



RAP

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Regulatory Framework and Cost Regulations for the Brazilian National Grid (Transmission System)

Final Report

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Brazilian National Grid Costs and Regulations

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1. Summary

Exeter Associates, Inc. (Exeter) was tasked by the Regulatory Assistance Project to prepare a case study on inter-regional transmission costs for Brazil. Specifically, the study focuses on the Brazilian transmission system price approval process and includes an analysis of the regulatory framework employed by the Brazilian government and its institutions tasked with overseeing the transmission system in Brazil.

This report provides a brief overview of the industry standards and practices involved in revenue requirement determination, cost allocation, and rate design for Brazil's inter-regional electricity transmission lines.

The report describes:

1. A brief overview of the Brazilian electric sector including the country's regulatory framework;
2. A brief overview of Brazil's generation, transmission, and distribution sectors;
3. The regulatory framework for the determination process of the transmission tariffs, including an analysis of the transmission rate tariff determination for the 2013 – 2014 cycle, which includes methods for how transmission costs are calculated, how they are allocated to different parties including customers, and how costs are included in retail prices; and
4. Maps that show the Brazilian National Grid.

For purposes of this report, the exchange rate is assumed at USD\$1 = R\$2.20, where USD\$ = U.S. dollars and R\$ = Reals (the current Brazilian currency); italics represent terms in Portuguese (the language of Brazil); and "Brazil" denotes the Federative Republic of Brazil – Portuguese: *República Federativa do Brasil*.

2. Regulatory Framework of the Brazilian Electric System

The Brazilian electric sector is regulated by seven government institutions organized in a hierarchy as shown in Figure 1, each with separate functions summarized as follows:

- National Council for Energy Policy – Portuguese: *Conselho Nacional de Política Energética* (CNPE) was created in 1997 and is responsible for, among other functions, advising the Brazilian Presidency, developing national policies for the Brazilian electric sector, and protecting the interests of Brazilian consumers regarding energy quality, prices, and supply. It also formulates energy policies to promote the optimal use of Brazilian energy resources. It is presided over by the Minister of Mines and Energy, and is comprised of one representative on behalf of each Brazilian state,¹ energy sector experts, non-governmental organizations (NGOs), and seven Brazilian ministers (part of the President's cabinet).
- Ministry of Mines and Energy – Portuguese: *Ministério de Minas e Energia* (MME) was established in 1960 and has responsibilities for, among other functions, fostering the investments in mining and energy related activities, funding energy related research, and enacting national energy policies. The MME oversees the ANEEL, the EPE (both defined below), and several other government agencies. It also oversees the energy companies Eletrobras,² Petrobras,³ and several others with public or mixed (public/private) capital, and public or mixed ownership.
- Electric System Monitoring Committee – *Comitê de Monitoramento do Setor Elétrico* (CMSE) is tasked with monitoring the continuous and reliable supply of electricity in Brazil and is comprised of four representatives from the MME as well as the the directors of ANEEL, EPE, ONS, CCEE, and the *Agência Nacional do Petróleo* (ANP).
- Electric Research Company – Portuguese: *Empresa de Pesquisa Energética* (EPE) was created in 2004 and is part of the MME. The EPE is in charge of the long-term planning of Brazil's electric system. EPE develops planning studies covering the power sector, the oil and gas sector, and renewable development/energy efficiency. EPE supports the public auction process by developing generation and transmission grid planning studies. Additionally, EPE develops studies for the MME to establish policies for the Brazilian energy sector.

¹ The current representative on behalf of the Brazilian states, appointed to the CNPE in August 2013, is the secretary of the state *Rio Grande do Norte*. This individual represents the interests of all 27 states in Brazil that comprise the Federative Republic of Brazil.

² Eletrobras – Portuguese: *Centrais Elétricas Brasileiras S.A.* (Eletrobras) is a public/private holding company with generation, transmission, and distribution subsidiaries. The Brazilian government is owner of about 54 percent of Eletrobras' stock. Eletrobras owns about 37 percent of the total electric generation assets in the country with 164 generation plants, including a 50 percent interest in the Itaipu generation complex (which by itself furnishes about 17 percent of the total energy demand of Brazil). It owns all of the nuclear generating plants in the country. It also owns 58,000 kilometers (km) of transmission lines which correspond to about 57 percent of the country's transmission lines.

