Naturales]. 2014. **Agenda Ambiental.** In: Derecho, Ambiente y Recursos Naturales. Lima. Año: 3 Número: 7 Marzo 2014.

DOUROJEANNI, M. 2009. **Hidroelétricas brasileiras na Amazônia peruana**, O ECO. 29/06/2009.

ELETROBRÁS. 2012. **Peru: Proyectos em Estudio.** Apresentação em PowerPoint elaborada por Rafael Lopes de Albuquerque, Departamento de Gestão de Ativos no Exterior. Rio de Janeiro.

FEARNSIDE, P.M. 2015. **Desenvolvimento hidrelétrico na Amazônia. pp. 9-33 In: Hidrelétricas na Amazônia: Impactos Ambientais e Sociais na Tomada de Decisões sobre Grandes Obras**. Vol. 1. Editora do Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas. 296 pp.

FINER M.; JENKINS C.N. 2012. **Proliferation of Hydroelectric Dams in the Andean Amazon and Implications for Andes-Amazon Connectivity**. PLoSONE 7(4): e35126. doi: 10.1371/journal.pone.0035126.

GOBIERNO DE LA REPÚBLICA DEL PERÚ Y EL GOBIERNO DE LA REPÚBLICA FEDERATIVA DEL BRASIL. **2010. Acuerdo para el Suministro de Electricidad al Perú y Exportación de Excedentes al Brasil**. Lima (Peru), 03 de Maio de 2010.

IIRSA & COSIPLAN [Conselho Sul-Americano de Infraestrutura e Planejamento]. 2011. **Agenda de Projetos Prioritários de Integração (API).** Documento Elaborado pela IIRSA e Aprovado pelo Comitê Coordenador do COSIPLAN. IIRSA/COSIPLAN.

LA ROSA, V.C. 2011. **Acuerdo para el Suministro de Electricidad al Perú y Exportación de Excedentes al Brasil: Buscando la Governanza Energética en el Perú.** Lima (Peru): DAR [Derecho Ambiente y Recursos Naturales], Junho de 2011.

MARGULIS, C. R.; SARKAR. S. 2008. **Systematic conservation planning**. Cambridge. Cambridge University Press.

MINEM/DGE [Ministerio de Energia y Minas/Direccion General de Electricidad]. 2007. **Elaboración de Resúmenes Ejecutivos y Fichas de Estudios de las Centrales Hidroelectricas con Potencial para la Exportación a Brasil**. Informe Final. Lima (Peru): MINEM/DGE, Novembro de 2007.

MINEM (Ministerio de Energía y Minas, República del Perú). 2009a. **Portfolio de Proyectos Hidroelétricos.** Vice Ministro de energia. Apresentação em PowerPoint elaborada por Daniel Camac Gutierrez. In: Seminario Internacional de Integracion Energética Peru-Brasil, Maio, 2009, Rio de Janeiro, Gesel/UFRJ.

_____. 2009b. **Propuesta de Ministerio de Energia y Minas del Perú sobre los temas relevantes para el Tratado de Inteconexión Eléctrica Perú – Brasil** (Proposta de Percentuais de Energia Destinada ao Brasil e ao Peru). In: ANEXO, OFÍCIO Nº 226-2009-MEM/VME.

_____. 2014a. **Plan Energético Nacional 2014 -2024, Documento de Trabajo (informe)**, 140pg, Direccion General de Eficiencia Energetica.

MME (Ministério de Minas e Energia, República Federativa do Brasil). 2009. **Temas Relevantes para o Tratado de Integração Energética entre Brasil e Peru.** In: Ofício nº 142/SPE/MME, 22/09/2009. Brasília.

MME/EPE. 2010. **Plano Decenal de Expansão de Energia 2019**. Ministério de Minas e Energia. Empresa de Pesquisa Energética. Brasil. Brasília.

_____. 2015. **Plano Decenal de Expansão de Energia 2024**. Ministério de Minas e Energia. Empresa de Pesquisa Energética. Brasil. Brasília.

MOREIRA, P.F. & CAMPOS, A.F. 2014. **Análise do Processo de Integração Energética Brasil-Peru: O Acordo Energético Peru-Brasil (1997-2014).** In: IX Congresso Brasileiro de Planejamento Energético. Florianópolis.

MOREIRA, P.F. 2015. **Agência de atores não estatais em pactos intergovernamentais América do Sul: A cooperação energética Brasil-Peru (2008-2014).** Tese de doutorado defendida em 29.10.2015, no Instituto de Relações Internacionais da Universidade de Brasília IREL/UNB. Available on the institutional repository http://repositorio.unb.br/handle/10482/19557

OLIVEIRA, Adilson de. 2010. **Segurança energética na América do Sul: o papel do Brasil**. Set. 2010. In: Brevíssimos CINDES 19.

RIBEIRO, D; KFURI, R. 2011. **A nova integração regional e a expansão do capitalismo brasileiro na América do Sul**. In: Integração Sul Americana – desafios e perspectivas. VIANA, J. et al. (Orgs.). Edufro Editora da Universidade de Rondônia.

RIVEROS, J.C. et al. 2008. **Energia sustentável e exploração racional dos rios amazônicos**. In: WWF-LAI. Available at http://myenergy.com.br/energy/wp-content/uploads/2012/06/Represas-na-Amaz%C3%B4nia.pdf Visited on 12/12/2012.

RODRIGUES, L. A.; HERNANDEZ, F. M.; BERMANN, C. 2011. **Producción de energía hidroeléctrica en Amazonía: evaluación del Acuerdo Perú Brasil y la internacionalización de problemas ambientales.** Revista Latinoamericana de Derecho y Políticas Ambientales, v.1. Lima (Perú), Abril de 2011, pp.253-276.

SALOMÃO, L. A. 2012. **Integração Energética Sul-Americana difíceis desafios a Superar**. In: Artigo para Seminário do Ministério de Relações Exteriores. Brasília. MRE

SANTOS, M. 2012. **Exploração de recursos naturais e conflitos sociais: os casos de Peru e Equador**. In: Territorialidades, conflitos e desafios à soberania estatal na América Latina. Luis Fernando Ayerbe (Org.). São Paulo: Fundação Memorial da América Latina.

SILVA, T. L. A. 2010. **O conflito entre o governo neoliberal de Alan García e os indígenas peruanos.** Revista IDEAS Interfaces em Desenvolvimento, Agricultura e Sociedade. v. 4, n. 2, p. 366-392.

VEGA, J.S. 2011. **Inambari: la Urgencia de una Discusión Seria y Nacional. Pros y Contras de um Proyecto Hidroeléctrico**. In: PRO NATURALEZA [Fundacion Peruana para la Conservacion de la Naturaleza], Junho de 2011. Lima (Peru). Available at: http://www.pronaturaleza.org/archivos/pdf/INAMBARI.pdf Visited on 28/08/2011.

VEGA, J. S.; MALKY, A.; REID. 2012. J. **Costos y Beneficios del Proyecto Hidroeléctrico del Río Inambari**. In: Série Técnica nº 13. Lima (Peru): Conservación Estratégica.

VENTURA FILHO, A. 2009. **Políticas y Perspectivas para Integración Energética.** In: Seminário Internacional de Integração Energética Brasil-Peru. Rio de Janeiro: GESEL/IE/UFRJ, 15 de maio de 2009. Available at: <http://www.nuca.ie.ufrj.br/gesel/eventos/peru/Altino.ppt#286,1,Slide_1>.Visited on: 13/12/2010.

ATTACHMENTS

Documents produced by the campaign prepared by the Transnational Advocacy Network against the Brazil-Peru Energy Agreement:

(1) Cartaz coletivo, (2) New York Times (3) *Brazil eyes the peruvian amazon* and (4) Award granted to Ruth Ashaninka for the campaign against Paquitzapango power plant

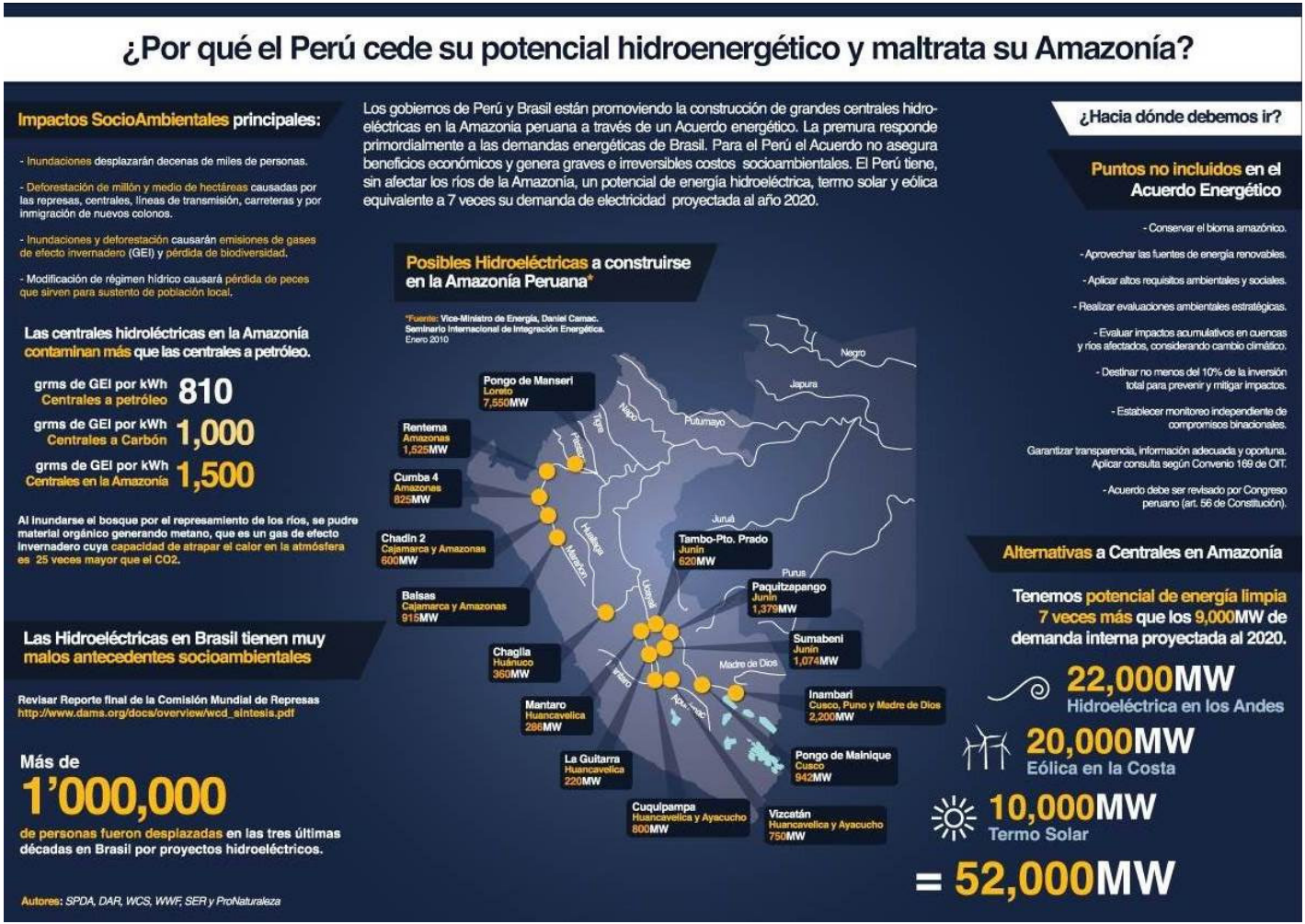

Figure 4. Examples of campaign material by the transnational advocacy network Colectivo Hidrelectricas Amazonia

The New York Times

AMERICAS | BOCA SANIBENI JOURNAL

Dam Project Threatens a Way of Life in Peru

By AARON NELSEN MAY 15, 2012

BOCA SANIBENI, Peru — Along the murky waters of the Ene River, in a remote jungle valley on the verdant eastern slopes of the Andes, the rhythmic humming of an outboard motor draws the stares of curious Ashaninka children.

With encroachment from settlers and speculators, and after a devastating war against Shining Path rebels a decade ago, the indigenous Ashaninkas' hold is precarious. And they are now facing a new peril, the proposed 2,200-megawatt Pakitzapango hydroelectric dam, which would flood much of the Ene River valley.

The project is part of a proposal for as many as five dams that under a 2010 energy agreement would generate more than 6,500 megawatts, primarily for export to neighboring Brazil. The dams would displace thousands of people in the process.

Antonio Metzoquiari, 59, a thin man wearing a New York Yankees baseball cap, considered the implications for his community. "This is a grave matter," Mr. Metzoquiari said. "It's a return to violence, another war. I don't know where or how, but we would have to find a new place to live."

At a time when hydroelectric dams have fallen out of favor in some parts of the world, the projects might seem an anachronism. But dams remain attractive in much of Latin America, where a number of nations have plenty of water but lack other conventional and affordable energy sources.

For now, the project is stalled in the Peruvian Congress, where it awaits debate by the Foreign Relations Commission. President Ollanta Humala has yet to take a position on the dams, but how he manages this and numerous other initiatives across the country that pit development against local and predominantly indigenous communities could very well define his presidency, said Michael Shifter, president of the Inter-American Dialogue, a research organization based in Washington.

“The biggest test for Humala is how he strikes the middle ground,” Mr. Shifter said. “I think he understands that if he moves too hard and too fast on this development path, that it can really come back to bite him.”

Already Mr. Humala is being tested in northern Peru, where thousands of people have taken to the streets in recent months to oppose the $4.8 billion Conga gold mine that the protesters say would pollute water supplies.

Mr. Humala capitalized on social movements like these, especially among Peru’s large and historically marginalized indigenous population, to win the presidency, much to the chagrin of the middle and upper classes in Lima, the capital, who were the primary beneficiaries of a decade-long economic boom based substantially on mining.

Mr. Humala opposed the Conga mine during the campaign, but he has since given the project his support while pledging to ensure quality of life improvements for surrounding communities. This conciliatory approach might be a first glimpse at how the president plans to achieve his social agenda while assuaging wary investors, said Fernando Romero, a sociologist and an expert on social conflict in Peru.

"I think what we are seeing is that the government will look to mining and investment from Brazil as the principal source of funding for its plan for social inclusion," he said.

So far, Mr. Humala has not staked out a clear position on the proposed dams, though that is likely to change when President Dilma Rousseff of Brazil visits Peru, a visit expected soon.

Officials with the Energy and Mining Ministry say the dams make economic sense only if much of the energy they produce is exported. The ministry added that while it considered environmental and social issues important, it also wanted to make sure that affected local populations benefit from the projects through electrification.

Despite claims that the welfare of affected communities is a top priority, several of the projects passed feasibility studies before local residents were even informed that the government had awarded concessions on the land. In response to that disclosure, the Central Asháninka del Rio Ene, which represents Ashaninka populations in the Ene River Valley, went to court to compel the Energy and Mining Ministry to disclose all feasibility studies on the dam proposals.

After the project was announced, the organization brought together 17 Ashaninka communities to explain that a dam would inundate some communities and dry out others that depend on the river for sustenance and transportation. Many people would be forced from their homes, critics argue, evoking memories of Peru's war against the Maoist-inspired Shining Path rebels, which officially ended in 2000 but scarred the Ashaninka.

Of the 70,000 people who were killed over two decades, 6,000 were Ashaninka, experts said. Thousands more were displaced and only over the past few years have they begun to resettle their communities along the Ene.

"This is why the Ashaninka brothers say because we have sacrificed while our families disappeared, I'm not going to give away our land so easily to the state," said CARE's president, Ruth Buendia.

She said the Ashaninka do not understand how a project of this magnitude was approved without their knowledge.

"They think we're going to break windows and protest like in Conga, but we aren't," Ms. Buendia said, thumping the table. "Just as they do to us with legal documents we are going to do to them."

When the scope of the dam project was made clear to the Ashaninka, many expressed disbelief while others worried that an exodus would lead to infighting over diminished resources. The final speaker, Dimer Dominguito, 25, who was accompanied by his wife and five children, captured the Ashaninka's desperation and outrage.

"In the city they make money and buy whatever they need, but here we live by our customs, our market, eating what we plant and we are happy," he said. "We want to defend our right to what is natural, to defend our market, and we support the government, but who supports us?"

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Site of the proposed Inambari Dam in the Peruvian Amazon. Photo: Nathan Lujan

Brazil Eyes the Peruvian Amazon

WILD RIVERS AND INDIGENOUS PEOPLES AT RISK

The Peruvian Amazon is a treasure trove of biodiversity. Its aquatic ecosystems sustain bountiful fisheries, diverse wildlife, and the livelihoods of tens of thousands of people. White-water rivers flowing from the Andes provide rich sediments and nutrients to the Amazon mainstream. But this naturally wealthy landscape faces an ominous threat.

Brazil's emergence as a regional powerhouse has been accompanied by an expansionist energy policy and it is looking to its neighbors to help fuel its growth. The Brazilian government plans to build more than 60 dams in the Brazilian, Peruvian and Bolivian Amazon over the next two decades. These dams would destroy huge areas of rainforest through direct flooding and by opening up remote forest areas to logging, cattle ranching, mining, land speculation, poaching and plantations. Many of the planned dams will infringe on national parks, wildlife sanctuaries and some of the largest remaining wilderness areas in the Amazon Basin. By changing the natural cycles of the region's river systems – the lifeblood of the Amazon rainforest – large dams threaten the rainforest and the web of life it supports.

BRAZIL'S ROLE IN PERU'S AMAZON DAMS

In June 2010, the Brazilian and Peruvian governments signed an energy agreement that opens the door for Brazilian companies to build a series of large dams in the Peruvian Amazon. The energy produced is largely intended for export to Brazil. The first five dams – Inambari, Pakitzapango, Tambo 40, Tambo 60 and Mainique – would cost around US$16 billion, and financing is anticipated to come from the Brazilian National Development Bank (BNDES).

The Peruvian government is hoping that the dams will boost foreign exchange earnings from energy exports, increase tax revenue, and help build local economies through the services and jobs required during dam construction. In a rush to

facilitate private investment, the government is pushing through two laws that would expedite approvals of dams, pipelines and road projects, and exempt them from obtaining environmental certifications as a prerequisite for concession approval.

Girl bathing on the Ene River, which is threatened by the Pakitzapango Dam. Photo: Jonathan McLeod

The electricity inter-connection between Brazil and Peru is part of a broader energy integration scheme in Latin America. The dams would enable the integration of Brazil with the national systems of the Andean region, and in turn the Brazilian connection would link Argentina, Paraguay and Uruguay to the rest of South America. Brazilian electric utility Eletrobras is leading the evaluation of the projects' feasibility in cooperation with Brazilian private companies such as Engevix, OAS, Andrade Gutierrez and Odebrecht.

ASHANINKA REJECT PAKITZAPANGO DAM

One of the first projects in line to be built is the Pakitzapango Dam, which would wall off the Ene River with a 165-meter-high dam. The project is being developed by Brazilian construction giant Odebrecht and electric utility Eletrobras, which estimate that it will generate 2,000 megawatts (MW) mostly for export to Brazil. In addition to the Pakitzapango Dam, the Tambo 40,Tambo 60 and Sumabeni dams are also planned in the Ene-Tambo River Basin.

Ten Ashaninka communities with close to 10,000 people living on both sides of the Ene River would be displaced and their livelihoods harmed by Pakitzapango alone. The health of the Ene River is crucial for the Ashaninka indigenous people, who depend on its fish resources, the fertile soils of its floodplains, and the many foods and products in the surrounding forests. They also cultivate small plots of land on which they grow manioc, yams, peanuts, bananas and pineapples. The forest provides edible and medicinal roots, honey, and materials to make baskets and mats. Yet the reservoir would flood 734 square kilometers of forests, arable lands and water sources upon which the Ashaninka depend.

Even though Peru ratified Convention 169 of the International Labor Organization (ILO), which requires that indigenous and tribal peoples be consulted on issues that affect them, the Ashaninka people whose lands are legally protected have not been consulted about the Pakitzapango Dam.

The Ashaninka are one of the largest indigenous groups in the Peruvian Amazon, numbering close to 70,000. Although the Spaniards never conquered the Ashaninkas, the intrusion on their lands – first by rubber-tappers and missionaries, and later by settlers, guerrillas, coca growers and traffickers – brought about enslavement, torture, displacement and massacres. During the internal war in Peru in the 1980s and 1990s, the Maoist guerrilla group Shining Path gained control over areas of the Ene and Upper Tambo rivers. Many Ashaninka were forcibly displaced or enslaved, and close to 6,000 were killed. Thirty to forty communities disappeared.

Yet, the resiliency of the Ashaninka is extraordinary, and they maintain their ethnic identity. Today, they are fighting against illegal logging and coca growing, and are working on managing and protecting their forests. The Ashaninka Organization of the Rio Ene (CARE), initially created in 1993 to support the Ashaninkas after the war, is the leading Ashaninka organization working in defense of communities, forests, and lands, and to protect the Ene River.

Pakitzapango Energia, S.A.C. obtained a temporary concession to conduct feasibility studies for the project in 2008. To counter this, CARE presented a legal administrative action against the project before the Ministry of Energy and Mines (MINEM) in 2010. MINEM established that the feasibility studies were not concluded within the time allowed, and resolved not to renew the temporary concession to Pakitzapango Energia. MINEM's decision has been appealed, and the case may end up in the Constitutional Court. Stopping construction of the Pakitzapango Dam and others planned for the Ene-Tambo River Basin is crucial for the survival of the Ashaninka as a people.

PAKITZAPANGO THREATENS AREAS OF HIGH BIODIVERSITY

Large areas of the region where the Pakitzapango Dam would be built are protected by the Otishi National Park, which connects to the Vilcabamba–Amboró Binational Corridor that links Peru and Bolivia, forming one of the last remaining contiguous forest ecosystems in the Andean-Amazonian region. Mainly mountainous with large areas of minimally disturbed forests, the area is endowed with astounding biodiversity characterized by endemic wild flora and fauna, some in danger of extinction.

Otishi (which means "summit" in Arawak) extends for 7,093 sq km, and was created in 2003 to conserve the stability and integrity of the soils and the waters of the Ene, Tambo and Urubamba river basins. Otishi National Park is home

Dams in the Peruvian Amazon

"For us the river does not generate money, the river gives us food, gives us life. The dam builders and oil, mining, and lumber companies want our resources, but we want development in concert with our culture. Dams are not a part of our development."

– Ruth Buendia Mestoquiari, President of CARE

Ruth Buendia Mestoquiari. Photo: Jonathan McLeod

to a large number of bird species, small and large mammals, amphibians, insects, butterflies, and much more. New species have been discovered here that are endemic to the region.

The Ashaninka Communal Reserve and the Machiguenga Communal Reserve were created as buffer zones to Otishi. Communities fear that construction of the Pakitzapango Dam and the associated transmission line corridor would open the buffer zones to logging and petroleum interests. Roads would make possible a wave of colonization, disrupting indigenous communities and causing environmental destruction, which eventually would reach Otishi.

INAMBARI DAM

Another project likely to be fast-tracked under the Brazil-Peru Energy Agreement is the Inambari Dam on the Inambari River in Puno, Cusco and Madre de Dios states, 300 km from the Brazil border. If built, the massive $4 billion project would form a reservoir of 410 sq km. The dam would be the first in a proposed cascade which, as well as generating electricity, would also send water during times of drought to Brazilian dams Jirau and Santo Antonio on the Madeira River. Companies in EGASUR – the Brazilian-Peruvian consortium created to build the project – have stated they have received promises of a $2.5 million loan from the Brazilian National Development Bank (BNDES) for the project.

The Bahuaja-Sonene National Park, a world-class sanctuary of high biodiversity, would be threatened as new roads are built, leading to increased colonization, forest burning, cattle ranching and large farms, hunting, and erosion.

Fifty small towns would be either flooded by the dam or their economy and transportation harmed, and close to 15,000 people would be displaced. Most people are migrants from the highlands of Puno State, who began to arrive 50 years ago. The newcomers began to grow cacao, pineapple, bananas and manioc. Others do small-scale fishing, or artisanal gold mining along the Inambari. A 100 km stretch of the Inter-Oceanic Highway (built by Brazil, not yet paid for by Peru) would also be flooded.

Communities from towns like San Gaban – which would be destroyed by the construction of the wall of the Inambari Dam through it – have held numerous protests over several years. Road blockades on main roads that give access to cities are regular occurrences, and signs of "No to Inambari Dam" can be found in many towns along the river. The Native Federation of Madre de Dios River (FENAMAD), comprised of several indigenous groups and other downstream communities in Madre de Dios State, have demanded cancellation of the project. They say they have not been consulted, and are concerned about the risks of extinction that isolated indigenous people would face. Downstream communities have not been made aware of the impacts that cutting off the river's flow would have on them.

Due to opposition to the project, required public consultations have not taken place, and the company has not been able to submit the Environmental Impact Assessment (EIA). EGASUR currently lacks permits to build the project, but if legislation that exempts companies from presenting an EIA are approved, EGASUR could obtain construction permits soon.

OTHER SOURCES OF ENERGY ARE POSSIBLE

The Peruvian government, which has yet to produce a long-term national energy plan, is now at a decision-making point for shaping the country's energy plan for decades to come. The government has shown signs of seeking and developing alternative sources of energy. Peru is renewable energy-rich, with close to 30,000 MW of non-dam renewable energy potential.

In May 2008 the Peruvian government passed a law to create incentives for the development of biomass, wind, solar, tidal and geothermal energy, and of hydroelectric power plants under 20 MW. The law guarantees a 12% rate of return for investments and gives priority to their dispatch into the national grid. As their generation costs are higher than the average cost of the present mix of mainly hydroelectric and natural gas power stations, a small increase in electricity tariffs would pay for them.

The Wind Atlas of Peru shows that the country has 22,000 MW in wind power potential. Three wind farms on the Pacific coast with an installed capacity of 142 MW will begin operations in 2012 and other wind projects are expected to be developed in the short-term.

The southern coast of Peru has favorable conditions for solar energy development. In 2010, contracts were granted for four photovoltaic plants with a total installed capacity of 80 MW to supply energy over a period of 20 years. The four plants in the southern regions of Arequipa, Tacna and Moquegua are expected to begin operations in 2012.

In 2008, the "Promotion of Efficient Energy Use" law was approved, aiming to develop a national culture for energy efficiency through programs and education, promotion of cogeneration and distributed generation. Additional regulation supports the replacement of incandescent lights by compact fluorescent bulbs. Energy efficiency labeling guidelines were recently issued to help consumers in their selection of efficient appliances. There is great potential for energy conservation in Peru, and with a concerted effort by government, substantial energy savings could be realized.

The government claims that the energy produced by the hydroelectric projects would be cheap for Peruvians, but this might not be the case. The feasibility study for the proposed Inambari Dam shows that the generation cost is higher than current national electricity tariffs. What's more, the high social and environmental costs – which would be transferred to the Peruvian people – have not been taken into account.

While Peru claims it will generate much-needed foreign exchange for the country through selling power to Brazil, the high costs of damming the Peruvian Amazon may outweigh its benefits.

CAMPAIGN TO SAVE THE RIVERS OF THE PERUVIAN AMAZON

CARE is leading a powerful national and international campaign for the protection of the Ene River and Ashaninka communities, and in opposition to planned dams. Ashaninka communities demand that their rights as indigenous people are respected under international law. They have already filed legal actions that have temporarily halted construction of the project, and insist that the government of Brazil respect the decisions of the Ashaninka people and call off any negotiation regarding the Pakitzapango Dam.

Communities from the Puno area continue to hold marches, roadblocks, meetings and strikes pressing for cancellation of Inambari Dam. They are exploring legal actions to stop the project. Local group FENAMAD has made alliances with other affected peoples to strengthen their opposition. Local NGOs are lobbying congress to modify the energy agreement made between Peru and Brazil, and a strong movement for the protection of the Amazon rivers of Peru is growing.

Join the movement to protect the rivers of the Peruvian Amazon at **internationalrivers.org/en/peru**.

