

**ITAIPÚ POST-2023:**  
Strategic Investment for Paraguay's Sustainable Development

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# INTRODUCTION

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Itaipú Dam was responsible for a massive transformation in Brazil and Paraguay, spurring economic growth in the 1970s and 1980s construction boom, providing electricity to fuel industry in São Paulo and Rio de Janeiro, and developing human capital in both countries. The dam once again has the potential to be a game-changer in Paraguay.

For this policy brief, we first analyzed the situation of Itaipú Dam and hydroelectricity in Paraguay with an eye to questions of economic and social development in order to then identify particular, context-situated, challenges. Per the standard expectations for policy analysis, our research methodology required that we rely upon publicly available, published information. Based on the Paraguayan context challenges, opportunities, and needs, we then explored actually-existing sustainable solutions worldwide that served as models for what Paraguay could do in order to leverage Itaipú Dam for growth that is ecologically and economically sustainable, politically viable, equitable, and inclusive.

The purpose of this text is to open conversation, not to be the final word. While our target audience is policy decision-makers, we believe that this document and the issues therein should be of interest to other sectors in Paraguay as well, including university students (and their professors), the business and start-up sector, NGOs, and Paraguayan civil society. Because we expect that our primary audience is familiar with Paraguay, we begin directly with Itaipú Dam and include the macro-context only briefly.

A note on language: though this discussion draft is first being disseminated in English, it will soon be available in Spanish and we anticipate its translation to Portuguese as well. In part, this arises because the authors are based at Duke University in the United States. But it is also the case that we are convinced that the lessons learned from Paraguay will have implications for water management and sustainable growth worldwide. And so, we hope that members of the international community will find content of interest in the text, too.

Support for this research and writing came through the generosity of the Duke Center for Latin American and Caribbean Studies, the Duke Brazil Initiative, the Duke Energy Initiative, and the Franklin Humanities Institute-Global Brazil Lab. The positions expressed in this brief are representations of the authors' only and not these organizations' positions. We thank the dozens of Paraguayans who lent their expertise and opinions to this working draft. We thank faculty experts at Duke and engaged undergraduate and graduate student audiences who dialogued on the finer points of energy and economics. And we especially thank the young people of Paraguay, who inspired this project. Aguije.

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# ITAIPÚ POST-2023: Strategic Investment for Paraguay's Sustainable Development

In 2023, important parts of the Itaipú Binational Hydroelectric Dam Treaty (Brazil-Paraguay), which governs the largest dam in the world, will be renegotiated. This presents a broad range of challenges and opportunities for Paraguay, including energy strategy, national and international politics, economic disparity, and environmental impacts. Because the central issues in these negotiations are all pressing global concerns, the outcomes have the potential to steer sustainable development not just in Paraguay, but around the world.

## CONTEXT: Paraguay leads in renewable energy

### SOUTH AMERICA IS THE WORLD LEADER IN RENEWABLE ENERGY GENERATION

Nevertheless, Paraguay stands apart in the use of renewable energy: all of its electricity is generated from renewable, non-fossil fuel sources.

### REVENUE FROM ITAIPÚ PROVIDES SUBSTANTIAL INCOME TO THE PARAGUAYAN GOVERNMENT: US\$650 MILLION IN 2016

Today, nearly US\$2 billion of the dam's US\$3.5-4 billion energy sales goes to its creditors every year. But in 2023, that debt will be paid off, leaving US\$2 billion, or US\$1 billion each for Paraguay and Brazil, up in the air.

### BRAZIL USES MOST OF ITAIPÚ'S ELECTRICITY, INCLUDING THE MAJORITY OF PARAGUAY'S SHARE

Itaipú Dam, which Paraguay co-owns with Brazil, supplies almost all of Paraguay's electricity. Paraguay's needs do not consume its half of the massive dam's energy: 20% of Paraguay's share goes to Paraguay. The rest is sold to Brazil, which gets ~17% of all its electricity from Itaipú Dam alone.

### THE RENEGOTIATION OF THE TREATY RAISES URGENT QUESTIONS

- How should the tariff be calculated once the debt is paid off?
- What will jumpstart sustainable growth: a lower cost for electricity or more government revenue invested in social and economic development?
- Will Brazil seek a lower price for Itaipú electricity?

# FINDINGS:

## Challenges and Opportunities

### RENEWABLE ENERGY IS NOT PERMANENT

Itaipú's ability to generate electricity and income is viewed by many as perpetual. Revenue from the dam pays significant government expenses, in place of taxes, a trade-off between short-term benefits and long-term democratic resilience. However, wear and tear and river siltation will ultimately render the dam inoperative, in the next 100 to 150 years. When that occurs, Paraguay will need to replace both the energy and the income from the dam.

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### MONOPSONY

At present, the only viable market for Paraguay's share of Itaipú energy is Brazil. Because of treaty stipulations, infrastructure, and demand, Brazil wields lone buyer (monopsony) power in the dam. And Brazil has new hydroelectric dams in the works and natural gas agreements with neighbors Bolivia and Peru, all of which may compete with Itaipú. If Brazil were to find a different source for the energy it buys from Paraguay, Paraguay could find itself with a large surplus of energy that is hard to sell.

### CONSUMPTION VS. JOB-CREATION

Electricity consumption is on the rise in Paraguay, but much of that increase has gone to the residential sector, rather than job-creating industry. If more of Paraguay's surplus energy were devoted to industry, it could be invested into spurring an energy transition and sustainable economic growth, rather than simply consumed. But the window of opportunity is finite. If current demand patterns continue, Paraguay's market will soon consume all its surplus electricity, and the opportunity to invest it in industry will be lost.

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### FLEXIBILITY

The longer the status quo persists, the more entrenched current systems and patterns will be, and the more difficult a transition to a sustainable solution will prove. Paraguay's important advances in the National Fund for Public Investment & Development, the Fund for Excellence in Education & Research, National Energy Policy, and National Development Plan are a crucial, but not sufficient step. Paraguay has the most room to maneuver now.

# RECOMMENDATIONS:

## Sovereignty, Institution-Building, and Capacity-Building

**Public Communications Strategy:** To inform the public, solidify democratic engagement, and generate support for alternate solutions. Paraguay's most valuable resource is a knowledgeable, empowered citizenry.

**Strategic Investment:** Itaipú financial benefits should be strategically invested because they are a finite and limited resource. We urge the establishment of a Natural Resource Fund with an anti-cyclic fiscal policy and expenditure rules.

**Itaipú Technology Park as Business Incubator and Accelerator:** Create environmentally-sustainable industry and innovative development with the dam's surplus energy under the rubric of public investment in research.

**Strengthen Energy Sector:** To consolidate better democratic governance and avoid the monopsony trap, establish an independent Ministry of Mines and Energy and diversify via energy integration.

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Itaipú Post-2023: Strategic Investments for Paraguay's Sustainable Development (Full Discussion Draft) contains assessments and recommendations in greater detail. Duke University's team will be in Paraguay from June 6 - June 17 to present and discuss these recommendations. Contact us at [Itaipu2023@duke.edu](mailto:Itaipu2023@duke.edu) with more questions.

Sources Cited: Belt, C. et al (2011). *Situación de Energías Renovables en el Paraguay*. Deutsche Gesellschaft für Internationale Zusammenarbeit. Energy Information Administration, U.S. Department of Energy. (2017) *International Data*. Washington D.C. Folch, C. (forthcoming) *Hydropolitics: Sovereignty, Energy, and Itaipú Dam*. Viceministerio de Minas y Energía, Paraguay. (2016) *Balance Energético Nacional 2015*.

# 1. OVERVIEW

## 1.1 ITAIPÚ BINATIONAL DAM BASICS

The governments of Brazil and Paraguay commenced the unprecedented joint Itaipú Dam project in the 1970s, which now generates more electricity than any other power plant on the globe. Last year, Itaipú singlehandedly supplied 16.8% of all the electricity consumed in Brazil and 75.6% of Paraguay's electrical demand (Itaipú Binacional, 2017:25). **The mega dam is owned in condominium with the two countries as legally equal partners**—by treaty, half of the dam's 20 turbines belong to Brazil, half to Paraguay. In practice, however, the asymmetries between the giant of South America and one of the region's smallest countries are also reflected in the electricity distribution, in the energy sales and finances of the dam, and even in the physical infrastructure of the dam.

Construction of the run-of-the-river hydroelectric dam commenced in 1974; the first turbines began generating electricity in 1984; energy sales commenced in 1985. The 18th turbine was brought online in 1991 and so, 1992 was the first year that Itaipú Dam operated at its full planned capacity. In 2006 and 2007, two additional turbines were added to the dam, one Brazilian, one Paraguayan, raising Itaipú Dam's installed capacity. As a sui generis binational entity, the dam is governed by the Itaipú Treaty (Brazil-Paraguay), which was signed in April 1973 and structures every aspect of the dam, including governance, electricity distribution, and energy pricing. Since that time, the energy pricing and distribution have been set by the Itaipú treaty, agreements which are set to change in 2023, the 50th anniversary of the treaty.

The binational dam requires a sophisticated balancing act in order to respect the sovereignty of the two countries. Itaipú Dam was designed as an autonomous legal entity, co-owned and capitalized equally by the two national utility companies of Brazil (Eletrobras) and Paraguay (ANDE). As a separate legal entity, Itaipú Dam is not subject to the National Comptrollers of either country and its finances do not appear on either country's ledger. Two binational boards with equal numerical representation from the Brazilian side and the Paraguayan side administer Itaipú Dam: the 12-member binational Supervisory Board (which includes the presidents of Eletrobras and ANDE) sets long-term planning; the 12-member binational Executive Board of Directors functions as a C-level board in the day-to-day management of the dam.

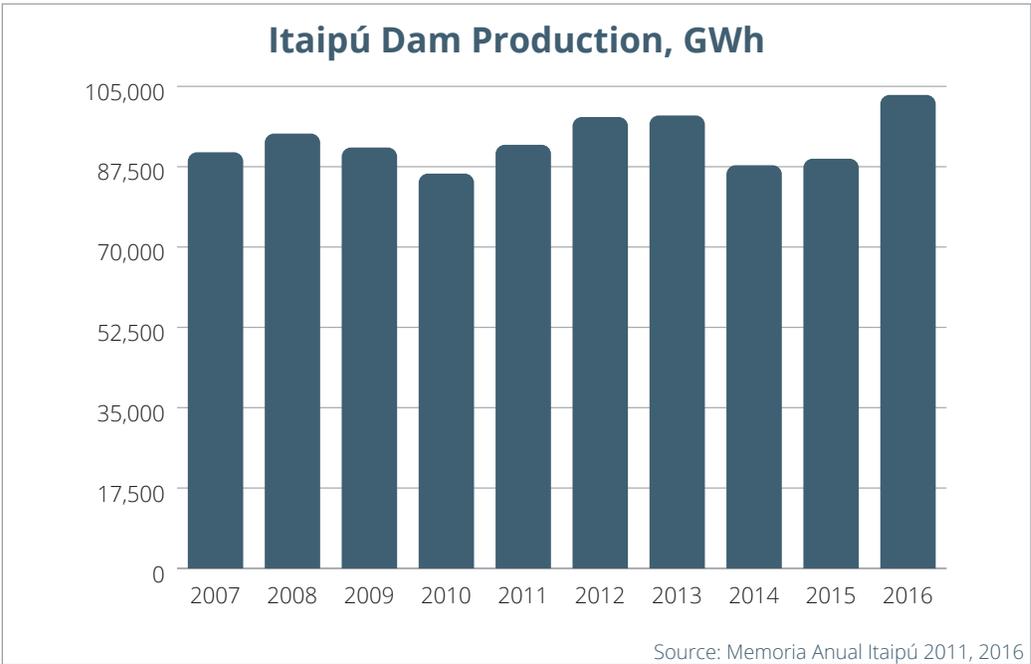
### 1.1.1 PRODUCTION

Itaipú Dam is the world's largest dam in terms of energy production, producing an average of 93,220 gigawatt hours annually. Per the treaty, all of the electricity produced must be purchased by ANDE or Eletrobras, ensuring the financial viability of the dam by assuring a market. Unlike barrels of oil or tons

of coal, hydroelectricity cannot be stored and has to be consumed as it is generated. In 2016, Itaipú shattered world records by producing more than 103,000 gigawatt hours of electricity. Although Itaipú has an installed capacity of 14,000 megawatts (twenty 700 megawatt rated turbines), per an agreement between Argentina, Brazil, and Paraguay, at any one time only 9 Brazilian and 9 Paraguayan turbines are to be in operation, limiting the operating capacity of the dam to 12,600 megawatts (Acuerdo Tripartito, 1979). For the sake of contrast, Three Gorges Dam in China has a greater installed capacity (22,000 megawatts), but produces less electricity than the Brazilian-Paraguayan Dam two-thirds its size. Itaipú Dam regularly sets and then breaks the world record for energy production.