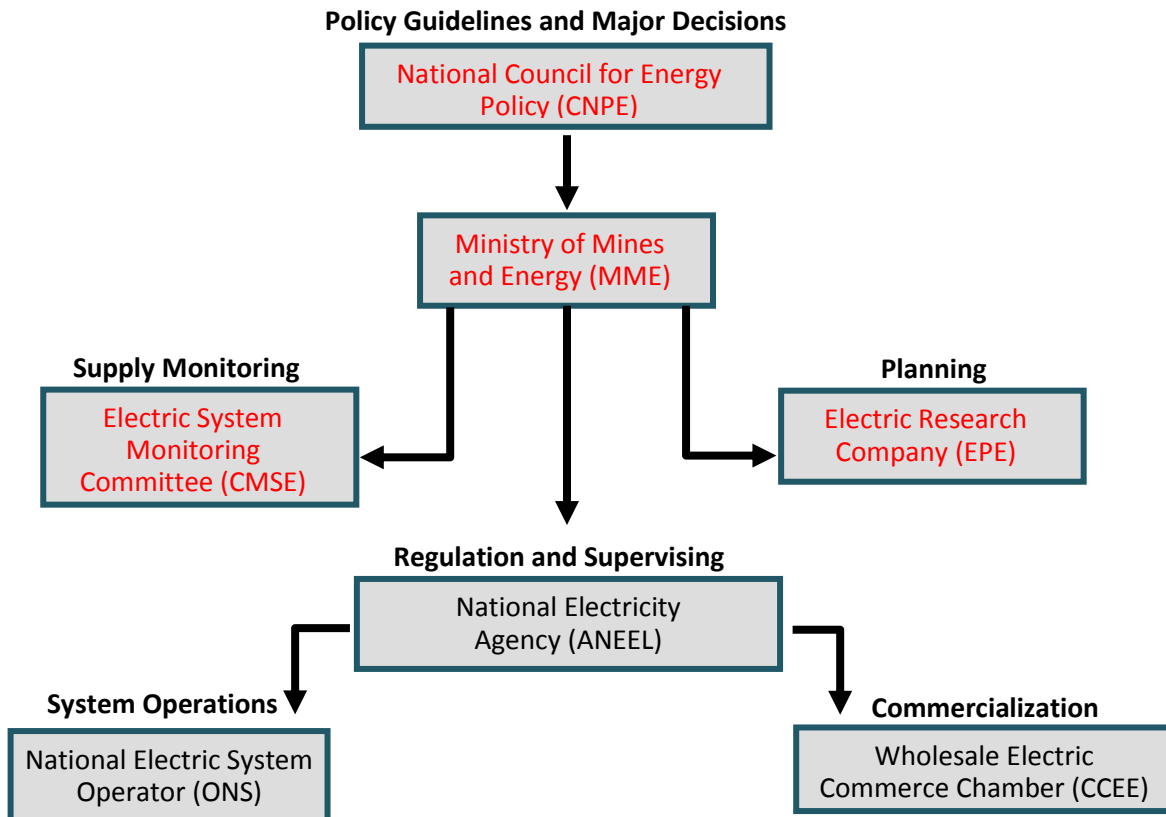
³ Brazilian Petroleum – Portuguese: *Petróleo Brasileiro S.A.* (Petrobras) is a public/private multi-national energy corporation with assets exceeding USD\$100 billion; it is the largest company in the southern hemisphere and is in the top five largest companies in the world by market capitalization. It is 64 percent owned by the Brazilian government, and is the largest company in South America by revenues. It produces about two million barrels of oil each day. Petrobras owns oil refineries, oil tankers, and is a major distributor of oil products.

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- National Electricity Agency – Portuguese: *Agência Nacional de Energia Elétrica* (ANEEL) is also part of the MME and was created in 1996 by Law No. 9427. It is charged with the regulation and supervision of the Brazilian electric sector including power generation, transmission, distribution, and commerce. It has similar regulatory functions to the Federal Energy Regulatory Commission (FERC) in the United States. Most of ANEEL's regulatory meetings are open to the public, and parties subscribed to the regulatory matter ANEEL is reviewing (interveners) have the right to participate.
- National Electric System Operator – Portuguese: *Operador Nacional do Sistema Elétrico* (ONS) is responsible for the coordination and control of the power generation and transmission on Brazil's National Grid – Portuguese *Sistema Interligado Nacional* (SIN). ONS develops various electric system studies and ensures the continuous supply of energy in Brazil. ONS is also tasked with providing favorable conditions that foster the growth of the electric system, consider the market stakeholders, and benefit society. ONS is under the supervision and regulation of ANEEL.
- Wholesale Electric Commerce Chamber – Portuguese: *Câmara de Comercialização de Energia Elétrica* (CCEE) provides support for the wholesale electric market on the interconnected transmission system. It is the clearinghouse that settles power contracts, calculates spot prices, and provides analysis and market data. It also conducts energy purchase auctions for the regulated market under the authorization of ANEEL.

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Figure 1. Regulatory and Planning Entities for the Brazilian Electric System



Source: Modified from the ONS website, http://www.ons.org.br/institucional_linguas/relacionamentos.aspx?lang=en.

3. Generation, Transmission, and Distribution Sectors

The Brazilian electric sector is divided into four sub-sectors: Generation, Transmission, Distribution, and Commercialization. Brazilian Law Nos. 10847 and 10848 of 2004 and Decree No. 5163 constitute the legislative framework for the country's energy system. The Brazilian Generation sector produces all of the energy used in the country and often has surpluses that are exported to other countries. The Transmission sector, which is the principal focus of this report, transports the energy generated throughout the country. The Distribution sector delivers electricity to the retail end-user (e.g., residential, commercial, industrial, etc.). The Commercialization sector is comprised of companies authorized by the Brazilian government to buy and sell electricity to and from approximately 40 large industrial and commercial customers that are permitted to participate directly in the unregulated market. This group of customers is called "Unregulated Consumers" – Portuguese: *Consumidores Livres*, and they represent about 25 percent of the entire power market.

In the regulated market, generators must sell electricity directly to distribution companies (Discos) through auctions. Discos must purchase enough generation power to ensure that their captive users' market demand is fully met. In the unregulated market, generators may sell energy through negotiated contracts, i.e., bilateral Power Purchase Agreements (PPAs), to certain consumers: (1) who were connected to the system after July 8, 1995 with demands above 3 megawatts (MW); or (2) who have voltage at the delivery point of greater than or equal to 69 kilovolts (kV). The generation sector in Brazil is highly concentrated; in fact, only about 100 generation companies are connected to the National Grid and are centrally dispatched. These companies are known as "Generation Agents" with Eletrobras, a public/private company managing generation assets that supply approximately 37 percent of the country's generation. About 70 percent of the country's generation comes from four Generation Agents: Eletrobras, *Companhia Energética de São Paulo* (CESP), *Companhia Energética de Minas Gerais S.A.* (Cemig), and *Companhia Paranaense de Energia* (Copel).

Interconnected (Interregional) Transmission System

Brazil is the world's fifth largest country by area, behind only Russia, Canada, China, and the United States (first to fourth largest countries, respectively). Brazil's total area of 8.5 million square kilometers (km²) presents a unique challenge in terms of the transmission and distribution of electricity. Additionally, most of the country's generation is sited far from the load consumers, further adding to the complexity.

Brazil's National Grid dates back to the 1930s when the government seized control of the electric sector and began regulating the development of new energy generation and transmission. Currently, the government gives concessions to private transmission companies to build and operate parts of the National Grid, pursuant to contractual arrangements between ANEEL and the concessioners.