RESOURCES

For further information, visit the following websites:

Central Ashaninka del Rio Ene (CARE)
http://ashanincare.org/

Derecho, Ambiente y Recursos Naturales
http://www.dar.org.pe/

JOIN US!

For more information, visit: internationalrivers.org/en/peru

Ruth Buendía

South and Central America 2014 Goldman Prize Recipient

- Peru
- Rivers & Dams

Overcoming a history of traumatic violence, Ruth Buendía united the Asháninka people in a powerful campaign against large-scale dams that would have once again uprooted indigenous communities still recovering from Peru's civil war.

In 2010, the governments of Brazil and Peru signed a bilateral energy agreement that called for a series of large-scale hydroelectric dams in the Amazon. Under this agreement, most of the energy would be exported to Brazil. Few economic benefits would come back to local communities in Peru, whose ancestral territories would be flooded during construction.

Among the indigenous people living in the proposed construction site of the Pakitzapango dam along the Ene River are the Asháninka, who have made a home in the thickly forested "eyebrow of the jungle" practicing subsistence farming, hunting and fishing.

The energy agreement was pushed through without any input from the Asháninka, in direct violation of the International Labor Organization's (ILO) treaty—which Peru ratified in 2006—that requires governments to consult with indigenous communities on any development projects in their territory.

Ruth Buendía was 12 years old when the Shining Path guerillas invaded Asháninka territory and set up political and military operations. Her father was killed during the violence that ensued, and her mother sent Buendía away to seek safety in Lima. Thousands of Asháninka were killed during the conflict; thousands more fled their ancestral lands.

Following her return home, Buendía worked at a juice shop in Satipo where she was approached by a customer who recognized her as a fellow Asháninka and encouraged her to join the Asháninka Center of the Ene River (CARE). Eager to reconnect with her roots and contribute to the Asháninka community's healing, she began volunteering with the organization, helping indigenous people obtain the documentation needed to attend school and access public services.

Traveling across the Ene River Valley, Buendía met several tribal chiefs who had known and respected her father—and felt at home for the first time. She thrived at CARE, and in 2005, a retirement in the organization's leadership led to an unexpected opportunity as Buendía, at 27 years old, was elected the first woman president of CARE.

Not long after the historic election, Buendía came across news coverage of the bilateral energy agreement and the proposed Pakitzapango Dam. CARE's requests to the Peruvian government for more information went unanswered, but it soon became clear that the massive dams would displace thousands of Asháninka—reopening old wounds from Peru's civil war a mere decade before.

Buendía and her team at CARE began reaching out to Asháninka communities, raising awareness about the dam and its threats using digital simulations of how the valley would be flooded during construction. They organized a region-wide assembly and united the Asháninka in opposition to the dam.

Buendía took the struggle to international leaders. She traveled to Washington DC as the representative of the Asháninka delegation and presented a report to the Inter-American Commission on Human Rights about the impact of Peruvian energy development on her people.

In December 2010, as a direct result of Buendía's advocacy, the Peruvian Ministry of Energy rejected a request from Pakitzapango Energy that would have allowed the dam to move forward. The following year, Odebrecht, the main shareholder in another dam, the Tambo 40, announced its withdrawal from the project, citing the need to respect the views of local communities.

With the Pakitzapango project tied up in court, Buendía is now working to firmly establish land rights for the Asháninka. She is developing a management plan for the Asháninka Communal Reserve that would protect their lands from future development while allowing local communities to pursue sustainable economic opportunities such as coffee and cacao farming.

Comments

0 comments

Energy integration in MERCOSUR: Itaipu Binacional emblematic case

Thauan Santos[1] and Luan Santos[2]

1. Introduction

Itaipu Binacional is often considered the most successful case in the Southern Cone energy integration model, most precisely the Southern Common Market (MERCOSUR). Thus, this chapter has the purpose of analysing this case, also highlighting the initiatives focused on environmental issues.

As indicated by Goldemberg and Lucon (2007), interpreting such themes requires a full comprehension of mutual relations between energy, environment and society by the decision-maker, that is, the current need to assess both matters together. More than ever, considering interdisciplinarity and internalising the negative externalities of certain projects has been a basic condition for the approval and maintenance of the most different projects.

Recently, themes like "sustainable development", "social and environmental management" and "climate changes" have been protagonists in national and international discussions. Instances are many (municipal, state, federal and also multilateral) evidencing the need to handle such matters with greater relevance and urgency (SANTOS & SANTOS, 2014). Notwithstanding, many authors emphasise the growing use of fossil fuels in the global energy matrix (GEORGESCU-ROEGEN, 2012; VICHI & MANSOR, 2009; PASSET, 1979), which is seen as a major dilemma to be faced in the search for sustainable development and environment preservation.

Therefore, the main purpose is to specifically highlight energy integration and its interface with the social and environmental theme. In this sense, and in order to narrow our analysis, we will discuss (i) physical; (ii) electrical; (iii)

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South America; and (iv) Southern Cone integration. Thereby, we will not only analysing other initiatives in the subcontinent that do not deal with electricity, but we will also not evaluate the initiatives in other Latin American regions, like the Andean and Caribbean region.

We will conduct a case study on Itaipu Binacional, especially due to the fact that the plant is a "successful" example in the region's energy integration model (FUSER, 2015; SANTOS, 2014b; CASTRO & ROSENTAL, 2012), also more recently, under the political and environmental management point of view. Throughout this chapter, we not only intend to highlight the history progress of the plant, but above all make a critical analysis of this example, emphasizing recent initiatives that take into account environmental issues and sustainable development of the region.

2. Regional Integration

By definition, regional integration is an extremely complex and malleable concept. Complex as it is interdisciplinary and multifaceted. Malleable because it is a process, which usually has different and often contradictory interpretations. The fact that the concept is fluid and dynamic means that there is no consensus about its real meaning (SANTOS, 2014b).

When we talk about the regional integration complexity, we refer to the fact that it includes politics, history, economy, society, culture, identity, rules, institutions, commitments, technology, and ultimately, a medium/long-term project. Commonly, not only in practice, but in literature itself, integration is associated to:

- Cooperation;
- International Trade;
- Capital flows and investments in a certain region; and
- Binational initiatives.

None of this is *necessarily* integration. In fact, each item emphasised *can be* considered one of the means to promote regional integration; however, separately, it does not constitute an integration project. "Project", because, as anticipated, integration is a *process* and not an end itself. Soon, the dynamics

of this same process shall be taken into account, as well as consider means to adapt this own process in a learn-by-doing mechanism.

When we say regional integration is "malleable", we refer specifically to this fact, but not only it. We are considering the historic component, the fact that processes are unique and; therefore, many times incomparable. Many authors insist in comparing the South America integration process with the European one. By doing this, they forget that the historic, political and economic context was entirely different in each case, as well as the key drivers of such processes.

Also, many authors handle the terms "integration" and "cooperation" as a replacement and synonym, thus reinforcing a great misunderstanding in literature (SANTOS, 2014b, 2014c; QUEIROZ *et al.*, 2013; MARIANO & MARIANO, 2002). In this sense, a joint long-term infrastructure investment process is addressed the same way, as Itaipu Binacional, with very short-term *ad hoc* projects, such as technical cooperation in certain economy sector.

The highlight of these first topics is intended to emphasise the need to consider the complexity of the matter, so as not to reduce it to timid and short initiatives in certain sectors. This way of addressing the theme seeks to look at the matter not only from one point of view.

As an example, the Economic Commission for Latin America and the Caribbean (CEPAL) addressed the theme of Physical Infrastructure and Regional Integration in its *FAL Bulletin*, which includes matters related to trade and transport facilitation in Latin America and the Caribbean (CEPAL, 2009). In addition, the same paper emphasises that integration can be seen from at least three angles, namely: economic and commercial integration; political integration; and physical integration.

When methodologically dealing this way, it suggests that such "angles" are independent and soon stop addressing the issue in the multifaceted and interdisciplinary approach we suggest. However, CEPAL represents one of the main sources of data and information for decision-makers of the region, which again would ratify why this theme is so misunderstood by players.

Thus, CEPAL (2009) highlights that *"it is essential to emphasize the importance of physical integration for the economic and social development of our region*"[3] and since we agree to this, we will focus on a specific field of physical inte-

3 Emphasising the importance of physical integration for the economic and social development of our region is essential (authors translation).

gration: energy physical integration. In the same paper, it is emphasised that physical integration is less addressed and discussed in literature, which evidences the need to deepen the matter.

Energy is essential to the life of the population and full economy activity. Considering the potential of renewable and non-renewable resources of the South American region, it can be imagined in advance that the rational use of these resources should occur. On the other hand, it is known that this does not occur in practice. Why?

Answering to this question is not easy. Fuser (2010, p.5) emphasises that:

> The prevailing understanding among the political and business actors, as well as expert analysts, is that there are possibilities to greatly expand energy integration activities in order to optimise the use of energy and get the maximum benefits of the natural complementarity between resources available in the region.

Several studies intended to understanding why energy integration in the region did not advance as much as the project despite the policies and initiatives that deal specifically with the issue (SANTOS, 2013a, 2014b, ZANETTE, 2013).

As regional integration, energy integration definition is not closed, clear and unanimous. Oxilia Dávalos (2009, p.16) states that there is no precise definition in the literature about the *energy integration* concept, thus suggesting its interpretation as follows:

> A process involving at least two countries directed to any activity of the energy industry (especially energy production and transport) through a permanent facility based on a specific agreement driving the rules of relationship between the parties.

This is a very interesting definition as it emphasises key topics to fully understand the theme. When highlighting the presence of "at least two countries" a difference is made between integration and bilateral cooperation. When addressing "permanent facility", the fact that integration is physical is emphasised, that is, counting on an infrastructure investment. When handling the "specific agreement driving rules", process institutionalisation is highlighted through rules, standards and Treaties.

In what regards specifically to the latter, Moreira and Pinto (2013, p.4) highlight that electricity integration, our specific case, not only requires phys-

ical connections of energy interchange and joint generation projects, but a set of agreements and institutions that have not yet been defined by South America countries. Thus, the need to promote a solid and participatory institutional framework dealing with the theme becomes evident in order to ensure the compliance of contracts, as well as consider energy hard infrastructure projects (on the environment, for example).

Honty (2006, p.126) is even more critical when he points out that:

> *La integración a la que asistimos es, esencialmente, una interconexión física para transportar electricidad y gas natural, sin ningún compromiso político e sin aspiraciones de proyectar un desarrollo regional sustentable. Su objetivo principal es logar el acceso a las fuentes energéticas disponibles a los precios más bajos. (…). Aunque esto puede ser cierto, si no se acompaña con una política común para la distribución de los beneficios del uso de la energía, entonces resulta en un mero abaratamiento de los costos de producción para las grandes industrias.*[4]

By putting it this way, Honty (2006) not only emphasises the political aspect that must exist in the physical analysis - overcoming CEPAL methodological limitations (2009) - but, above all, the need for such benefits to be shared throughout the society, and not only serve to benefit certain sectors. A similar criticism is made about the *Initiative* for the *Integration* of Regional Infrastructure in South-America (IIRSA) once many authors criticise the ones who are really benefited by energy physical integration, transport and telecommunication projects promoted (SANTOS *et al.*, 2013a; FUSER, 2010; COUTO, 2008).

Although this section does not specifically address the IIRSA, it is anticipating that it is usually associated to physical bottlenecks and regulatory problems of the South American region (SENNES & MENDES, 2008). Terms as "market failures", "privatisation", "free competition" and "free initiative" are avoided and, more than this, criticised once they consider unreal and simplifying assumptions of the political and economic reality, in our view. Therefore, and for dealing with areas with strong environmental sensitiveness, IIRSA will be addressed in the following section.

4 Integration that we assist is essentially a physical interconnection to transport electricity and natural gas, *without* any political commitment and *aspirations* to project a sustainable regional development. Its main purpose is to access energy sources available at lower prices. (...). Although this can be right, if not followed by a common policy for distribution of energy use benefits, then it is resumed to mere cheapening of production costs for large industries (translation and emphasis of the authors).

With the risk of making comparisons with the European regional integration model, Lima and Coutinho (2006) highlight that the first steps towards European integration in the last century were given from the creation of the Coal and Steel Community (CECA). In fact, and despite the different political, economic and international contexts, the root of the European Union integration process is related to the energy theme, given its relevance, its cross-cutting effects on the economy, as well as its relations with the social and economic development (DIAS LEITE, 2007) .

3. Energy Integration and Sustainable Development

After the second half of the 19th century, the Industrial Revolution enabled man to get power, speed and yield gains during the production and consumption process by establishing a new grandeur order of power consumption and resources (PASSET, 1979). The steam machine was initially implemented powered by coal and wood, but only in the Second Industrial Revolution, in the second half of the 19th century, it became possible to burn fossil fuels for the generation of jobs. The use of such primary energy sources is inherent for gases emission affecting human welfare in local, regional and global levels.

However, only during the 20th century discussion about economic and environmental matters became one of the main aspects analysed in the scope of environmental management, international negotiations on the environment, as well as climatic changes (SANTOS, 2014a). This fact is mainly due to the understanding that, until recently, the economic theory considered the relations between the economic system and the environment on the background having, in the extreme, sophisticated theories of general equilibrium and economic growth focusing on the economy as a single system, that is, a system that does not interchange matter nor energy with its external environment (MUELLER, 1996).

In *L'Économique et le Vivant*, René Passet[5] (1979) argues that the economic sphere, that include productions, changes and consumptions of goods and services, had a closed system logics, that is, focused on itself. In this sense, he

5 The Economic and the Live (translated by the authors).

states that this position of the economic theory conflicts the logic of human activities and biosphere spheres, especially when considering that the current scale of economic impacts on other spheres is often superior to the carry capacity.

Thus, the economic system would work as if there were an inexhaustible source of material inputs and energy. According to Mueller (2007), all inputs of the production process would be entirely converted into products, with no undesired input and, in consumption, all products would disappear completely. It was as if the economy was an isolated system, while the economic theory focus on the analysis of exchange value flows circulating inside, between businesses and households.

Such a posture was justified as they were limited, in relation to the ecosystem, to the demands of material and energy of the economic system, as well as their emissions of waste and tailings. The first efforts of neoclassical economy to change the basis of theory only emerged in 1960, when it became evident the fact that environmental externalities are part of economic processes. As emphasised by Georgescu-Roegen (2012), the economic thinking has always been influenced by the current economic problems; however, the centre of such currents of thought simply did not know the crucial fact that the economic activity can not last without continuous exchanges with the environment.

Many facts influenced this change, such as the decrease in the quality of life in industrialized countries - in 1962, a series of environmental disasters started happening in various parts of the world, such as the contamination of Minamata Bay in Japan where hundreds of people were poisoned by mercury after eating contaminated fish. In this same period, the biologist and writer Rachel Carson launched the book Silent Spring, which would become a classic for preservationist, environmentalist and ecologist movement. The same warned of the increasing loss of quality of life caused by the indiscriminate and excessive use of chemicals and fertilisers and the effects of such use on environmental resources (CARSON, 1962).

In 1987, the Brundtland Report entitled "Our Common Future" defined a concept that would change the concept of economic growth adopted by most countries so far. Thus, "sustainable development" would be the development satisfying the present needs without compromising the capacity of future generations to satisfy their own needs (UN, 1987). This con-

cept was consolidated at the United Nations Conference on Environment and Human Development (UNCED), more commonly known as Eco-92 or Rio-92.

However, the search for sustainable development has led to constant challenges and questions since concepts were previously considered antagonistic, as profit, environmental conservation and social welfare, that is, the economic, environmental and social tripod, should now be harmonised and treated inseparably. It is in this sense that the whole discussion about the relationship between economy, environment and energy, in the context of economic development of the regions, has proven to be crucial to understand the importance of environmental issues on energy integration projects. The same clearly arises as a desirable goal - first, by the gains from the economic complementarity between the different countries; second, for the possibility of reducing energy costs; and, lastly, for the opportunity of diversifying the energy matrix. Not coincidentally, energy has been identified, along with large highways projected or being built, as the backbone of South American integration.

Historically, integration or energy interconnection initiatives in South America occur in clearly different phases (OXILIA, 2009). The first phase, during the 1970 and 1980, is characterised by the strong State participation in projects related to the energy sector. It is the period of major binational projects with emphasis for Itaipu (Brazil-Paraguay), Yaciretá (Argentina-Paraguay) and Salto Grande (Argentina-Uruguay) power plants. The first international gas pipeline in South America, Yabog, was launched in 1972 to send Bolivian natural gas to Argentina. On the northern border of Brazil, Roraima state began to receive power from the Venezuelan Guri dam, the world's third largest.

The second phase, during the 1990s, is characterised by the centrality of private investments within the neoliberal political hegemony in the region. Over this period, power plants were on the background given the priority to install thermal power plants, which were more attractive from the transnational businesses point of view, but less attractive from the environmental point of view. The focus changed for natural gas trade through large pipes. Gasbol construction started in 1996 between Bolivia and Brazil, and it was launched three years after. At the same time, the energy industry privatisation in Argentina with the sale of YPF (*Yacimientos Petrolíferos Fiscales*) and *Gas del Estado* to foreign capital was followed by the construction of a network with

seven gas pipelines (all of them belonging to private businesses) for the export of Argentine gas to Chile.

However, the fact is that the environmental matter, and even social, has been put as extremely relevant variables in the context of regional integration projects in South America. The Declaration of Margarita, for example, established that "energy integration of the South American Community of Nations[6] should be used as an important tool to promote social and economic development, and poverty eradication." This type of commitment is repeatedly emphasised in declarations of several representatives of member countries to enhance the commitment of each country to the project (OLIVEIRA *et al.*, 2014).

The intersection assessment between improvement in the South American power matrix, poverty and conservation of natural resources starts from this reflection. In this sense, Oliveira *et al.* (2014) highlights that several countries in South America have a peculiar situation in relation to its energy inventories: they are very abundant. If we only think in terms of direct exploration energy resources as fossil fuels, natural gas, water, wind and solar incidence, these have gigantic dimensions, but if we also add biodiversity to them as a coding source of energy and raw material genetics for future development in response to environmental changes, we will have an abundance of energy resources and functions provided by them with unimaginable magnitude.

In the energy arena, in addition to players that have dedicated historically to energy integration, especially OLADE (*Organización Latino Americana de Energía*) and CIER (*Comisión de Integración Energética Regional*), the Initiative for the Integration of Regional Infrastructure in South-America (IIRSA) appears more recently. Created during the First Meeting of South America Presidents in Brasília, in 2000, IIRSA is a multinational infrastructure initiative involving all twelve South America countries, which *somehow* include economic, political, social, cultural and environmental aspects comprising coordination mechanisms between Governments, multinational financial institutions promoting it and the private sector (BONO & BORDAZAR, 2011).

According to Couto (2007), IIRSA would thus be responsible for promoting the basic transport, telecommunication and energy infrastructure

6 UNASUR.

providing the foundation for better commercial and social integration[7] in South America. Therefore, it would enable investment plans and programmes with a political view, thus considering the regional integration strategy. However, it is noted that the environmental matter is still extremely marginal once it is not even included in projects' selection criteria - according to IIRSA official website.

According to Vainer and Nuti (2008), the social and environmental balance of projects from several power sectors does not recommend any optimism. In Brazil, this balance is dramatic, to say the least, given the social and environmental costs not properly compensated and repaired in the implementation of power plant projects, according to the authors. The violation of human rights has led the Council for the Defence of Human Rights, linked to the Special Secretariat for Human Rights of the Presidency of the Republic, to create a Special Commission to "conduct an empirical survey" of "instances of violations of human rights arising from the implementation of dams in the country" and "present suggestions and proposals regarding the prevention, assessment and mitigation of social and environmental impacts from implementing such dams, and the preservation and repairing of the rights of the affected populations" (Resolution no. 26/2006).

Serious damages caused by the implementation of power plants on traditional populations of the Brazilian Amazon (Tucuruí, Balbina), Chile (Bio Bio) and Colombia (Arru) are equally known. Binational projects did not escape the same problem, such as the problems seen in Yaciretá and even in Itaipu where the situation of Guarani Oco'y remains unresolved (VAINER & NUTI, 2008).

Thus, energy, use and management of water resources and, more broadly, the forms of association of the territory and environmental resources (territorialised) are undoubtedly decisive themes in any national strategy or project. Likewise, they should be emphasised in long-term projects and strategies focused on South America regional integration.

The fact that most IIRSA projects are bilateral make energy projects, out of which not many are related to energy integration, not deal specifically with the theme in question. Thus, there are a few projects addressing energy

7 Couto (2007) highlights IIRSA's social relevance despite the many criticisms to the fact that it fundamentally considers the basic infrastructure to only promote economic activity in the region, especially toward private actors.

interconnection and construction of new plants, and, when there is, the environmental issue is marginal (Santos *et al.*, 2013).

4. Itaipu Binacional

This section is mainly focused on emphasising Itaipu Binacional's relevance regarding energy integration in South America. For such, the first subsection shall present a brief history of Itaipu Binacional, as well as some of the main criticisms to the plant. Then, several analyses will be made for Itaipu considering the environment.

4.1. Brief history and main criticisms

Before introducing the political and economic problem existing in Brazil-Paraguay bilateral relations regarding Itaipu Binacional, emphasising the physical characteristics of the plant and the region in order to be certain about Itaipu's magnitude is important. Located at Paraná River, it has an installed capacity of 14,000 MW and supplies 73% of the Paraguayan and 17% of the Brazilian market. With an annual production of 87,795 GWh in 2014[8], it had an area reservoir of 1,350 km^2 (the seventh largest one in Brazil) with a length of 170 km (SAMEK, 2012).

The dam is 196 m high and 7,919 m in total length. According to the plant's official website, transmission for the Brazilian interconnected system starts from Foz do Iguaçu substation in Paraná and is conducted by Furnas and Companhia Paranaense de Energia (Copel). Energy at 50 Hz uses Furnas direct current system and energy at 60 Hz uses Furnas 765 kV system and Copel 525 kV system. For Paraguay, the transmission is made at 500 kV and 220 kV from Margem Direita substation.

After briefly presenting the plant's characteristics, it can be considered that Itaipu Binacional's construction put an end to the long diplomatic conflict between Brazil and Paraguay from 1750 to 1960 (SOUZA, 2005; BLANCO; 2009). The heart of the matter was the territorial sovereignty of the Salto Grande of Seven Falls region, since in the words of Andersen (2009, p.2):

8 Drop of 11% compared to the previous year.

> Itaipu's power plant was built in this international, shared, contiguous and successive river of Bacia do Prata, upstream the Argentine territory. Itaipu was built in the "triple border", formed by the boundaries between Brazil, Paraguay and Argentina.

A series of agreements aimed at solving the tension in the region: Paraguay-Brazil limits treaty (27 March 1872), Foz do Iguaçu Act (22 June 1966), Itaipu Treaty (26 April 1973) and Itaipu-Corpus Tripartite Agreement[9] (19 October 1979). According to Cunha (2011), Itaipu Treaty details the planning of the plant specifying the legal structure, as well as three annexes:

- Annex A: Statute of the binational entity called Itaipu;
- Annex B: General description of facilities intended for electricity production and auxiliary works with eventual necessary changes; and
- Annex C: financial bases and electricity services provision of Itaipu.

According to Canese (2011), one of the negative parts of Itaipu Treaty concerns the fact of highlighting the "right to purchase" energy not used by Paraguay by Brazil (instead of "pre-emptive right to acquire" as in Iguaçu Act). Thus, one of the main complaints by the Paraguayans is because Brazil interprets that Paraguay is forced to deliver (sell) all of its unused energy to the Brazilian park. Another question refers to the term "compensation" for energy transfer (instead of "fair price" as in Iguaçu Act), whose calculation basis has been criticised and questioned by the Paraguayans.

However, it is worth mentioning that many players state that such criticisms would not have economic basis. Castro and Brandão (2013), for example, have published a brief article in response to the text published by *Vale Columbia Center* called *Leveraging Paraguay's Hydropower for Sustainable Economic Development*, in 2013. Most specifically, the authors questioned certain assumptions in the cash flow simulation, indicating inconsistencies in it. "We therefore recommend that the authors revise this simulation and also revise the conclusions based on it for the final version of the report"[10] (*Ibid.*, p.4).

Itaipu starts producing power in 1984 and, since then, definitions of Annex C and (possible) interpretations related to the above terms have been causing

9 Signed between Argentina, Brazil and Paraguay, it evidences the cooperation in Bacia do Prata.

10 *Nós, portanto, recomendamos que os autores revisem esta simulação e também revisem as conclusões com base nela para a versão final do relatório* (translation of the authors).

disagreement between Brazil and Paraguay.This is specially due to the fact that Brazilian entities (Eletrobras, BNDES, BNB, BB, CEF, FINEP)[11] financed, on average, 71.3% of the project (OXILIA DÁVALOS, 2009; PUERTO SANZ, 2002); therefore, the tariff price paid for unused energy in Paraguay takes into account the initial investment fundamentally made by Brazil.

Consequently, a new agreement has been signed (25 July 2009) and, according to its article 5, the amount to be paid for the power granted by Paraguay for Brazilian use is tripled and, according to its article 6, *Administración Nacional de Electricidad* (ANDE) may negotiate exceeding energy with other companies from the Brazilian market, not being limited to negotiate it with Eletrobrás (BLANCO, 2009). According to the same article, Paraguay may negotiate its surplus of power with third markets as of 2023[12] - which has been causing even greater pressure and tension over current Brazil-Paraguay relations.

In this sense, Canese (2011, p.195) states that "*el Paraguay logró avanzar con éxito (…) en el 2008: abrir negociaciones y fijar la agenda*"[13]. According to the author, Itaipu Treaty's signature deepened the political and economic dependence model, and the country became "periphery of the periphery". Thus, it is highlighted that the signature by the then President of Paraguay, Alfredo Stroessner, and the President of Brazil, Gen. Emilio Médici, did not mean progress for both countries, but the Paraguayan subordination.

Therefore, despite the different agreements and treaties related to the plant, there is a series of matters still being debated by both countries. Costs, prices, sovereignty and autonomy, thus star this discussion. However, in spite of this and of the fact that this is the most mentioned energy integration model in South America, Itaipu Binacional is often put as a mere bilateral cooperation project between Brazil and Paraguay.

Taking into account the division between energy produced by both countries, in what regards specifically to the plant's installed power, there are currently 20 700MW units, totalling 14,000MW, out of which 50% belong to each country. It is worth mentioning that with the Tripartite Agreement,

11 The National Bank for Economic and Social Development (BNDES), the Banco do Nordeste do Brasil (BNB), the Bank of Brazil (BB), the Federal Savings Bank (CEF), and the *Financing* Agency of *Studies and Projects (FINEP)*.

12 When the terms of Itaipu Treaty expire, 50 years later.

13 Paraguay was able to successfully achieve (...) in 2008: open negotiations and set the agenda (translation of the authors).

Itaipu cannot generate over 18 units (12,600MW). In addition, in Paraguay's side, Itaipu not only represents employment, but also 82% (45,000 GWh/year) of the power offer in the country - Yaciretá corresponds to 16% and Acaray to 2%, according to 2009 Energy Balance and Paraguay (CANESE, 2011).

Despite the strategic relevance with a strict relation to Paraguay sovereignty, a new diplomatic threat has been putting the regional integration between Brazil and Paraguay at stake since 2012. Not only the temporary suspension of Paraguay from the Southern Common Market (MERCOSUR) shook the bilateral relations, but the fact that the current President, Frederico Franco, have again questioned the value of the tariff that Brazil pays for Itaipu energy not consumed by Paraguay.

In the words of President Franco, "*la decisión del Gobierno [paraguayo] es clara y no se continuará cediendo nuestra energía*"[14]. And he adds: "*noten que usé la palabra 'ceder', porque lo que estamos haciendo es darle la energía a Brasil y Argentina, pues no la estamos vendiendo*"[15] (SANTOS *et al.*, 2013b). Therefore, since Paraguay only consumes almost 5% of its share, 45% of the remainder is consumed by Brazil (according to the established in Itaipu Treaty) whose tariff value is a major question.