As the country with sufficient demand, Brazil consumes the majority of the energy from Itaipú Dam, including most of Paraguay's "half" of the electricity. In 2016, 89% of Itaipú production supplied 16.8% of Brazil's demand in 2016, powering industrial centers in Curitiba, São Paulo, and Rio de Janeiro (Itaipú Binacional, 2017: 25). In the same year, Paraguay used 11% of the dam's production (21.9% of its half), which supplied 75.6% of the national demand. Paraguay also draws electricity from Yacyreta Dam (co-owned w/Argentina) and Acaray Dam (100% Paraguay owned).

Per the original feasibility studies, Itaipú Dam has a "guaranteed" production of 75,170 gigawatt hours annually. But because of the efficiency of the turbines (which were slated to run at 700 megawatts, but regularly run at 740, 750, or 760 megawatts) and because of the reliability of the Paraná River (which does not experience the same seasonal variation as the Yang-tze River and which is well-regulated because of the presence of 40+ up-river dams), **Itaipú Dam also generates substantial amounts of "additional energy."** In fact, the regulation of the Paraná River in 2016 ensured that the river possessed 29% more water that year than in either 2014 or 2015, leading to the record breaking production (Itaipú Binacional, 2017:18).



Itaipú's average annual production is enough to meet nearly 19% of Brazil's demand, 33% of the state of California, or 7 Paraguays (California Energy Commission, 2016:1; Itaipú Binacional, 2017:25). Eletrobras makes annual contracts to purchase 93% of the guaranteed capacity, which it distributes via Furnas and Copel. ANDE makes annual contracts to purchase 7% of the guaranteed capacity, which it sells directly to Paraguayan consumers. Initially, the additional production was divided under the same proportions as the guaranteed electricity. But in 2002, this was adjusted to 50/50 (Parlasur, 2008). Additional energy megawatt hours are a consistently significant portion of Itaipú Dam's production, but the vast majority is still guaranteed energy. Of the 102,335 gigawatt hours Itaipú supplied to ANDE and Eletrobras, 75,170 gigawatt hours (or 73.5 %) was in the form of guaranteed electricity and 27,165 gigawatt hours (or 26.5 %) was additional electricity.

In sum:

- Paraguay uses a little more than 2 turbines (out of 10) worth of Itaipú electricity to power almost all of its needs.
- Today, Paraguay enjoys a substantial energy surplus in the binational dam and in its installed capacity overall.
- But economic growth and increased domestic consumption of electricity decrease that surplus every year.

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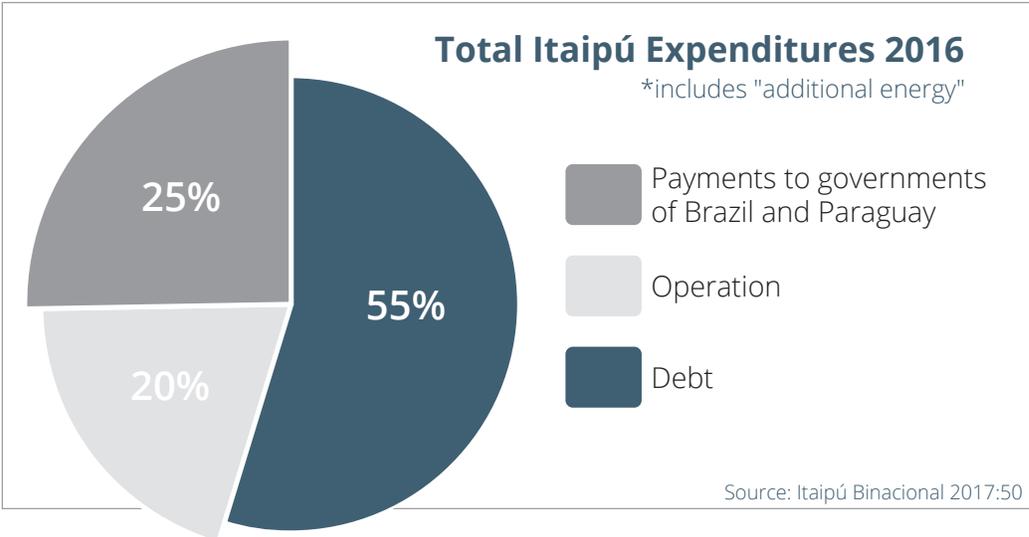
## 1.1.2 ENERGY SALES AND TARIFF PRICING

Two important principles govern the finances of Itaipú Dam: financial equilibrium and prohibition from profit. Thus, the energy tariff is calculated based on expenses, not by the market and not by the value of the electricity nor the value of the water nor the value of the dam. Itaipú Dam energy sales run between US\$3.5 - \$4 billion annually. Since 1973, Itaipú has operated in the neutral currency of the U.S. dollar, though its capitalizers and electricity vendors Eletrobras and ANDE operate in their national currencies (Cruzeiros and then Reales for the former; Guaranies for the latter). Notably, although ANDE is still 100% government owned, in the mid-1990s, Eletrobras was partially privatized.

Because the majority of the electricity generated by the dam is purchased by the Brazilian utility company, the majority of the income of the dam comes from the Brazilian consumer. Correspondingly, the Paraguayan government receives additional compensation for Paraguayan energy sold in Brazil. The formula to calculate the base tariff is laid forth in Annex C, Article III of the Itaipú Treaty:

$$\text{THE COST OF ELECTRICITY} = \frac{\text{PAYMENTS TO GOVERNMENTS (BRAZIL \& PARAGUAY)} + \text{DEBT} + \text{OPERATIONS (MAINTENANCE \& PAYROLL)}}{\text{GUARANTEED PRODUCTION}}$$

The expenses of the dam are the costs of exploitation (maintenance, wages, social projects funded by the dam), debt (principal and amortization), and royalties and other payments to the governments of Brazil and Paraguay. The Itaipú base price was US\$43.68 per megawatt hour in 2016, but the average cost per megawatt hour in Paraguay was US\$32.74; in Brazil it was US\$37.80 per megawatt hour (Itaipú Binacional, 2017:49). The reason for the variation is the difference in price between guaranteed production and additional production. Additional energy megawatt hours have a much lower tariff—around US\$5 per megawatt hours—because they do not include the costs of exploitation or the debt. Paraguay purchased 7% of the US\$43.68 per megawatt hour priced electricity and 50% of the US\$5 per megawatt hour priced electricity in 2016. Like the production amounts, the bulk of Itaipú Dam’s energy sales comes in the form of guaranteed energy. Even without the discount that comes from additional energy, the base price of Itaipú Dam electricity is one of the lowest costs per megawatt hour from renewable sources in the hemisphere; both countries benefit from a lower-than-average electricity tariff.



Last year, 60% of the base tariff went to the \$60 billion construction debt, which will be paid off by 2023; 22% covered maintenance and payroll; 18% was transferred directly to the governments (national, departmental/statal, municipal) of Brazil and Paraguay. In keeping with the parity principle, payroll between the two sides of the dam must be on par, even though the cost-of-living and the cost-of-labor in Paraguay is much lower than in Brazil. The 18% must be evenly divided between the two countries, as well. Paraguay thus benefits from higher-than-average salaries, pensions, and money which is circulated through the national economy.

Record amounts of energy sales lead to record-breaking government income. In 2016, the government of Brazil and the government of Paraguay each received US\$240 million in the form of royalties; ANDE and Eletrobras each received US\$18.5 million in dividends and administrative fees. Energy pricing for Paraguayan electricity sold to Brazil also includes “compensation”—a non-market based price that pays for electricity “ceded.” Compensation runs ~US\$9.50 per megawatt hour, or ~US\$368.9 million in 2016, which goes to the government of Paraguay. **And so, in 2016, the government of Paraguay alone received US\$650 million.**

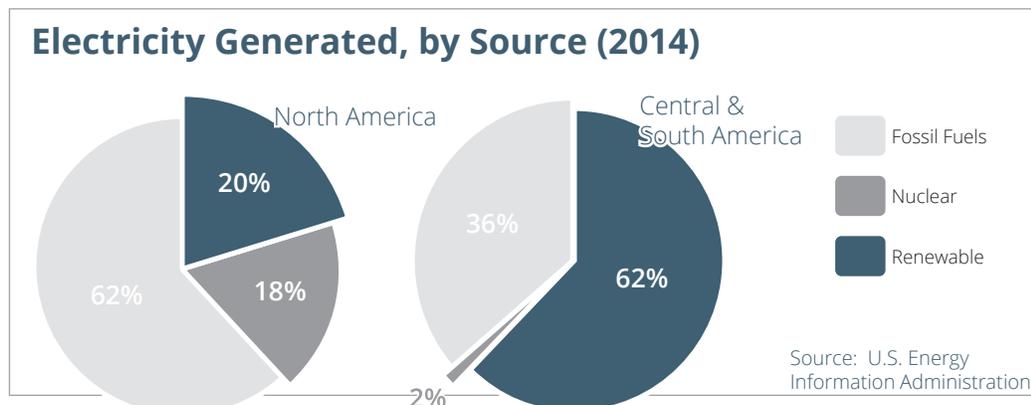
Today, nearly US\$2 billion goes to Itaipú Dam’s creditors every year. And that US\$2 billion a year—US\$1 billion for Paraguay, US\$1 billion for Brazil—is what is in play in 2023. The current tariff formula thus presents a challenge and an opportunity: how should the tariff be calculated once the debt is paid off? Is there a better way to value water and the energy services of the dam? What will jumpstart sustainable growth: a lower cost for electricity or more government revenue to be invested in social and economic development.

In Sum:

- 2023 involves a renegotiation of the energy distribution arrangements and the tariff formula,
- Which will influence what happens with US\$2 billion in energy sales per year.