The National Grid – Portuguese *Rede Básica do Sistema Interligado Nacional* (SIN) is an interconnected transmission, power transformers, electric busbars, and substations system with voltage levels equal to or greater than 230 kV that spans across six regions in Brazil (defined below) and encompasses the majority of the country's electrical system.

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Any participant within the energy sector, upon fulfilling certain legal and technical requirements, has the right to access the National Grid. This right is dubbed “*Livre Acesso*” (free access). *Livre Acesso* is guaranteed by ANEEL and ensures the direct commercialization between producers and users, independent of where they may be located within the SIN.

The SIN is comprised of the Itaipu Dam – Portuguese: *Hidro Itaipu* and six regions: *Intercâmbio Internacional, Sul, Sudeste, Centro-Oeste, Nordeste, and Norte* (International Exchange, South, Southeast, Center-West, Northeast, and North). Approximately 96.6 percent of the entire energy production in Brazil travels through the SIN, with the exception of small grid islands located predominantly in the Amazonas region of the country.⁴ The SIN is also interconnected to the neighboring countries of Paraguay, Uruguay, and Argentina. This inter-country connection provides for import/export opportunities; for example, in 2011, a total of 2,547 gigawatt hours (GWh) was exported through the SIN from Brazil to Uruguay and Argentina.

Transmission companies connected directly to the National Grid are dubbed “Transmission Agents.” There are roughly 65 Transmission Agents in Brazil, the largest of which is Eletrobras with approximately 57 percent of all of the country’s transmission assets, followed by the *Companhia de Transmissão de Energia Elétrica Paulista* (CTEEP) which transmits approximately 30 percent of the country’s power. CTEEP is also a private/public Company with 89.5 percent of its stock in private hands.

ONS is the national independent transmission and system operator, dispatching the system according to a least cost, centralized generation assets pool. ONS has both associated and participant members:

- ONS associated members are Generation Agents with centrally dispatched power plants, Transmission Agents, Import/Export agents connected to the grid, Distribution Agents within the SIN, and unregulated customers.
- ONS participant members include the MME, consumer councils, Generation Agents without centrally dispatched power plants, and Distribution Agents with small loads (below 500 GWh per year).

One of the most important functions of the SIN is that it transports power across Brazil’s regions and distributes generated power from the Itaipu Dam in the south of Brazil to other parts of the country. The Itaipu Dam is the second largest hydroelectric facility in the world, measured by installed generation capacity, behind the Three Gorges Dam (长江三峡水利枢纽工程) located in Hubei, China. The Itaipu Dam has 14,000 MW of installed capacity, with 20 generating units providing 700 MW each.

In 2011, the Itaipu Dam produced 92,246 GWh, of which approximately 84,029 GWh was transported via direct (one-directional) current through the SIN to the southeast and center-west regions of Brazil. The Itaipu Dam is located on the Brazil and Paraguay border, in the south of Brazil. It is a bi-national project between Brazil and Paraguay that began operations in 1984. Most of the Itaipu Dam production is exported directly to Brazil. Figure 1 shows that, of the total 2011 production of 92,246 GWh, 84,029 GWh were exported to Brazil, with the rest utilized by Paraguay. The transmission

⁴ From the ONS website: http://www.ons.org.br/conheca_sistema/o_que_e_sin.aspx.

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lines that connect the Itaipu Dam to the SIN are two 600-kV high-voltage direct current (HVDC) lines, each rated at 3,150 MW and each approximately 800 km long.⁵ These two HVDC lines distribute energy to the city of São Paulo (regions southeast and center-west as shown on Map 3) where the power is then converted from 50 hertz (Hz) to 60 Hz. The HVDC technology was chosen since there are less transmission line losses than other transmission systems.

Figure 2 on the following page shows total generation in each of Brazil's six regions and the interregional net energy transfers during 2011.

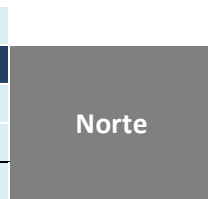
⁵ The longest HVDC link in the world is Chinese Xiangjiaba–Shanghai 2,071 km, 800 kV, 6,400 MW link connecting the Xiangjiaba Dam to Shanghai, built by the State Grid Corporation of China (SGCC). The Rio Madeira HVDC in Brazil, once completed, will surpass the Xiangjiaba–Shanghai line in length as it is anticipated to be 2,375 km upon completion (see Map 1 for dotted 600 kV line going northwest to southwest, connecting *Porto Velho* in the state of *Rondônia* to the *São Paulo* area for exact location of this transmission line).

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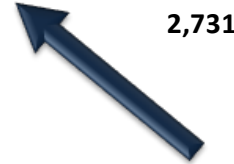
Figure 2. Energy Transfers on SIN During 2011

Energy Transfers - GWh

Consumption	35,111
Generation	
Hydro	42,698
Therm	1
Total	42,699
Net Exports to Other Regions	7,587
% of Consumpt.	21.6%



Consumption	71,615
Generation	
Hydro	50,529
Therm/Wind/Bio	7,040
Total	57,569
Net Imports from Other Regions	14,046
% of Consumpt.	19.6%



Generation for Brazil*		Itaipu
50 Hz	60 Hz	
41,857	42,172	
Total	84,029	

Consumption	302,713
Generation	
Hydro	186,472
Therm	30,182
Total	216,654
Net Exports to Other Regions	6,460
% of Consumpt.	2.1%

TOTAL ALL COUNTRY	
Hydro	450,237
Therm/Wind/Bio	43,555
Total	493,792

8,490



Consumption	81,833
Generation	
Hydro	86,510
Therm/Wind	6,332
Total	92,842
Net Exports to Other Regions	11,009
% of Consumpt.	13.5%



2,519

* Net of Itaipu Gen to Brazil

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As shown in Figure 2, the Nordeste region of Brazil (northeast Brazilian states) consumes more energy than is produced in the region, hence, the important role of energy transfers from other regions through the SIN, in addition to the SIN transporting power from the Itaipu Dam.