In this sense, and considering the complex scenario in question, it is worth considering that Itaipu Binacional is not only one of the main examples of South American energy integration mention, but it represents more than a simple energy cooperation project. Both countries invested in hard infrastructure, involving workforce from both countries with mutual benefits. Even though the matter of which country has benefited the most is still open, Itaipu ensure energy supply for both countries and when built it was an example of boldness in technical, human, environmental and financial terms (PINTO, 2009).

4.2. What about environmental matters?

According to Bolea (1985), environmental impact is the difference between the future environment situation (natural and social) changed by the

14 The [Paraguayan] government decision is clear and we will not continue granting our energy (translation of the authors).

15 Note that I used the word "grant" as what we are doing is to grant energy to Brazil and Argentina since we are not selling it (translation of the authors).

implementation of a project and the future situation of the environment as it would have been without such project. Thus, as indicated in the name, the impact is caused by an action on the environment; therefore, there is an action-reaction relation.

However, it is noted that this definition has some difficulties, as the identification of the borders of impacts since they are spatially and temporarily propagated through a complex inter-relations network - concept defined by Drummond (2000) as "contiguity of natural resources" and also broadly discussed by Hardin (1985). In addition, there are instrumental and methodological deficiencies to predict ecosystems' responses to human actions.

According to CONAMA Resolution 001/86, environmental impact is:

> (...) any change to physical, chemical and biological environment properties caused by any form of matter or energy resulting from human activities directly or indirectly affecting:

- health, security and the well-being of the population;
- social and economic activities;
- biota;
- aesthetic and sanitary conditions of the environment; and
- quality of environmental resources.

In this sense, given the energy integration context in South America, it is extremely important to analyse the environmental impacts of such projects, not only in terms of quality of air and water, for example, but also to analyse the related social aspects. Thus, Itaipu shall be analysed from this perspective.

From the environmental management point of view, many stated that due to their dimensions, these projects should be analysed from the Strategy Environment Assessment (AAE) and not the Environmental Impact Studies (AIA) point of view. AAE is originated from EIAs limitations including the difficulty to change the decisions of projects linked to policies or plans whose decision has been taken without the due necessary analyses.

Thus, according to Partidário (1999), AAE is a systematic and continuous procedure of assessment of the environment quality and environmental consequences from alternative development visions incorporated in Policies, Plans and Programmes (PPPs) formulation initiatives. It aims to ensure the

effective integration of biophysical, economic, social and political aspect as soon as possible to public planning and decision-making processes. Hence, benefits include the early identification of potential impacts and cumulative and synergistic environmental effects, reducing time and resources required for the Environmental Impact Assessment of individual projects.

However, the discussion purpose is not to ascertain what would be the best methodology to be used to analyse the case of Itaipu, but precisely check how the environmental issue is considered by the plant. In this perspective, it is important not only to analyse the current situation of the project, but to check the environmental impacts caused on the region since the plant construction.

To conduct this major work alone, it would be necessary to divert Paraná river to the dam construction and, in this sense, a lot of iron and concrete would be used until the work was completed (RIBEIRO, 2002). The construction of a project of this proportion, from the modification of a region with great biodiversity, caused a huge environmental impact, such as the flooding of a large amount of forest, the loss of many animal species, the displacement of the local population, among other impacts (MAZZAROLLO, 2003). However, after reading the environmental conservation plants it is interesting to realise that Itaipu was said to be aware of impacts caused by the work already in the first years of its construction.

However, environmental conservation policies formulated by Itaipu Binacional power plant started in 1975, a year after the beginning of its construction. This project was called Basic Environment Conservation Plan and gave rise to the formulation of other projects aimed at the conservation of animals and vegetation that was in the place. It was intended to "mitigate some negative consequences of the project, emphasise and gradually improve the benefits and other uses the reservoir will provide to the vast region" (MAZZAROLLO, 2003, p.180).

The creation of a museum to obtain a collection of researches conducted by Itaipu before, during and after the lake formation was already proposed in this environmental conservation plan. According to Ziober (2009), Ecomuseu was created in 1987 to conduct researches and conserve natural and cultural elements representing the region. Itaipu managers also intended to create zoos, conduct studies of fishes, water, climate, vegetation in the area, surveys on the earth and archaeological and historical aspects in this plan.

Collection, identification and safeguard activities of elements considered important to be conserved were conducted through this plan.

> Surveys of animals and vegetation in the region were conducted and 623 botanical species, 70 mammal species, 252 birds species, nearly 1,600 insects species and 23 reptiles species were identified. During these collections, another 210 archaeological sites were discovered on the Brazilian side. The idea was that most of these animals was rescued before the formation of its reservoir. (*Ibid.*, p.8).

According to the same author, such plans for fauna and flora protection of the region are marks of a period characterised by environmental concerns in international scope due to the perception that human actions causing wears in Nature. On the other hand, Brazil's internal policy in the period was marked by the search for economic development included in the proposal of military presidents of the time. Therefore, Itaipu construction would be an understanding of this idea of progress.

Emphasising that not all the region population was in favour of the plant's construction is important. The landscape changes profoundly altered the way of life of its residents. For the local population, seeing the flooding of the territory had a different meaning than for those interested in the construction of Itaipu - they thought, at first, in the (economic) development of the nation (SANTOS, 2006). Manifestations wishing to conserve this place did not have enough strength to stop the construction of this work (RIBEIRO, 2002; SANTOS, 2006).

However, given the current discussion on sustainable development, inherent and dissociable of contemporary businesses, Itaipu presents several fronts when considering its environmental policy. According to information available on the website,[16] *rivers, streams and sources supplying water that move the plant receive special attention inside the plant's environmental management actions;*
so as to preserve the fauna and flora, Itaipu maintains biological reserves and refugees, in addition to a biodiversity corridor, which promotes the conservation of the forests of the region.

Also according to official information of the website, in devastated areas found by the agricultural practice, the plant launched reforestation actions that would allow the plantation of 23 million tree seedlings on the reservoir

16 https://www.itaipu.gov.br/meio-ambiente-capa

protection strip. There are also other environmental management policies related to the reuse and recycling of materials, thus promoting environmental education of adults and children throughout the coverage area of the plant lake, and encouraging environmentally correct practices in agriculture, fishing and recreation activities.

The plant is considered a reference in the power industry and received many awards, as the Earth Charter Prize in 2005. In 2015, the Cultivating Good Water Programme, created by Itaipu Binacional in 2003 and developed in the 29 municipalities of the West of Paraná was considered the world's best practice in water resources management. Sponsored by the United Nations (UN), the Water for Life Award evaluated other 40 initiatives from all continents in the "best water management practices" category. This programme is based on integrated management - with city halls, public bodies, businesses and communities – wishing to solve social and environmental problems of Paraná Basin.

5. Conclusion

As it can be noted after reading the chapter, regional integration is complex and interdisciplinary, which requires proper analysis and training considering such matters. Regional integration is not a synonym for cooperation and, focusing on the energy case, having political will and joint investments is necessary, In addition, and considering the current sustainable development and social and environmental policies context, taking these matters into account in energy integration projects is becoming increasingly essential.

It is in this sense that the whole discussion about the relationship between economy, environment and energy, in the context of economic development of the regions, has proven to be crucial to understand the importance of environmental issues on energy integration projects. Thus, this reflection enables intersection assessment between improvement in the South American power matrix, poverty and conservation of natural resources in the region. However, emphasising that the social and environmental balance of projects from different domestic power sectors in South America does not recommend any optimism is important; serious damages caused by the implementation of power plants on traditional populations of the Brazilian Amazon, Chile and

Colombia are equally known, not escaping binational projects to the same problem as shown by pending problems in Yaciretá and even in Itaipu.

Regarding the case study under analysis of Itaipu Binacional power plant, it is worth emphasising that it takes to a optimal level of sharing of resources (Paraná river waters). After conducting an analysis of social and environmental impacts since the plant's construction, it is noted that it has been using policies aiming at reducing space, environment and society transformations in order to soften the negative image associated with its construction. In this context, it is emphasised that Itaipu Binacional is also currently considered a reference in the power industry, and has received many awards and, in 2015, had the Cultivating Good Water Programme considered the world's best practice in water resources management.

It is worth mentioning that Itaipu Binacional is related to the need for promoting energy security at competitive prices in the region, such as increased trust, as well as a greater scale productivity. Besides, more than a revolution and an engineering challenge, Itaipu has proven itself successful and a real break in political and, specially, legal paradigms. However, it is known that policy, as well as tariffs cost has been shaking Brazil-Paraguay bilateral relations. In this sense, the Paraguayan debt will be fully settled in 2023 thus opening a space for new relations between the countries.

Bibliographical References

BLANCO, L. F. **O Novo Acordo Brasil-Paraguai e a Renegociação do Tratado de Itaipu: Enfim uma postura de liderança sub-regional?** Rio de Janeiro: Fundação Konrad Adenauer, 2009.

BOLEA, M. T. E. **Evaluación del impacto ambiental**. Madrid, Fundación MAPFRE, 1984.

BONO, L. M.; BORDAZAR, L. L. B. La iniciativa IIRSA a 10 años de la reunión de Brasilia. **Revista Intellector**. Ano VII, v. 8, nº15, jul/dez, 2011.

BRASIL. **Resolução CONAMA Nº 001**, de 23 de janeiro de 1986. Brasília: Diário Oficial da União de 17 de fevereiro de 1986.

CANESE, R. **La recuperación de la soberanía hidroeléctrica del Paraguay: en el marco de Políticas de Estado de Energía**. Asunción: CINERGIAS, 2011.

CASTRO, N. J.; BRANDÃO, R. Comments on Vale Columbia's Leveraging Paraguay's Hydropower for Sustainable Economic Development. **GESEL-IE-UFRJ**, 2013.

CASTRO, N. J.; ROSENTAL, R. Os desafios da integração do setor elétrico na América Latina. **Blog Infopetro**, 2012. Available at: <https://infopetro.wordpress.com/2012/09/10/os-desafios-da-integracao-do-setor-eletrico-na-america-latina/>. Visited on: 26 February 2015.

CEPAL – COMISSÃO ECONÔMICA PARA A AMÉRICA LATINA E O CARIBE. Physical Infrastructure and Regional Integration. **FAL Bulletin**, Issue nº. 280, nº. 12, 2009

COUTO, L. F. A Iniciativa para a Integração da Infra-estrutura Regional Sul-americana - IIRSA como instrumento da política exterior do Brasil para a América do Sul. **Revista Oikos**, vol. 5, nº. 1, 2008. Available at: <http://www.revistaoikos.org/seer/index.php/oikos/article/viewFile/109/77>.

COUTO, L. F. Initiative for the Integration of Regional Infrastructure in South-America – IIRSA. **Global Forum on Governance – Modernising Government: strategies & tools for change**. Out, 2007.

CUNHA, L. F. da. **Itaipu: uma entidade sui generis**. Universidade de Relações Internacionais, Brasília, v. 9, n. 1, p. 227-246, jan./jun., 2011.

DIAS LEITE, A. **A Energia do Brasil**. Rio de Janeiro: Eselvier, 2007.

DRUMMOND, J. A. Os Recursos Naturais como Bens de–Interesse Difuso': Dificuldades Institucionais e Materiais para as Leis e Políticas Ambientais, In: HERCULANO, S. (Org.), **Meio Ambiente: Questões Conceituais**. Niterói, PGCA-UFF; Riocor, Rio de Janeiro, 2000, pp. 9-40.

FUSER, I. O caminho pedregoso da integração energética. **Blog do GR-RI**, 2015. Available at: <http://www.cartacapital.com.br/blogs/blog-do-gr-ri/o-caminho-pedregoso-da-integracao-energetica-4485.html>. Visited on: 15 March 2015.

_____. A (des) integração energética na América do Sul: uma crítica ao brasil-centrismo. **IV Simpósio Lutas Sociais na América Latina:**

Imperialismo, nacionalismo e militarismo no Século XXI, Londrina: UEL, 2010, pp.115-124.

GEORGESCU-ROEGEN, N. **O Decrescimento: entropia, ecologia, economia**. São Paulo. Editora Senac, 2012.

GOLDEMBERG, J.; LUCON**,** O. Energia e meio ambiente no Brasil. **Estudos Avançados**. 21 (59), 2007**.**

HARDIN, Garrett. **Filters Against Folly: How to Survive despite Economists, Ecologists, and the Merely Eloquent**.Viking, 1985.

HONTY, G. Energía em Sudamérica: uma interconexión que no integra. **Nueva Sociedad**, nº 204, julio-agosto 2006, pp. 119-135.

MARIANO, M. P.; MARIANO, K. L. Pasquariello. As teorias de integração regional e os Estados subnacionais. **Impulso**, Piracicaba, vol. 13, nº. 31, 2002, pp. 47-70. Available at: <http://www.unimep.br/phpg/editora/revistaspdf/imp31art02.pdf>.Visited on: 09 March 2015.

MAZZAROLLO, J. **A Taipa da injustiça**. São Paulo: Loyola, 2003.

MOREIRA, J. M. L.; PINTO, R. T. S. Integração energética ou integração de mercados: qual é a melhor solução para a comercialização de energia elétrica? **4º Congreso de la Asociación Lationamericana de Economía de la Energía – ALADEE**, Montevideo/Uruguai, 2013.

OLIVEIRA, C. M.; CINTRA, R. H. S.; ZABOTTO, R. L. M. Integração Energética Sustentável: uma possibilidade real na América do Sul através da UNASUL. **IX Simpósio Internacional de Qualidade Ambiental**. Porto Alegre, RS, 2014.

ORGANIZAÇÃO DAS NAÇÕES UNIDAS (ONU). **Our Common Future**. Report of the World Commission on Environmental and Development. General Assembly Resolution, 1987.

_____. **The Future We Want - Zero draft of the outcome document**, 2012a. Available at: <http://www.uncsd2012.org/futurewewant.html>. Visited on: 8 June 2014.

OXILIA DÁVALOS, V. E. Raízes Socieconômicas da Integração Energética na América do Sul: análise dos projetos Itaipu Binacional, Gasbol e Gasandes. **Tese de Doutorado – Programa de Pós-Graduação em Energia**, Universidade de São Paulo, 2009.

PARTIDÁRIO, M. R. Strategic Environmental Assessment – principles and potential. In: PETTS, J. (ed.) **Handbook of Environmental Impact Assessment**, vol.1. Oxford: Blackwell, 1999, pp. 60-73.

PINTO, T. G. **Itaipu: integração em concreto ou uma pedra no caminho**. Barueri: Manole, 2009.

PUERTO SANZ, L. M. La internacionalización del capital y la integración económica en el sector energético: el caso de Itaipú 1976-1991. **Tese Doctorado en Economía**, Universidad Complutense de Madrid, 2002.

QUEIROZ, R.; TAVARES, F. B.; VILELA, T. O Papel do Brasil como Ator Regional Energético: obstáculos e desafios institucionais. **4º Congreso de la Asociación Lationamericana de Economía de la Energía – ALADEE**, Montevideo/Uruguai, 2013.

RIBEIRO, M. de F. B. **Memórias do concreto: vozes na construção da Itaipu**. Cascavel: Edunioeste, 2002.

SANTOS, L. Otimização do valor de produção no Brasil com restrições de emissão de gases de efeito-estufa, a partir de um análise insumo-produto. **Dissertação do Programa de Planejamento Energético – PPE/COPPE/UFRJ**, Rio de Janeiro, 2014a.

SANTOS, T. Integração Energética na América do Sul: desdobramentos do desenvolvimento institucional. Rio de Janeiro, **Dissertação de Mestrado – Instituto de Relações Internacionais**, Pontifícia Universidade Católica do Rio de Janeiro, 2014b.

_____. A Critical Deconstruction of Myths and Misunderstandings about Energy Integration in South America. **5º SimpoRI-UERJ**, RJ, 5 a 7 de novembro, 2014c.

SANTOS, L.; SANTOS, T. Desarrollo Sostenible y Cambio Climático: una mirada de los gobiernos locales brasileños respecto las principales iniciativas desde la de Río-92+20. In: ODONNE, N; VÁZQUEZ, H. R. **Municipios y Cambios Climáticos: hacia la construcción de paradiplomacia ambiental**. Unión Iberoamericana de Municipalistas, Granada-España, 2014.

SANTOS, T.; SANTOS, L.; MAHECHA, E. G. Integración Energética en Latinoamerica: breve historia y sus oportunidades en el siglo XXI. **4º**

Congreso de la Asociación Lationamericana de Economía de la Energía – ALADEE, Montevideo/Uruguai, 2013a.

SANTOS, T.; SANTOS, L; OLIVEIRA, C. Energy Security and Binational Cooperation: a Case Study of the Itaipu Dam. **Integration & Trade Journal - Revista Integración & Comercio**, nº 36,Volume 17, Jan-Jun 2013, 2013b, pp.105-115.

SANTOS, A. P. dos. Lago de Memórias: A submersão das Sete Quedas. **Dissertação de Mestrado**, Universidade Estadual de Maringá. Maringá, 2006.

SENNES; R.; MENDES, R. C. **Projeto América do Sul: serviços de logística, IIRSA e integração regional – Relatório Final.** Centro de Estudos de Integração e Desenvolvimento – CINDES, 2008.

TOLEDANO, P.; MAENNLING, N. **Leveraging Paraguay's Hydropower for Sustainable Economic Development**.Vale Columbia Center on International Sustainable, 2013.

VAINER, C.; NUTI, M. **A integração energética sul-americana: subsídios para uma agenda socioambiental**. Brasília: INESC, 2008.

VICHI, F. M.; MANSOR, M.T. Energia, meio ambiente e economia: o Brasil no contexto mundial. **Química Nova**,Vol. 32, Nº. 3, 2009, pp. 757-767.

ZANETTE, A. L. Eletricity integration in South America and the lessions from international experiences. **4º Congreso de la Asociación Lationamericana de Economía de la Energía – ALADEE**, Montevideo/Uruguai, 2013. ´

ZIOBER, B. R. As políticas de conservação do meio ambiente da usina hidrelétrica de Itaipu Binacional no período de sua construção. **ANPUH – XXV Simpósio Nacional de História**. Fortaleza, 2009.

Brazilian energy integration in Latin America: History, current situation and perspectives.[1]

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1. Introduction

Electrical integration is discussed and encouraged worldwide for a long time due to the advantages for the countries involved, such as: more efficient use of resources for electricity generation, reduction of electricity wholesale prices and, above all, of its volatility, encouragement to efficiency through increased competition and increased reliability and safety in service provision.

To leverage these and other advantages, many countries, particularly in Europe, have chosen to create regional electric markets with competition in purchase and sale of electricity. However, setting up a regional electric market in South America with the models adopted in Europe is an even more distant option due to economic and social asymmetries of countries and, mainly, due to the adoption of different rules and energy trade standards in countries of the region, which largely hinders the process of regional electrical integration.

Despite such difficulties, Brazil has built and maintains energy interconnections with Paraguay (Itaipu Binacional), Argentina (Garabi converters), Uruguay (Rivera converter) and Venezuela (Roraima transmission line -

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Guri).[6] These projects have been developed in a context of searching for punctual solutions and/or levering specific opportunities, being conducted without support of a strategic policy for energy integration between Brazil and the other countries of the region.

Additionally, there are some electrical integration projects included in the discussions' agenda, such as: the construction of a new converter and transmission line, reinforcing the capacity for power trade between Uruguay and Brazil; the construction of two binational power plants; Garabi and Panambi, at Uruguai River, on the border between Brazil and Argentina in phase of engineering and environmental studies; the construction of binational power plant with Bolivia at Madeira River, still under preliminary phase of discussion; the construction of power plants in Peru to meet the internal market, generating surplus of power that can be exported to Brazil, under the auspices of the Treaty Brazil and Peru signed in 2010[7]; and the construction of power plants in Guiana and Bolivia, with export of part of the electricity to Brazil, also under preliminary phase of analysis.

Within this context, this study seeks to understand, delimit and analyse the electric integration process in the region, having Brazil and its relationships with other countries as the focus of the analysis. Therefore, the work is divided into six parts, including this introduction. The second part examines the central characteristics of the power matrix and the Brazilian potential for power generation based on local resources, also addressing the main constraints of the Brazilian regulatory and commercial model. The third part examines the Brazilian trade model. In the fourth part, the restrictions the Brazilian trade model imposes for full markets integration, as in the model used in European regional markets, are discussed. The fifth part describes Brazilian electrical integration experiences, while the sixth part addresses power import and export potentials in the current regional context. Lastly, conclusions are presented, indicating, in general, that the electric integration with the direct participation of Brazil is more feasible for binational projects and interchanges of short-term surplus, due to differences between the Brazilian trade model *vis a vis* other neighbour countries. The study is supple-

6 Analysis of these electrical integration projects of Brazil with Argentina, Paraguay, Venezuela and Uruguay is attached.

7 This document is available at the website of the Ministry for Energy and Mines of Peru at: http://www.minem.gob.pe/minem/archivos/file/Electricidad/acuerdo%20peru%20brasil%2016%20julio%202010.pdf

mented by an analytical synthesis of past experiences of electrical integration in Brazil with neighbouring countries presented in the Attachment.

2. The Brazilian Electrical System

The purpose of this section is to present the central characteristics of the Brazilian electrical system, examining the power matrix, its expansion perspectives and, lastly, the regulatory model in force since 2004. Prior knowledge of these elements is fundamental to examine the electrical integration possibilities between Brazil and Latin American countries.

2.1 The Brazilian power matrix

The Brazilian Electrical System - SEB - presented a total installed capacity of 139.8 GW in 2014 (MME, 2015) being the total installed capacity of the National Interconnected System[8] - SIN - of 128.4 GW.[9] Within the scope of SIN, 73.1% of its capacity refers to hydro power plants.

Source	SIN	Isolated systems	Self-production	Total Brazil
Hydroelectric	73.1	21.7	8.8	68.0
National	68.7	6.3	8.8	63.8
Imported	4.4	15.4		4.2
Thermal	21.5	78.3	91.2	27.1
Nuclear	1.5			1.4
Wind	3.8		0.015	3.5
Solar	0.009		0.038	0.011
Total	**100.0**	**100.0**	**100.1**	**100.0**
Total (GW)	**128.4**	**1.3**	**10.1**	**139.8**

Table 1: Generation installed capacity in Brazil per source in 2014
(in % of the Total)
Source: Ministry for Mines and Energy (2015, p. 10)

8 The National Interconnected System (SIN) interconnects all the main consumption centres, as well as basins where the main power plants developments are located.

9 The rest of the installed capacity is divided into 1.3 GW of the isolated systems and 10.1 GW belong to private installations intended for self-production, especially in industrial establishments.

Total generation of the Brazilian market was 624.2 TWh in 2014, out of which 566.7 TWh is intended for the SIN (MME, 2015). The analysis of sources distribution, in terms of participation in the power generated, reveals the role of hydro power for the supply of the SIN load, even in face of the change in the Brazilian power matrix paradigm and water crisis in the sector since 2012. According to data on Table 2, 71% of the total electricity generated in the SIN was hydroelectric in 2014, and thermal plants generated 24.1% of the entire power, thus showing its growing importance in the power matrix. Emphasizing the penetration of wind power is also important. It accounted for 2.2% of SIN in 2014 while nuclear generation accounted for 2.7% of the power at the SIN.

Source	SIN	Isolated systems	Self-production	Total Brazil
Hydroelectric	71.0	27.5	6.5	65.2
National	65.2	11.6	6.5	59.8
Imported	5.8	15.9	-	5.4
Thermal	24.1	72.5	93.5	30.3
Fossil	20.1	71.8	49.1	22.9
Renewable	4.1	0.7	44.3	7.4
Nuclear	2.7	-	-	2.5
Wind	2.2	-	-	2.0
Solar	0.002	-	0.010	0.003
Total	100.0	100.0	100.0	100.0
Total (TWh)	566.7	5.3	52.2	624.2

Table 2: Power generation by source in 2014
(in % of the Total and in TWh)
Source: Ministry for Mines and Energy (2015, p. 7)

The Brazilian electrical system was characterized for meeting the consumption, in years of regular hydrology, almost exclusively by central power plants, by other plants with zero variable costs (combined heat and power and wind generation) and plants that have minimum generation defined contractually, such as both nuclear plants (Angra I and Angra II) and thermal plants with take or pay contracts for the purchase of fuels, and most part of the thermal farm remains as a backup for the system.

However, as it can be seen on Table 3, thermal generation is becoming more representative since 2012, partly due to a cyclical factor and partly due to a structural factor.

The cyclical factor relates to the water crisis that crosses Brazil as of the end of 2012, which led ONS to dispatch all thermal plants for a long period of time. In several cases, the operating period of the UTE, mostly hired to operate as a back-up for power generation, broadly overcame the expectations. From 2012 to 2014, plants hired in 2007 auctions have overcome the original triggering projections for the total duration of the 15-year contract, which ended up causing technical operation and maintenance problems (CASTRO *et al*, 2014).

The structural factor is related to a structural change to the generation matrix with reduced participation of hydro power plants in the generation mix. On one hand, it reflects the difficulties being faced by the Government to obtain environmental licenses to build new hydro power plants. On the other hand, recent water projects are almost all run-of-the-river with reservoirs with storage capacity for only a few days. Run-of-the-river plants have little environmental impact; however, they reduce the regulatory capacity of water supply throughout the year due to the reduction of system power storage capacity in relation to the load. Such a lower capacity to regulate the system determines the need for supplementary sources to the hydroelectric park mainly to meet the demand in the dry season (CASTRO *et al*, 2012). In this context, the Brazilian power matrix needs supplementary sources and will tend to a greater participation of other sources in the annual generation, including thermal plants with fossil fuels, as it can be noted in Table 3.

Year	Hydraulic (%)	Thermal (%)
2005	92,4	5,1
2006	91,8	4,8
2007	92,8	4,3
2008	88,6	8,1
2009	93,3	3,7
2010	88,8	7,9
2011	91,2	5,3
2012	85,9	10,4
2013	78,7	17,7
2014	73,0	23,0

Table 3: Dispatched power generation or programmed by ONS for SIN: 2005-2014

Source: ONS (2015, a). History of Operation

The Brazilian transmission system totals more than 100 thousand km of high voltage lines and was built to allow the optimisation of hydropower generation through the exchange of large blocks of energy over long distances. Figure 1 shows the main load centres and watersheds currently explored and the main interconnections. The transmission system allows to leverage the large water diversity in the country. Thus, watersheds that have plenty water resources at certain times of the year are used by the National System Operator - ONS - more intensely, saving water in other hydro power plants and reservoirs, reducing the need for thermal generation. As run-of-the-river plants in the Amazon are included in the generation park simultaneously with increased demand, ONS shall operate existing reservoirs in order to promote greater variation in reservoirs levels in short periods of time (CASTRO *et al*, 2012), and there will be greater need for supplementary sources to the water park.

Figure 1 shows a schematic drawing of the main watersheds with hydroelectric exploitations, the main axes of transmission and interconnections with Itaipu Binacional - which has an important participation in the Brazilian power market[10] -with Argentina through Garabi's converter, and with Venezuela.

10 In 2014, 14% of the power in the Brazilian market was supplied by Itaipu Binacional. (ITAIPU BINACIONAL, 2015 a).

Figure 1: Power Integration in Brazil: 2014
Source: ONS (2015, b). SIN Maps

Figure 2 shows the high voltage transmission system (the so-called Basic Network operated by ONS) with higher level of detail. Smaller international interconnection lines are indicated therein: Uruguaiana (AR-BR), Rivera–Livramento (UR-BR), and Roraima-Guri (VN-BR), in addition to international lines that should be built yet as Melo (UR-BR).