## 1.2 PARAGUAY ENERGY BASICS

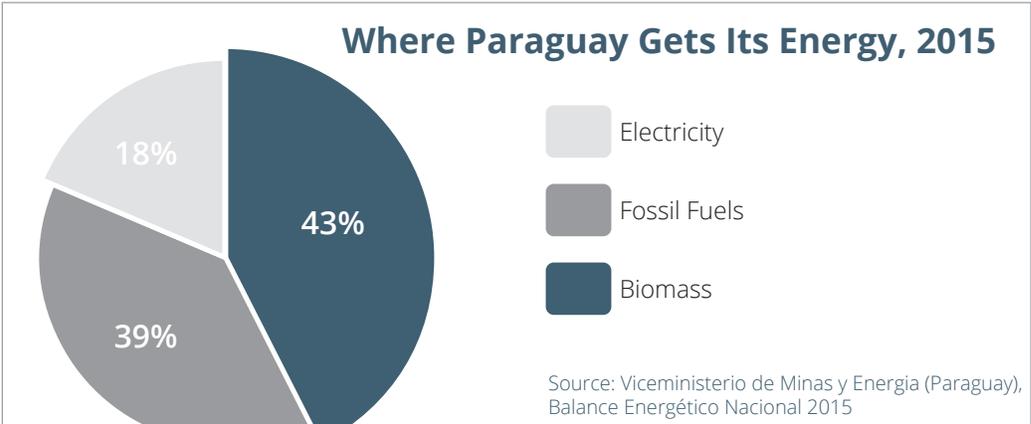
### 1.2.1 GENERAL INFORMATION



South America is the world leader in reliance on renewables for electricity generation; nevertheless, within South America, Paraguay stands apart as wholly reliant on renewable energy sources to satisfy its electric demand. Clean energy powers industrialization in the hemisphere because **nearly 2/3 of the electricity consumed in the region comes from renewable sources.** Even fossil fuel exporters like Bolivia, Brazil, and Venezuela internally depend on hydropower. Paraguay produces enough electricity to not only satisfy its own demand, but to actually export the majority of the electricity it produces to its neighbors Argentina and Brazil. Although Paraguay currently enjoys a significant surplus, the window is closing. Government estimates expect Paraguay to require all its installed capacity sometime between 2023 and 2030 (Secretaria Técnica de Planificación de Desarrollo Económico y Social, 2014:56; Belt et al, 2011:15).

In spite of the importance of energy as a source of international revenue for the government, energy decision-making institutionally takes place in the Vice-Ministry of Mines and Energy, a dependency of the Ministry of Public Works and Communication. For the first time in the history of Paraguay, the government approved a National Energy Policy in October 2016 which sees natural resources as key to “economic growth, industrial development, and social progress” (Decreto 6092). It calls for the establishment of a Ministry of Hydrocarbons and Energy to oversee the long-term coordination of Paraguay’s natural resources and public agencies.

Paraguay’s energy matrix presents several fascinating paradoxes. Paraguay has an electricity surplus and is the region’s largest energy exporter per capita, but electricity only represents 18% of the energy consumed in Paraguay (Viceministerio de Minas y Energia, 2016:19). All of the fossil fuel derivatives consumed in Paraguay, which account for 39% of the energy consumed in the country, are imported and the primary fuel used for transportation or household cooking. Exploration of natural gas deposits in the Chaco region (bordering Bolivia’s natural gas producing Tarija region) has begun, but national production of hydrocarbons remains hypothetical. Biomass is still the most popular source of energy—43%. Paraguay has experienced alarming rates of deforestation due to the expansion of soy agriculture; cleared forests provide wood for charcoal. Biomass is used for residential needs as well as commercial and industrial processes.



## 1.2.2 ELECTRICITY

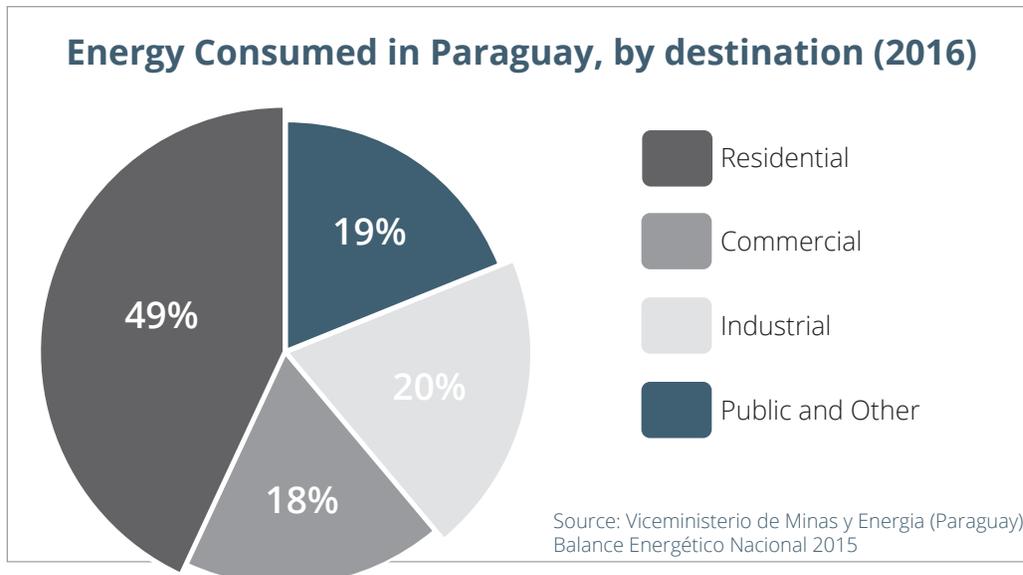
ANDE (Administración Nacional de Electricidad), the national electricity company founded in 1948, is the sole provider of electricity to the country. Paraguay's strong hydroelectric sector possesses 8,800 MW of installed capacity, which is nevertheless impacted by losses in system transmission. The country also has untapped hydroelectric potential on its transboundary waterways and its interior rivers. Three hydroelectric dams provide electricity and/or energy revenue to the country: Acaray Dam, 210 MW (in eastern Paraguay); Itaipú Binational Hydroelectric Dam, 14,000 MW total (co-owned with Brazil, Paraná River); Yacyretá Binational Entity, 3,200 MW total (co-owned with Argentina, Paraná River) (ANDE, n.d.; Yacyretá, n.d.). Like ANDE, the heads of the three dams are presidential appointees. ANDE suffers a high rate of losses in transmission and distribution. Of the 14,189.6 GWh that passed through ANDE in 2015, 3590.1 GWh or 25.3% was lost in transmission and distribution (Viceministerio de Minas y Energía, 2016:17).

### Paraguay's Installed Capacity, MW

Acaray Dam	200
Yacyretá Dam	1600
Itaipú Dam	7000

Source: ANDE

National electricity demand has increased with the economic upturn though it remains well below the current installed capacity of 8,800 MW. Electricity consumption and electricity access mirror the inequality in income and population. As would be expected, urbanites have greater access to electricity than their rural counterparts. In 2014, 99.001% of the urban Paraguayan population had access to electricity compared to 97.747% of the rural population, but "access" does not refer to how regularly available that electricity is (World Bank, 2014). Residential usage makes up the bulk of electricity consumption in Paraguay: 42% in 2015. By comparison, in that same year 23% went to industrial uses, 19% to commercial uses, and 16% to various public uses (including public lighting) (Viceministerio de Minas y Energía, 2016:40). The high economic growth rates of the past decade have sent residential consumption of electricity on a steep ascent. From 2009 to 2015, residential demand grew by 67% (ranging between 5% and 13% per year) (Viceministerio de Minas y Energía, 2016:20). Interestingly, the use of electricity for cooking has not followed the same upward trend: in 2015 9.5% of Paraguayan homes used electric stoves, down from 9.7% in the year before, implying that increased electricity consumption is not displacing biomass and petroleum derivatives for home food preparation or heating (Viceministerio de Minas y Energía, 2016:19).



In sum:

- Paraguay’s energy matrix is a combination of some of the most advanced energy trends (a carbon neutral electricity system) paired with an exceptional reliance on biomass for residential, commercial, and industrial processes.
- According to current trends, Paraguay’s demand will consume its installed capacity by 2030.
- Growth in access disproportionately favors urban centers.
- Most of the growth in electricity consumption has gone to residential and commercial use, not to industry, job creation, or transportation.

### 1.2.3 GOVERNMENT USE OF HYDROELECTRIC FINANCIAL RESOURCES

The Royalties and Compensation from Itaipú Dam received by the Paraguayan government are administered according to the Royalties Law (first established in 1998) and now also the National Fund for Public Investment and Development (established in 2012, better known by its acronym FONACIDE, in Spanish) (Ley 1309/98; Ley 4758/2012). Both the Royalties Law and FONACIDE represent important steps taken by the Paraguayan government to designate metrics and procedures for the financial resources of the dam. The Royalties Law transfers 50% of Itaipú Dam royalties to the central government and 50% to municipalities and departmental governorships (where municipalities affected by the reservoir get 15%, those unaffected by the reservoir get 25%, departments affected by the reservoir get 5%, those unaffected by the reservoir divide up the remaining 5%). By law, municipalities and departmental governorships are required to spend 85% of the Royalties and Compensation on capital expenditures and can direct the remaining 15% to revenue

expenditures, recurring costs, etc. In the past, the 50% that remained within the central government included 10% to national infrastructure, 5% to the Institute for Rural Development, and 5% to support low income housing, but it is unclear what the current distribution is (Decreto 5816, 2010).

[Pulled out side quote: “In some places in the interior [of the country], some municipalities get 40% of their income from the binationals. This is fiscal weakness.”—Paraguayan government energy expert. November 2009]

The Paraguayan government has also put in place new programs—namely, the National Fund for Public Investment and Development (FONACIDE), approved in 2012—to better manage the financial hydroelectric resources. FONACIDE is funded exclusively by a portion of what the Paraguayan government receives in the form of compensation. The exact amount is not publicly available; anecdotal evidence suggests that ¼ of compensation income is transferred to the FONACIDE program (Peralta, 2017). The fund arose because of concern that Itaipú Dam proceeds were directed toward expenses and not toward investment, particularly by local governments. One Paraguayan government energy expert said in late 2009, “There are municipalities where royalties provide half of the budget for the municipality. The municipality isn't self-sustaining. This is fiscal negligence.” The National Fund for Public Investment and Development was designed to address this problem. Among its greatest successes has been its intentional attention to research and education from primary school to post-graduate education.

The National Fund for Public Investment and Development law:

- 28% to the National Treasury for Programs and Infrastructure
- 30% to the Fund for Excellence in Education and Research
- 25% to Departments and Municipalities (of which 50% must go to education infrastructure and 30% to school meals for financially vulnerable communities)
- 7% to the Financial Agency for Development
- 10% to the National Health Fund

The Fund for Excellence in Education and Research has had an immediate impact at the university level, allowing Paraguayans to pursue advanced degrees overseas and financing university-based research within Paraguay. However, of the fraction of Itaipú compensation that is administered by FONACIDE, a minority of that fraction—20%—is destined for public primary and secondary education.

The Royalty Law and the National Fund for Public Investment and Development (FONACIDE) are an important but not sufficient step. Although the laws specify the destination and use of the funds, incomplete transparency and accountability in the distribution of the resources has made it difficult for the National Comptroller’s Office to verify the use of funds. The Royalties law, under which all of the Itaipú royalties (US\$240 million in 2016) and an unknown portion of Itaipú compensation (US\$368.9 million in 2016) are administered, does not provide for regular publicly available detailed audits.