The SIN has installed capacity to transport approximately 105,343 MW from different generation sources, as shown in Table 3. The SIN has transmission lines ranging in voltage from 230 kV to 750 kV. Lines with voltage lower than 230 kV are considered distribution lines, and therefore are not considered as part of the SIN. As of December 2011, there were more than 103,000 km of installed transmission lines in Brazil, distributed in voltage size and length as shown in Table 1.

Table 1. Installed Transmission Lines in the SIN as of 2011		
Voltage Capacity (kV)	Length (km)	Percentage of Total
230	45,709	44.2%
345	10,062	9.7
440	6,681	6.5
500	35,003	33.9
600 CC	3,224	3.1
750	2,683	2.6
Total	103,362	100%

Source: *Dados Relevantes Operador Nacional do Sistema Elétrico 2011*, prepared by ONS.

During the last four years, an average of 3,620 km of new transmission lines were added to the SIN annually, as shown in Table 2. In 2011, a total of 59 new transmission projects were energized.

Table 2. Five-Year History of Total Transmission Lines in the SIN (km)					
Voltage Capacity (kV)	2007	2008	2009	2010	2011
230	37,155	37,710	41,437	43,185	45,709
345	9,772	9,772	9,784	10,060	10,062
440	6,671	6,671	6,671	6,671	6,681
500	29,392	31,868	33,196	34,356	35,003
600 CC	3,224	3,224	3,224	3,224	3,224
750	2,683	2,683	2,683	2,683	2,683
Total	88,898	91,928	96,995	100,179	103,362

Source: *Dados Relevantes Operador Nacional do Sistema Elétrico 2011*, prepared by ONS.

That same year, Brazil produced a total of 493.8 terawatts per hour (TWh) of energy for internal and external (outside Brazil) consumption, with 91.2 percent of this production generated from hydropower (approximately 17 percent generated from the Itaipu Dam alone, as previously referenced in Figure 2). As of December 2011, the installed generation capacity in Brazil, excluding contracted imports from other countries, was 105,343 MW, distributed by generation source as shown in Table 3. During 2011, a

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total of 40 new generation projects were connected to the SIN, representing approximately 1,529 MW of new generation capacity with the majority from new hydro plants.

Table 3. Installed Generation Capacity in the SIN in 2011		
Generation Source	MW	Percentage of Total
Hydropower	81,516	77.4%
Conventional Thermal (Gas & Oil)	16,228	15.4
Nuclear Power	2,007	1.9
Wind	1,342	1.3
Biomass	4,250	4.0
Total	105,343	100%

Source: *Dados Relevantes Operador Nacional do Sistema Elétrico 2011*, prepared by ONS.

During 2011, hydropower represented approximately 77 percent of the installed generation capacity in Brazil, as shown above in Table 3, but in terms of energy production, hydropower's share is even greater, at approximately 91 percent of total generation, as shown in Table 4. Brazil's hydro plants have large reservoirs that can provide potential energy capacity for several years.

Table 4. Total Energy Production by Source Transported in the SIN During 2011		
Generation Source	GWh	Percentage of Total
Hydropower	450,237	91.2%
Conventional Thermal (Gas & Oil)	22,049	4.5
Nuclear Power	16,659	3.2
Wind	1,904	0.4
Biomass	313	0.7
Other	3,629	0.7
Total	493,791	100%

Source: *Dados Relevantes Operador Nacional do Sistema Elétrico 2011*, prepared by ONS.

4. Brazilian Transmission Tariffs

New Transmission Auction Process

The MME, through the EPE, the ONS, and other organizations, is in charge of planning for new transmission lines in Brazil. For example, the EPE develops two major planning documents for this purpose, one with a 5-year planning horizon and the other with a 10-year planning horizon.

EPE's 5-year planning document is entitled the "Transmission Expansion Program" – Portuguese: *Programa de Expansão de Transmissão* (PET) and was last updated in March 2013. The most recent PET reflects expansion projects through 2017 and includes R\$14.6 billion (USD\$6.6 billion) in improvements, including approximately R\$4 billion (USD\$1.8 billion) for a planned 800 kV direct current, 2,140 km line with transmission capabilities of 4,000 MW to deliver power from the *Belo Monte Hydro* in the north of the country. Table 5 and Table 6 summarize the investments included in the PET by region of the country.

Table 5. PET Projected Investments in Transmission Lines		
Region	2013-2017 Cycle (km)	2013-2017 Cycle (R\$ billion)
Sudeste / Centro-Oeste	2,705	R\$1.5
Sul	625	0.5
Nordeste	2,418	1.5
Norte	<u>4,752</u>	<u>4.9</u>
Total	10,500	R\$8.4 billion

Source: March 2013 PET, as published by EPE.

Table 6. PET Projected Investments in Substations and Equipment		
Region	2013-2017 Cycle (km)	2013-2017 Cycle (R\$ billion)
Sudeste / Centro-Oeste	7	R\$2.8
Sul	3	0.3
Nordeste	5	0.9
Norte	<u>6</u>	<u>42.2</u>
Total	21	R\$86.2 billion

Source: March 2013 PET, as published by EPE.

ONS publishes a 2-year planning document entitled the "Expansion and Refurbishment Plan" – Portuguese: *Plano de Ampliações e Reforços* (PAR). The 2013 – 2015 PAR included 153 proposals that included construction of an additional 8,608 km of transmission lines, and installation of more than 20,550 transformers.

The MME, with collaboration from EPE and ONS, creates a macro-level planning document entitled "Consolidation of National Grid Projects" – Portuguese: *Consolidação de Obras de Rede Básica* which incorporates information from the PAR, PET, and other planning documents to aid in the granting of concessions and to include updated and consolidated information regarding new improvements on the Brazilian transmission system.