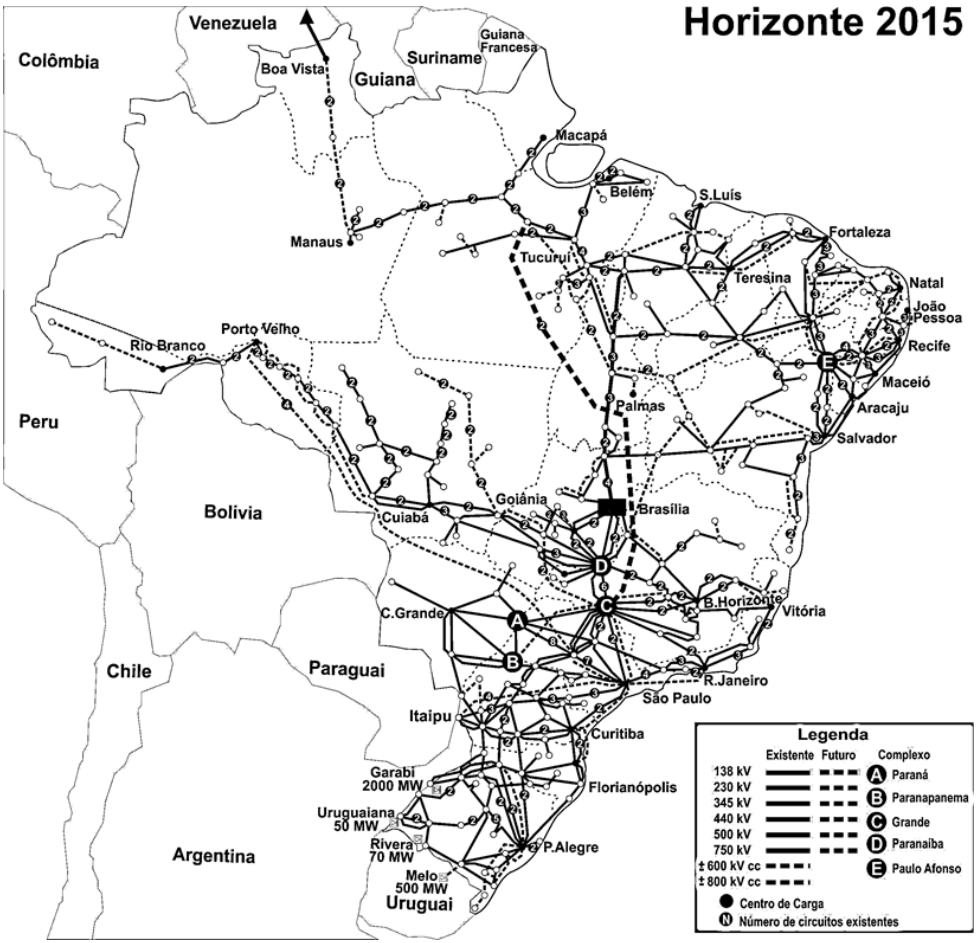

Figure 2: Transmission line in Brazil: 2015

Source: ONS (2015, b). SIN Maps

2.2. Energy potential and perspectives of the power matrix

During the 70s and most part of the 80s, Brazil's external dependence on power grew and represented 46% of the country's global needs (EPE, 2007; p. 24). In 2014, Brazil's external dependence on power accounted for 12.7% of the global needs (EPE, 2015; p. 102). Although the external power dependence has been substantially reduced since the 70s and 80s, it has been increasing in the last five years (2010-2014). Table 4 shows that there was increased

import of fuels from 2010 to 2014, especially in natural gas import with an increase of 53%, and of coal with an increase of 23%. It is also noted that this trend of increase in imports was more pronounced as of 2012, being mostly related to greater dispatch of thermal plants.

Import	2010	2011	2012	2013	2014
Oil	17.516	17.140	17.855	20.373	18,082
Natural Gas	11.130	9.223	11.602	14.926	17.001
Coal	10.867	12.206	11.154	12.044	13.416
Diesel Oil	7.638	7.914	8.241	8.501	9.561
Others	23.595	24.978	31.321	23.751	23.795
Total (10^3 tep)	70.746	71.461	80.173	79.595	81.855
External dependence (%)	7.6	7.9	10.7	14.4	12.7

Table 4: External dependence and import of power in Brazil, 2010-2014

(In 10^3 tep)

Source: National Energy Balance 2015 (p. 102,104)

Almost all of power import corresponds to the purchase of part of Itaipu Binacional power belonging to Paraguay, which represented 5.8%[11] of the power supply in SIN in 2014 (MME, 2015; p. 7).

Official perspectives for the power sector include expressive increase in consumption over the next years[12], which will be exclusively met from national generation plants. However, even though there is a broad diversity and quantity of energy sources to be used within reasonable scale and economic feasibility, Brazil might need to import fossil fuels for thermal generation, especially in the form of LNG. Supply perspectives from the remaining water potential, wind resources and solar generation, biomass and fossil fuels are analysed below.

11 This amount is a reference to part of Itaipu Binacional power exported by Paraguay, and not the total of the power supplied by Itaipu to the Brazilian electric sector.

12 According to EPE (2014, p. 35), power consumption will be 780.4 TWh in 2023, 45% above the consumption of 535.2 TWh seen in 2014.

The Brazilian electrical system has a national projects portfolio that allows for power market supply with safety in supply. The Ten-Year Energy Expansion Plan (PDE 2023), prepared by the Energy Research Company (EPE) state company, can be divided into two dimensions: on the one hand, one has the projects already hired through New Energy Auctions which start operating from 2014 to 2018, totalling 30,043 MW (EPE, 2014; p.80); on the other hand, it takes in consideration new projects, necessary in order to meet the demand by 2023 (estimated at 41,044 MW[13]). This future demand will be meet mainly through the construction of new central power plants (14,679 MW), followed by thermal plants (7,500 MW) and alternative power sources (wind power, combined heat and power from biomass and small central power plants).

There is still a great water potential to be explored in Brazil. According to TOLMASQUIM (2011), Brazil has a water potential of 260 GW. The remaining water potential is concentrated in the Amazon biome and, therefore, the Brazilian electric border expands toward the Amazon region with the construction of large power plants (CASTRO, 2007)[14]. By 2023, the North of the country should expand the generation capacity of 30,504 MW to another 14,506 MW existing in 2013 (EPE, 2014; p. 78). Most of this expansion will be based on run-of-the-river plants, which shall require the hiring of additional generation to the water park, due to the low regularisation capacity. However, it should be noted that there is a certain complementarity in hydrologic seasonality of water projects included in the 2023 PDE, especially among the hydrological regimes of South and Amazon regions with the Southeast/Midwest region, where the largest reservoirs of the current electrical system are located.

PDE 2023 already provides for a great expansion of the thermal farm in the order of 7,500 MW between 2019 and 2023, while the expansion already

13 According to EPE data (2014, p. 78), 71,087 MW will be added by 2023, out of which 30,043 MW should start operating by 2018.

14 The main power plants in construction are: Santo Antônio (3,150 MW) and Jirau (3,750 MW), both located at Madeira River and in final phase of motorisation; Belo Monte (11,233 MW) at Xingu River and Teles Pires (1,820 MW) in the river with the same name. Several other projects are also in the environmental licensing phase, the largest one is Tapajós complex with over 11 thousand MW of capacity. The Amazon Basin hydroelectric potential is estimated at over 100 thousand MW, a magnitude that determines the priority of the Government energy policy in keeping an intense rhythm of hydroelectricity investments in this region. This decision is subject to the obtainment of environmental licenses at times consistent to the need of meeting the demand growth.

hired to start operation by 2016 is 1,446 MW (EPE, 2014. P. 88). Thermal generation expansion depends essentially on the availability of fossil fuels. The thermal farm expansion is expected to basically depend on the availability of natural gas. Natural gas supply in Brazil depends on three factors: national production, import through Bolivia-Brazil gas pipeline and import of liquefied natural gas - LNG.

EPE foresees an increased national raw production of natural gas of 170% in 2023 with relation to the raw production of 2013 (EPE, 2014; p. 222), from 76.15 to 205.7 million m³/day. In addition to total reserves, contingent reserves and undiscovered resources are also considered in this estimate. Considering only the discovered resources, the natural gas production is estimated at 179.64 million m3/day.

In addition to national production, Chart 1 shows that the offer of natural gas in Brazil will still considerably depend on imported resources both from Bolivia, through gas pipeline, and other countries with imported LNG.

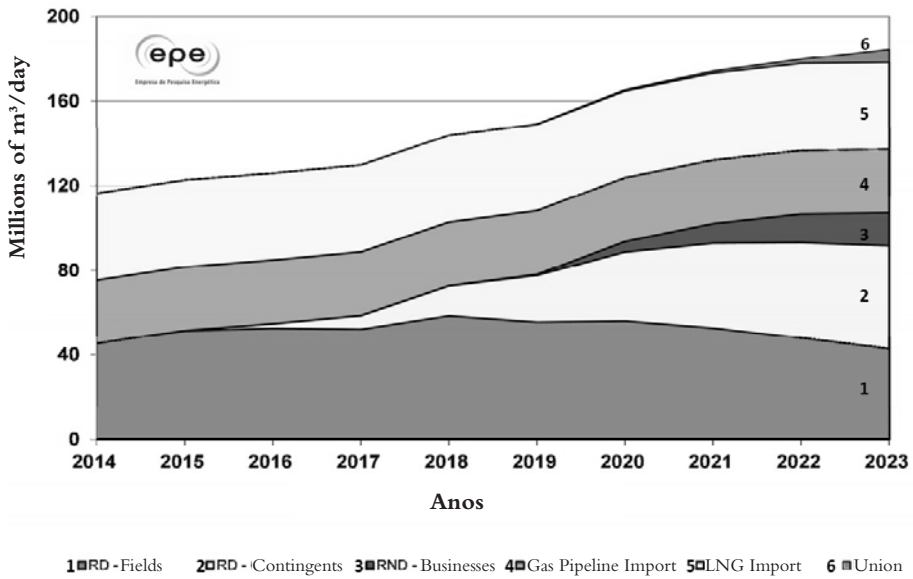

Chart 1:

Offer of natural gas for Brazil's integrated network. 2014-2023[15]
Source: EPE (2014). PDE 2023 (p. 293)

15 RD = Discovered resources, RND = Undiscovered resources.

Natural gas demand for all uses (industrial, residential, vehicle and thermal generation) is estimated to have increased consumption in 2023 (a year with very low hydrology in which gas thermal plants will be continuously activated), domestic consumption could reach 197 million m³/day, staying at around 127.7 million m³/day in years of hydrology within the historic average (EPE, 2014; p. 47).

The Brazilian power sector is important for gas producers since it provides long-term contracts for the power purchase[16] associated to long-term contracts of gas supply. Thus, increased natural gas power generation is not only a feasible, but also a necessary alternative considering the change in the Brazilian power matrix, in which thermal generation will have an essential role, not only as a system backup, but probably also as a basis generation source, at least during the dry period of the year. As a concrete example of the importance of thermal sources in the Brazilian matrix, a large thermal plant that will use imported LNG[17] *(1,515 MW) belonging to the GPE SERGIPE consortium obtained a supply agreement offering electricity at 279 R$/MWh in the last energy auction held in April, 2015 for the purchase of power from new projects in 2020 (called auction A-5) (ANEEL, 2015 a). In addition to indicating LNG competitiveness for thermal generation, this project breaks the dependence of Petrobrás natural gas offer sector.*

Wind power penetration in the power matrix is highlighted in relation to other renewable sources. In 2001, the potential had been estimated at 143 GW based on 45-meter tower and small capacity wind turbines technologies. However, considering new technologies with more powerful wind turbines and higher towers, the estimated potential is 350 GW (IEA, 2014, p. 391).

Only after 2005, Brazil started to explore its great wind potential and costs reduction has exceeded the most optimistic forecasts. Competitiveness of this source was shown in the increased hiring of wind projects. For example, in new energy and reserve auctions held in 2014 and 2015[18], 2,874 MW of wind power were hired. Brazil has already hired over 7 thousand MW of wind power installed capacity, including those hired in 2014 and 2015

16 These contracts usually last 15 years.

17 The UTE will be installed in Sergipe Port at an estimated construction cost of R$ 3.2 billion. The project has the construction of a regasification terminal for UTE operation. (GENPOWER GROUP, 2015).

18 Auction 19 A-3 (June, 2014), auction 20 A-5 (November, 2014), alternative power auction (April, 2015), auction 21 A-3 (April, 2015), and auction 22 A-3 (August, 2015).

auctions for the entry into operation from 2016 to 2020 (ANEEL, 2015 a). Given the current prices scenario and the Brazilian wind potential, the concentration rhythm should remain intense over the next years, thus allowing a progress of the wind power participation in the Brazilian generation matrix.

As noted, increased participation of wind power in the Brazilian power matrix happened and shall remain happening through market mechanisms via auctions without the help of a feed-in tariff as seen in other countries (CASTRO *et al*, 2010). In addition to water, gas thermal and wind generation options, Brazil also has another option at competitive costs. It is the combined heat and power from sugarcane residual biomass; the technical potential of production of this source for SIN would enable to offer an average of 7.7 GW by 2023, out of which an average of 1.4 GW has already been hired and should be supplied as of 2018 (EPE, 2014; p. 90).

Solar power installed capacity is still very small. However, the participation of this source is expected to grow. In fact, 889.6 MW of solar power at an average price of 215.3 R$/MWh have been hired in the reserve power auction held on October, 2014 (ANEEL, 2015 a).

It is noted that there is no forecast for any increase in the import of electricity in PDE 2023 (EPE, 2014). However, this position does not mean that international projects involving the import of power generated in neighbour countries cannot be developed[19]. These projects can be included in the planning, but would be directly subject to negotiations that enable the hiring of firm energy by the Brazilian market. Until now, there are no consistent studies to enable medium and long-term import contracts in the current Brazilian regulatory environment and, given the unsuccessful experience of Argentina's firm power import contract[20], there is no expectation of a strong interest in the short or medium-term by Brazil to enable the import of firm energy, except through binational projects based on Itaipu Binacional successful experience. In any case, since negotiations for eventual power import projects involve negotiations between Governments exceeding EPE sphere of competence, they are not included in the power industry planning.

19 From the ten-year mechanic planning point of view, it will be easy to include for forecast for the import of power in case projects move forward. Every year, EPE remakes the planning targeting ten years ahead. In the first five years, the horizon is already defined since there are projects already hired in new energy auctions. For the last five years, the planning can be changed substantially as new facts are presented or new guidelines are defined.

20 See Attachment.

2.3 Characteristics of the Brazilian power industry

Institutional, regulatory and commercial constraints are very important to enable the exploitation of the national energy potential. A country with great energy potential is not enough if institutional, regulatory and commercial arrangements are not at all consistent. The Brazilian power industry model approved in 2004 has been proven efficient and with capacity to ensure a dynamic balance between electricity offer and demand at competitive costs. However, the change of the Brazilian power matrix has direct implications on the *modus operandi* of the electrical system, and also needs adjustments in the sector model (CASTRO *et al*, 2012).

On one hand, the so-called New Energy Auctions created with the 2004 new model are public disputes over long-term energy contracts[21] to meet the regulated market[22]. In line with the auctions, BNDES offers long-term financing in the Project Finance modality for all winning projects, accepting as main guarantee for financing the cash flow from long-term contracts of purchase and sale of electricity. This business model has drawn the interest of investors and has been resulting in decreasing prices for energy in new ventures, as it can be noted on Chart 2.

Also on Chart 2, it can be noted that, as a consequence of the change in the Brazilian power matrix, the price of energy hired in auctions held in 2014-2015 has been higher than in projects hired before 2014, the last ones to start operation between 2017 and 2020. This is due to the higher concentration of thermal sources also in plants operating with LNG, as well as the inclusion of the solar source that elevates the average price of renewable sources.

21 Up to 30 years for power plants and 15 years for thermal plants.

22 For the energy auctions' role in the Brazilian power industry model see, among others: TOLMASQUIM (2011); D´ARAUJO (2009) and CASTRO (2005).

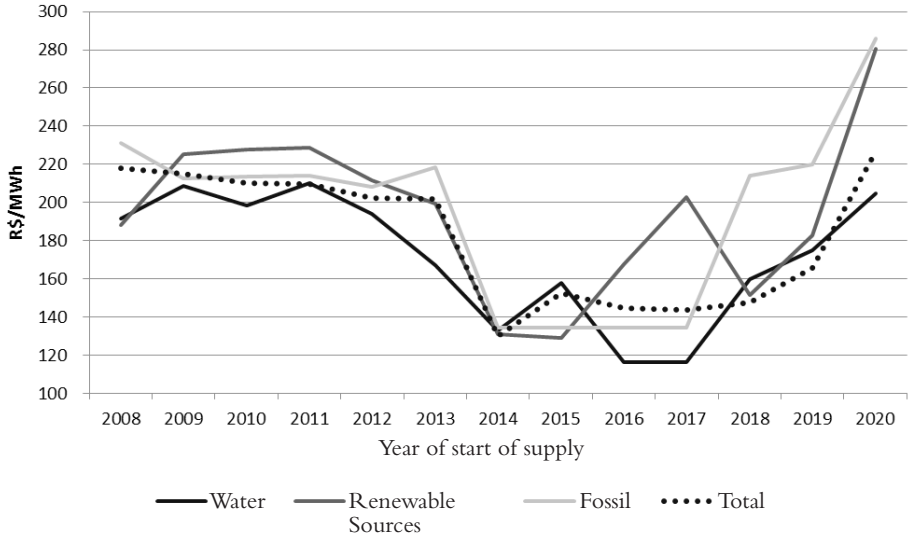

Chart 2:

Average sale price of New Energy auctions updated on September, 2015[23]: 2005-2015

(R$/MWh)

Source: CCEE (2015) - Consolidated result of auctions.

The energy hiring model by auctions has been an important and flexible instrument to generation expansion planning.[24] The Government may direct the hiring of new ventures for a desirable profile according to the strategic matrix defined by studies for ten-year or longer planning. Rules for the public notice of each auction can be drafted to limit (or encourage) the dispute between sources and even energy intra-sources.

On the other hand, the reduced "strategic reserve" of hydro power plants with large reservoirs requires a change in the electrical system operation paradigm, which became evident with the water crisis of 2012-2015. With the entry into operation of run-of-the-river Amazon plants, the system configuration now demands more from plants with regularization capacity, thus generating great changes in reservoirs' level for shorter periods of time and

23 Updated price calculated by CCEE due to IPCA, all projects hired from 2005 to 2015 in new energy auctions, reserve energy auctions, alternative sources auctions and structuring auctions are considered.

24 For a deeper analysis on this matter, see CASTRO, BRANDÃO and DANTAS (2011).

demanding greater thermal dispatch to meet seasonal load requirements (EPE, 2014). Given this scenario, in addition to the change in the operation standard, there is a need to complement the water park with other sources to meet the load during the dry period of the year (CASTRO *et al*, 2012).

The energy policy is also articulated with the industrial policy, and wind generation projects reflect this. BNDES long-term financing obtainment is subject to equipment purchase with pre-established nationalisation indexes. For example, the greater volume of wind power hired led to the installation of the main wind equipment producers in the world, thus increasing the competition and contributing to the drop in the costs of this source in new energy auctions.

Although Brazil has abundant alternatives for the generation of electricity from national natural resources and a model that enables projects at low costs, the need for firm energy and relative local scarcity of gas may create opportunities for energy integration.

On one hand, the seasonality of flows between the Southeast/Midwest hydrological regimes (where reservoirs with greater regularisation capacity are located) and the hydrological regime of the South and Amazon region (EPE, 2014; p. 84) enabled the progress of binational projects with Bolivia[25] and Argentina[26] for the joint exploration of natural resources.

On the other hand, the growing need for natural gas at competitive prices has been creating opportunities to import LNG exclusively for electricity generation, in addition to the interest of companies from neighbour countries with availability of this resource[27] in investing in the Brazilian power market by building thermal plants.

25 An Amendment to the Memorandum of Understanding was signed on 17 July 2015 in the field of electricity between the Ministry for Mines and Energy of the Federative Republic of Brazil and the Ministry of Hydrocarbons and Energy of Bolivia (signed on 17 December 2007), whose objective is to facilitate the study of financial, technical and environmental feasibility of the construction of a binational power plant on the Madeira River basin.

26 Since 2012, the *Unión Transitória de Empresas,* upon request of Eletrobrás and Ebisa, has been developing engineering and environmental studies, and the social communication plan of Garabi and Panambi plants located at Uruguai River in the binational section between Brazil and Argentina (ELETROBRAS, 2010).

27 This is the concrete case of Empresa Nacional de Energia Eléctrica de Bolívia (ENDE), which has been weighting the possibility to build a thermal plant for supply to the Brazilian market by using Bolivian gas as a fundamental resource.

3. The Brazilian trade model

Unlike other countries of the region, the Brazilian trade model does not focus on purchase and sale of physical energy. All consumers - captive and free - are forced to hire power through a financial mechanism that does not necessarily include the physical delivery of electricity by the generation company. Power sector agents purchase and sale contracts that represent a guarantee of power supply, and not the power itself.

An industrial consumer acting in the free market is taken as an example. This consumer agent will be subject to fines if the power consumption exceeds the amount agreed in "guaranteed power" contracts (or "physical guarantee") signed. In the other direction, a generator agent that does not have a contract will be prevented from selling power to consumers even if his/her plant is idle and ready to supply power. The logic behind this market rule is that the responsibility to meet consumer's demand does not lie on the individual generator that has no management power over his/her power generating unit, but over the system operated centrally and optimally by ONS[28].

This commercial model was created to meet the singularities of the Brazilian power system, predominantly hydroelectric, in a business environment that underwent a liberalisation process as of the 90s with the introduction of market mechanisms in power trade[29]. The problem that had to be solved through market rules refers to short-term power price profile in a system such as the Brazilian one, which produces electricity essentially at fixed costs:

28 The centralised and optimised management of water resources in a system with Brazilian scale and size reduces the dependence that hydropower has with respect to the local hydrology uncertainties and, therefore, makes it possible to meet a higher load than an uncoordinated system would reliably. The Brazilian water system comprises 1,180 power plants (including small power plants), located in dozens of watersheds spread over a geographical area with continental dimension covering several different weather systems. Optimised generation of this set of plants and eventual resource to the complementary thermal generation allows for measurable economic gains, and ensures compliance to a much greater global load than the sum of the loads that each water generator could meet alone. For this technical reason, Brazil maintained the centralised and optimised management of generation and transmission resources even after the end of the power industry state model.

29 In the model in force until the beginning of the 90s, the economic logic was that of guaranteed remuneration for sector companies (the rate was calculated to cover operating costs and remunerate the capital invested properly) and not the remuneration logic as a result of market operation.

hydro power plants basically, but also wind power, combined heat and power, thermal generation with take or pay contracts and, to a lesser extent, nuclear generation.

It is easy to show through elementary micro economy categories that price configuration equal zero may occur in industries with predominant production based on fixed costs and where products are sold in a competitive market. Prices can be null because: (i) in competitive markets, the price is always equal to the marginal cost of the less efficient producer; and (ii) the marginal cost of an industry that only produces at fixed costs is supposedly null. Accordingly, given the characteristics of the Brazilian electrical system, if a short-term power market was the basis of the commercialisation model, prices would low or zero in most part of the time, only becoming significant in times of shortage of water. If the revenue of generator agents was based on market prices set this way, it would not be enough to cover costs for long periods, that is, whenever hydrology was favourable to allow for full consumption supply only by generators with cost structure based on fixed costs. As a consequence, the generation economic activity would operate with strong economic instability, and threatened economic and financial balance, eliminating any incentive for investments in new generation facilities.

Unfortunately, the Brazilian power industry only learned these basic principles of microeconomics in practice with the 2001-2002 rationing crisis. At the time of the liberalising reforms of the 1990s, it was thought that the energy market could operate in Brazil analogously to the European markets, where the electrical system is predominantly composed of thermal generation based on fossil fuels, that is, generation with significant marginal costs. In such systems, the price resulting from power trade in a physical market enables the proper remuneration of an efficient generator and may give correct signals to guide investments in the expansion of the installed capacity. The attempt to make the physical power market price a reference in Brazil was unsuccessful. The practical result was a total disincentive to investment, which culminated in a supply crisis and a compulsory rationing of 20% of load to all consumers in 2001, in a year with only moderately bad hydrology.

Problems in the Brazilian power market design were corrected in the 2003-2004 reform. The new model ensures and encourages competition conditions in power generation. However, the competition *locus* is not the

physical power market, but a market of "physical guarantees"[30] financial contracts. Dynamics of new energy auctions is such that the price of long-term contracts tends to convert for medium cost of power, which is a situation that would never be ensured if the prices reference were a short-term physical market, as analysed. On the other hand, by offering long-term contracts with highly predictable revenues indexed to inflation, new energy auctions attract the intense interest of entrepreneurs with effective results for low rates.

Given the specificity and differentiation of the Brazilian model in relation to other countries of the region, the analysis of its fundamental characteristic, which is the "physical guarantee", should be deepened. Agreements are not power contracts, but power guarantee. Each power central, regardless of the source, receives certificates from the Ministry for Mines and Energy (MME) that can be traded with consumers through contracts. As a rule, these certificates represent only a fraction of the power that the generation plant may produce. The quantity of certificates that each power central receives is calculated by an official methodology consisting in an optimised SIN operation model with all facilities already hired and new projects to be enrolled in an auction. In the first step, the purpose of the model is to calculate the higher load (critical load or physical guarantee of the system) the system can meet given a safety criteria (deficit risk of 5% in any year) and constraints of economy in operation.[31] In the next step, the system's critical load is divided into all modelled production units. The portion that is up to each of them is the physical guarantee corresponding to power certificates that can be traded via contracts with consumers.[32]

30 On one hand, 100% of agents' consumption must be backed by "physical guarantee" financial contracts. On the other hand, all the need of power from the regulated market should be hired in long-terms (up to 30 years). Hiring for the captive market is made through new energy auctions organised by the Government on behalf of utility companies, thus creating a monopsony purchasing structure.

31 Determining the critical load or physical guarantee of the system is a problem inherent to pure water systems or systems massively dominated by hydropower generation. In a thermal system, the supply guarantee problem is much more simple. Thermal power plants are controllable by nature, always able to generate when triggered. Thus, ensuring a load corresponding to the total installed capacity less a safety margin is possible in thermal systems. The same is not applicable to water systems, once power plants generation is inherently subject to uncertainties. Even though it is possible to estimate the average production of a hydroelectric plant in the long run with certain precision, the short term power production (and therefore, supply guarantee) is always subject to local hydrology.

32 Read study Castro and Brandão (2010) for a more thorough analysis.

Financial contracts are backed by the system's capacity to ensure fulfilment of the load. Since consumers have to acquire power contracts in advance - notably captive consumers - any projected growth in electricity demand leads to the need to expand the total volume of power certificates, which can only be done by hiring the construction of new power plants, which in turn will allow the system to meet the new load safely.

This commercial design has proved to be adequate to ensure the correct functioning of the Brazilian electrical sector, since while giving economic indications of the need to expand the installed capacity, it allows to promote the expansion at a low cost through auctions for the regulated market.

However, it is a commercial system based on a "physical guarantee", concept only consistent if the generation park is represented as a closed system, operating in a central and optimised way. No other country in Latin America adopts a commercial model similar to Brazil.

In neighbouring countries, long-term hiring is usually optional, and not mandatory, as in Brazil. However, agreements are for energy (and eventually power) and not for "physical guarantee". Lastly, short-term prices are generally representative of the power cost, unlike in Brazil where prices mostly reflect the hydrology level (ENA - affluent natural energy) and the amount of water stored in reservoirs of hydropower plants.

Given the technical and commercial characteristics of the Brazilian system, electrical integration with neighbouring systems could not be made in a common power market, as in Europe, responsible for defining the generation of each plant, the price of power and interchanges. In fact, the Brazilian model does not even make sense if it is not possible to represent generation resources and the load to be supplied as a closed system, optimised centrally.

4. Energy integration: a power market in South America?

In addition to the lack or abundance of power resources in a country, there are consistent technical and economic reasons that recommend the international integration of electrical systems. For example, the integration of generation matrices and of different hour-seasonal consumption profiles allows the optimisation of the set of available resources, thus providing ben-

efits for the parties involved. Even the simple shared use of resources may bring savings and reducing, for example, the global need of reserve or maintain infrastructure replicated to the settlement and management of contracts or derivatives. Such types of arguments support, for example, European directives aiming to build a future electricity European market through the strengthening of regional energy markets and harmonisation of regulatory and commercial practices. The paradigm of integration of power markets are the European regional markets, for example, Nordpool (Sweden, Norway, Finland and Denmark) and Mibel (Portugal and Spain) where the allocation of electricity resources is made by daily auctions.[33]

However, the technical benefits of energy integration are only maximised when establishing relatively homogeneous and solid commercial rules is possible. The harmonisation, or at least compatibility, of regulatory standards and commercial rules is the basic premise for a joint optimisation of electrical resources between countries.