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FONACIDE does provide for publicly available audits, an important step forward, but the reports indicate that there is room for improvement. For example, in the National Comptroller's 2014 audit of the 2013 FONACIDE expenditures, FONACIDE reported that US\$18,275,423 had been disbursed to the Financial Agency for Development and US\$26,107,747 had been disbursed to the National Health Fund (Contraloría General de la República, 2014: 9, 29). Nevertheless, in both instances, after six months of communication with the two recipients, the National Comptroller reported that it had not received adequate accounting of those monies by either the Financial Agency for Development or the National Health Fund (Contraloría General de la República, 2014: 28, 76). The media has played an important role in expressing citizen concerns regarding the quality of services purchased by those funds. A frequent complaint is the physical collapse of new schools built by municipal and department governments with FONACIDE support (See ABC Color, 2014; Última Hora, 2017; Vanguardia, 2017).

Without transparent processes, one concern is that financial resources might be directed to short-term expenses and recurring government costs rather than investment or that the resources are spent in subpar infrastructural projects.

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### 1.3 PARAGUAY GENERAL INFORMATION: MACRO CONTEXT

The Republic of Paraguay (pop 6.6 million) is a middle-income landlocked country in the heart of South America southwest of Brazil, north of Argentina, and southeast of Bolivia. With a GDP of US\$27.09 billion and a per capita GDP of US\$4,728, agriculture and ranching dominate the economic sector of the Spanish-Guaraní speaking country; soy, beef, cotton, and sugar are the chief exports (World Bank, 2017). For the sake of comparison, Brazil has a population of 207 million and a GDP of US\$1.8 trillion (World Bank, 2017). From 2000 to the present, a boom in soy production has transformed the economy and the countryside: GDP rose from US\$8.196 billion in 2000 to US\$27.094 billion in 2015, with a growth rate of about 5% over the past decade—higher than its neighbors (World Bank, 2017). In spite of this growth, Paraguay has a high rates of inequality with a GINI index of 51.7 in 2014 (World Bank, 2017). 22.6 % of the population is poor according to national standards; 2.8% is extremely poor, living on less than US\$1.90 a day (World Bank, 2015).

Although the 406,752 km<sup>2</sup> country approximates the size of Italy or California, it is relatively underpopulated and, compared to other countries in the region, less urbanized. The capital city of Asunción and its surroundings boast a population of 2.536 million; 529,400 live in Asunción alone, making it the largest city in the country (DGEEC, 2015). Ciudad del Este (Paraguay's second financial capital, on the border with Brazil) has 281,400 inhabitants, Encarnación (on the border with Argentina) has 119,300 inhabitants (DGEEC, 2015). Similar to income inequality, the distribution of resources favors urban centers, which lie in its eastern and southern agriculture region bordering

neighbors Argentina and Brazil. The arid Chaco region, which borders Bolivia, is sparsely populated, though the growing Mennonite community has managed to transform the north into the dairy production center of the country. As a founding member of the Common Market of the Southern Cone (MERCOSUR), most of Paraguay's trade is with its neighbors to the east and to the south as it depends on or passes through the Argentine and Brazilian markets.

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## 2. ASSESSMENT: Opportunities and Risks

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Paraguay faces several trade-offs regarding Itaipú, all of which are exacerbated by the 2023 treaty renegotiation deadline:

- Renewable energy is not permanent,
- Electricity has not been directed at job-creating industry, and
- Financial resources have gone to short-term expenses rather than long-term investments.

Among the constraints that impinge upon Paraguay vis-à-vis Itaipú, we highlight the time limitations and the market limitations that will require a sustainable energy transition. While the path of least resistance is the status quo, the cost of maintaining the status quo in the short run is that patterns become more entrenched and therefore transitioning will become much more difficult. Paraguay has the most room to maneuver now.

The long-term costs of inaction however, are much more severe: when Itaipú Dam ceases operations, Paraguay will have an energy deficit and an income deficit.

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### 2.1 DUTCH DISEASE EFFECTS ON ECONOMIC DEVELOPMENT AND GOVERNANCE

**Cost of status quo: uneven economic development and weakened governance.**

Like other countries that experience a boom from the export-oriented production of a valuable resource, Paraguay has experienced some of the negative political economic impacts associated with natural resource dependence as well as the industry-ennervating spill-over effects of “Dutch disease.” A lack of accountability between government and civil society arises when government is able to rely on energy rent for income, not taxes (Overseas Development Institute, 2006).

Ironically, the increase in available electricity does not necessarily translate into an increase in electricity-intensive, job-creating industry. Several factors may contribute to this. One common problem is a “brain drain” or a concentration of talent in one sector to the detriment of other sectors. That is, because of the unparalleled earning potential associated with the hydroelectric sector, it may attract human capital and innovation, such that other areas of the economy suffer a corresponding slowdown. Another common problem has to do with economic distortions from having one disproportionately lucrative section of the economy. The example of petrodollars in oil-producing OPEC states of the 1960s and 1970s illustrates the point: selling valuable resources on the global market strengthens the local currency (especially if the resource is sold in USD, as are barrels of oil). But if economic vibrancy is limited to one sector, the monetary impacts can negatively impact the competitiveness of manufacturing and the economy as a whole. The strengthening of the local currency increases the price of all locally manufactured goods, thus depressing exports, increasing imports, and slowing job creation. And so, without an industrialization plan that actively reinvests resources in the rest of the economy, growth outside of the resource sector stagnates.

In Paraguay, local governments rely upon hydroelectric rent for income (CADEP, 2016). And with the passage in 2009 of an increase in the amount for compensation and royalties, the last few years have seen a dramatic rise in the amount of money available for direct transfer (CADEP, 2017:19). Out of a total US\$250 million that municipal governments received from the central government in 2016, a full 93% came from Paraguay’s binational dams (CADEP, 2017, 20). US\$148 million came from Royalties and Compensation (67% of the grand total distributed to the municipal governments) and another US\$65 million came via FONACIDE (26%). At the same time, the central government transferred US\$34 million via Royalties and Compensation and US\$10 million via FONACIDE to department governments in 2016--21% and 10%, respectively, out of the US\$160 million total transferred by the central government--(CADEP, 2017:20). While municipalities and departments also draw income from a modest local tax burden and from fees for government services, the increased energy rent of recent years has flooded local governments with liquidity. We find that, given the unclear decision-making processes mentioned in 1.2.3, one concern is that the monies might be destined for recurring costs and/or that the capital expenditures paid are not first set out via a development plan (for example, following the National Development Plan 2030). Better financial practices arise when funding follows planning and not the other way around.

OUT OF A  
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IN 2016, A FULL  
93% CAME FROM  
PARAGUAY’S  
BINATIONAL  
DAMS.

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## 2.2 ELECTRICITY INFRASTRUCTURE, ACCESS, AND EQUITY

**Cost of status quo: inadequate to current demand, favors urban and wealthy residents over rural and bottom-of-the-pyramid residents.**

Paraguay's energy consumption has grown between 5-10% for the past several years, severely straining already limited electricity infrastructure. Although Paraguay co-owns the world's largest dam and has a significant energy surplus, inadequate infrastructure results in energy uncertainty. Paraguay lacks the infrastructure necessary to transport and distribute its half of the Itaipú electricity. The Brazilian electricity system has three 750 kilovolt lines (60Hz), two  $\pm$  600 kilovolt lines (dc), and one 500 kilovolt line (60 Hz) leading from the left bank substation, able to distribute the electricity to its world class network. Until recently, the Paraguayan electricity only had four 220 kilovolt lines (50Hz) leading from the Itaipú right bank substation in order to transport electricity to the Paraguayan market. Construction of a 500 kilovolt line (50Hz) connecting Itaipú to Villa Hayes was completed in 2013 and has dramatically improved electricity distribution, but Paraguay's network suffers regular black-outs as it cannot keep up with the growing demand. Moreover, electricity infrastructure still favors urban centers: Asunción, Encarnación (near Yacyretá Dam), Ciudad del Este (near Itaipú Dam and Acaray Dam).

The Vice-Ministry of Mines and Energy has reported that, based on current patterns, Paraguay's demand will grow to require all of its installed capacity sometime between 2023 and 2030 (Beltatal, 2011:15; Secretaría de Planificación de Desarrollo Económico y Social, 2014:56). Once demand reaches capacity, Paraguay may need to turn to either electricity imports (including payment of compensation to the Brazilian and Argentine governments) and/or to relying more upon importation of carbon-emitting fossil fuels.

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## 2.3 INCREASED DEMAND VS. OPERATIVE LIFESPAN OF DAM

**Cost of status quo: Time-limited, finite resources strained and not used strategically**

Renewable energy is not perpetual or permanent. Both the electricity and the energy rent are limited resources with finite deadlines. In Paraguay, electricity from the dam goes to residential consumption, instead of industry or job creation, despite the suggestions of national economists. And energy rent bolsters recurring government expenses rather than long-term development (Alcaraz Gavilán, 2014). Although energy extraction does not drain the source of energy (i.e., the Paraná river is refilled), wear-and-tear due to usage and siltation of the river will eventually render Itaipú Dam inoperative. Estimates published by Itaipú Dam itself range between 100-150 years (Itaipú Binacional Dam, n.d.a:15, n.d.b), although public statements by the leadership of Itaipú Dam suggest a longer time span for both the reservoir and the turbines

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themselves. We find that this technical detail has political, economic, and social impacts which have not been fully considered in public policies regarding Paraguay's hydroelectricity. Paraguay is expected to need all of its installed energy potential to meet its internal demand by 2030. Since Itaipú Dam will also eventually be phased out of production (as will Yacyretá Dam and Acaray Dam), Paraguay will need other sources to replace the energy.

Second, the energy rent from the dam will face at least two disruptive inflection points. When Paraguay begins to use all of its Itaipú electricity, the energy rent proceeds from compensation (electricity sold in Brazil) will cease, which means that government budgets will need to find replacements for compensation-based income. This is a precursor to the larger budget adjustment that will have to come when the dam itself ceases energy production and the electricity tariff no longer provides revenue for the government.

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## 2.4 MONOPSONY

**Cost of status quo: With no other viable market and no pre-set agreement, Paraguay may find itself forced to sell its Itaipú electricity to Brazil for an unexpectedly low price.**

Because of treaty stipulations, infrastructure, and sufficient demand, Brazil exercises monopsony power in the dam. Monopsony—one lone buyer who can effectively set the price for a good or service—is the opposite of monopoly, a situation where there is one lone vendor. And the asymmetry is exacerbated by the specific constraints of hydroelectricity, which must be consumed when it is generated. Per the Itaipú Treaty, only the two signatories are permitted to purchase electricity from Itaipú. Paraguay has to sell Itaipú electricity to Brazil. However, a Joint Declaration (2009) signed by Brazilian President Lula da Silva and Paraguayan President Fernando Lugo called for “an effective regional energy integration that contemplates the possibility that Paraguay and Brazil may commercialize Itaipú energy in third-party markets beginning in 2023,” which suggests possibilities that will be discussed in 4.3 (Joint Declaration, 2010: Item 6).