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Wholesale energy is commercialized in Brazil under one of two frameworks, or markets, through regulated and unregulated contracts.⁶ Power generators and distributors can take part in either market, while the unregulated market offers participation opportunities to wholesale marketers, import/export energy wholesalers, and unregulated consumers.⁷

In the regulated market, generators and transmission companies must sell their energy and transmission services through reverse auctions to ensure price competitiveness.⁸ These transmission and generation services for the regulated market are used to serve the captive customers which are supplied through Discos. The transmission system is considered a natural monopoly because of the high entry costs due to significant capital requirements and presence of economies of scale, which make the long-term average cost of providing service lower for a single firm. Therefore, competition in the transmission sector is not expected to generate economic gains. ANEEL oversees these closed envelope auctions which are held annually and in advance of delivery dates. Generation auctions are held at least three years in advance of the start of operations of the generators. Typically, the transmission auctions are for 30-year contracts, with a typical 24- to 60-month lead time before energizing.

The auction winner is awarded the concession right to provide transmission services in a certain delimited service area; such as to build and operate a 230 kV transmission line between two specific substations for a limited period of time (usually 30 years). The concession lasts until: (1) the contract term expires; (2) expropriation of service by the government; (3) cancellation due to irregularities in the process of granting the concession; or (4) bankruptcy or extinction of the concession winner (transmission company).

The electricity bought from generators, as explained earlier, is performed through ANEEL's auctions which are overseen by the CCEE, or through short- and long-term PPAs.⁹ The distributors sign contracts directly with the generators to meet their retail demand. The distributors localized in the *Regiões Sul, Sudeste e Centro-Oeste do Brasil* are required by law to receive electricity from the Itaipu Dam and to pay the corresponding costs of such electricity.

The transmission auctions include the construction, operation, and maintenance of the transmission line. ANEEL calculates the maximum lowest Annual Allowed Revenue – Portuguese: *Receita Anual Permitida* (RAP) for each transmission project. For example, in ANEEL's most recent auction, Notice of Auction – Portuguese: *Editais do Leilão* No. 02/2013-ANEEL in June 2013, ANEEL calculated the maximum (reference) RAP for each set of transmission projects pursuant to the parameters shown in Table 7. ANEEL calculated a RAP that would provide theoretical or reference maximum for net present value of the project to equate zero using the parameters established in Table 7.

⁶ According to the World Bank Study: *Electricity Auctions: An Overview of Efficient Practices*, approximately 70 percent of Brazil's load is supplied through the regulated market via distribution companies (Discos).

⁷ The markets are referred to as *Ambiente de Contratação Regulada* (ACR) and *Ambiente de Contratação Livre* (ACL) for the regulated and unregulated markets, respectively.

⁸ In the past, ANEEL has infrequently authorized new transmission projects through resolution, not under auction. Cost recovery for these transmission assets is determined through a regulated rate of return that is subject to revision every four years.

⁹ The PPAs are stop-gap measures to supplement the electricity bought through auctions and for balancing, and are a very small portion of the total electricity purchased.

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Table 7. Parameters Used by ANEEL to Determine the Reference RAP for Notice of Auction No. 02/2013-ANEEL

Parameters	Amounts	Status for Periodic Revision
Own Capital Structure	36.45%	Fixed for revisions pursuant to Clause 7 of the concession contract (5-year revision).
Third-Party Capital Structure	63.55%	
Real Cost of Own Capital	8.81%	
Operations and Maintenance	1.8% or 2.00% ¹	Actualized at the moment of periodic revisions pursuant to the concession contract.
Real Cost Third-Party Capital	3.31%	
TJLP ¹	6.03%	
IPCA ²	5.53%	
TRM ³	0.00%	
Spread s1 ⁴	3.00%	Fixed for revisions pursuant to Clause 7 of the concession contract (5-year revision)
Spread s2 ⁵	0.00%	
Constant α	1.00	
Median Annual Depreciation Rate	Varies depending on each “LOT” of transmission lines. ⁶	

¹Varies depending on each “LOT” of transmission lines.

²Reflects the representative inflation rate – Portuguese: *Taxa de Juros de Longo Prazo* established by the National Brazilian Monetary Council – Portuguese: *Conselho Monetário Nacional*.

³Reflects the representative rate of interest – Portuguese: *Índice Nacional de Preços ao Consumidor Amplo* established by the Instituto Brasileiro de Geografia e Estatística (IBGE).

⁴Representative market rate – Portuguese: *Taxa Referencial de Mercado* (TRM),calculated by the Brazilian Central Bank.

⁵Additional market risk rate added to the capital cost in nominal terms.

⁶For Auction No. 02/2013, the depreciation rate ranged from 3.50 percent to 3.77 percent.

The auction is awarded to the party that offers the lowest RAP below the maximum RAP established by ANEEL using the parameters shown in Table 7. The RAP reflects the payment stream that the awarded transmission developer would receive to make the system available to ONS, and to provide the public with service of transmission to the users of the National Grid upon commencement of commercial operations. The RAP payments are guaranteed pursuant to the Guarantee Contract – Portuguese: *Contrato de Constituição de Garantia* which is part of the Transmission Installation Use Contract – Portuguese: *Contrato de Uso dos Sistemas de Transmissão* (CUST) and ensures that the transmission company shall receive the amounts owed by the transmission asset users. Certain older concession contracts have a RAP payment profile dubbed "Degrau" with a reduction of 50 percent beginning in the sixteenth year after the concession is granted.¹⁰

The RAP, starting with contracts adjudicated after 2006, is readjusted annually every July 1 by the IPCA or the IGP-M,¹¹ and is also recalculated every three to five years pursuant to the terms of the concession contract. The RAP is paid in 12 monthly installments to the awarded developer.

While providing the service, the transmission company agrees to employ materials and equipment of high quality and maintain adequate facilities and operating methods that ensure high levels of reliability characterized by the continued provision of the service, as well as efficiency, safety,

¹⁰ ANEEL stopped issuing auctions with a RAP Degrau payment structure beginning in 2007.

¹¹ The IPCA, or Extended National Consumer Price Index, is calculated by IBGE (a government agency) and reflects the average cost of living in 11 major Brazilian cities for families with incomes of up to 40 minimum monthly salaries, akin to minimum wage in the United States. The *Índice Geral de Preços do Mercado* (IGP-M) is an inflation index published by the *Fundação Getúlio Vargas*.