According to CASTRO, BRANDÃO and DANTAS (2011), an integrated operation of the electrical sector of several countries tends to lead to a more efficient resources allocation than it would be possible if domestic markets remained isolated. The own structure of the Brazilian power industry, with a continental dimension, integrated into a single electrical system of over 4,200 power plants (ANEEL, 2015 b) with 139.8 thousand MW of installed capacity and over 100 thousand km of high voltage transmission lines are a proof of how integration generates synergies and scale savings. However, due to the economic, energetic and regulatory asymmetries in South America, expecting a substantial convergence of commercial rules in the medium-term is not possible, which makes it difficult to enable a regional power market on the same basis as Nordpool and Mibel.

Practicing the application of subsidies and imposing administered prices for electricity or energy inputs are emphasised among asymmetric and impeditive factors in several Latin American countries. Another factor contrary to the full integration among electrical systems is the need to submit the internal energy safety to factors that go beyond national control. In a large scale energy integration, eventual vicissitudes of neighbouring countries may

33 Auctions determine the price of power and generation of each plant of countries involved. It is a resources allocation process through competitive market in which each country has full access to the set of generation resources available, naturally respecting the electrical limitations of the transmission.

threaten the local supply of power, such as what happened in Chile when, due to a lack of natural gas production in Argentina, gas export was strongly restricted, thus imposing serious consequences to domestic supply of gas and the safety of the electrical system.

Specifically regarding the Brazilian position in relation to the regional electrical integration process, it is worth noting that the commercial mode of the Brazilian electrical sector is an obstacle to the formation of integrated markets according to the European experience. As analysed, the Brazilian commercial model is idiosyncratic having being structured to allow the trade of electricity through market mechanisms in a system with clear predominance of hydroelectric generation. It is a closed system, planned and operated in an optimised and centralised way and therefore is poorly adjusted to a full market scheme.

But even with a prognostic of difficulties and limitations to the implementation feasibility of a real integrated energy market in South America in the models of European electricity markets, this does not amount to a negative view of the regional electricity trade perspectives. The Brazilian trade model comprises both import and export of electricity, which has been practised for some time with Paraguay, Argentina, Uruguay and Venezuela.

The integration mode adopted with Argentina and Uruguay involving the export (and import) of electricity on an interrupted way, without long-term contracts, leveraging short-term opportunities with relatively simple trade rules has shown the benefits of intensifying exchanges of power surpluses for all parties.

Contracts dedicated to the export/import of firm power can also be signed, in case conditions which grant effective legal safety for such commercial arrangements are created. There are also opportunities to build binational power plants between Brazil and Argentina and Brazil and Bolivia, which can be developed using power sale in the Brazilian market as a guarantee for financing.

In fact, as already mentioned, such a possibility of regional energy integration has had important progresses with the hiring, in 2012, of engineering, environmental studies and the communication plan of Garabi and Panambi plants, a project between Argentina and Brazil; in addition to the signature of an addendum to the memorandum of understanding for electricity between Bolivia and Brazil, on July, 2015, which intends to enable studies of Binacional at Madeira River.

5. Integration Experiences and the Brazilian trade model

The Brazilian energy integration experiences with its neighbours were conceived in its operating and commercial aspects to work properly in the Brazilian model of centralised and optimised operation of generation resources. For example, although Itaipu Binacional was built long before[34] the new model of the Brazilian power industry has been implemented in 2004, the trade of its electricity had to be adapted to the new model's logic. Thus, Itaipu Binacional is part of the Brazilian system optimised dispatch comprising not only the domestic market supply, but also the power needs of Paraguay, which adopts different market arrangements from Brazil.

In turn, Argentina's original energy import contract through CIEN also fitted the Brazilian model, being represented by ONS in the system operation planning as a "border thermal" triggered when the water situation required complementation of thermal power. When Brazil did not need power, that is, in favourable hydrology, Argentine gas plants associated to CIEN contract were released to supply the Argentine market.

In both cases, Itaipu Binacional and CIEN, the import of power was possible through a commercial design that made the exporter adjust to the logic of operation of the Brazilian system. However, the most recent power trade experiences with Argentina and Uruguay follow another logic.

When Argentina's import via CIEN was interrupted unilaterally due to Argentina's energy crisis, causing the break of 20-year export contracts for Brazilian utility companies, Garabi converters started to be occasionally used to export power from Brazil to Argentina and, also sporadically, to allow for the export of power to Uruguay passing through the Argentine transmission system. In 2004, an emergency export was made to allow the supply in the Argentine system. An eventual power trade was established in the following years using the existing large interconnection focused on power export from Brazil to the Argentine market due to the endemic crisis of the power industry due to the unbalance between offer and demand.

Brazilian power exports for Mercosur neighbours have alternated three trade models:

34 Itaipu Binacional plant's construction was agreed between Paraguay and Brazil in 1973, and the International Treaty sets the particular power trade rules for this plant with partner countries.

1. The first type of export includes an auction with the participation of Brazilian thermal generators that are not being dispatched by ONS at the time. Export is subject to the network traffic conditions in Brazil. For example, generators located in the Brazilian Southeast or Northeast are only authorized to export if the transmission system has capacity to transfer power to the South, from where it will be exported. An important distinguishing factor is that thermal generators do not need to offer the same variable costs practised in the Brazilian market in the auction for sale in Argentina or Uruguay. Thus, prices reflect opportunities set by the importer market and these are businesses between private agents once there is no official and public information available on monetary values for such operations. The only information is that export prices are usually higher than those practised in the Brazilian market.
2. The second type of export includes the submission of hydropower in the colder months of the year (June-July) when power consumption increases in Argentina to further return the same physical amount of power sometime later (August-September) when temperatures start to rise in Argentina, at the same time Brazil is at the peak of the dry period. Similar trade schemes are being practised with Uruguay using a small converter in Rivera or passing through the Argentine transmission system.
3. Finally, Brazil is authorized to export hydropower corresponding to pumpable spill to be returned later. Pumpable spill occurs during favourable hydrology times when power plants' reservoirs no longer have capacity to store water. At these times the system needs to spill water. Such water can be turbocharged and exported for a neighbour country and, when this happens, the amount exported is accounted to be returned later.

All such power export modalities practised with Argentina and Uruguay are occasional. There is no Brazilian commitment of firm energy contract to export guaranteed amounts of power. These are punctual and temporary contracts.

Weekly export auctions are always subject to the optimisation of the Brazilian model: most of the time, only thermal generators which are not

programmed by ONS remain authorized to export. And, at other times, when hydropower is exported, the entire water consumed for power export is restored with the further return of the electricity. It is not about power purchase and sale in the strict sense, but rather a type of loan, exchange, to be later returned, without implying power transaction.

The fact that the power trade with Argentina and Uruguay has been happening eventually and punctually is emphasised. Most of the time, existing interconnections remain idle.

Brazil adopted the principle that surplus export or eventual imports should not impact contracts signed or rights from contractual relations in the domestic market. Thus, export can only be made with effectively idle resources from dispatch optimisation, which does not take into account the possibility of international trade. For example, it is impossible to activate an idle thermal generator far from international interconnection for export if interconnections between Brazilian subsystems are programmed to be fully used. This because, even if the foreign importer is willing to pay, it is impossible to calculate a price to move the generators already programmed, thus freeing the Brazilian internal network.

The situation is more complicated for the import. Import of power surpluses by Brazilian agents is very hard to be incorporated to the current trade arrangement model. Currently, in addition to the exchange of pumpable spill for further return without involving cash transaction, there is interruptible electricity import from Argentina[35] and Uruguay[36]. This type of import involves weekly power offers at Brazilian borders[37] having the short-term market as a destination and being remunerated through the Settlement Price for Differences (PLD). Such power can only be traded in the short-term market since generators lack physical guarantee in the Brazilian market, which prevents them from obtaining revenues through trade contracts.

In this sense, the firm import of power is not expected because generation is optimised simulating the operation of a closed system. Taking this optimisation as a reference, import would necessarily move a generator with "the right to generate" from the dispatch merit order. To preserve this right, there

35 Through Garabi frequency converter (MME, 2015 - Ordinance No. 81).

36 Through Rivera frequency converter and future Melo converter (MME, 2015 - Ordinance No. 82).

37 Weekly power offers for ONS can be adjusted as per daily dispatch scheduling.

is no commercial mechanism to import power surplus, even if it was possible to purchase power at lower costs than those of domestic thermal generational in a neighbouring country.

Evidently, such difficulties can be removed if there is political willingness to negotiate commercial rules enabling and encouraging continuous trade of power through existing interconnections. However, evidences show that these high level political negotiations have not been made so far to create a commercial framework enabling the firm interchange of energy. And, as already mentioned, progresses have not been made to enable the interruptible import of power.

Governments are negotiating the use of border water resources, particularly with Argentina at Uruguai River (Garabi and Panambi plants) and Bolivia at Madeira River basin, similarly to Itaipu Binacional's model. However, eventual agreements to build binational plants between Brazil and another partner should consider trading mechanisms compatible to the model adopted in the Brazilian power sector.

6. Perspectives for import and export of electricity by Brazil

Firm energy export is understood as contracts in which the export volume is guaranteed at any time or at least in which the export is equivalent to the local consumption. Therefore, in case of a problem in the exporting country, such as rationing for example, exports should have the same treatment as internal consumption, that is, they should be limited in the same proportion imposed to the domestic market. International trade of surpluses is an occasional and punctual trade for the export or import dictated by conveniences and opportunities of prices at the time, without a commitment to import or export predetermined power volumes in the medium or long term.

In order to enable long-term contracts power export for the Brazilian market, a technical and commercial arrangement capable of matching import by Brazil to a power plant operating in an optimised way inside the Brazilian system should be prepared.

At first, the export of hydropower to the Brazilian interconnected system would need to meet Itaipu Binacional's model, a power plant operated under

the Brazilian model logic, at the same time. Major problems related to the use of this model are not seen in projects of binational plants under studies with Argentina and Bolivia, notably in the 50% share that will be naturally set for Brazil. However, outside of these examples, such a technical commercial arrangement could face acceptance restrictions in the case of projects located in the territory of neighbour countries.

Building a central power plant dedicated in whole, or in part, to the export to Brazil and dispatch it according to the Brazilian system operation logic would probably imply imposing a type of restriction to the power optimisation needs. To consider the local demand of an exporting country making a joint optimisation, which sometimes could be the Brazilian system to send power to compensate adverse local hydrology situations, consumers from the neighbour country would have to be part of the Brazilian market and acquire financial contracts supported by "physical guarantee". This hypothesis is equivalent to the adoption of the Brazilian trade model by another country and cannot be ruled out, although it is unlikely to be achieved in the short or medium term.

Structuring a contractual model analogous to CIEN original import scheme would be possible in the case of thermal power export to Brazil; however, with greater legal safety. Therefore, from the formal and contractual viewpoint, signing an international treaty including power trade between States and not companies would be necessary, as in the case of CIEN. Such a requirement would make it even harder to repeat the unsuccessful and traumatic case of CIEN power import contract with Argentina. However, as already analysed, Brazil is not expected to import power from thermal source from neighbouring countries.

Due to the economic, energetic and political asymmetries between Brazil and countries of the region, the greatest and fastest opportunities of international integration and trade of power involving Brazil include the import and export of surpluses. Current power trade contractual schemes adopted by Brazil with Argentina and Uruguay have this exact logic of surpluses and could be expanded, since the transport infrastructure for the Argentine market already exists and a large interconnection with Uruguay is being built.

Although functional surplus trade mechanisms already exist using existing interconnections, creating a legal, regulatory and commercial framework capable of making interchanges more frequent and interesting for all parties is

essential, thus enabling interchanges of larger power blocks with more dilated contract terms.

It takes political willingness of countries to create conditions that allow the progress of the energy integration process in South America. The development of high level political negotiations using the existing institutional structure (Mercosur, UNASUR - American South Union of Nations - IIRSA - Initiative for the Integration of the Regional Infrastructure of South America) is fundamental to the creation of a new framework for international power interchanges.

7. Conclusion

In terms of the power industry, the Brazilian energy integration process can be divided into two phases. The first one, started in the 70s, was mainly focused on the construction of the then greatest power plant in the world, Itaipu Binacional, with a double and strategic goal: ensuring greater domestic supply and competitive costs.

Emphasising that the unsuccessful gas thermal power import experience from Argentina, CIEN, launched in 2000, had a different logic is important. In the 90s, when this project was designed, Brazil was in the macro economic crisis and the power industry had reduced capacity for investments. Thus, the import of power from Argentina, a country undergoing a phase of great economic prosperity and with significant gas reserves, seemed a more interesting solution than mobilising scarce capital available in Brazil to make local investments.

The second phase of the integration process started from 2003-2004 when Brazil redefined its regional economic integration strategic policy focused on Latin America. Emphasising the power industry restructuring role seen in 2003-2004 is also necessary. This process included: recovery of the State planning with the creation of the EPE - Energy Research Company; use of new energy auctions as the main instrument to expand the offer; formatting of a new and consistent institutional framework, strengthening of the regulatory agency (ANEEL) and operation of BNDES - state bank that supports the economic development - financing generation and transmission

projects through project finance operations directly articulated with auctions. This new model of the power industry enabled Brazil to gradually resume the exploration of the hydroelectric potential, in addition to supporting investments in wind power, sugarcane biomass and generation from natural gas.

Since the commercial model has been structured due to a unique and fundamental characteristic of the power industry, the high prevalence of hydroelectricity in the matrix, the Brazilian model has specifications that distinguish it clearly from prevailing commercial arrangements in Latin American countries. It is a model in which power is not traded, but "physical guarantee" financial contracts, where the central generator of electricity does not make sales in physical energy contracts and does not have autonomy over its own dispatch, which is determined by the national system operator following an optimisation logic of all of the over 4,200 electricity generating units.

In this sense, the energy integration through the import and export of power in Brazil should respect the design of the Brazilian trade model. The Brazilian model characteristics and specificities thus determine boundary conditions that need to be observed to facilitate international electricity trade. This implies indicating that, except for binational central power plants projects as in the case of Madeira River project with Bolivia and Garabi and Panambi power plants with Argentina, energy integration through projects or contractual arrangements focused on the export of blocks of electricity with long-term contracts and at competitive prices for the Brazilian power market would depend directly on regulatory and commercial adjustments converging and adhering to the Brazilian model.

Such specificities tend to restrict energy integration possibilities according to European models as in the case of Nordpool (Sweden, Norway, Finland and Denmark) and Mibel (Portugal and Spain). In these terms, the energy integration dynamics in South America with the direct participation of Brazil is limited to four possibilities.

As already shown, the first and simpler one is the construction of binational central power plants based on Itaipu Binacional successful experience. The production of a binational is 50% for each country. And it is also possible to define in the international treaty that shall support the commercial agreement the surpluses sale conditions, as it was made with Paraguay in relation to Itaipu Binacional.

The second possibility is the model of energy import by Brazil such as of a thermal plant on the border, as it already happened with CIEN contract. This

option is essential for the import of thermal power and its feasibility requires the understanding between countries, probably at a Treaty level, providing legal safety for the commercial arrangement.

The third, more complex, alternative is the construction of hydropower plants (and respective segments of transmission lines) in neighbouring countries, defining export conditions of part of the production, that will not be consumed by the country of origin, to Brazil. Difficulties are many and examples include the submission of the generating unit to commercial rules (for example, join and win auctions) and also to the centralised load dispatch criteria from Brazil.

Power surpluses trade in the trade model already being practised by Brazil, even though sporadically, with Argentina and Uruguay is the fourth possibility. It is about selling and purchasing exceeding power through short-term contracts that can be signed without a deep regulatory harmonisation of the involved countries' commercial models. In this type of trade, each country seeks to ensure the safety of supply of their own market, and may also count on surpluses of neighbouring countries and alternatively counting on the option of selling power surpluses. Such an integration aspect has great potential for expansion, especially in countries with which Brazil already has interconnection. Brazil would probably occupy more frequently the position of exporter than importer given the scale asymmetries with neighbouring countries and, especially, the characteristics of the Brazilian model that may have idle thermal power and occasionally surplus of hydropower. Therefore, a legal, institutional, regulatory and commercial framework providing legal and financial safety for transactions and facilitating the routine international trade of power should be prepared.

Attachment
Brazilian International Energy Integration Projects

1 - Itaipu Binational Central Power Plant: Paraguay - Brazil

The energy integration between Brazil and Paraguay by building Binacional Itaipu had the initial objective of solving an impasse created by the

questioning of border marking between Brazil and Paraguay next to the complex of Seven Falls waterfalls at Paraná River. The so-called Seven Falls Jump was only a Brazilian tourist attraction and its hydroelectric potential had never been sufficiently studied until 1950 or was part of the Brazilian energy planning.

Leveraging the hydroelectric potential was the solution for the diplomatic impasse. In this sense, Iguaçu Act was signed on June, 1966 to conduct studies and survey the economic possibilities of hydroelectric resources belonging for both countries.

Itaipu Treaty enabled the plant construction in 1973, and created an entity called Itaipu Binacional with the purpose of building and operating the region's hydroelectric potential. Curiously, that year coincided with the first oil crisis that gave more strategic importance to this venture. On the other hand, Itaipu construction consolidated and reaffirmed the Brazilian option for hydro power production, which represented an approximate increase of 50% of the entire Brazilian installed capacity at the time.

Itaipu Binacional entity is comprised with equal capital share by the state company Eletrobrás, from Brazil, and the state company Ande, from Paraguay.

The plant has an installed capacity of 14,000 MW, and the two first generating units started to operate in 1984 and the last two units in 2007. With all 20 generating units operating at Paraná River under favourable conditions with regular levels of rains throughout the basin, the generation may achieve 100 terawatts-hour per year. It was invested nearly US$ 30 billion (ITAIPU BINACIONAL, 2015 b).

Itaipu Treaty established that the energy produced by Itaipu hydroelectric use should be divided into equal parts between both countries, each of them with the inalienable right to acquire unused power by the other country for its own consumption, thus not being allowed the sale power surpluses for other countries. Brazil committed to purchase the entire power not consumed by Paraguay, which enabled ensuring revenues for the entire power produced. Given the economic asymmetries between Brazil and Paraguay, Brazil consumes over 80% of the power produced by Itaipu plant.

More recently, the Government of Paraguay has sought to negotiate the removal of the clause requiring one of the parties to assign all of its surplus production at cost price to the other partner. Paraguay claims the possibility to sell the surplus to other countries that would be willing to pay prices closer to in-

ternational market and/or sell directly to the free Brazilian power market and not to Eletrobrás (which sells exclusively to the captive market). As a result of these negotiations, the Brazilian Government tripled the value of compensations paid to Paraguay for assignment of its surplus power generated to Brazil in 2011. Compensations raised from US$ 120 million to US$ 360 million per year.

It is worth mentioning that the financial engineering that enabled the construction of Itaipu Binacional plant had the central purpose of ensuring the project's financial feasibility. Thus, the commercial design adopted at the time ensures total consumption of the production and the rate charged allows collecting sufficient resources to operate the plant and pay the debt service. In this sense, a rate set by the service cost on a cash basis was adopted. Debts will be settled only in 2023 and the project costs will be entirely amortized then (DORADO, 2014). Additionally, Itaipu Treaty establishes that renegotiating the plant's financial and commercial basis is necessary in 2023, as well as renegotiating Attachment C of the Treaty.

2 - Garabi Converter and CTE AES Uruguaiana: Argentina - Brazil

The first energy integration attempts between Brazil and Argentina happened at the beginning of the 70s with the purpose of building the binational hydroelectric use in Garabi, similar to binational experiences of Itaipu, between Brazil and Paraguay, and Yacyretá, between Argentina and Paraguay. According to the original project, Garabi would be a 1800 MW plant located near the homonymous localities of Garruchos, in Argentina and in Brazil. Studies lasted during the 1970s and the Garabi project's feasibility study was completed in 1977. However, the difficulties experienced by the electricity sector of both countries in the 1980s and the implementation of liberal reforms of the 1990s prevented the continuance of the project. However, the binational generation project between Brazil and Argentina was resumed by the end of 2000, and in 2008 Eletrobrás and Ebisa signed the Cooperation Agreement for joint execution of inventory studies at Uruguai River and, later, in 2012, a consortium responsible for conducting environmental and engineering studies was hired. (ELETROBRAS, 2010).

In parallel to Garabi power plant, power interchange studies between electrical systems from both countries, held by the end of 1980 and beginning

of 1990, consider the possibility to install a frequency converter substation in Garabi independent from the power plant construction.

Both countries signed a Protocol of Intentions on Energy Cooperation and Interconnection in 1996. Under the influence of this Protocol, Garabi frequency converter construction was promoted. The central objective was to export firm energy to Brazil based on thermal power generation from Argentine natural gas. Garabi converter was inaugurated in June, 2000. With the interconnection between both systems, power flow from Argentina to Brazil was possible through its associated transmission system of 500 kV. CIEN imported through several contracts that summed 2,100 MW of firm energy.

Uruguaiana central thermal plant (CTE) also started operating in December 2000 with natural gas from Argentina. CTE was designed as base load, that is, operating based on the system and to be dispatched most part of the time. Gas supply from Argentina was made through agreement between the private companies AES Uruguaiana, from Brazil, and Repsol/YPF, from Argentina.

The commercial contract between both companies was based on the premise of firm offer of Argentine gas. However, this premise was not maintained due to the gas supply crisis in Argentina as of 2004. Initially, these failures only occurred during the winter, but the problem was gradually worsened until reaching total interruption in 2009, leading to CTE stoppage and forcing the early termination of AES Uruguaiana contracts with Brazilian utility companies. In 2008, the Brazilian Electricity Regulatory Agency (ANEEL) revised for zero the power of AES Uruguaiana contracts, thus allowing distributors to hire power at special regimes to cover the deficit in their contract portfolios.

Gas supply difficulties also reached the power import contract via CIEN, which was modelled in the Brazilian electrical system as a thermal generator on the border, with a power supply capacity of 2,100 MW and operating at 100%.

In short, the consequences of gas unavailability for Uruguaiana thermal plant and the power associated with CIEN contract represented a reduction of over 2,500 MW of firm energy for the Brazilian electrical system. Such loss led the Brazilian government to start adopting the signature of international treaties approved by the respective Congresses as a prerequisite for the international trade of electricity in order to ensure legal safety and supply.

This new posture of the Brazilian Government was adopted for energy integration projects with Peru.

In contrast, Garabi converter has been used sporadically contrary to what it was intended: to export interruptible power from Brazil to Argentina due to the endemic energy crisis faced by this country.

3 - Rivera Converter: Uruguay - Brazil

Negotiations were made between Brazil and Uruguay in 1993 in order to enable electrical interconnections projects allowing the best use and interchange of energy resources from both countries. The Protocol to the Treaty of Friendship, Cooperation and Trade between Brazil and Uruguay was signed in New York, in September 1994 for Electricity Interconnection. Article II of the protocol provided for the constitution of a Binational Work Group to conduct the necessary studies for power interconnection and interchange, analysis of trade forms and legal reference frameworks to regulate trade relationships related to electricity interchange. The Memorandum of Understanding on Extra High Voltage Interconnection was signed in May 1997 between the Governments of Brazil and Uruguay for both countries' electrical systems.

Rivera converter started to operate in 2001 as a result of these negotiations, upon an agreement between the company *Administración Nacional de Usinas y Transmisiones Elétricas* - UTE and Eletrosul, Eletrobrás subsidiary, with nominal capacity of 70 MW, located in Uruguay and interconnected to Santana do Livramento 2 substation in Rio Grande do Sul. UTE owns this frequency converter, which was used for emergency supply in Brazil and Uruguay and for punctual power export opportunities to Argentina (ONS, 2015 c).

Eletrobrás is the formal import and export agent for this interconnection. Rivera converter has been used frequently, especially to meet the critical power situation in Argentina and Uruguay. Idle central thermal plants are dispatched for the commercial export of power following the load dispatch criteria of the Electric System National Operator - ONS.

4 - Guri to Roraima Transmission Line: Venezuela - Brazil

Guri - Roraima (Venezuela - Brazil) interconnection was built with the specific purpose of improving the quality and cost of service of Boa Vista, capital of the State of Roraima. The State of Roraima was and continues to be an isolated system without connection to the National Interconnected System (SIN).[38] The electrical system serving Boa Vista had high costs, as it was served by generators powered by fuel oil. Eletronorte, Eletrobrás subsidiary, and Electrificación Del Caroní – EDELCA, a Venezuelan company, signed a contract to build a 676 km-transmission system in 1997, being 485 km in Venezuela and 191 km in Brazil. Such a transmission line enabled to connect Guri - Macágua power complex with the city of Boa Vista. The contract provides for the purchase of power over 20 years with a contracted amount of 200 MW. The system started to operate in 2001, thus reducing high operation, maintenance costs and favouring the electricity market growth, especially with the installation of industries in the region. Investments were budgeted at the time of the contract (1997) at around US$ 185 million, out of which US$ 55 million in Brazil and US$ 130 million in Venezuela (SERRADOR, 2007). Since Roraima is not connected to the National Interconnected System, this interconnection is different from other energy integration projects. It is a connection to a city of the isolated system with firm energy contract being traded on a safe and beneficial basis for both countries. Problems directly derived from the critical situation of the reservoirs in Venezuela occurred only in 2011, but they were negotiated within the own commercial contract milestones.

5 - Cuiabá Central Thermal Plant: Bolivia - Brazil

Governador Mário Covas Central Thermal Plant (Cuiabá CTE) is located in the State of Mato Grosso and is powered by natural gas, and may also operate with diesel oil such as during the rationing crisis of 2001-02. This plant represented an investment of approximately US$ 750 million and has capacity to generate 480 MW. It is part of "Cuiabá Integrated Project", which

38 Roraima System interconnection to SIN was bided in 2011.

started to be designed in 1996 when Mato Grosso was still in deficit of electricity. In 1997, Eletrobrás published an international bidding for lower price, which was won by the Energy Production Company or Pantanal Energia, as it became known, to supply electricity among all participants.

Cuiabá CTE stopped the generation of power in 2007 due to the reduced supply of natural gas by the Bolivian state company YPFB. Initial justifications were based on operation difficulties that started with the Bolivian gas reserves nationalisation process and led to the suspension of the existing contracts between the operator of the thermal - Pantanal Energia - and a private gas producer in Bolivia, YPF - Repsol, subsequently privatised. The argument of the Bolivian government was that the natural gas supply contract was set at extremely low prices, considered harmful to the country's interests. Without input at ideal volumes and frequencies to maintain the operation, CTE stopped generating power in 2007.

After a contract signed between the Government of Bolivia, Petrobras and Pantanal Energia, CTE resumed its operation in March 2011. To enable the contract, Petrobras leased CTE from Pantanal Energia being responsible for providing some of the gas it receives from the neighbouring country to the Mato Grosso unit (2.2 million cubic meters) and being directly responsible for the sale of electricity. Pantanal Energia became Petrobras' service provider only, being responsible for the operational part of the power plant.

Bibliography

ANEEL (Agência Nacional de Energia Elétrica). (2015 a). *Editais de Geração. Site Institucional*. Brasilia, Brasil: Agencia Nacional de Energia Elétrica. Available at: http://www.aneel.gov.br/area.cfm?idArea=53 Visited on 1 August 2015.

ANEEL (Agenência Nacional de Energia Elétrica). (2015 b). *Capacidade de Geração do Brasil. Banco de Informações de Geração*. Brasilia, Brasil: Agência Nacional de Energia Elétrica. Available at: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.cfm Visited on 1 August 2015.