Electricity markets are often characterized by monopsony dynamics, which may be an efficient solution for the market, but the challenge in Itaipú Dam is binationality (Brennan, 2009). That is, the incentive to demand a low price point for energy may be beneficial to Eletrobras and the Brazilian market; but this comes as a cost for the Paraguayan government in the form of decreased revenue for social expenditures, including expanding electrical infrastructure. For the Paraguayan consumer, a lowered price for Itaipú electricity offers both benefits and disadvantages. Current users of electricity are benefitted; yet given the inadequate electricity access and the need for economic development in the country, lower socio-economic communities would miss out on electrification and job creation, further marginalizing the already marginalized.

As a smaller landlocked country with only three neighbors, Paraguay has little room to maneuver in energy distribution. Paraguay already shares a binational dam with its second-largest neighbor (Yacyretá-Argentina). The infrastructure problems mentioned earlier also complicate the problem of monopsony: Paraguay still lacks all the high tension wires needed to transport its half of Itaipú electricity to its own market, let alone others. The only other networked market is Argentina. Brazil has the infrastructure to transport Itaipú electricity to markets with sufficient demand, both internal and even international (e.g., Uruguay). Recent research also illustrates the concern of switching from an external to internal monopsony (in the recent past, Paraguay debated whether to sign a multi-decade, price-fixed contract with aluminum producer Rio Tinto). A slight adjustment in the status quo might best suit the needs of the Paraguayan government, but a monopsonic situation has been shown to not serve the interests of the private sector, the Paraguayan public, or environmental concerns (Blanco et al., 2017).

At present, Brazil is building hydroelectric dams and geothermal plans (LNG) in both Bolivia and Peru that can replace Paraguay's half of Itaipú, giving it more room to negotiate on electricity pricing in a way that challenges Paraguay's expected revenue (Ministério de Minas e Energia, 2016: 16). Belo Monte dam, under construction on the Xinga River (one of the Amazon's important tributaries), will have 11,263 megawatts of installed capacity and, though controversy has delayed completion, its designers estimate that it will begin energy generation in 2019 (Norte Energia, n.d.).

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## 2.5 INADEQUATE DISPUTE SETTLEMENT MECHANISM

### **Cost of status quo: Reactive rather than proactive posture in international energy politics leaves less room to maneuver.**

The Treaty does not provide a clear mechanism by which to resolve disagreements over Itaipú Dam. Disagreements have been settled via the Governing Council and the Executive Directorate, taking advantage of the close day-to-day interactions built through working in Itaipú Dam. "The solution for Itaipú will come from within Itaipú," was a phrase often repeated to one of this report's authors during interviews with Paraguayan energy sector experts (Folch, 2012). Reliance on the close personal and professional contacts within the Itaipú Dam leadership has resulted in political dynamics that give rise to conflicting political objectives.

Two recent points of conflict resolution illustrate this point. Between 1993-1996, the Supervisory Board and the Executive Directorate were responsible for re-assessing the construction debt, resulting in a raised energy tariff, the dollarization of debt held by Eletrobras, and a cap on the interest rate on debt held by Eletrobras. Between 2008-2009, the government of Paraguayan president Fernando Lugo sought greater parity in the energy pricing and

greater flexibility in energy sales. Many of the adopted resolutions were first proposed and discussed within the Executive Directorate and the Supervisory Board before then being treated between the foreign ministries (Folch, 2012, forthcoming).

While successful, this practice has unintended consequences:

- It replicates the brain-drain problem of the highest human capital concentrated in Itaipú Dam, to the detriment of institution-building in the rest of the Paraguayan government.
- It requires engineering and energy personnel in Paraguay who have dual profiles: sufficient engineering expertise to have worked in the binational energy sector, sufficient foreign policy and/or international finance experience to be able to design the appropriate legal and financial mechanism.
- Proceedings and decision-making processes are less transparent.
- A “double discourse” arises within the Paraguayan public conversation where antagonistic rhetoric operates in civil society and even in some aspects of the government, rather than an integrated, focused strategy.

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## 2.6 PUBLIC PERCEPTION OF RENEWABLE ENERGY

### **Cost of status quo: Public pressure directed away from goals that would better serve public interests.**

Paraguay's public is highly informed about many aspects of the minute details of the dam's financial arrangements (particularly regarding the increase in the Itaipú Dam construction debt, which grew as a result of underpayment in the 1980s and 1990s) and the Paraguayan press has consistently kept seemingly esoteric engineering questions at the center of public debate (Toledano & Maennling, 2013). The result is that there is a lively public conversation about Itaipú Dam and about how energy rent should be re-invested that crosses the political spectrum. By the same token, based on extensive qualitative data (interviews and participant-observation) which has been quantitatively corroborated by coding and content analysis of Paraguay's chief documentary media sources, there are notable gaps in public awareness regarding other key aspects of the financial and technical dimensions of Itaipú Dam, such as:

- Misperception that “renewable” energy is “perpetual” energy. Corresponding assumption that energy rent is an unlimited resource. Assumption that the demand for electricity will increase, as will price. All dams, including Itaipú, have operative lifespans and have a temporal limitation similar to peak oil.
- Governance challenges are known, but the inflationary dangers and economic distortions associated with Dutch Disease are not commonly discussed, much less addressed via development policy.

**A note on gender inclusivity and participation:** We are concerned that a common perception is that energy and engineering are the proper domain of men, rather than both men and women, in Paraguay. Although Itaipú Dam has formed a committee on gender equity, there is more work to be done in this arena. Of the Supervisory Board and Executive Directorate—the two boards that offer senior leadership to the dam—only 1 person out of 24 was female as of June 2017 (to be clear, the female Supervisory Board member was nominated by the Paraguayan president). More importantly, among the Executive Directorate, responsible for the day-to-day management of the world’s largest hydroelectric plant, every single director was male as of June 2017. An examination of the publicly-available list of Paraguayan employees dating to May 2017 revealed that, of the 26 Paraguayan employees listed as “Engineers,” only 2 were female and all of the senior-rank Paraguayan engineers were male (Itaipú Binacional, 2017b). During fact-finding visits and seminar presentations of the findings of this policy research within Paraguay, female members of the Duke research team were told that it was remarkable and surprising that women would be interested in energy matters.

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## 2.7 CLIMATE CHANGE

Climate change adds uncertainty to hydroelectricity. Although other parts of the South American region have been hit with drought—Brazil’s drought in 2014 drove São Paulo residents to drill wells in their homes in order to access water—Paraguay has suffered record breaking floods. Rainfall patterns are expected to shift over the next century; and even if Paraguay does not experience droughts (models have predicted increases in rainfall), upriver drought dynamics in Brazil affect the quantity of water in Paraná and therefore energy generation (Marengo et al, 2012). In fact, regional rainfall in the River Plate Basin (in which Itaipú Dam sits) has increased from 1970 to the present (Depetris, 2007). While more rainfall contributes somewhat to the ability of Itaipú to generate electricity, excess water in the reservoir has to be discharged via the spillways. And flooding would have additional negative impacts on the dam as Itaipú is forced to play more of a role of flood manager rather than electricity generator. Second, flooding increases siltation and sedimentation, affecting the operative life of the dam.

Moreover, though rainfall has risen in the past and is predicted to rise in eastern Paraguay, climate modeling focused on Itaipú and the Paraná River suggests that the expected precipitation will be uneven throughout the year, with drier dry periods and wetter wet periods, which may negatively affect productivity of Itaipú even before its expected obsolescence (Rivarola et al, 2011).

# 3. DIAGNOSTIC:

**Governance Context & Access to Information** - Report by Odette Rouvet, M.I.D.P. (Sanford School of Public Policy)

## *Why does it matter?*

The scholarship on governance has developed sophisticated definitions of what good governance means. For the purpose of this policy brief we will focus on the “thin” concept, coined by Versteeg & Ginsburg (Versteeg & Ginsburg, 2017:9), a balance between the formal procedural rules. The rule of law, on the other hand, has been stated to be “capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, and property rights” (Kaufmann et. al., 2010:4).

Itaipú Dam, in terms of information access and procedural transparency, calls for a reflection on governance and the rule of law. The clear definition of the rule of law, and the governance of the binational dam will not only provide to the Paraguayan society the sense that the decisions made at Itaipú do not have an arbitrary character nor are subject to personalization; it will also represent a new way of providing certainty of the financial responsibility of the dam in Paraguay. In this sense, Itaipú is being looked at under the microscope as an inflection point not only for the improving of governance within the dam, but also as a great catalyst of change within Paraguay by demonstrating the way to have clear cut rules and procedures and strengthened institutionality.

An improvement of governance in Itaipú Dam, specifically in the form of making information publicly available to a Paraguayan public, has the potential to transform Paraguayan bureaucracy and society by serving as a crucial model of better governance. The ripple effect that this can have in connecting business to markets and increasing the spillovers to society sets a precedent for Latin America and the Caribbean in how to use one big financial institution, such as the dam, to catalyze major transformations.

## *How is governance related to Sustainable Growth?*

Sustainable growth needs long-term vision and long-term strategies within a country. Long-term strategies are impossible to establish without the certainty of clear rules and processes. In particular, long-term planning is hindered when there is no certainty regarding the financial management and national planning of public spending and the impacts on human development.

## *Itaipú Public Reporting*

The very heart and core of academic research is that its recommendations and/or findings contribute to the generation and communication of knowledge that can foster good practices. In this sense, the research for this section of the policy brief has focused only on the information that is publicly available on the official Itaipú website. By doing this, we are focusing on what is available to the public within and outside Paraguay. As a result of this approach, here we highlight areas of governance that can be improved.

Itaipú is already an exemplary model of a sustainable business. It has integrated in its core corporate governance several different internationally accepted best practices, such as the Global Reporting Initiative (GRI), the adoption of the Law Sabarnes-Oxley (SOX) for anticorruption practices, a code of ethics, the association with the International Hydropowers association, the ISO for Sustainable Procurement, and a multi-stakeholder approach to the core structure of the interior governance. These practices put Itaipú Dam at the cutting edge of governance and transparency within Paraguay.

Nonetheless, there are areas in the governance that are missing from the public knowledge that are worth highlighting for improvement, such as:

- the social responsibility programs,
- capacity and opportunities training for technical personnel, and
- gender equity components to improve opportunities of female employees in Itaipú.

The Annual Reports presented at Itaipú's website demonstrate the consistency of the energy enterprise's objectives with their actions. There is an opportunity and even a need to learn even more. The 2016 Annual Report describes the efforts for capacity-building and training as well as the type of activities that were pursued as part of their social responsibility objective. Nevertheless, there are still relevant questions revolving around the cycle of design, implementation, and results of each program and/or activity. Questions around the who, how, when, how much, and why also require an answer.

- Who decides which activities are part of the social responsibility objective? Or better yet, who proposes the activities?
- How is this decided? The website mentions a Board, but what are the selection criteria, if any, and what is the weight of each criteria to select a program?
- When do programs/projects/activities take place? Are there any mechanisms to protect them from political use?
- How much is assigned to each program/project/activity? The 2016 Annual Report, for example, does not contain a specific itemized budget of each of the activities.
- Why are some areas and/or activities/projects/programs more important, than others? What are the priorities for social investment in Itaipú? How are they a reflection of what the broader Paraguayan society has prioritized in, for example, the National Development Plan 2030?