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courtesy toward the users of the service, reasonable rates as envisioned by the continuing effort of the company to minimize costs, social integration, and preservation of the environment.

The transmission company must provide an annual report to ANEEL that summarizes the technical performance of the transmission assets under its concession. This report shall include information regarding levels of availability, efficiency, etc. The transmission company must also maintain an up-to-date maintenance plan of the transmission lines.

Auction Process

The auction process begins with the publication of the Notice of Auction – Portuguese: *Edital Do Leilão* for the transmission line concessions. Interested parties must complete their registration online in order to participate in the auction. Parties can request clarification in writing, conforming with the timeline posted with the Notice of Auction which includes a chronogram of deadlines and specific milestones of the auction process. Interested parties may request to visit existing transmission and/or distribution lines, substations, and other installations that are relevant to the auction.

Legally constituted domestic or foreign entities, alone or combined in a consortium, may participate in the auction as proposers. Additionally, investment funds – Portuguese: *Fundos de Investimento em Participações* (FIP) and private pension funds may participate either alone or combined in a consortium with other FIP and/or private pension funds. The participation is conditional on the participation of one or more private entities in the consortium that are not characterized as FIPs. Distribution Agents are not permitted to participate in the auction process.

Upon selecting the auction winner, the awarded transmission company will enter into separate contracts with different entities as follows: (1) a concession contract – Portuguese: *Contrato de Concessão* with ANEEL; (2) a contract to provide transmission services – Portuguese: *Contrato de Prestação de Serviços de Transmissão* (CPST) with ONS; (3) and connection contracts to the transmission installations – Portuguese: *Contratos de Conexão às Instalações de Transmissão* (CCT) with different users pursuant to *livre acesso* rules.¹² The concession owner must also enter into contracts to share installations – Portuguese: *Contrato de Compartilhamento de Instalações* (CCIT) when required.

Typically, the concession contract is for a 30-year concession term with a construction period of between 24 and 60 months. Upon signing the contract, the transmission company awarded the contract has 120 days to present ANEEL with the basic project documentation of the transmission installations to be built. ANEEL has 90 days after receiving the basic project documentation to respond with changes to the basic project and to verify that the project conforms with the technical requirements established in the auction specifications. The transmission company must begin commercial operations on the project within the time frame set forth in the concession contract or be subject to penalties specified in the concession contract, national legislation, or the CPST.

The auction response consists of two envelopes delivered by bidders, typed or printed electronically on A4 size paper without corrections, erasures, blemishes, or additions, and initialed on all pages by the legal representative of the bidding company, with all pages numbered sequentially. All documents produced by the proposer shall be signed by a legal representative, notarized, and signed and dated on the last page, with the printed name of the signatory.

¹² The winning transmission company has 60 days after entering into the concession contract to sign the CPST with ONS and the CCT with the different users to ensure *livre acesso*.

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Bidders must provide a Proposal Guarantee – Portuguese: *Garantia de Proposta* equal to 1 percent of the calculated maximum RAP established by ANEEL either in cash deposit, bank guarantee, or public debt certificates payable to ANEEL (i.e., ANEEL as the beneficiary). The Proposal Guarantee is returned to auction losers within five business days after publication of adjudication of the auction. For the auction winner, the Proposal Guarantee is substituted with the Performance Guarantee – Portuguese: *Garantias de Fiel Cumprimento* which is 5 percent of the calculated maximum RAP, payable to ANEEL for the duration of the anticipated construction of the project plus 90 days beyond the anticipated date of commercial operations commencement. For example, for Auction No. 02/2013, unjustified delays for commencing commercial operations would trigger the execution of the Performance Guarantee that protects ANEEL from such delays.

As previously mentioned, the auction winner is the transmission company bidding the lowest accepted RAP. The winners must provide a set of qualification documents – Portuguese: *Documentos de Habilitação* that show that the winner has the legal, technical, and financial means to fulfill the requirements outlined under the auction. For example, the winning bidder has to demonstrate with financial ratio calculations that their respective company is financially healthy. The ANEEL Auction Commission – Portuguese: *Comissão Especial De Licitação* (CEL) would analyze the qualification documents for completeness and compliance. Table 8 summarizes the qualification documents required as part of the auction process.

Table 8. Summary of Qualification Documents (*Documentos de Habilitação*) Required to Grant the Concession

Qualification Document	Description
Technical Requirements	1. Proof of registration and regularity with the responsible Engineering Technical Regional Council, Architecture and Agronomy (CREA). 2. Contracts or letters of commitment with all contractors that will carry out the construction, assembly, operations, and maintenance functions. 3. Certificate showing that the bidder or contractor has among its permanent staff high level professionals who are holders of CREA certificates for execution or supervision of the construction, assembly, maintenance, and operation of the transmission lines and substations with loads greater than or equal to 220 kV. 4. Proof of employment of professional staff.
Financial Requirements	1. Certificate showing that the company is not included in government records for civil bankruptcy, receivership, judicial recovery plans, or insolvency. 2. Latest financial statements showing that the company fulfills the auction requirements regarding liquidity, minimum capital, and equity levels, etc.
Tax Requirements	1. Certificate showing no amounts due or outstanding issues with the Brazilian Social Security Administration. 2. Certificate of good standing with the FGTS (a severance pay fund). 3. Certificate of tax compliance with the Federal Government. 4. Certificate of tax compliance with the State Treasury. 5. Certificate of tax compliance with the Municipal Treasury. 6. Certificate of compliance with federal labor requirements.

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In the event of a dispute or controversy with any decision by ANEEL or the CEL, any party has five business days to present an appeal. Other bidders will be communicated of the dispute filing and then will also have five business days to challenge the appeal. The CEL will analyze the appeal, address the issue raised by the appellant(s), and publish the decision on ANEEL's website and on the Official Registry of the Brazilian Government – Portuguese: *Diário Oficial da União*.