BRASIL, PERU. (16 de Junio de 2010). *Acuerdo entre el Gobierno de la República del Perú y el Gobierno de la República Federativa del Brasil para el suministro*

de electricidad al Perú y exportación de excedentes al Brasil. . Manaos, Brasil: Ministerio de Energia y Minas de la República del Perú. Available at: http://www.minem.gob.pe/minem/archivos/file/Electricidad/acuerdo%20peru%20brasil%2016%20julio%202010.pdf. Visited on 5 August 2015.

CASTRO, N. J. (2005). *O leilão de energia nova e a reestruturação do setor elétrico* . Brasil Energia. Rio de Janeiro, Brasil: NUCA-IE-UFRJ. Available at: http://www.provedor.nuca.ie.ufrj.br/eletrobras/artigos/castro26.htm Visited on 3 August 2015.

CASTRO, N. J. (Abril-Maio 2007). *O destravamento ambiental do setor elétrico brasileiro*. Custo Brasil. N°8, 68-73. Available at: http://raceadmv3.nuca.ie.ufrj.br/buscarace/Docs/njcastro83.pdfVisited on 3 August 2015.

CASTRO, N. J., & BRANDÂO, R. (Septiembre de 2009). *Las Negociaciones con Paraguay sobre la energía de Itaipu*. TDSE N°4. Rio de Janeiro, Brasil: GESE-UFRJ. Available at: http://www.gesel.ie.ufrj.br/app/webroot/files/publications/18_TDSE4.pdfVisited on 3 August 2015.

CASTRO, N. J., & BRANDÂO, R. (Março de 2010). *A seleção de projetos nos leilões de energia nova e a questão do valor da energia*. TDSE N°16. Rio de janeiro, Brasil: GESEL-UFRJ. Available at: http://www.gesel.ie.ufrj.br/app/webroot/files/publications/25_TDSE16.pdfVisited on 5 August 2015.

CASTRO, N. J., BARA NETO, P., BRANDÂO, R., & DANTAS, G. d. (Maio de 2012). *Expansão do Sistema Elétrico Brasileiro e o Potencial Hidroelétrico da Região Amazônica*. TDSE N°50. Rio de Janeiro, Brasil: GESEL-UFRL. Available at: http://www.gesel.ie.ufrj.br/app/webroot/files/publications/53_TDSE50.pdf. Visited on 5 August 2015.

CASTRO, N. J., BRANDÂO, R., & DANTAS, G. d. (2011). *O planejamento e os leilões para a contratação de energia do setor elétrico brasileiro*. Canal Energia. Rio de Janeiro, Brasil: Available at: http://www.canalenergia.com.br/zpublisher/materias/Artigos_e_Entrevistas.asp?id=84667 Visited on 10 August 2011.

CASTRO, N. J., DANTAS, G. d., SILVA LEITE, A. L., & GOODWARD, J. (2010). *Perspetivas para a energia eólica no Brasil*. TDSE N°18. Rio de Janeiro , Brasil: GESEL-UFRJ. Available at: http://www.gesel.ie.ufrj.br/app/webroot/files/publications/01_tdse18.pdf. Visited on 10 August 2015.

CASTRO, N. J., HUBNER, N., & BRANDÂO, R. (Maio de 2014). *Desequilibrio econômico e financeiro das usinas termoelétricas frente à persistência da crises hidrológica: 2012-2014*. TDSE N°61. Rio de Janeiro, Brasil: GESEL-UFRJ. Available at: http://www.gesel.ie.ufrj.br/app/webroot/files/publications/20_TDSE%2061-%20Crise%20das%20UTE%20(1).pdfVisited on 10 August 2015.

CCEE (Câmara de Comercialização de Energia Elétrica) (2015). *Resultado consolidado dos leilões, 09/2015*. CCEE, Available at: http://www.ccee.org.br/portal/faces/acesso_rapido_header_publico_nao_logado/biblioteca_virtual?tipo=Resultado%20Consolidado&assunto=Leil%C3%A3o&_afrLoop=1490898141044009#%40%3F_afrLoop%3D1490898141044009%26tipo%3DResultado%2BConsolidado%26assunto%3DLeil%25C3%25A3o%26_adf.ctrl-state%3D63ib-6vbvs_45 Visited on 21 September 2015.

D´ARAÚJO, R. P. (2009). *Setor elétrico brasileiro: Uma aventira mercantil*. Brasilia, Brasil: Confea. Available at: http://www.joinville.ifsc.edu.br/~aryvictorino/leituras_SIP_2011-1/sugest%C3%A3o%20de%20leitura%20da%20aula%206%20-%20setor%20el%C3%A9trico%20brasileiro%20-%20uma%20aventura%20mercantil.pdf Visited on 9 August 2015.

DORADO, P. S. (2014). *O impacto da exportação de energia elétrica das usinas hidrelétricas binacionais no crescimento econômico do Paraguai no periodo de 1995 a 2013*. Dissertação de Mestrado PPED. Rio de Janeiro, Brasil: IE-UFRJ.

ELETROBRAS. (2010). *UnE Garabi-Panambi. Site institucional*. Brasil.: Available at: http://www.eletrobras.com/elb/data/Pages/LUMIS-39833F64PTBRIE.htm. Visited on 15 August 2015.

EPE (Empresa de Pesquisa Energética). (2007). *Balanço Energético Nacional 2007*. Rio de Janeiro, Brasil: Ministério de Minas e Energia. Available at: https://ben.epe.gov.br/downloads/BEN2007_Versao_Completa.pdf. Visited on 15 August 2015.

EPE (Empresa de Pesquisa Energética). (2014). *Plano Decenal de Expansão de Energia 2023*. Brasilia, Brasil: Ministério de Minas e Energia. Available at: http://www.epe.gov.br/PDEE/Relat%C3%B3rio%20Final%20do%20PDE%202023.pdf. Visited on 2 August 2015.

EPE (Empresa de Pesquisa Energética). (2015). *Balanço Energético Nacional 2015*. Rio de Janeiro, Brasil: Ministério de Minas e Energia. Available at: https://ben.epe.gov.br/downloads/Relatorio_Final_BEN_2015.pdf. Visited on 6 August 2015.

GENPOWER GROUP. (Maio de 2015). *Category Archives: Leilão A-5 . Site institucional*. Brasil: Available at: http://www.genpowergroup.com.br/pt/category/leilao-a5/. Visited on 6 August 2015.

IEA (international Energy Agency). (2013). *World Energy Outlook 2013*. International Energy Agency. Available at http://www.worldenergyoutlook.org/publications/weo-2013/. Visited on 22 August 2015.

ITAIPU BINACIONAL. (2015 b). *Perguntas frequentes. Site institucional*. Brasil: Available at: https://www.itaipu.gov.br/sala-de-imprensa/perguntas-frequentes. Visited on 22 August 2015.

ITAIPU BINACIONAL. (2015). *Participação nos mercados . Site Institucional* . Brasil: Itaipu Binacional. Available at: https://www.itaipu.gov.br/energia/participacao-nos-mercados. Visited on 22 August 2015.

MME (Ministério de Minas e Energia). (2015). *Resenha Energética Brasileira. Exercício 2014*. Brasilia, Brasil: Ministério de Minas e Eneria. Available at: http://www.mme.gov.br/documents/1138787/1732840/Resenha+Energ%C3%A9tica+-+Brasil+2015.pdf/4e6b9a34-6b2e-48fa-9ef8-dc7008470bf2 Visited on 3 August 2015.

MME (Ministério de Minas e Energia) (25 de Março de 2015). *Portaria N°81*. Diário Oficial da União N°58, Seção 1. Available at: http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=26/03/2015&jornal=1&pagina=60&totalArquivos=80. Visited on 10 September 2015.

MME (Ministério de Minas e Energia) (25 de Março de 2015). *Portaria N°82*. Diário Oficial da União N°58, Seção 1. Available at: http://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?data=26/03/2015&jornal=1&pagina=60&totalArquivos=80. Visited on 5 September 2015.

ONS (Operador Nacional do Sistema Elétrico). (2015). *Acompanhamento Mesal do Intercâmbios Internacionais . Site Institucional* . Brasil: Available at: http://www.ons.org.br/resultados_operacao/acompanhamento_mensal_intercambios_internacionais/index.aspx Visited on 26 August 2015.

ONS (Operador Nacional do Sistema Elétrico). (2015, a). *Histórico de Operação. Site institucional*. Brasil: Operador Nacional del Sistema Elétrico. Available at: http://www.ons.org.br/historico/geracao_energia.aspx. Visited on 23 August 2015.

ONS (Operador Nacional do Sistema Elétrico). (2015, b). *Mapas do SIN. Site Institucional*. Brasil.: Operador Nacional do Sistema Elétrico. Available at: http://www.ons.org.br/conheca_sistema/mapas_sin.aspx. Visited on 22 August 2015.

SERRADOR, J. (Junho/Julho 2007). *Linhão de Guri: energia da Venezuela garante crescimento em Roraima*. Corrente Continua N°215, 11-14. ELETRONORTE. Available at http://www.eln.gov.br/opencms/export/sites/eletronorte/modulos/correnteContinua/arquivosCC/corrente215.pdf. Visited on 21 August 2015.

TOLMASQUIM, M. (2011). *Novo Modelo do Setor Elétrico Brasileiro.* Brasilia, Brasil: Synergia.

Energy Integration in South America: Experiences, Potential Benefits, Fears and Challenges[1]

Ricardo Raineri[2]

Abstract

As world energy demand grows, which is expected to increase at least by more than 30% until 2040, the pressure on a sustainable development and on the use of cleaner energy sources will increase. Latin America and the Caribbean Region (LAC) has abundant energy resources, with great complementarities, which are sufficient to cope with its own energy needs as well as to contribute to the energy needs of other regions. However, the lack of energy integration in LAC is topping great economic, social and environmental benefits that can be benefit the countries in the region. LAC primary energy demand is expected to growth by 80% to, and electricity is expected to increase in 90%. In this chapter I revise global and regional energy demand trends highlighting the greater pressure that the countries will face for a more sustainable development. What stands today LAC on

1 This document follows on presentations builds on what I presented at two Conferences. The first was "Accessing the Global Energy Market to Enhance Local Energy Security: The Latin American Case", panel "Plausibility of Political Energy Integration and Energy Security", speaker, Fundação Konrad Adenauer (KAS), through its Regional Program Energy Security and Climate Change in LAC (EKLA), Centro Brasileiro de Relacoes Internacionais (CEBRI), and Instituto de Estudios Internacionales (IDEI) Pontificia Universidad Católica de Perú. September 2016, Lima – Peru; and the Second. was "Integração e segurança elétrica na América Latina", panel "Integração dos Mercados Elétricos na Europa e América Latina: desafios e avanços", presider - speaker, Fundação Konrad Adenauer (KAS), through its Programa Regional Segurança Energética e Mudanças Climáticas na América Latina (EKLA), and Grupo de Estudos do Setor Elétrico (Gesel) do Instituto de Economia da Universidade Federal do Rio de Janeiro (IE/UFRJ), August 2016, Rio de Janeiro – Brazil.

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energy integration, what stories of success and failure the region has, and identify the potential benefits that can be accrued with greater levels of energy integration in the region. Also, explore on the more political aspects of energy integration, the issues of risk and trust, and energy security. Additionally, discusses on the existence of a regional consensus if energy integration would enhance energy Security in Latin America, on which are main challenges on regulatory convergence/ harmonization to advance on energy integration, and on which are the requirements for a positive agenda on energy integration. Finally conclude highlighting on the key issues to move forward on the energy integration of LAC, where the main challenge is trust and a unified vision that energy integration will bring great benefits across the region.

World Energy Demand

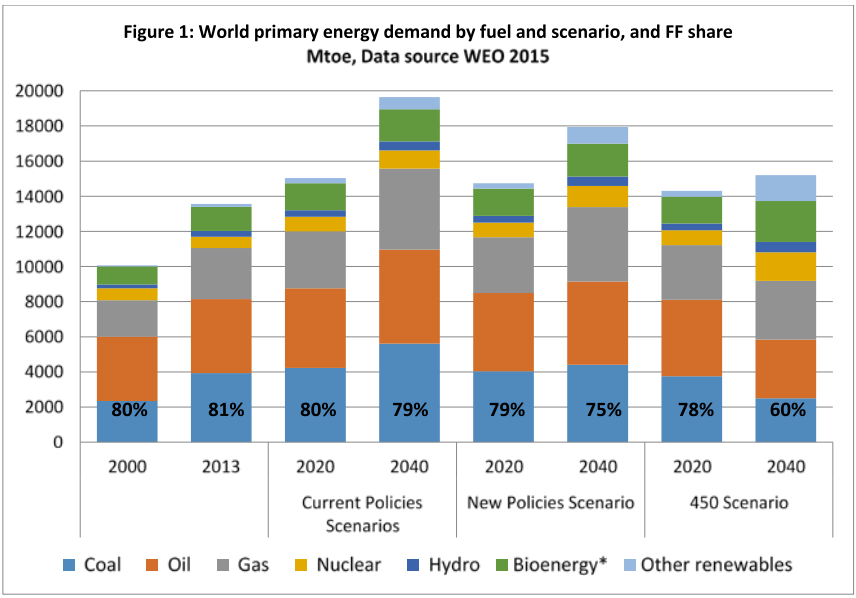
According to International Energy Agency (IEA) New Policies Scenario world energy demand is expected to increase from 13,559 Mtoe in 2013 to 17,934 Mtoe in 2040,[3] what represents a 32% increase in energy consumption, and where fossil fuels (FF) participation in primary energy consumption is expected to remain high, but to decrease from 81% in 2013 to 75% in 2040, as presented by Figure 1 which shows IEA primary energy demand projections up to 2040 under the different scenarios used in their WEO 2015.[4] FF, in absolute terms (Mtoe), will increase besides their smallest share in primary energy mix, thus we might expect CO_2e emission to grow even further in the coming decades. We should underscore that the 32% increase in primary energy consumption projected by IEA in the New Policies Scenario con-

3 The New Policies Scenario in WEO-2015 takes into account the policies and implementing measures affecting energy markets that had been adopted as of mid-2015 (as well as the energy-related components of climate pledges in the run-up to COP21, submitted by 1 October), together with relevant declared policy intentions, even though specific measures needed to put them into effect may not have been adopted. The Current Policies Scenario takes into account only policies enacted as of mid-2015. The 450 Scenario depicts a pathway to the 2 °C climate goal that can be achieved by fostering technologies that are close to becoming available at commercial scale. Against a backdrop of uncertainty over economic growth and a persistent oil market imbalance, a Low Oil Price Scenario explores the implications of sustained lower prices on the global energy system.

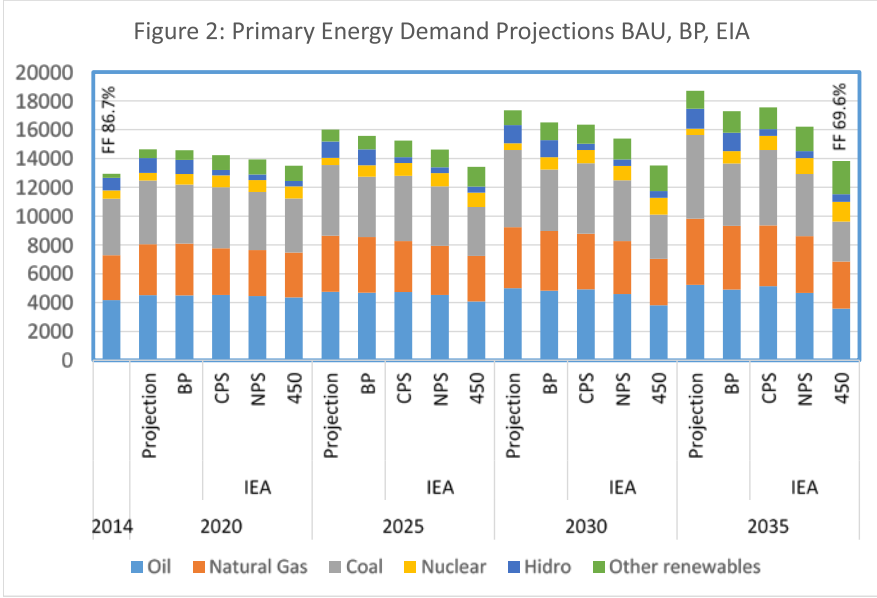
4 World Economic Outlook, International Energy Agency 2015.

siders the achievement of large investments in energy efficiency to leverage a smaller rate of growth in primary energy consumption. IEA estimates that $48 trillion of investment will be needed to cope with energy needs up to 2035, to satisfy new energy demand needs as well as to replace obsolete energy infrastructure and the depleted FF, where 18% of all the investments should go to energy efficiency (EE). As a sensitivity of the scenarios analyzed by IEA regarding future energy primary energy demand, Figure 3 compares projections for Primary Energy Demand from British Petroleum (BP), the IEA, and a Business as Usual Scenario (labeled as Projection) where I have projected future primary energy demand based on what has been the primary energy demand growth rate in the last 10 years. Comparing BP, IEA primary energy demand projections with the Business as Usual Scenario, we see that IEA and BP made more conservative growth rates projections with primary energy demand growth compared with what has happened in the last decade.

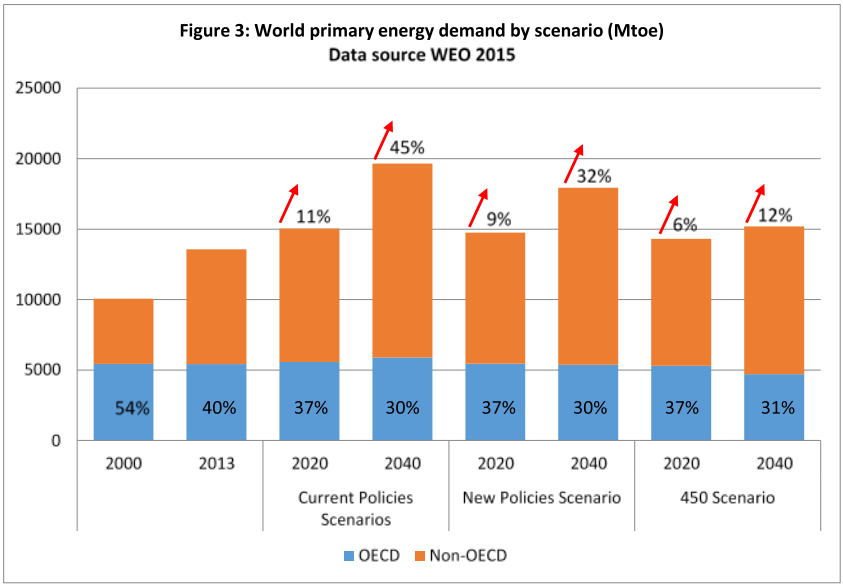
Figure 1: World primary energy demand by fuel and scenario, and FF share
Mtoe, Data source WEO 2015



* Includes the traditional use of solid biomass and modern use of bioenergy.



Source: Projection based on BP and IEA data.



** Excludes international bunkers.

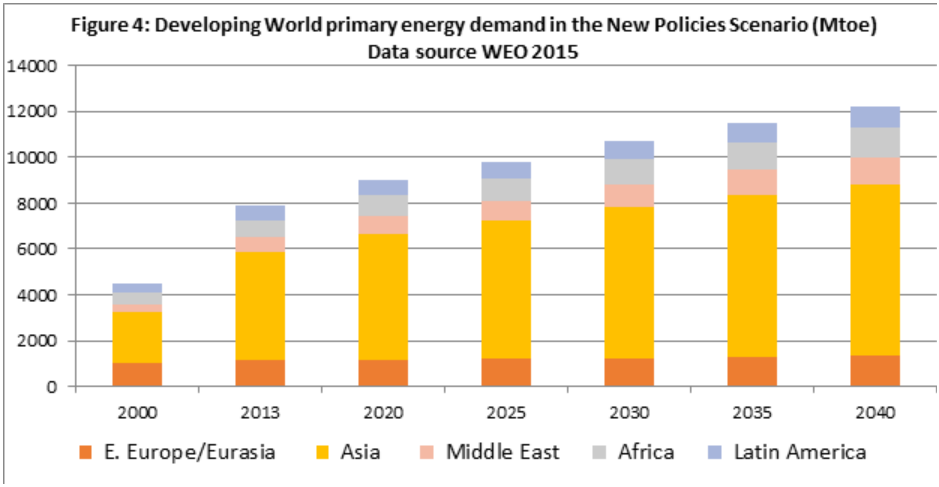
Looking forward, most of the increase in primary energy consumption is expected to take place in the developing world, Non-OECD countries (Figure 3), driven by population and economic growth. As in the developing world improves the living conditions of their population and its countries become more productive and industrialized, primary energy demand is expected to increase. In 2015, world population reached 7.349 billion, and is expected to reach 8.501 billion in 2030 and 9,725 billion in 2050; where, according to United Nations (UN) data (Table 1), the largest increase in number of people is expected to take place in Africa and Asia.[5] Energy consumption from the developing world is anticipated to increase its share in world energy consumption from 60% in 2013 to 70% in 2040, according to the IEA New Policies Scenario, and this is after being only 46% in 2000 and 42% in 1990. Within the developing world, the largest increase in energy consumption is expected to take place in China, India and the resto of Asia, as illustrated by Figures 4 and 5.

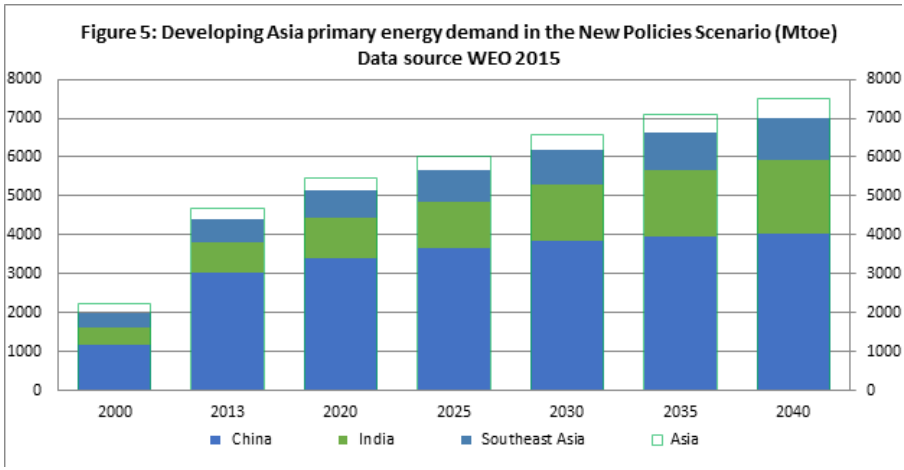
Table 1: Population of the world and major areas, 2015, 2030, 2050 AND 2100, According to the medium-variant projection

Major area Population (millions)	2015	2030	2050	2100
World	7,349	8,501	9,725	11,213
Africa	1,186	1,679	2,478	4,387
Asia	4,393	4,923	5,267	4,889
Europe	738	734	707	646
Latin America and the Caribbean	634	721	784	721
Northern America	358	396	433	500
Oceania	39	47	57	71

Source: United Nations, Department of Economic and Social Affairs, Population Division (2015). World Population Prospects: The 2015 Revision. New York: United Nations.

5 Source: United Nations, Department of Economic and Social Affairs, Population Division (2015). World Population Prospects: The 2015 Revision. New York: United Nations.



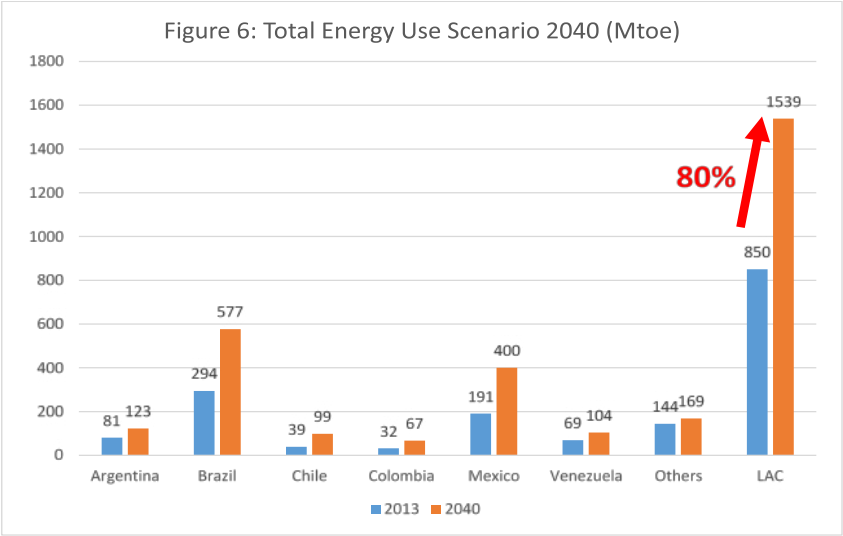


LAC Energy Demand

With the boom of natural resources in the last decade, LAC achieved some important success in terms of economic growth and reduction in its levels of poverty. With a population of 643 million, LAC expects 100 million more by 2030, where between year 2000 and 2015, the percentage of people

living in poverty decreased from 42.8% of the population to 23.3%,[6] and the percentage of people that is in the middle class increased from 21.2% to 35%. Nevertheless, beyond these accomplishment, LAC still has 150 million people living in poverty, where more than 22 million (3.5%) lacks access to electricity and 80 million (13%) lacks access to modern cooking facilities.

LAC primary energy consumption represents 6.7% of world energy consumption, or 884Mtoe according to BP data, and it has grown on 103% in the last 25 years, or at an annual rate of 2.87%. LAC energy consumption is expected to reach 1,531 Mtoe by 2040, an increase of more than 80%, with an annual growth rate of 2.2% (Figure 6 and Table 2).[7] As these forecasts shows, this large increase energy demand will require huge investments in energy infrastructure, as well as in exploration, exploitation and the harvesting of current and new energy sources.



Source: Lights On? Energy Needs in Latin America and the Caribbean to 2040. Lenin H. Balza, Ramón Espinasa, Tomas Serebrisky. IADB 2014.

6 The LAC poverty line defined at US$ 4 (2005 PPP) is a more stringent line than the current US$ 1.9 (2011 PPP) used by the World Bank Group to count the number of poor people around the world; where with the US$ 1.9 threshold, in 1990 we have that 36,9% of world population or 1.95 billion people living in poverty, figure that decreased to 10.7% or 770 million people in 2013.

7 Calculations with BP estimates, projects a 1.8% annual growth rate of primary energy consumption for central and south America, and 2.1% for LAC, and IDB estimates that primary energy consumption will growth at an annual growth of 2.2% for the wide Latin America region, with primary energy demand increasing at least by 80% in 2040 with respect to the present day. I follow IDB 2.2% annual growth rate, what is more align with what have happened with primary energy consumption in LAC since year 2000, where primary energy consumption has grown at an annual average of 2.46%.

Table 2: Total Energy Use Scenario 2040 (Mtoe)				
	2013	2040	Growth	CAGR
Argentina	81	123	51.9%	1.56%
Brazil	294	577	96.3%	2.53%
Chile	39	99	153.8%	3.51%
Colombia	32	67	109.4%	2.77%
Mexico	191	400	109.4%	2.78%
Venezuela	69	104	50.7%	1.53%
Others	144	169	17.4%	0.59%
LAC	850	1539	81.1%	2.22%
Source: Lights On? Energy Needs in Latin America and the Caribbean to 2040. Lenin H. Balza, Ramón Espinasa, Tomas Serebrisky. IDB 2014.				

Electricity demand in LAC is expected to increase at a 2,43% rate, from 1,552TWh in 2013 to 2,970TWh in 2040, what implies an increase of 90% (Figure 7 and Table 3). Regionally, Brazil will remain close to 38% of LAC electricity consumption, and taking the largest five economies in the region, the largest percentage increase in energy demand is expected to take place in Colombia and in Chile, with annual growth rates of 3.37% and 3.29% respectively. While, in absolute terms, Brazil is expected to account for the largest increase energy consumption from 570TWh in 2013 to 1,120TWh in 2040, with an increase of 550TWh, what is about the size of what is the expected to be the electricity demand in Mexico by 2040.