Itaipú Dam already has a practice of reporting on how socially-targeted funding is distributed. For example, the 2016 Annual Report mentions that the Brazilian side of the Itaipú Technology Park invested almost three and a half million reales, nearly R\$ 3,478,305.12, for the attention of 271 teenagers, including salaries and social charges, food, transportation, and learning and training workshops. Additionally, Itaipú Technology Park-Brazil invested nearly two million reales (R\$ 1,976,436.76) in scholarships, transportation support, apprenticeships, and training workshops (Itaipú, 2017: 89). In this same area

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of Social Responsibility (Objective 4.1.1. “Socioeducational Promotion”), the Report describes that Paraguay also held several activities aligned to this objective including the project “Paraguay Resuelve,” the “Campaña Vial,” and “Aulas Móviles de Formación Continua en la República del Paraguay” (Itaipú Binacional, 2017: 90). Yet, there is no mention on how much was destined for these activities, neither what the criteria was to select participants, nor even what the specific projects within this objective were.

As another example of how information might be made more easily accessible to the public, the website has no published information on the 2017 Call for Scholarships. Neither does it have in its website’s Scholarships section a simple and clear mention of previous awarded scholarships, selection criteria, the amounts of the each award, and the objective of such program, and the objectives of such program. Up to today, it is unclear if scholarships are awarded, for example, with an emphasis to indigenous Guarani students or if they have gender-sensitive criteria.



In a different vein, it was difficult to find publicly available independent audits for Itaipú Dam on their website. The only one that could be located, the “Informe del Auditor Independiente,” contained a portion of one audit by PricewaterhouseCoopers. Of that document, only pages 71 to 74 were made available (PricewaterhouseCoopers, 2017). No documents were found under the “Fiscalización Empresarial” (Business fiscalization) section on Itaipú’s website, as of July 3, 2017. Financial reporting and independent audits are all the more important given the relevance of the money that is transferred from Itaipú Dam to the governments of Brazil and Paraguay.

## *Governance & Sustainable Growth: Itaipú and Paraguay Post-2030 now*

Using Itaipú as a point of leverage for sustainable development Post-2030 does not mean that we have to wait until then. Now, in 2017, we suggest increasing the public debate on Itaipú and Paraguay’s Sustainable Development in the agenda, something already underway. As a reflection of this value, Duke University’s team has participated in International Seminars on this subject

and remains in close cooperation with Facultad Politécnica of the Universidad Nacional de Asunción.

Additionally, the public debate is also a constant reminder of the need to increase transparency and accountability of the single largest financial asset in Paraguay, the 50% of Itaipú Dam that it owns. Public expenditure of the financial transfers from Itaipú Dam to the Paraguayan government would necessarily have to be open and consistently measured as a first input for long-term planning.

### *Considerations*

Improvements in Itaipú-related governance suggested above will need to be measured with an understanding of the limitations of what the binational enterprise can do within its jurisdiction and responsibilities. For example, as mentioned in a previous section, oversight of the funding that goes to education at the local level lies in the hands of the National Treasury and the Ministry of Education. Once Itaipú distributes royalties and compensations to the governments of both Brazil and Paraguay, the dam no longer has any further jurisdiction over the administrative management of those funds. It is a far stretch to expect that Itaipú could singlehandedly increase the distribution of social welfare programs or increase the accountability and transparency of public finances. Nonetheless, it is a major inflection point in the institutional narrative and behavior of accountability, transparency, and efficiency. If we can improve governance in the form of transparency between Itaipú Dam and the Paraguayan public and the Paraguayan government, then it will be possible to have more certainty on how those resources are applied within Paraguay, thus fostering sustainable development.

In this tenor, it is vital to have clarity on how much Itaipú Dam contributes to Paraguay's development and economic growth, not only in economic value, but also in terms of evaluation of interventions via scholarships, contributions to education, and infrastructure. Doing so will help to better identify the areas for improvement by highlighting current shortcomings and therefore, ways to identify strategic investment from government authorities. Thus, one of the most relevant conclusions from analyzing Itaipú governance as a point of entry for sustainable development in Paraguay is that clear governance in well-defined process, rules, and economic contributions will also have positive spillover effects in Paraguay. We see the broader social narrative of development in Paraguay strengthened by clarity in one of the principal agents of sustainable development in the country, i.e., the dam.

The tariff renegotiation of 2023 is almost around the corner and the expected date when Paraguay uses all of its installed capacity (sometime between 2023-2030) is also rapidly approaching. Thinking, and more importantly, acting to prepare for post 2030 requires clear priorities for the country, but also, defined and known rules for decision-making and the allocation of resources that come from Paraguayan soil, such as its water.

This section was written having in mind the simple understanding that we cannot improve what we cannot measure, a concept used by economists

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and policy makers, who aim to improve the targeting of public policies and its impact for human development and poverty relief. I hope that this effort is one contribution to improve Paraguay's chances to set a sustainable development agenda post 2030 in the pure interest of making Latin America and the Caribbean a prosper, peaceful, and equitable region for all.

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## 4. RECOMMENDATIONS: Sovereignty, Institution Building & Capacity Building

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Paraguay has a tremendous and realistic opportunity to transition to an inclusive, vibrant, and ecologically sustainable economy. And because of the temporal constraints mentioned above, time is of the essence.

The most fundamental change we recommend is to rethink Itaipú Dam resources. Instead of spending Itaipú financial resources and instead of consuming the abundant Itaipú electricity, we encourage Paraguay to invest the financial and energetic resources. Not all spending is investing; investing returns. But we also see the binational dam as a resource in other ways. Itaipú Dam has developed human capital and know-how as well as world-class institutional capacity to an unparalleled degree within Paraguay. These are valuable resources to leverage for sustainable growth as well.

We recommend 4 specific courses of action that accomplish this goal and show how to rethink Itaipú resources:

- develop a public communications strategy,
- establish a Natural Resource Fund,
- strengthen the energy sector within the Paraguayan government,
- use Itaipú Technology Park-Paraguay as a business incubator and accelerator.

Rather than reinventing the wheel, we build upon Paraguay's already existing strengths: each recommendation takes already established institutions or practices and innovates them. We also conceive of an active role for different sectors of Paraguayan society—we envision that the business sector will play a leading role in Recommendation #3 and that it will share leadership with the university in Recommendation #4, while civil society organizations will be at the helm of Recommendation #1.

Finally, in order to develop our strategies, we searched for precedents and a successful track record outside of Paraguay and even outside of Latin America. For policy recommendations to make a difference, they must be both pragmatically viable and culturally appropriate. In designing these recommendations, we took into consideration the sociocultural specificity of Paraguay and the historical context as well as learning from best practices elsewhere.

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## 4.1 RECOMMENDATION #1: PUBLIC COMMUNICATIONS STRATEGY TO BUILD CITIZENRY SUPPORT

Though this is the least elaborated recommendation, it is the most important because the greatest resource of a country is an informed and engaged citizenry. We urge a public communications strategy in order to build citizen support for the recommendations enumerated here and in order to develop even better solutions to pressing problems. Part of the key message to Paraguay's already knowledgeable public is that, because Itaipú Dam resources are limited, there is an urgent need to invest those resources now for the long-term growth and development of Paraguay.

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## 4.2 RECOMMENDATION #2: ITAIPÚ FINANCIAL BENEFITS SHOULD BE STRATEGICALLY INVESTED VIA A NATURAL RESOURCE FUND BECAUSE THEY ARE A FINITE AND LIMITED RESOURCE

*As an expression of Paraguayan sovereignty and to protect Paraguay's resources in the present and the future, we urge the establishment of National Natural Resource Fund into which all Itaipú financial benefits (Royalties and Compensation) are invested, with anticyclic fiscal policies and clear expenditure rules.*

Itaipú financial resources, because they are finite and limited, should not be used for recurring government expenses. We urge that Paraguay establish a Natural Resource Fund with anticyclic fiscal policy and clear expenditure rules, in order to strategically invest all Itaipú financial benefits. The challenge and goal for natural resource rich developing countries is to convert financial gains (both the ordinary proceeds and the exceptional windfall profits) into long-term economic stability. A mechanism that accomplishes this transition is a Natural Resource Fund, which is a form of institution-building in addition to a financial mechanism (Mehlum, 2012).

One potential model for a Paraguayan National Natural Resource Fund is to serve as an organizational umbrella for several funds, including an Anti-Cyclic Economic Stabilization fund, a revised FONACIDE, a National Solidarity Pension fund.

*Anti-cyclic fiscal policy: Save when income is high and the economy is growing; Spend when income is low and the economy has stalled.*

Natural resource-dependent governments tend to a pro-cyclical energy fiscal policy: when energy prices are high, government income is correspondingly high; pro-cyclical spending patterns occur when government spending mirrors government income (Conceição et al, 2011). And so, when energy prices are high, government spends more proceeds, but when prices plummet, government investment in social programs and public goods also plummets. This makes long-term planning difficult and leads to short-term instability. Instead, windfall income—of which Itaipú compensation, given its very limited time horizon, is an example—should be saved and stewarded for times of economic contraction.

**Example of Best Practices: Norway and Chile.** Norway's Government Pension Fund Global (informally called "the oil fund") is a sovereign fund and not a traditional pension-offering mechanism. Instead, it manages the financial resources from petroleum on behalf of the Norwegian nation, with strict limitations on how much can be disbursed from the fund to finance government projects and expenses every year. As part of the Ministry of Finance, the Government Pension Fund Global invests in international equity, fixed income markets, and real estate, most of which are outside Norway in order to avoid inflation. As of June 2017, its market value was US\$935.8 billion (NBIM, 2017). From 1992 to the present, the government of Norway's annual expenditures have grown at a steady rate of about 5% per year, even though at the same time, government revenue has experienced extreme volatility—some years contracting -10%, other years growing at nearly 30% (Bauer, 2014: 3). And so, the expenditures of the Norwegian government are buffered from revenue differences. This is achieved through strict budgeting rules and supported by transparent detailed reporting to the Ministry of Finance, which is publicly available online.

During the global economic downturn of 2009, Chile used its newly formed Economic and Social Stabilization Fund (which replaced the Copper Stabilization Fund in 2007) in order to increase public spending and thus avoided a greater economic slow-down. As of April 2017, the ESSF had a market value of US\$14.209 billion (Hacienda, n.d.a). Similar to Norway's Government Pension Fund Global, Chile's ESSF is a sovereign wealth fund, dedicated to benefit all Chileans and the Chilean economy. Chile also established a Pension Reserve Fund in 2006 to guarantee pensions to Chile's aging population and to persons with disabilities (Hacienda, n.d.b).

## *Natural Resource Funds in Developing Countries: Committing Financial Benefits to a National Development Plan*

Although Paraguay should consider the model of Norway, which has a standard-setting Natural Resource Fund, we suggest that Paraguay also consider the model of Botswana (Mejía & Castel, 2012). In setting the fiscal rules for strategic planning for natural resource rich countries, the International Monetary Fund distinguishes between advanced and developing economies and between a long production horizon versus short production horizon for the natural resource in question (International Monetary Fund, 2012). Paraguay is a developing economy with a long production horizon in Itaipú Dam. In addition to the tendency to pro-cyclical expenditures, natural resource rich developing countries often have a low rate of savings. Given that municipal and departmental governments are accustomed to receiving hundreds of millions from royalties and compensation, we urge a scaled, but steady increase in the amount of Itaipú financial resources that are directed into the Natural Resource Fund, 15% per year until all of the Royalties and Compensation are directed to the fund.