SIN Transmission Tariffs – TUST

Historically and up until recently, the Brazilian electric sector was fully run by the federal government and was significantly subsidized.¹³ Currently, the electric sector is partially competitive with both private and government-owned companies participating in the major electricity functions (generation, transmission, and distribution).

As previously mentioned, ANEEL is the governmental agency in charge of regulating the electric sector in Brazil. This regulatory function is similar to that of the FERC in the United States. In fact, similar to the FERC and as part of its regulatory function, ANEEL serves as a judge to resolve conflicts between the different entities involved in the electric market. However, ANEEL has some unique functions that are akin to those that typically fall under the purview of the Independent System Operators (ISOs), Regional Transmission Organizations (RTOs), and State Public Service Commissions in the U.S. For example, ANEEL implements all MME mandates regarding new generation and transmission investments. That is, ANEEL implements what MME (and other entities under MME's umbrella) decides needs to be built and under what terms. ANEEL also develops the energy tariffs for most of the market participants.

The current tariffs that regulate access to the SIN are called the Transmission System Use Tariffs – Portuguese: *Tarifas de Uso do Sistema de Transmissão* (TUST), and were originally set forth in ANEEL Resolution No. 281/1999. The TUST aim is to fulfill a number of objectives, including: (1) ensure non-discriminatory treatment of users; (2) ensure the recovery of costs compatible with standard costs;¹⁴ (3) encourage new investments for expansion of the electric system; (4) encourage the rational use of the electric system; and (5) minimize the costs both to operate and expand the electric system. For the Itaipu Dam transmission line, there is a special tariff, the Transport Tariff of Itaipu – Portuguese: *Tarifa de Transporte de Itaipu*. Specifically, the TUST are divided into three sub-tariffs: (1) TUST-RB sets forth the tariffs for transmission lines greater than or equal to 230 kV, which are applicable to all the SIN users; (2) TUST-FR is specific to distribution lines below 230 kV, which allocates costs to the distribution agents; and (3) TUST-G is specific to energy generators.

The TUST have changed over the years, including a major change in the methodology for calculating the rates with the incorporation of nodal (localized) pricing. The TUST are readjusted annually, with tariffs effective for a 12-month period beginning each July 1. The TUST are calculated based on the results of a nodal simulation, simulating the grid configuration including transmission lines, substations, power generators, the total revenue to be collected, and other parameters as established in

¹³ An interesting fact is that from 1974 until 1995, the tariffs were the same by type of retail customer (i.e., all residential customers had the same tariff and all commercial customers had the same tariff) in the entirety of the country, regardless of location. Areas of the country that operated under economic surpluses subsidized the electricity for areas of the country where companies were operating under economic losses. This system was called the “rate equalization regime.”

¹⁴ Standard costs – Portuguese: *custos-padrão* are asset replacement costs as incorporated in ANEEL's Price Reference Book.

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ANEEL's normative resolution (REN) 117/04.¹⁵ The total revenue requirements which comprise the TUST include the sum of the RAP to be paid to all transmission companies, a portion of the operating costs of the ONS, an adjustment payment corresponding to any difference in revenue from the previous period and the revenue forecast for transmission assets anticipated to begin operations during the 12-month period, and other costs including the True-Up PA – Portuguese: *PA Apuração*, a true-up mechanism used by the ONS to validate the charges.

Another significant change in the methodology to calculate the TUST occurred in 2010 pursuant to ANEEL's Normative Resolution – Portuguese: *Resolução Normativa* No. 399 which established a mechanism to gradually incorporate on-peak/off-peak pricing in the TUST. The resolution established that the MUST contracted during on-peak time, which were historically zero, would gradually increase over time. The 2013 – 2014 cycle is the first cycle with complete calculation and incorporation of on-peak and off-peak pricing, based on the proportion of MUST that falls under on-peak and off-peak times.

The transmission tariffs are calculated based on a methodology that assigns costs that users impose to the National Grid in periods of high demand during normal operations calculated considering the investment, operation, and maintenance of the grid needed to transport the flow of energy in high demand periods. The charges are adjusted to the amount necessary to cover the costs of the transmission system by an additive rate that preserves the relative charges between different users.

The current TUST for the period July 1, 2013 through June 30, 2014 establishes nodal rates for generators, consumers, and self-generators that have access to the National Grid; energy import/export agents; and energy distributors. The ONS is responsible for managing the invoicing, collection, and settlement services for use of the transmission facilities pursuant to TUST-RB and TUST-FR.

Sample Calculation of TUST-RB for 2013

The TUST-RB is calculated and approved by ANEEL every year for the 12-month period beginning July 1 through a multi-step process that culminates with ANEEL approving a Discovery Resolution – Portuguese: *Resolução Homologatória* that sets forth the TUST-RB. Using the 2013 – 2014 cycle as an example, the major steps taken to approve the TUST-RB can be summarized as shown below:

- Step 1: The ONS calculates the cost recovery portion of its budget to be recovered via the TUST-RB. For the 2013 – 2014 cycle, for example, the ONS 2013 – 2014 budget totals R\$511.2 million; R\$487.3 million of which it plans to recover through TUST-RB (as shown in Table 9).
- Step 2: The sum of: (1) the RAP; (2) the RAP RBNI for installations established by resolution and not by auction; and (3) the RAP RBSE for concessions connected to the National Grid prior to December 31, 1999 is determined for the annual cycle and approved by ANEEL via a *Resolução Homologatória*. This resolution determines the RAP for each of the concessions for the respective annual cycle.
- Step 3: All the other components of the TUST-RB are determined, e.g., specific TUST to recover ONS costs or exporting costs such as TUSDg ONS, TUSDg T, etc.

¹⁵ Another important parameter considered when calculating the TUST is the Contracted Amounts of the Transmission System – Portuguese: *Montantes de Uso do Sistema de Transmissão* (MUST) which represents the amounts of contracted energy. The MUST ensures that the energy generated is fully contracted by the distributors.

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- Step 4: TUST-RB for on-peak and off-peak periods is calculated using nodal simulation and is approved by resolution.