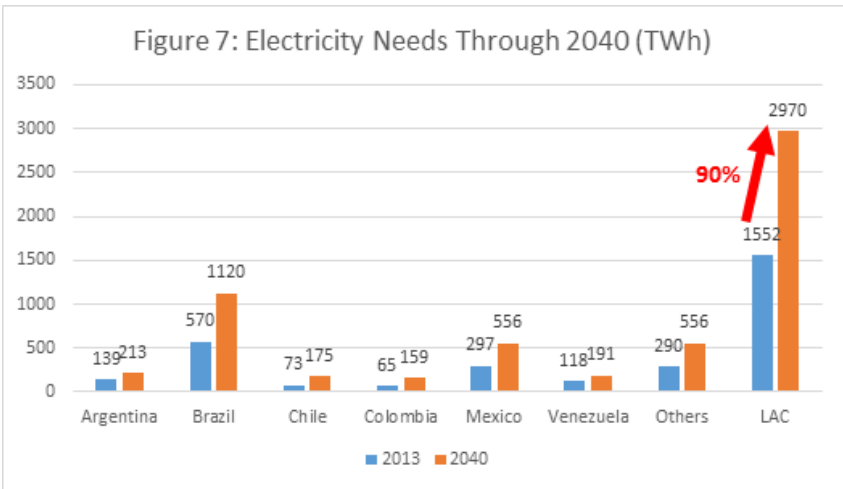
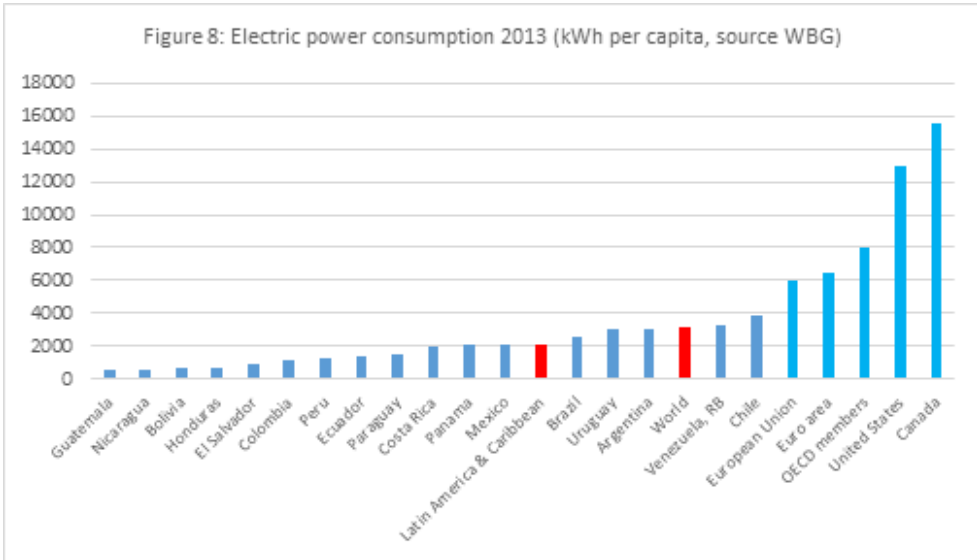
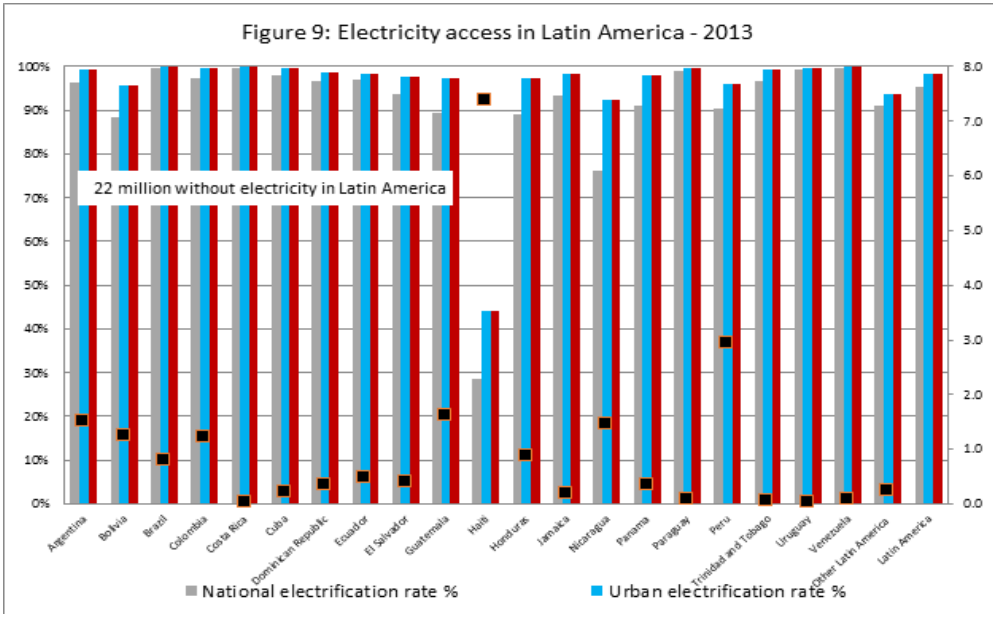


Table 3: Electricity Needs Through 2040 (TWh)				
	2013	2040	Growth	CAGR
Argentina	139	213	53.2%	1.59%
Brazil	570	1120	96.5%	2.53%
Chile	73	175	139.7%	3.29%
Colombia	65	159	144.6%	3.37%
Mexico	297	556	87.2%	2.35%
Venezuela	118	191	61.9%	1.80%
Others	290	556	91.7%	2.44%
LAC	1552	2970	91.4%	2.43%
Source: Lights On? Energy Needs in Latin America and the Caribbean to 2040. Lenin H. Balza, Ramón Espinasa, Tomas Serebrisky. IDB 2014.				

Per capita electricity consumption in LAC average 1/3 of the European Union, ¼ of OECD members, and less than 1/6 of the one in the US (Figure 8). And, as the region improves even further the standard of living of its population, where the number of people living in poverty decreases more and the number of people that enters the middle class increases more, and the size of regional economies increases and become more productive, we should expect that energy demand will increase coming much closer to the per-capita levels of energy consumption that we see in the more advanced economies. Also, and except for the more disadvantage countries in the region, such as the case of Haiti, the region has the opportunity to achieve universal energy access if governments and the private sector take that commitment seriously, and make the effort to close the gap that this last mile requires (Figure 9). In most of LAC countries, electrification rates are above 90% and in many above 97%, where the largest gaps remaining in the rural areas.





As the population in LAC and the world keeps growing, and peoples living conditions improve, we will witness and increasing pressure on the regional and world energy markets and resources. There is a huge appetite for energy, we are more and the modern economy is addicted to energy. To cope with this larger demand, globally, regionally and locally, it is going to be key the

harvesting of local energy resources, where innovation will be fundamental to uncover new energy sources and also to use energy in a more efficient way.

LAC Resources

How can LAC deal with this large expected increase in energy demand? LAC has enough resources to satisfy its own energy needs as well as to contribute to some other regions energy needs. It has abundant FF, and has a huge potential of renewables such as hydro, wind, solar, geothermal, biofuels and biomass, and tidal and wave energy. If this resources are put at work in a smart, efficient and sustainable way, LAC has great chances to develop one of the more efficient, clean, and sustainable energy systems on a world scale.

LAC Fossil Fuels

The region has 22% of the world's oil proven reserves, of which 20% of world reserves are in Venezuela, and most of the remaining 2% in Brazil, Mexico and Ecuador (Table 4). At current levels of consumption, the region has enough oil reserves to satisfy its oil consumption for 100 years, and as a region it has been a net oil exporter, where in 2015 it exported more than 12% of its production. On unconventional oil, the Energy Information Administration of the U.S. (EIA) estimates that LAC has 18% of technically recoverable Shale Oil, where 7% is in Argentina, 4% in Colombia and Venezuela in the Maracaibo basin, and 3% in Mexico. On top of that, we must consider the Pre Salt discoveries in Brazil, that adds an estimated 13.3 billion barrels of commercially recoverable reserves from announced projects in offshore Brazil.

Table 4: OIL Proven Reserves Total LAC as % World	
OIL PR Total LAC as % World	21.95%
Venezuela	19,62%
Brazil	0,79%
Mexico	0,62%
Ecuador	0,49%
Argentina	0,14%
Colombia	0,14%
Otros LAC	0,14%
Source: BP 2016	

On Natural Gas, LAC has 4.2% of proved reserves (Table 5), which at the current regional levels of consumption could last almost 40 years. And, as of 2015, the region was a net importer of NG, importing 10.4% of its consumption. The region also has important Shale gas resources, and the EIA has uncovered a great potential where it calculates that the region has 22% of the shale gas that currently has been estimated in a total of 95 major basins in 42 countries in the world, where Argentina has 9%, Mexico 6% and Brazil 3%.

Table 5: Natural Gas Proven Reserves as % World PR	
Natural Gas PR as % World PR	4.3%
Venezuela	3.0%
Mexico	0.2%
Brazil	0.2%
Trinidad and Tobago	0.2%
Peru	0.2%
Argentina	0.2%
Other LAC	0.3%
Source: BP 2016	

On Coal, the region has more modest reserves with respect to the world reserves, and they represent 1.7% of world coal reserves. Nevertheless, at today levels of regional consumption, they could last more than 150 years. Besides the modest regional coal reserves, in 2015 LAC was a net coal exporter with 27% of its production.

LAC Renewables

LAC has one of the most renewables primary energy and electricity matrix in the world. LAC share of renewable energies (RE) in the primary energy mix was 21.2% in 2015 v/s 9.6% worldwide (no counting for the use of traditional biomass for cooking and heating which would add 10% to LAC primary energy mix, and 5% worldwide). For electricity generation, the proportion of RE in LAC is 55%, where 49% correspond to large hydro, compared to 11% world average.

In terms of the regional renewable energy potential, the Inter-American Development Bank (IADB) estimates that LAC has a non-conventional re-

newable energy (NCRE) potential for electricity that can cope more than 22 times with the expected demand for electricity in 2050.[8] IADB assess the region electricity potential of NCRE, besides small and large hydro, in 78PWh, where from that solar PV is 46%, solar CSP 21%, wind 16%, marine 11%, geothermal 4% and biomass residues 2%, energy potential that is enough to satisfy an energy demand that is 22 times bigger than the one that is expected in 2050 for LAC, of 3.5PWh. Also, we must underline the great biofuels potential of the region, where today Brazil stands as the second largest producer of ethanol and biodiesel, biofuel which is used with a mandated minimum ethanol blend in regular gasoline of 25% to 27%,[9] but which can go up to 100% if by Brazilian drivers wants to run 100% on fuel obtained from sugar cain.

On hydropower LAC has developed only 1/3 of regional hydropower potential, estimated in 320 GW (Table 6).[10] Together to this large undeveloped hydropower potential in the LAC, the different regions present great complementarities in the rainy seasons, under the Niño and the Niña condition in the Pacific (El Niño Southern Oscillation -ENSO-). The Niño condition implies extensive rains in the south part of South America (SA) and in the east of Central America; and it implies deep draught or absence of rains in the north of South America and in the west of Central America. Further, el Niño/La Niña has an impact on wind speeds, and in the north of South America and in Central America, the overall cycles of El Niño (dry years) might provide for windier conditions, which favors an increase in wind power generation; while in regions of the south of South America the opposite might happen. Thus, these patterns of rains and wind depict great complementarities between the hydropower generation capacity within north and south under the Niño/Niña condition, as well as great complementarities between hydropower and wind power generation.

8 IADB 2013.

9 In mid-March 2015 the government raised temporarily the ethanol blend in regular gasoline from 25% to 27%. In terms of energy equivalent, sugarcane ethanol represented 17.6% of the country's total energy consumption by the transport sector in 2008. Empresa de Pesquisa Energética (2009). "Balanço Energético Nacional 2009: Ano base 2008". Ministério de Minas e Energia do Brasil.

10 World Energy Council SER 2010.

Table 6: Hydropower Potential LAC			
	Hydroelectric potential (MW)		In Operation 2015
	Gross Theoric Cap.	Technically Explotable Cap.	Capacity MW
Argentina	40,411	19,292	10,118
Bolivia	20,320	14,384	494
Brazil	347,032	142,694	91,650
Chile	25,913	18,493	6,622
Colombia	114,155	22,831	11,392
Ecuador	19,292	15,297	2,297
French Guyana	228	114	119
Guyana	9,247	4,224	1
Paraguay	12,671	9,703	8,810
Peru	180,023	45,091	4,190
Surinam	4,452	1,484	189
Uruguay	3,653	1,142	1,538
Venezuela	83,447	29,795	15,393
Total South America	860,845	324,543	152,813
World Energy Council SER 2010 and 2016 Hydropower Status Report from the International Hydropower Association Ltd.			

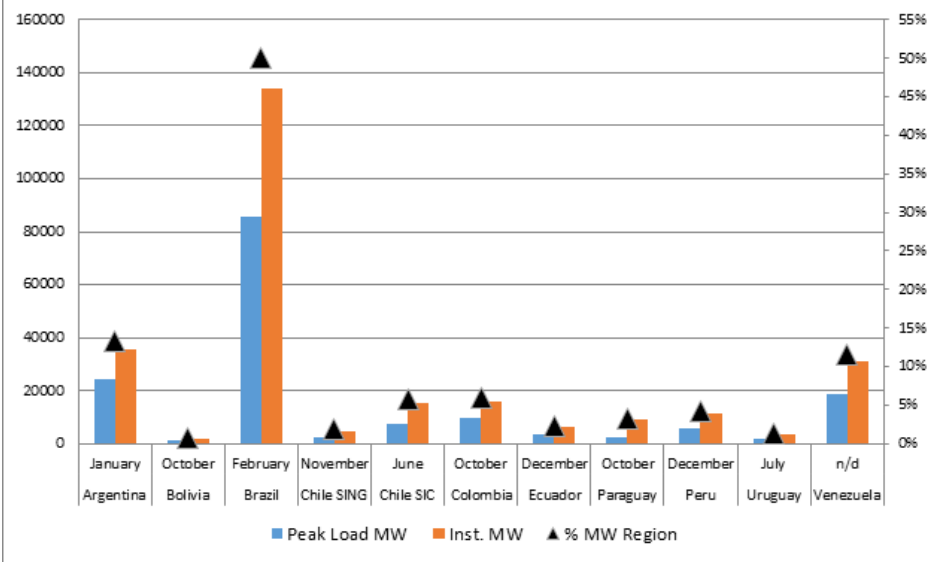
Regional Energy Integration, Infrastructure and Energy Trade[11]

Figure 10 highlights SA countries power generation install capacity in 2014 and the percentage that each of them represents in the SA install capacity of almost 255GW. Stands out Brazil as the country with the largest install capacity of 134GW, which represents 50% of the regional power generation capacity; and is followed by Argentina (35GW), Venezuela (31GW)

11 For a more detail outline of the different attempts of energy integration in LAC see in the book "Evolution of Global Electricity Markets: New paradigms, new challenges, new approaches" by Elsevier, edited by Fereidoon P. Sioshansi, Menlo Energy Economics, the Chapter 14: "Latin America Energy Integration: An Outstanding Dilemma", by Ricardo Raineri, José Goñi, Isaac Dyner, Nivalde Castro, Yris Olaya and Carlos Franco, 2013.

and Chile (20GW).[12] Figure 10 also underlines peak demand in MW, as well as the month when peak demand happens in each country. Besides the large differences that exists in the install power generation capacity within the countries, there are opportunities to complement their install power generation capacity, by providing support to each other during peak demand, but also, as we already mention, during different rainy and windy conditions during El Niño and La Niña, or from energy exports from energy resource rich countries to energy resource not as rich countries.

Figure 10: South America: Peak Load, Inst. Cap. and % Regional Inst. Cap. 2014 (MW)
Source: CIER y MinEnergia

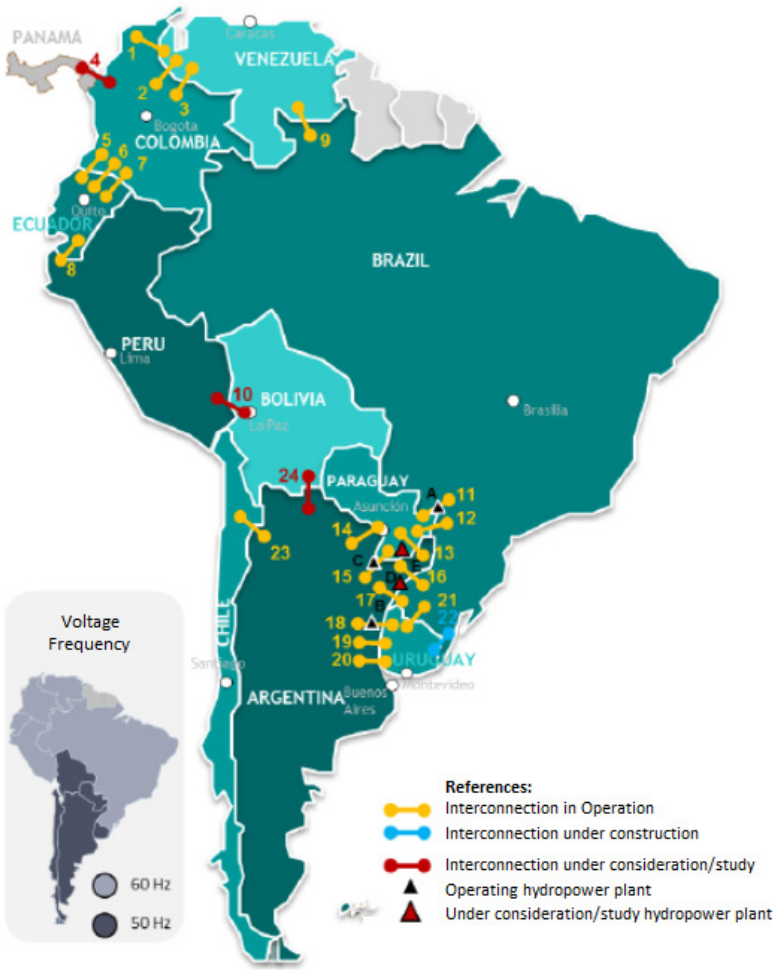


Today there is about 20 cross border electricity interconnection lines in SA, with some other potential lines under study or consideration by the respective authorities. Most of these lines allow for commercial or convenience power exchanges, where countries have exchanged surpluses to confront short term energy deficits or as backup in the case of and energy outages. But also, some of the lines have being used to export large blocks of electricity as is done through the lines that go from Paraguay, in their part of the Itaipú power plant, to the city of Sao Paulo, what mostly correspond to power ex-

12 Guyana, French Guyana and Suriname adds about 1.1 GW of install capacity to the South American electricity matrix.

changes associated with binational projects.[13] Figure 11 maps the main cross border electricity transmission lines and binational hydro power plants, and Table 7 list the main binational hydropower plants in the region that has been built in binational rivers. Also, Table 7 list some large potential binational hydropower plants currently under consideration.

Figure 11: Major electricity interconnection lines and power generation plants 2014

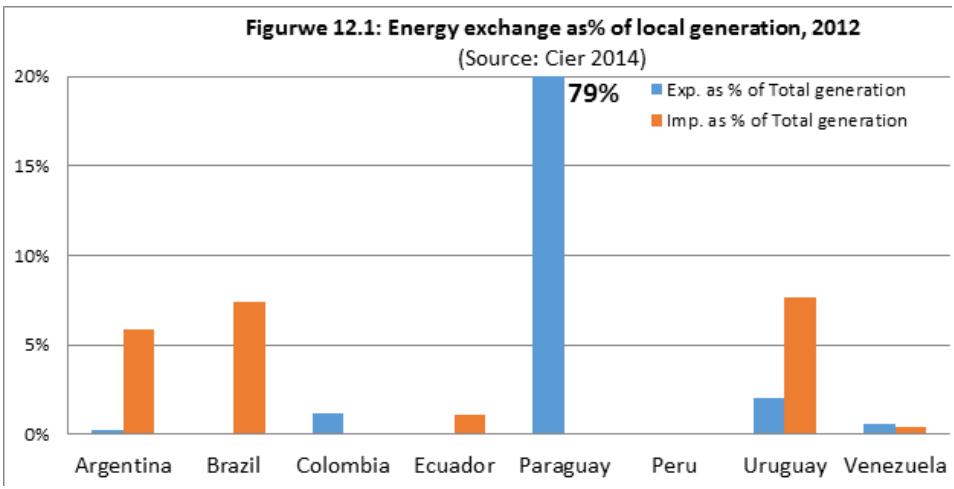


Cier, 2015

13 Itaipú, with an install capacity of 14GW stands as the second largest hydropower plant in the world, after The Three Georges in China with 22.5GW of install capacity. Itaipú power plants is owned in equal parts by Paraguay and Brazil.

Table 7: Major power generation plants 2014					
Ref.	Country	Name	River	Inst. Cap.	Comment
A	Br -Py	Itaipú	Paraná	14.000 MW	In operation
B	Ar -Uy	Salto Grande	Uruguay	1.890 MW	In operation
C	Ar -Py	Yacyretá	Paraná	3.200 MW	In operation
D	Ar -Br	Garabí	Uruguay	1.500 MW	In Study
E	Ar -Py	Corpus	Paraná	3.400 MW	In Study
Source: CIER 2015					

For volumes of electricity exchanges within SA, Paraguay appears as the largest electricity exporter in the region, where in 2014 it exported 75% of the electricity it produced to Brazil and Argentina, mostly explained because of its energy surplus in the binational hydropower plants of Itaipú and Yacyretá (Figure 12.1 -2 and Table 8.1 – 2). Also, in 2014 Uruguay arose as a next electricity exported given the large investments in renewables it has made, in wind, what created electricity surplus which are being exported to Argentina and some to Brazil through the Melo conversion station. Beyond Paraguay, Uruguay, and some power exchanges between some Andean countries, and as a whole, in 2014 power exchanges only accounted for 3.9% of the electricity produced in SA, figure that is small if we notice that 75% of that number corresponds to the Paraguayan exports to Brazil given its large energy surplus in the Itaipú hydropower plant.



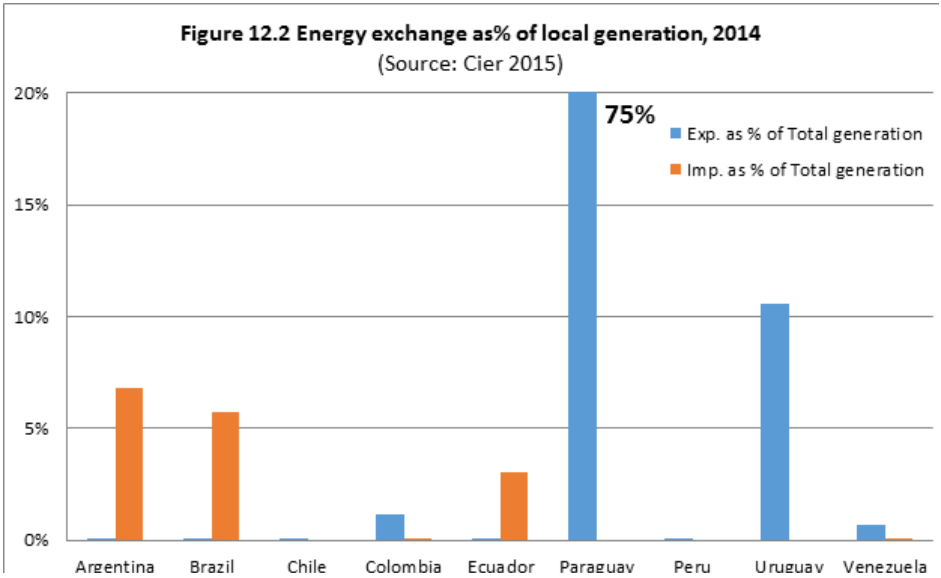


Table 8.1: Regional Power Exchanges GWh 2012 (Source CIER 2013)									
	Argentina	Brazil	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela	Total Imp.
Argentina		79			7.646		194		7.919
Brazil					40.016			705	40.721
Colombia				7					7
Ecuador			236			2			238
Paraguay									
Peru				5					5
Uruguay	279	463							742
Venezuela			478						478
Total Exp.	279	542	714	12	47.662	2	194	705	50.110
Total GWh generation South America									1.083.766
Power Exchange as % of Total generation									4,6%

Table 8.2: Regional Power Exchanges GWh 2014 (Source: Cier 2015)										
	Argentina	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela	Total Imp.
Argentina		3	4			8,461		1,267		9,735
Brazil	1					32,939			839	33,779
Colombia					20					20
Ecuador				718			13			731
Venezuela				28						28
Total Exp.	1	3	4	746	20	41,400	13	1,267	839	44,293
Total GWh generation South America										1,141,144
Power Exchange as % of Total generation										3.9%

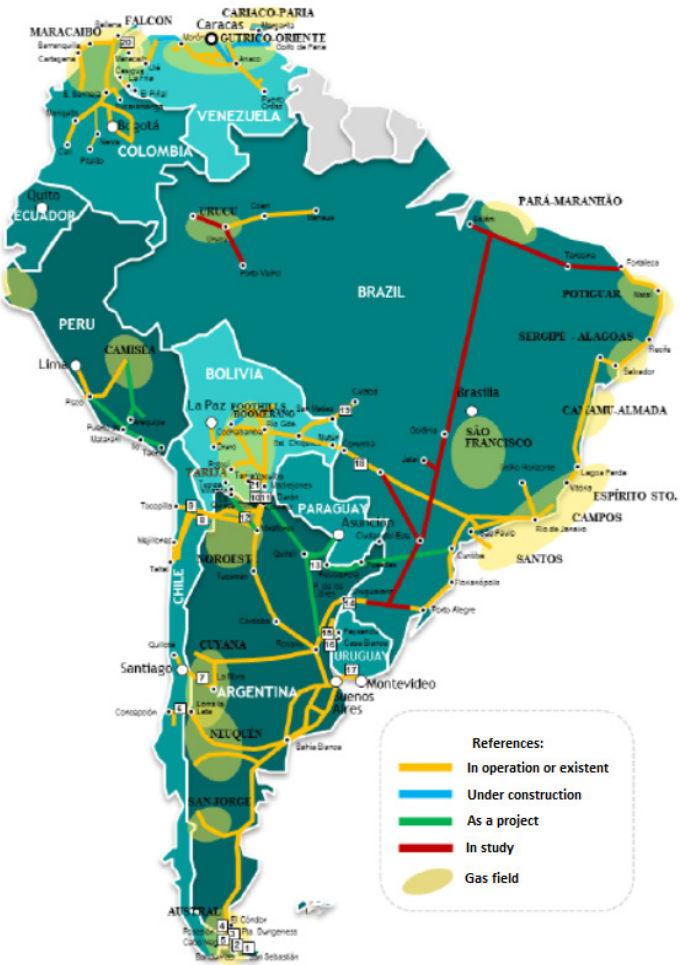
Figure 13 maps the main gas pipelines in South America and the location of main gas fields. Stands out NG pipelines from Bolivia to Brazil, Bolivia to Argentina, between Venezuela and Colombia, and from Argentina to Chile. Bolivia is the largest exporter of NG in SA, and currently exports NG to Argentina and Brazil. For the Bolivian economy, NG exports accounts for roughly 50% of the country total exports, and in 2015 it financed more than half of its government budget. Beyond the relevance of Bolivian NG exports to Argentina and Brazil, the odd side of NG exports in SA is the failed NG integration between Argentina and Chile, where, after huge infrastructure investments in the late 1990s and early 2000s to export NG from Argentina to Chile, the economic crisis in Argentina that erupted in 2002 lead to a sharp stop in NG exports from Argentina, with deep economic and social costs in Chile that a sudden interruption in a key energy source have implied for the economy.[14][15] The speed that we see in the 1990 with the construction of many international gas pipelines, mostly in the Southern Cone, shifted to a much lower speed after the Argentinean crisis that erupted in 2002, when a progressive reduction of NG exports to Chile took place. Only in 2010 a

14 In Chile in the late 1990 and early 2000, large investments in power plants as well as industries and household, who changed/adapted their equipment's/systems to use NG from Argentina were made. See Ricardo Raineri "Chronicle of a Crisis Foretold: Energy Sources in Chile", IAEE Newsletter, International Association for Energy Economics Newsletter, pg. 27-30, Fourth Quarter 2007.