**Example of Best Practices: Botswana.** Like Paraguay, Botswana is a land-locked country with a small population and comparatively minimal inter-ethnic strife. Prior to the development of extractive mining, Botswana's economy was dominated by cattle agriculture. From independence (1966) to today, the per capital GDP has grown from US\$70 to more than US\$6000 today and life expectancy has gone from 37 years to 64 years in 2015 (Lewin, 2011: 81-90; World Bank, 2017). The Botswanan government has undertaken a social investment plan that has moved the country from one of the 25 poorest countries in the world to a leading upper-middle income country on par with Chile. Although challenges remain, Botswana has been able to avoid or limit several of the pitfalls associated with export-oriented intensive extraction industrialization through carefully designed government policy:

1. Botswana tightly links expenditures to 5-year National Development Plans (NDPs) that are discussed and approved by congress. Therefore, money follows projects and planning, rather than the reverse.
2. Only the interest from Botswana's NRF can be used for government expenditures, leaving the principal untouched.
3. Strategic investment in diversifying the national economy, including industry and tourism.

Paraguay's National Development Plan 2030 (Plan Nacional de Desarrollo 2030) establishes a model for more specific 5-year development plans that could be linked to the National Natural Resource Fund expenditures.

Components of a Natural Resource Fund for developing countries with long resource production horizons are (see Bauer, 2014 for more):

1. Anti-cyclical spending pattern: instead of spending temporary windfalls, saving and investing the surplus; using benefits from the surplus in times of economic contraction in order to jumpstart the economy.

*Why it matters to Paraguay:* Spending of NRF monies would be independent of changes in year-to-year revenue or would be counter cyclical, increasing when revenue decreases.

2. Expenditure rule: a multi-year fiscal rule that limits spending from the NRF, either in absolute terms, in growth rates, or as a percentage of GDP. For example, in Botswana, fund expenditures cannot exceed 40% of GDP. In Mongolia, expenditure growth is limited to the growth of the economy apart from the mineral sector. And Peru limits changes in expenditures to 4%.

*Why it matters to Paraguay:* Clear constraints on how NRF monies are spent based on the health and growth of the rest of the economy, thus combatting Dutch disease.

3. Balanced budget rule: creates limits on the national budget (not just the NRF), clearly establishing constraints on how much debt the government will incur.

*Why it matters to Paraguay:* Avoids the temptation or need to break the two rules listed above by not allowing the government to incur debt that would then need to be discharged by NRF monies. This allows the NRF to achieve its social and economic goals, rather than being diverted to balance the objectives of a particular administration.

4. Transparent Auditing: grants the National Comptroller access to all financial reporting from the NRF and makes the expenditure details publicly-available in order to assure accountability and goal-setting.

*Why it matters to Paraguay:* Transparency increases public buy-in on policies that require saving; transparency encourages outside investors in sovereign wealth funds, thus buoying Paraguayan National Natural Resource Fund assets all the more.

Investments via the National Natural Resource Fund should be explicitly linked to public goals. Research has shown that support for energy-related public policy increases when the public sees the benefits of the fund savings in their day-to-day lives and sees natural resource revenues visibly linked to improvements in the national economy (Overseas Development Institute, 2006). We also note the need to deepen structural checks and balances regarding energy resources and therefore the Ministry of Mines and Energy should not host the Natural Resource Fund. Rather, the fund might be better located at the Central Bank.

## EASE OF DOING BUSINESS:

One useful way to get a picture of how Paraguay enables business and entrepreneurship is through indicators. These internationally recognized scorecards foster competition among regions and countries; they also give a snapshot image of key areas of opportunity that can lead to economic growth. In this particular case, we present the Ease of Doing Business 2016, which is reported by the World Bank Global Indicators Group.

The Indicator has multiple sub-indicators--such as Getting Electricity, Registering Property, Obtaining Credit, Dealing with Construction Permits, and Resolving Inefficiency--which signal the bureaucratic efficiency of the national and state governments primarily responsible for these processes. These dimensions reflect some of the most important

processes needed for the private sector to flourish and prosper. Having low scores means that there are some inefficiencies from the public sector that undermine the potential of economic growth, since they increase the costs and time that people should incur to open a new business.

Perhaps the most surprising indicator is in the Ease of Doing Business in Paraguay, a first glimpse of the different dimensions measured by the indicator Ease of Doing Business 2015 (benchmarked to June 2016). Interestingly, Getting Electricity is an area that is not exemplary scored in this indicator. Paraguay has a score of 102, where 1 is the best score possible and 190 is weakest. For the sake of contrast, Brazil has a score of 47 and Argentina has a score of 9. Recall that Paraguay has an unprecedented energy surplus. It

### *Recognizing the Value of Water*

Most models for natural resource funds across the world are mineral or hydrocarbon-based (See list from Natural Resource Governance Institute, 2014:7). But in establishing a National Natural Resource Fund to capture financial benefits from hydroelectricity, Paraguay would be recognizing the value of water in a time of climate change. This places Paraguay at the vanguard of natural resource management.

is a paradox that a country that co-owns the largest dam in the world, in terms of energy generation, does not score at the top of the countries reviewed by this indicator.

Another point of interest: contracts enforcement and property registration also score at lower levels. This is relevant for the policy

recommendations regarding how the financial resources of Itaipú Dam (especially once the debt is paid) should be allocated in, for instance, expanding the electricity grid, or for providing alternative clean energy, or on fostering entrepreneurship via technology parks, or installing capacity for agricultural processing.



Source: Constructed by the author with information from the World Bank, Ease of Doing Business Indicator 2015

### 4.3 RECOMMENDATION #3: STRENGTHEN ENERGY SECTOR TO CONSOLIDATE DEMOCRATIC GOVERNANCE & AVOID THE MONOPSONY TRAP

*Modernize Energy Sector via Gender-Inclusive Capacity-Building, a Ministry of Mines & Energy*

As energy resources become more crucial in the 21st century, Paraguay needs a growing cadre of experienced technocrats as well as clear institutional

dedication to its energy sector. Paraguay's newly approved National Energy Policy (Decreto 6092, 2016) includes goals, metrics, and strategic pathways. It should be implemented as part of strengthening the energy sector. We highlight the importance the energy policy places on capacity-building and institution-building. For example, we urge the establishment of an independent and authorized Ministry of Mines and Energy fully empowered to oversee and coordinate the agencies, the binational dams, and future hydrocarbon development.

Given the importance of energy integration as part of continent-wide energy security, especially in light of climate change, a prudent move is to develop greater energy sector representation and expertise within Paraguay's foreign ministry with healthy ties to the Ministry of Mines and Energy. Institution-building depends upon capacity-building. Paraguayan universities should develop rigorous masters programs in energy-related subjects (not just engineering, which is a hallmark strength of the current system).

The anecdotal comments indicating surprise that female researchers would study energy topics and the numerical paucity of female participation in the technical, engineering aspects of Itaipú Dam indicate that gender inclusivity in STEM fields should be a priority as both Paraguay and Itaipú Dam create capacity-building plans.

### *Electricity Infrastructure & Access*

Because Paraguayan demand is rapidly growing, ANDE should consider re-investing the proceeds from Itaipú administrative fees to secure financing for this energy infrastructure construction boom. In order to improve distribution and transmission, infrastructure should be developed simultaneously with the expansion of demand, rather than a hasty attempt to catch up with burgeoning growth that results in lower quality work.

Paraguay needs more high-tension lines that connect to the Itaipú right bank substation as well as substantial grid improvements, which is an opportunity for national construction firms because it implies a multi-year infrastructure project. Energy access should be more equitable, allowing low-consumption users access as well as expanding access beyond the traditional metropole of Asunción. By better integrating the rest of the country in the energy transition, an energy infrastructure expansion would take advantage of the entrepreneurial potential of other areas of the country as well as providing a broader tax base for municipalities (replacing the dependence on royalties and compensation). And so, participation from the private sector is crucial for two reasons: to construct the infrastructure and to highlight exactly where those infrastructural investments are most urgently needed for business development.

## *ANDE Direct Sales on Brazilian Market*

ANDE already sells a small amount of electricity directly on the Argentinian market. We urge that Paraguay take full use of the advances made in the 2009 Joint Declaration (Brazil-Paraguay), which affirmed the right of Paraguay to sell electricity directly to the Brazilian market, an opportunity which did not move forward at the time. ANDE direct sales on the Brazilian market would circumvent the challenges of an international monopsony because the Paraguayan firm would receive the same price as other competitors on the market. As importantly, having to compete in one of the world's most advanced electricity sectors would build the institutional capacity of ANDE, with beneficial spillover effects within Paraguay.

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## **4.4 RECOMMENDATION #4: INVEST IN INDUSTRIALIZATION → ITAIPÚ TECHNOLOGY PARK-PARAGUAY AS BUSINESS INCUBATOR & ACCELERATOR**

*Technology Park: A place where science and research are commercialized.*

*Technology Incubator: Provides workspace, mentoring, and other crucial resources to young start-up firms.*

Paraguay has a budding technology and start-up sector that has already had international impact as young entrepreneurs re-think new business opportunities. Technology incubators provide workspace, mentorship, and business support services to entrepreneurial firms at the most vulnerable stage of their business—the beginning (Innovation Policy Platform, n.d.). Accelerators are even more focused on helping teams get their business off the ground (Unitus Seed Fund, 2015). A nationally-based technology incubator and accelerator allows Paraguay to achieve strategic development goals laid out in Paraguay's National Development Plan 2030, which calls for inclusive economic growth (point #2) and innovation and diversification (point #3) in the economy.

As part of an industrialization plan and as an example of how to re-think Itaipú resources, we urge the development of Itaipú Technology Park-Paraguay as a business incubator and accelerator, with linkages to Paraguayan universities and the start-up sector. ITP-Brazil serves as a model for how to use the energy, financial, and technological resources of Itaipú in order to spur innovation. ITP-Paraguay should place an emphasis on incubating and accelerating green

businesses, on high-tech start-ups, on firms with ecological, financial, and social sustainability as part of their value proposition. It should also emphasize firms that bring added value to existing value and supply chains (e.g., agriculture).

The basic components of a successful technology park and incubator are:

- Strong ties to universities
- Availability of funding (public and/or private)
- Strong leadership and commitment

Most technology parks never make it past the planning phase; others start well, but do not continue because they lack a sustaining financial commitment from the public sector and buy-in from the private sector (National Research Council, 2009). When they fail, they do so due to poor planning, faulty conceptualization, or lack of integration with nearby universities. According to studies of best practices in technology parks worldwide, parks need both public funding that is consistent and participation from the private sector in addition to effective public policies that support start-up firms as they convert ideas into successful commercial innovations (Brown, 2011). For example, in Brazil, the state government of Paraná matches funding of 50% for federal investments in research and development (OECD, 2011). Technology parks need commitment from local leaders and from organizations who will continuously direct resources to the park.

In recent years, Paraguay has opened its side of Itaipú to industry in the form of maquila-based work. But there are limitations and drawbacks to solely prioritizing maquiladoras: employment tends to be lower skilled (and not skill developing), because it is located on a border, it offers fewer backward linkages for economic growth, and much of the value-added wealth remains within the export-oriented corporation, often headquartered in a difficult country. Using ITP-Paraguay as a business incubator for Paraguayan companies prevents the brain drain by granting opportunities for Paraguayans themselves to start their own companies. One key beneficiary and crucial partner would be the Paraguayan university system, which could take advantage of the research potential of Itaipú and the chance to link majors to employment opportunities.

# CONCLUSION

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We recognize that, given the scale and complexity of Itaipú Dam and of the development needs within Paraguay, one policy brief is just the beginning of a conversation. We welcome feedback, comments, and questions on this discussion draft.

# REFERENCES

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ABC Color. (2014). Reclaman dinero de FONACIDE, March 18. Retrieved from <http://www.abc.com.py/nacionales/reclaman-dinero-de-fonacide-1225865.html> June 17, 2017.

Administración Nacional de Electricidad, ANDE. (n.d.). *Generación*. Retrieved from <http://www.ande.gov.py/generacion.php>

Alcaraz Gavilán, P.R. (2014). *Influencia de los royalties y compensaciones generadas por las Entidades Binacionales Itaipú y Yacyretá, en el desarrollo humano y la pobreza extrema de la población paraguaya, en el período 1.989-2.010*. Graduation Thesis. Universidad Americana: Asunción.

Bauer, A. (2014). *Fiscal Rules for Natural Resource Funds: How to Develop and Operationalize an Appropriate Rule*. Policy Brief. Revenue Watch Institute, Vale Columbia Center on Sustainable International Investment.

Belt, C. et al. (2011). *Situación de Energías Renovables en el Paraguay*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Blanco, G. et al. (2017). *Energy transitions and emerging economies: A multi-criteria analysis of policy options for hydropower surplus utilization in Paraguay*. Energy Policy 108(September): 312-321. <https://doi.org/10.1016/j.enpol.2017.06.003>

Brennan, T.J. (2009). *Energy Efficiency: Efficiency or Monopsony?* Resources for the Future (RFF) Discussion Paper. Washington, DC. Retrieved from [http://economics.umbc.edu/files/2014/09/wp\\_09\\_110.pdf](http://economics.umbc.edu/files/2014/09/wp_09_110.pdf).

Brown, A. (2011). *Technology Parks on the Rise*. American Society of Mechanical Engineers. Retrieved from <https://www.asme.org/engineering-topics/articles/technology-and-society/technology-parks-on-the-rise>.

California Energy Commission. (2016). *Tracking Progress: Statewide Energy Demand*. Retrieved from [http://www.energy.ca.gov/renewables/tracking\\_progress/documents/statewide\\_energy\\_demand.pdf](http://www.energy.ca.gov/renewables/tracking_progress/documents/statewide_energy_demand.pdf).

Centro de Análisis y Difusión de la Economía Paraguaya, CADEP. (2016). *Cartilla Fiscal 15. Royalties y Compensaciones*. Asunción, Paraguay.

Centro de Análisis y Difusión de la Economía Paraguaya, CADEP. (2017). *Monitoreo Fiscal: Evolución de las Cuentas Publicas*. Asunción, Paraguay.

Conceição, P., Fuentes, R., & Levine, S. (2011). *Managing Natural Resources for*

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*Human Development in Low-Income Countries. Working Paper.* United Nations Development Programme.

Contraloría General de la República. (2014). *Informe sobre la rendición de cuentas de la ejecución de los programas y proyectos financiados con recursos del FONACIDE del ejercicio fiscal 2013.*

Depetris, P. J. (2007). The Parana River Under Extreme Flooding: A Hydrological and Hydro-Geochemical Insight. *Interciencia*, 32(10), 656-662. Retrieved from <http://proxy.lib.duke.edu/login?url=http://search.proquest.com.proxy.lib.duke.edu/docview/210144748?accountid=10598>.

Dirección General de Estadística, Encuestas y Censos, DGEEC. (2015). *Paraguay. Proyección de Población por Sexo y Edad, según Distrito, 2000-2025, Revisión 2015.* Asunción, Paraguay. Retrieved from <http://www.dgeec.gov.py/Publicaciones/Biblioteca/proyeccion%20nacional/Proyeccion%20Distrital.pdf>.

Folch, C. (2012). *The Flows of Sovereignty: Itaipú Hydroelectric Dam and the Ethnography of the Paraguayan Nation-State* (Doctoral thesis).

Folch, C. (forthcoming). *Valuing Renewable Energy: Hydropower in South America.*

Hacienda, Chile. (n.d.a). Market Value. Retrieved from <http://www.hacienda.cl/english/sovereign-wealth-funds/economic-and-social-stabilization-fund/financial-situation/market-value.html>, June 27, 2017.

Hacienda, Chile. (n.d.b). Sovereign Wealth Funds. Retrieved from <http://www.hacienda.cl/english/sovereign-wealth-funds.html>, June 27, 2017.

Innovation Policy Platform. (n.d.). *Incubators, accelerators and S&T parks.* Retrieved from <https://www.innovationpolicyplatform.org/content/incubators-accelerators-and-st-parks>, June 24, 2017.

International Monetary Fund. (2012). *Macroeconomic Policy Frameworks for Resource-Rich Developing Countries.*

Itaipú Binacional. (2012). *Memoria Anual 2011.*

Itaipú Binacional. (2017). *Memoria Anual 2016.*

Itaipú Binacional. (2017). *Nomina de empleados-margen derecha.* Retrieved from <https://www.itaipu.gov.br/sites/default/files/Informe%20Mayo-2017.pdf>.

Itaipú Binacional. (n.d.a). *Itaipú Mitos e Fatos.* Retrieved from [https://www.itaipu.gov.br/sites/default/files/publicacoes/BX\\_itaipu\\_mitos\\_e\\_fatos\\_21x28cm\\_v2.pdf](https://www.itaipu.gov.br/sites/default/files/publicacoes/BX_itaipu_mitos_e_fatos_21x28cm_v2.pdf).

Itaipú Binacional. (n.d.b). *Website: FAQ.* Retrieved from <https://www.itaipu.gov.py/es/sala-de-prensa/faq>, June 14, 2017.

Lewin, M. (2011). Botswana's Success: Good Governance, Good Policies, and Good Luck. In *Yes, Africa Can: Success Stories from a Dynamic Continent*, Chuhan-Poe, P. & Awafo, M. (Eds.) Washington, DC: World Bank Publications.

Marengo, J. A., Chou, S. C., Kay, G., Alves, L. M., Pesquero, J. F., Soares, W. R., Tavares, P. (2012). *Development of regional future climate change scenarios in South America using the eta CPTEC/HadCM3 climate change projections: Climatology and regional analyses for the Amazon, São Francisco and the Parana river basins*. *Climate Dynamics*, 38(9-10), 1829-1848. doi:<http://dx.doi.org.proxy.lib.duke.edu/10.1007/s00382-011-1155-5>

Mehlum, H., Moene, K., & Torvik, R. (2012). Mineral Rents and Social Development in Norway. In *Mineral Rents and the Financing of Social Policy*, Hujo, K (ed). New York, NY: Palgrave MacMillan, 155-184.

Mejía, P.X. & Castel, V. (2012). *Could Oil Shine Like Diamonds? How Botswana Avoided the Resource Curse and its Implications for a New Libya*. African Development Bank. Retrieved from <https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Could%20Oil%20Shine%20like%20Diamonds%20-%20How%20Botswana%20Avoided%20the%20Resource%20Curse%20and%20its%20Implications%20for%20a%20New%20Libya.pdf>.

Ministério de Minas e Energia (Brasil). (2015). *Plan Decenal de Energia 2024*. Retrieved from [http://www.mme.gov.br/documents/10584/3642013/02+-+Electricity+in+the+2024+Brazilian+Energy+Plan+\(PDF\)/96be552a-4a2c-4a32-839a-f51299c911fb;version=1.1](http://www.mme.gov.br/documents/10584/3642013/02+-+Electricity+in+the+2024+Brazilian+Energy+Plan+(PDF)/96be552a-4a2c-4a32-839a-f51299c911fb;version=1.1).

Ministério de Minas e Energia (Brasil). (2016). *Boletim Anual de Exploração e Produção de Petróleo e Gás Natural - 2015*. Retrieved from <http://www.mme.gov.br/documents/10584/2533848/Boletim+Anual+de+Explora%C3%A7%C3%A3o+e+Produ%C3%A7%C3%A3o+de+Petr%C3%B3leo+e+G%C3%A1s+Natural+%E2%80%93+Base+2015./393c43bf-f2cc-4287-925d-58cee-5b87c58?version=1.0.s>.

National Research Council. (2009). *Understanding Research, Science and Technology Parks: Global Best Practices: Report of a Symposium*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/12546>.

Natural Resource Governance Institute & Columbia Center on Sustainable Investment. (2014). *Natural Resource Fund Governance: The Essentials*. Policy Overview.

Norte Energia S.A. (n.d.). *Getting to know Norte Energia S.A.* Retrieved from <http://norteenergiasa.com.br/site/ingles/norte-energia/>, June 24, 2017.

Norges Bank Investment Management. (2017). *Market Value*. Retrieved from <https://www.nbim.no/en/the-fund/market-value/>, June 27, 2017.



Retrieved from <http://www.vanguardia.com.py/2017/02/25/es-raro-que-nadie-este-presos-por-caida-de-aulas/>.

Viceministerio de Minas y Energía (Paraguay) (n.d.). *Electricidad-Generación*.

Retrieved from: [http://www.ssme.gov.py/vmme/index.php?option=com\\_content&view=article&id=1216&](http://www.ssme.gov.py/vmme/index.php?option=com_content&view=article&id=1216&).

Viceministerio de Minas y Energía (Paraguay). (2016). *Balance Energético Nacional*.

Retrieved from <http://www.ssme.gov.py/vmme/pdf/balance2015/Balance%20Energetico%20Nacional%202015.pdf>.

World Bank. (2014). *Access to Electricity Data*. Retrieved from <http://data.worldbank.org/indicator/EG.ELC.ACCTS.RU.ZS?end=2014&locations=PY&start=1995&view=chart>.

World Bank. (2015). *Poverty & Equity Databank*, Paraguay. Retrieved from <http://povertydata.worldbank.org/poverty/country/PRY>.

World Bank. (2017). *World Development Indicators*, Botswana, Brazil, Paraguay. Retrieved from <http://data.worldbank.org>.

Yacyretá Entidad Binacional. (n.d.). *Official Website*. Retrieved from <http://www.eby.gov.py/>.

### **Legal Documents**

Acuerdo Tripartito para el Aprovechamiento Hidroeléctrico Itaipú y Corpus. Argentina, Brazil, Paraguay, 1979.

Decreto 5816 Por el cual se reglamentan el sistema de distribución y deposito de los recursos en concepto de royalties y compensaciones en razón el territorio inundado provenientes de las entidades binacionales Itaipú y Yacyretá (2010). Presidencia de la República, Asunción, Paraguay.

Decreto 6092 Política Energética. (2016). Presidencia de la República, Asunción, Paraguay.

Ley 1309/98 Que Establece la Distribución y Deposito de Parte de los Denominados 'Royalties' y 'Compensaciones en Razon del Territorio Inundado' a Los Gobiernos Departamentales y Municipales. (1998). Presidencia de la República, Asunción, Paraguay.

Ley 4758/12 Que Crea el Fondo Nacional De Inversion Pública y Desarrollo (Fonacide) y el Fondo para la Excelencia de la Educación y la Investigación. (2012). Presidencia de la República, Asunción, Paraguay.

Tratado de Itaipú. Brazil, Paraguay, 1973.