15 On March 24th of 2004, by Resolution n° 265 of the Energy Secretary, the Argentinean government decided to suspend exports of excess supply of natural gas in order to keep the internal demand satisfied.

renewed impetus has open new dialogues for advance energy integration in SA, but with consciousness that it should be a model of energy integration that should not jeopardize, as happened in the 1990s with Chile, energy security and independency.

Figure 13: Major Gas Pipelines and Gas Fields, LAC 2014



Cier, 2015

The structure of NG trade in LAC, when we compare it with the structure of world NG trade on average, is not quite different. On a world scale, in 2015 30.1% of NG consumption was served by international pipelines (20.3%) and transported as LNG (9.8%), and in LAC, 28,7% of NG consumption was imported by pipe or as LNG. Pipe imports on total NG consumption represent 18.7%, and LNG imports on total NG consumption represent 10.5% (Table 9). Therefore, as it has been happening on world markets, where LNG is becoming increasingly important on the NG market, in LAC too LNG is becoming increasingly important in the NG market. And this reflects a regional and world trend, where the countries look for more flexibility and a greater diversification of NG suppliers in their energy mix.

Table 9: Gas Trade in 2015 (billion cubic meters)				
World Gas CONSUMPTION	3468.6			
LNG	9.8%			
PIPE	20.3%			
Total gas trade LNG and Pipe	30.1%			
LAC Gas CONSUMPTION	258.0			
	Pipeline imports	LNG imports	Pipeline exports	LNG exports
Mexico	29.9	7.1	0.0	0.0
Trinidad and Tobago	0.0	0.0	0.0	17.0
Other S. & Cent. America	18.5	20.0	18.5	5.0
LAC Total trade	48.3	27.1	18.5	22.0
LAC LNG imports/LAC Gas Consumption				10.5%
LAC PIPE imports/LAC Gas Consumption				18.7%
LAC LNG and PIPE imports/LAC Gas Consumption				29.2%
Source: Own calculations with BP data.				

There have been many attempts to advance on energy integration in LAC, but the success has been, in general, modest. The most know initiatives are the attempts under the umbrellas provided by SIEPAC (Sistema de Interconexión Eléctrica de los Países de América Central), MERCOSUR, UNASUR, CAN (Colombia – Ecuador, Ecuador - Peru), and most recently SINEA connected to CAN (Sistema de Interconexión Eléctrica Andina - Electric Interconnection System of the Andean region-). Beyond these multinational

integration initiatives, also we have the binational projects, such as Itaipú, Yacyretá, and Salto Grande, which are standalone projects of energy integration with a specific agreement or treaty that governs them; and binational initiatives that provide for commercial power exchanges of convenience through international power lines, or FF trade as NG through international pipelines.

The most advance electricity integration in LAC, as a multinational energy integration initiative, is SIEPAC in Central America, project that was launched with the Treaty for the Electricity Market in Central America and its first protocol, ratified between 1997 and 1998, by the respective congresses of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama, which created the regional bodies for the operation and regulation of the regional Electricity market: Regional Operating Agency (EOR) and the Regional Electricity Interconnection Commission (CRIE), that respectively defined the Company Owner of the Network (EPR) that has been in charge of the development and operation of the first regional interconnection system (SIEPAC infrastructure). The infrastructure component under the responsibility of the EPR, consisted primarily in the design, engineering and construction of approximately 1,793 kilometers of transmission lines of 230 kV with towers capable of having a second future circuit, which are connected to 15 substations in the countries through 28 connections, the SIEPAC infrastructure also included reactive compensation equipment. These initial infrastructure, together with reinforcements of national transmission systems, has allowed for a reliable and secure energy transmission capacity of 300 MW, among the countries of the region, which may be doubled when the second circuit is enabled.[16]

SINEA, known as the Andean System for Electricity Interconnection, is an initiative where the countries of Peru, Colombia, Ecuador, and Chile seeks to interconnect with a 500kV line the four countries from Colombia to Chile. Bolivia is an observer but a secure candidate to join the initiative. These four countries have acted in a joint effort to achieve a regional interconnection. So far, a study mandated by SINEA, financed by the IADB and approved by CAN, has set a roadmap for the interconnection in the region which would bring significant benefits. To this end, Chile is participating as an associated country with CAN in CANREL (Andean Committee of Regulatory Bodies and Regulators of Electricity Services), GOPLAN (Technical Group

16 Source EPRSIEPAC.

of Organizations Planners electricity sectors) and GTOR (Technical Group for Member Electricity Regulatory Services). Recently, Ecuador and Peru has agreed to concrete the initiative which would allow for transaction and transit of electricity within the countries. The main challenges that should be solved have to do with the minimum regulatory requirements which will enable the construction of the needed energy infrastructure, where the key topics to be reviewed and prioritized are:

- short term market operation, with the proper treatment power generation dispatch;
- management of congestion rents on the interconnection lines;
- conceptualization of the treatment of energy in transit as it crosses a country that is not the producer or consumer of that energy.

Potential Benefits from Energy Integration

LAC has abundant RE and FF resources, that are unevenly distributed, but that shows great complementarities, with sufficient resources for its energy needs and to contribute to the energy needs of other regions. Technically, the integration of the energy systems of LAC has a great potential to create wealth for the countries, for those energy rich countries that have energy surpluses as well as for those that are less energy rich and have a deficit. Among the energy exporters, energy integration creates jobs and boost economic growth, but also provides additional sources of revenues which can be used to improve peoples` living conditions, as is the case of Bolivia where more than half of government expenditures really on the revenues from natural gas exports to Brazil and Argentina. Also, energy integration creates wealth for the energy importing countries, as energy imports are expected to substitute more expensive or inefficient, and less clean energy sources, improving the country competitiveness, boosting economic growth, reducing energy costs and with that unlocking in the importing country resources which can be used in other needs of the population. For example, energy integration avoids the use of expensive oil for power generation, displaces more polluting energy source with ones with lower CO_2 emissions, such as NG, Hydro, and NCRE. Energy integration could improve system reliability as the countries

can obtain backup from other countries, which might allow them to cope with energy shortages that in the emergency or short term cannot be solved with local infrastructure or native resources. Energy integration also reduces the system needs of reserve capacity; and increases the reliability and resilience of the interconnected system with a reduction of energy losses due to an optimized operation. Furthermore, as outlined above, energy integration can take advantage of the complementarities of the energy sources of different basins and with it reduce the systems energy costs.

On noteworthy potential benefits for different Sub Zones in LAC, we can emphasize the following:[17]

Central America

- Economies of scale
- Enable more efficient energy infrastructure
- Reduce energy costs and dependency on oil for power generation

Andean community

- Energy exchanges
- Optimization of an integrated power system
- Complementarities on power generation for peak demand
- Complementarities on rain seasons with El Niño and La Niña

South Cone and Brazil

- Chance to optimize the use of energy resources
- Binational hydro projects
- Electricity and natural gas swaps
- Energy Wheeling
- Synergies between natural gas, hydro, wind, solar and biomass.
- Develop energy infrastructure for export that provides a stream of revenues

17 Source: CIER

Plausibility of Political Energy Integration and Energy Security

Technically we have drawn attention to large potential benefits from energy integration in LAC. However, beyond the technical aspects, and coming more into a geopolitical discussion, we might question if:

- Is there a consensus that energy integration would enhance energy Security in Latin America?
- Which are main challenges on regulatory convergence/ harmonization?
- Which are the requirements for a positive agenda on energy integration.

These inquiries bring as to highlight the question of energy security. What is energy security and why it is important? Energy security could be understood in many different ways, but IEA and NATO provides a definition and some views to understand the concept of energy security, as well underscores it importance for the countries development, its economic, political and social environment. IEA defines energy security as the uninterrupted availability of energy sources at an affordable price; and NATO on talking about energy security says that "there's much more at stake than cheap, reliable sources of energy. It's about independence". Thus, following these definition and views, we can say that energy security is a lot more than energy infrastructure and energy supply, energy security is about politics, sovereignty, political stability, democracy and development. Without a reliable and secure source of energy, the countries' economies are exposed to risks that might lead to volatility and lower economic growth, and to increased levels of social and political instability, and risk which might compromise national security. Energy security has to do with risk, risk in different levels of the society.

In any investment project we can identified different types of risk, risks specific to the project, economic risks, and political risks. In the first category, or risks specific to the project, there are risks related with construction costs, corporate issues, human resources, environmental and social issues, operational aspects of the project, and on the technology. On the second category, of economic risks, there are market risks, macroeconomic risks, and financial risks. And, in the third category, on political risks, there are risks related with

the country own realities in matters such as exposure to war, terrorism and civil unrest, of expropriation, related with the rule of law and policies, linked with currency inconvertibility and transfer restriction, and connected with a breach of contract. All of these different categories of risk are present in any investment project that is undertaken in a foreign country. But, more specifically if we look at projects connected with energy integration, we can underline some risks that should demand a particular consideration from the perspective of an energy importing country and from that of an energy exporting country, risks that has to do with each country reality, its business environment, and how they can be spread to the other country.

Risk on Energy Integration for an Import Country

A country that imports energy from neighborhood countries will be exposed to idiosyncratic risk, as it is exposed to other nations choices, where as an alternative to energy integration it has the possibility to diversify energy sources by gaining access to regional and/or global markets, or by developing native energy resources/sources which might be more expensive but where the country has a larger leverage. Within the specific, non-systemic, risks at which a country is exposed by depending on energy sources from neighborhood countries are:

- of opportunistic behavior (principal-agent problem) from the neighborhood country;
- on idiosyncratic price instability, different to global markets price risk;
- of sudden energy disruptions with deep economic and political effects;
- from changes in fiscal regimes, changes in tax regimes, royalties, contractual schemes in export country which might affect price and supply;
- that energy might be used as a political weapon;
- that the price/energy might be used to punish/rewards, or as a mean of extortion/manipulation;
- of changes in foreign regulatory framework, environmental/social safeguards which might affect price and supply;
- of exposure to political decisions, ex. energy subsidies, and conditions of turmoil and social unrest in neighborhood countries;

- of exposure to the Rule of Law and changes in the business environment in neighborhood countries;
- of being left with stranded assets/investments, and huge switch costs to alternative energy sources in the short term;
- of being left with a disrupted energy system, with all the economic, social, environmental and political consequences that comes when a sudden disruption in energy supply happens.

A well-crafted energy policy for an importing country must properly asses the benefits, the costs and the risks of being an energy import dependent country, and that should be done comparing with a scenario where the country has access to more diversify energy source, by gaining access to regional and/or global markets, or by developing native energy resources/sources. The advantages of each business model will depend on the costs and risks involved in each of them.

Risk on Energy Integration for an Export Country

Also as we have seen some idiosyncratic risks that should be assessed from an energy importing country, there are also some specific risks, idiosyncratic risks, which should be accounted for from the perspective of an exporting country. A country that exports energy to neighborhood countries will be exposed to its own idiosyncratic risk, as it depends on other nations choices, where its revenues will depend on other nations, and this situation, if technically possible, should be confronted with the possibility of having access to more diversified energy markets by gaining access to regional or global energy markets to sell the energy. Thus, an exporting country need to secure a market and a stream secure of revenues, where among the main risks it might face are:

- on revenues stream, government revenues, and its impact on social and political stability, what also can be more intricate because of the challenge regarding revenue management and the presence of energy subsidies;
- of being left with stranded assets because of a reduction or a switch in

demand to substitute energy sources;

- of opportunistic behavior (principal-agent problem) where the importing country can ask to renegotiate energy prices and contract conditions after the infrastructure has being deployed;
- of price instability or price extortion/manipulation by importing country;
- of changes in tax regimes, royalties, contractual schemes in import country which might affect price and demand;
- changes in foreign regulatory framework, environmental/social safeguards which might affect price and demand;
- demands from local/national civil society/communities that expects a share from energy rents.

On a related aspect, we also should account for the risks that comes with energy integration when energy has to cross through a third country, a wheeling country, as there is extensive experience with NG and oil imports in the EU and the instability that exist in Russia, the Middle East, Caucasus, the Caspian Region, and Ukraine.

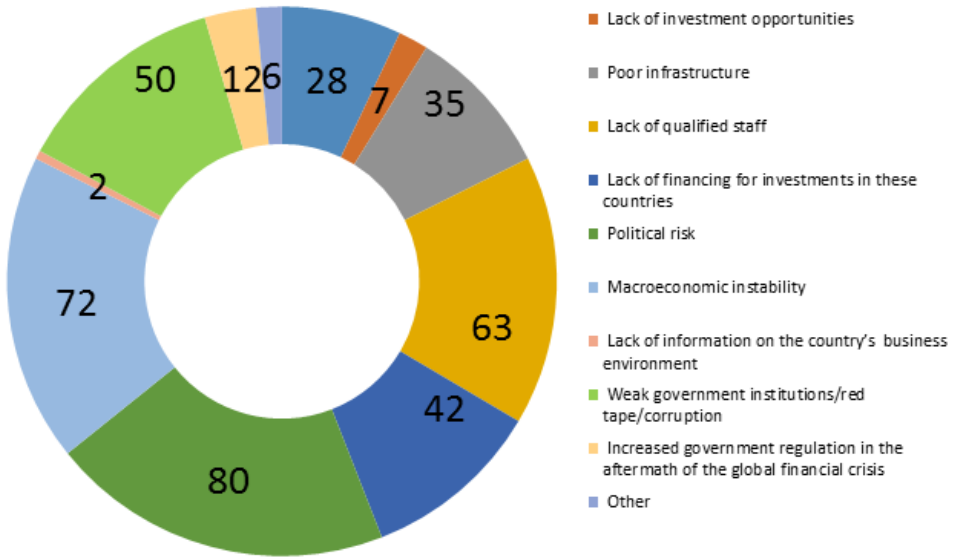
Investors` Risk Perception

The Multilateral Investment Guarantee Agency (MIGA) of the World Bank Group, with the Economist Intelligence Unit (EIU), have collected investors opinion regarding the main risk that foreign investors face in developing countries (Figure 14).[18] The issues that received the largest number of mentions, in descending order by the number of mentions, are:

- Political Risk
- Macroeconomic Instability
- Lack of qualified staff
- Weak government institutions, red tape and corruption
- Lack of financing for investment in these countries

18 World Investment and Political Risk Report 2013, 2012, 2011, 2010.

Figure 14: Main Constraints to Invest in Developing Countries
Main risk foreseen in the next three years



Source: MIGA WIPR report 2010-2013, MIGA-EIU Political Risk Survey

As this survey underline, for foreign investor in developing countries, the main risk that they face talks about political risk, macroeconomic instability, lack of qualified staff, lack of government capabilities, red tape and corruption, which all are present when we analyses energy integration.

Is there a Consensus that Energy Integration Would Enhance Energy Security in Latin America?

From a technical point of view yes, we already have identified potential benefits that LAC can achieve by the integration of its energy systems, with benefits accrued at the countries` and regional level. However, from an energy security/geopolitical perspective we can't assure that there is a consensus that energy integration would enhance energy security in LAC countries. There is some recent history of fails, and there is a wide diversity of views, diversity of views on development models, on the role of the private and public sectors, and State Own Enterprises (SOE) within the region. Also, there exist a diversity of views on the distribution of energy resource rents,

on who takes the responsibilities of energy shortage and how to prioritize energy consumption, on energy prices for the internal and external markets. Also, there is some evidence that the region might have suffered some degree of resource course, where a twisted competition has existed to capture of energy resources rents, and on how to allocate/use of those rents. Recent history of unilateral changes, by the use of energy as a tool of geopolitical power an as an arm of political coercion, to achieve other objectives of national/political interest, locally, within the region or with energy partners, have not been unusual in the region. And, all these have happened besides the great business opportunities that energy integration brings to the region, and the great potential to create wealth and improve people's living conditions. Nevertheless, as of today most of the potential benefits of energy integration have not materialized and as long as trust issues are not clear up, those opportunities will not materialize. SIEPAC provides a success example of multilateral energy integration, SINEA looks to be in the right track, large binational hydropower plants provide success models of binational integration, and international power lines and NG pipelines provide good examples of the opportunities and risks involved when for success and un-success energy integration projects.

Which are main Challenges on Regulatory Convergence/ Harmonization?

The convergence/ harmonization of regulatory framework needed within SA will depend on the level or degree of integration planned. There are different layers of energy integration, the simplest one is physical, which may allow for the commercial exchange of energy, surpluses of convenience, to face short term energy deficits as might happen in the power sector, or recent NG exports from Chile to Argentina; a second layer might be the creation of a unified regulatory regime and market that governs energy trade at the level of the infrastructure being deploy in the bilateral/multilateral energy integration project initiative, but without touching domestic markets; while a more complex, is one that requires the unification of the regulatory regimes and energy markets, which might allow for an integrated operation of the energy systems within a single market. For example, today the EU is working on

the construction of a single electricity market, which requires a high degree of regulatory convergence and harmonization of regulatory and operational models. Although, for commercial or convenience power exchanges, a much lower level of regulatory convergence is required, where its need to agree on the quantity of energy exchanged, its price, and under what conditions, with firm or interruptible contracts. Additional, depending on the type of electricity interconnection, synchronous or asynchronous, the degrees of technical coordination and coupling of the electric systems differs, where with an asynchronous interconnection (HVDC line) the instability or perturbations that might occur in one system are not copied to the other, making the exchange of electricity much easier to manage. For NG exchanges, the technical issues are much simpler, and the need is to agreeing the volume of NG exchange, its price, and under what conditions. The integration of the energy systems of the different countries should be done gradually, adding, as the knowledge and understanding of the system improves, and as the trust between the countries is constructed, higher layers of complexity, where the final objective should be to have an integrated energy market, in electricity, NG and other fuels.

For binational energy projects, such as the Itaipú, Yacyterá, or Salto Grande hydropower plants, a singular agreement (ring fencing) was required for the development and exploitation of the joint energy resources. This business model dos not need necessarily the integration of the systems, and can be managed by a special agreement. The model used for the development of binational energy projects can also be a model for the development of projects in foreign territory dedicated to export, such as the Bolivian Cachuela Esperanza and El Bala hydropower projects to export electricity to Brazil.

In LAC there are different degrees of energy integration. In SA we have witnessed a physical integration, which allow for commercial electricity exchanges on across the border power lines, power exchanges for convenience, and exports/imports from binational projects, where none has required the harmonization of the countries regulatory models. Electricity integration, has work without the creation of a single market, and reaching to that state will require much higher layers of coordination and agreement between the countries, further agreements on the business model, on the role of the State, the private sector and SOE. In binational projects, as Itaipú, secure contracts and agreements between the governments have been signed and ratified by the parliaments, what has provided for a fertile ground for the success of these

projects. For NG, and from a technical point of view, integration becomes is much easier than in the electric case, because it does not carry the day to day, minute to minute, and second to second, complexities that entail the operation of large power systems, in terms of stability, frequency, peak load, ramp up, backup capacity, etc… NG trade has to be agreed between the governments and the private sector, what are the business conditions, volumes and prices under which NG exports/imports will be approved, and what to do in situations of NG shortage. In Central America, SIEPAC has proven to be a more structured electricity integration, being constructed around a 230kV transmission line and the regional electricity marker (MEM).

An important issue to account in an energy integration project have to say with issues of energy security and operational safety, an aspect that has to be embedded on the government agreements according to the layer of integration that is achieved:

- exchanges of opportunity;
- energy exports;
- binational energy projects;
- swap and wheeling;
- firm or interruptible contracts, and the managements of energy shortages;
- coordinated operation, centrally managed/dispatched or market driven (oil and gas versus electricity synchronous or asynchronous interconnections);
- single or independent markets.

Where, available energy resources need not be at risk in the short term, and must provide a safe environment for the importing country that mimics a scenario of energy independence. Too, the impacts of energy integration should be analyzed in terms its effects on the behavior of national and international companies, their impact on the markets, and on the positive and perverse incentives that might emerge in one country/company to freeride on other countries`/companies' energy security

Thus, to move forward on the energy integration of LAC energy systems, there is no need from the beginning to have a harmonization/convergence of the regulatory systems, and that can be developed by steps as the levels of

physical integration advances, and the knowledge and understanding of the operation and markets of a multilateral energy system improves. And what is needed, is to reach a trustable compromise/agreement on the what, the where and the how (single or independent markets) on energy integration. Thus, the main challenge is to create an environment of trust, to compromise/commit and to deliver on the what, the where and the how.

Requirements for a Positive Agenda on Energy Integration.

In the last decade LAC has achieved important success by reducing the poverty levels, increasing the number of people that belongs to the middle class. These, in hand with population growth, has led to a large increase in energy demand, the energy that is needed to fuel economic growth as well as the one that is needed to close the gaps on energy access. As LAC countries` energy systems are getting bigger and more integrated, plus the abundance of RE and FF resources with great complementarities in the region, emphasize the great benefits that can be achieved in LAC if a proper integration of the energy systems is set in place. Adding on these benefits, in the last decade a new regional map of energy sources, for RE and FF, has been reshaped in LAC redefining the energy landscape. Innovations has unlocked new sources of energy, NCRE, shale/tight oil and shale/tight gas, which has enlarged the energy sources across the region, and where the potential of the new sources of energy have provided to an evener distribution of energy resources within LAC countries`. Too, investments in energy infrastructure, such as LNG terminals, and a larger integration inside of the countries of their energy systems, has contributed to improve energy security and increased the countries energy independency, as is in Chile, Brazil and Argentina, where all provides for a better ground to advance in the integration of LAC energy systems.

Within this renew scenario, the integration of the countries` energy systems should recognize the particular characteristics and layers of harmonization required on each stage/project:

- commercial energy integration, where the countries exchange surpluses to cope with short term energy shortage;

- binational energy projects as the Itaipú, Yacyretá and Salto Grande hydropower pants, where countries compromise financing, energy resources/ infrastructure to cope with the energy needs of other countries;
- projects in foreign territory dedicated to export, as can be the Bolivian Cachuela Esperanza and El Bala hydropower projects to export electricity to Brazil, or the geothermal power plant Laguna Colorada to export electricity to Chile, where a specific treaty can be work to compromise energy resources over a long period of time to satisfy the energy needs of other country,[19]
- integration of energy markets, something where SIEPAC has achieved with some success, while SA is lagging behind and where SINEA seems to be in the right track for a physical integration;
- wheeling or transit of energy in a third country, what requires pre-establish free transit policies and tariffs, with the guarantee that the wheeling country will not uses its position as an arm of geopolitical power.

Energy integration within the SA region should move with a firm foot and by stages, as it has been the EU experience. First, comes the physical integration, second the creation of a market taking advantage of the infrastructure installed for energy integration, third a regulatory harmonization, and finally the integration of the markets to have single market. It must move forward accounting for the characteristics of the particular project, recognizing the different risk that comes with energy integration, and adopt tools that mitigate those risks, creating a system that is resilient to changes in global and regional energy markets, civil society and climate change issues, as regional politics can affect the nations interests. As the number of links increases, the need will mandate the necessity to advance to more complex layers of integration, from commercial exchanges through physical connections, to wheeling and transit, up to the creation of a single market. For binational projects, or projects in foreign territory dedicated to export, they can be managed by bilateral treaties with proper measures that mitigate the risks. There is a need for a resilient business model, where independence and security are not at

19 Brazil and Peru have a Treaty to the construction of hydro projects in Peru for export for export to Brazil. But, this process has not moved forward and seem to be paralyzed.

risk, with clear roles to be played by the governments, SOE, private companies and, where financing mechanisms and risk mitigation measures should be put in place, where the engagement of multilateral development agencies (MDA) such as the World Bank Group, IADB, or CAF, can greatly enhance security and improve trust.

The key challenges for energy integration are not technical, they are more on the political side, where the first objective is one to overcome mistrust; and, without compromising energy security, the need is to share the benefits of a more efficient development, the need to have well- crafted agreements between States, transparent pricing policies for internal consumption as well for exports, an appropriate mechanism for dispute resolution, pre-establish free transit policies, pricing and development of transport systems, and a clear role of international organizations and multilateral development banks as enablers of secure agreements within the states.

The Way forward

LAC is advancing at firm foot with the integration of its energy systems, is a path that need perseverance and commitment from the governments, and today appears to exist a more unified understanding on the roles of the State, the private sector, SOE and MDA. Where the greater abundance of energy sources in the region, in terms of RE and FF, provides a better ground to advance in the integration of LAC energy systems. Even though there have existed many multilateral initiatives in the region which have promoted a larger energy integration in LAC, the results have been very poor. Today, SIEPAC provides a leading example of multilateral energy integration in the region, and SINEA seems to be in the right path. CAN and the Pacific Alliance are playing important roles to achieve a larger integration of the energy and electric systems of Colombia, Ecuador, Peru and Chile, with Bolivia as clear future member of this initiative. Also Brazil is playing an important role with a strong voice calling for a larger integration of LAC energy systems, but at the same time with strong interest to advance in bilateral alliance which can fruitful enable the development of large binational energy projects or of projects in foreign territory dedicated to export, where it has working agendas with Bolivia, Peru and the north arc of SA that is the Guyana's and Surinam.

On these agendas, there is an important role for MDA as enablers of trusted agreements, of the needed financial resources, and guarantees of what is agree.

The main do list to advance in the energy integration of LAC is to have well-crafted and resilient agreements between States; clear roles as enablers of the agreements, on the what, the where and the how, and by leveraging financial resources and guarantees played by MDA; the construction/adoption of a robust dispute resolution mechanism. Where all of this should sheltered that the public goods problem of providing energy security is properly managed, and that there is an enabler framework that brings the required level of investments to bring the sufficient energy resources that are needed in the system to cope with the countries energy demand.

But, the biggest challenge is to build trust, to have confidence, confidence that energy will not be used as a political tool or as an arm of geopolitical power, and that the countries will be rid from populist policies that jeopardize investments and with it energy supply. As LAC experience has shown, importing countries should securer them self that they have an antidote to not be exposed to the use of energy as a political tool or as an arm of geopolitical power.

References

British Petroleum (2016), Energy Outlook.

CIER (2015), Síntesis Informativa Energética de los Países CIER.

CIER (2016), Síntesis Informativa Energética de los Países CIER.

Empresa de Pesquisa Energética (2009). Balanço Energético Nacional 2009: Ano base 2008. Ministério de Minas e Energia do Brasil.

Energy Information Administration (2013). Basins with assessed shale oil and shale gas formations.

EPRSIEPAC (2016). SIEPAC Empresa Propietaria de la Red.

Hydropower Association Ltd. (2016). 2016 Hydropower Status Report.

Inter-American Development Bank (2013). Rethinking our energy future.

Inter-American Development Bank (2014), Lights On? Energy Needs in Latin America and the Caribbean to 2040. Lenin H. Balza, Ramón Espinasa, Tomas Serebrisky.

International Energy Agency (2014), World Energy Investments Outlook.

International Energy Agency (2015), World Energy Outlook (WEO).

Juan Jose Carrrasco (2015), PPT presentation CIER.

MIGA (2016), World Investment and Political Risk Report for the years 2013, 2012, 2011, 2010.

Ricardo Raineri (2007), "Chronicle of a Crisis Foretold: Energy Sources in Chile", IAEE Newsletter, International Association for Energy Economics Newsletter, pg. 27-30, Fourth Quarter 2007.

Ricardo Raineri, José Goñi, Isaac Dyner, Nivalde Castro, Yris Olaya and Carlos Franco (2013). Book "Evolution of Global Electricity Markets: New paradigms, new challenges, new approaches" by Elsevier, edited by Fereidoon P. Sioshansi, Menlo Energy Economics, Chapter 14: "Latin America Energy Integration: An Outstanding Dilemma".

United Nations (2015), Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2015 Revision. New York: United Nations.

World Energy Council SER (2010).

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