The first step needed to calculate the TUST-RB is to determine the revenue requirements to be recovered during a given period. For the tariff year 2013 – 2014, the majority of the revenue requirements relates to RAP, anticipated RAP for new installations, *PA Apuração*, and costs related to the international interconnection. Table 9 shows the revenue requirements used to establish the transmission system nodal tariffs for the TUST-RB for the 2013 – 2014 cycle.

Table 9. Cycle 2013-2014 Total Revenue Requirements Used to Establish Nodal Tariffs for Use of the Transmission System (TUST-RB)

Parameters	2013-2014 Cycle (R\$)	2013-2014 Cycle (USD\$)	Percentage of Total
Value Added to the RAP as an Incentive ¹	R\$5,351,323	USD\$2,432,420	0.1%
Previous Cycle Adjustments	14,760,252	6,709,205	0.2
<i>PA Apuração</i>	-275,335,414	-125,152,461	-3.2
PA for Installations without prior RAP	3,966,236	1,802,835	<0.1
RAP for RBNI ²	144,984,426	65,902,012	1.7
RAP for RBSE ³	1,993,729,049	906,240,477	23.5
RAP for Concessions through Auctions	4,864,124,161	2,210,965,528	57.2
Anticipated RAP for Transmissions before June 30, 2014	1,061,237,899	482,380,863	12.5
International Interconnects	296,376,445	134,716,566	3.5
Other Adjustments	<u>-289,416</u>	<u>-131,553</u>	<u><0.1</u>
<i>Subtotal</i>	<i>R\$8,108,904,961</i>	<i>USD\$3,685,865,891</i>	<i>95.4</i>
Cost Recovery Portion of ONS Budget	487,269,000	221,485,909	5.7
Other Adjustments ⁴	<u>-95,375,760</u>	<u>-43,352,618</u>	<u>-1.1</u>
Total	R\$8,500,798,201	USD\$3,863,999,182	100%
Exchange rate assumed of USD\$1 = R\$2.20.			
¹ Pursuant to REN 270/07, reflects financial incentives that transmission concessions receive for meeting certain goals on the amount of unplanned disconnections from the grid. It is known as the component Q of the Factor X (as further discussed in this report).			
² Pursuant to ANEEL Resolution No. 167 of 2000, reflects sum of RAP for the RBNI reflecting revenue requirements for installations authorized by ANEEL Resolution.			
³ Pursuant to ANEEL Resolution Nos. 166 and 167 of 2000, reflects sum of RAP for transmission concessions that were connected to the National Grid before December 31, 1999.			
⁴ Reflects adjustments for <i>Passivo Termonorte I and II</i> , and other adjustments.			

Source: *Nota Técnica nº154/2013- SRT/ANEEL – Estabelecimento das Tarifas de Uso do Sistema de Transmissão – TUST para o ciclo 2013-2014.*

The revenue requirements shown in Table 9 are allocated 50 percent to the consumer segment of the TUST and 50 percent to the generation/production segment. Table 10 shows how this allocation is performed.

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Table 10. Cycle 2012 – 2013 Allocation of Total Revenue Requirements to the Consumer Segment and the Generation/Production Segment

Line No.	Parameters	2013-2014 Cycle (R\$)	2013-2014 Cycle (USD\$)	Percentage of Total
1	Total Revenue Requirements from Table 9	R\$8,500,798,201	USD\$3,863,999,182	100%
	<u>Allocation to the Generation/Production Sector</u>			
2	50% of Revenue Requirements	R\$4,250,399,101	USD\$1,931,999,591	50.0
3	Reduction from TUSDg ONS ^{1,2}	-41,780,037	-18,990,926	-0.5
4	Reduction from TUSDg T ^{1,3}	-32,669,000	-14,849,545	-0.4
5	Difference for Stabilized Rates	<u>1,671,160,860</u>	<u>759,618,573</u>	<u>19.7</u>
6	Total Generation/Production Sector (Sum of Lines 2 through 5)	R\$5,847,110,924	USD\$2,657,777,693	68.8
	<u>Allocation to the Consumer Sector</u>			
7	50% of Revenue Requirements	R\$4,250,399,101	USD\$1,931,999,591	50.0
8	Difference for Stabilized Rates	<u>-1,671,160,860</u>	<u>-759,618,573</u>	<u>-19.7</u>
9	Total Consumer Sector (Sum of Lines 7 and 8)	R\$2,579,238,241	USD\$1,172,381,019	30.3
10	Total Generation/Production and Consumer Sector TUST-RB (Sum of Lines 6 and 9)	R\$8,426,349,165	USD\$3,830,158,711	99.1
11	Reduction from TUSDg ONS ¹	41,780,037	18,990,926	0.5
12	Reduction from TUSDg T ¹	<u>32,669,000</u>	<u>14,849,545</u>	<u>0.4</u>
13	Total Revenue Requirements	R\$8,500,798,201	USD\$3,863,999,182	100%

Exchange rate assumed of USD\$1 = R\$2.20. Amounts might not be exact due to rounding.

¹ Amounts to be raised by generators in the context of distribution as TUSDg. These amounts are transferred to the transmission companies and to the ONS.

² TUSDg ONS reflects the portion relating to the funding of the ONS. Only about 30 distribution companies pay this charge.

³ TUSDg T reflects the portion relating to the funding of the exporting capacity of the National Grid. Only five distributors pay the TUSDg T, with the majority of the payment (approximately 75 percent) going to *Centrais Elétricas Matogrossenses S.A. (CEMAT)*.

Source: *Nota Técnica nº154/2013 – SRT/ANEEL- Estabelecimento das Tarifas de Uso do Sistema de Transmissão – TUST para o ciclo 2013-2014.*

The results of the nodal simulation for the recovery of the R\$8,500,798,201 for the 2013-2014 cycle establishes several different TUST rate schedules, including the following:

- TUST for REN 267/2007 Generators: This first rate schedule reflects the TUST for each generator covered under REN 267/2007.¹⁶ This TUST is calculated on a R\$/kW-month basis, is specific to each generator, and for 2013 – 2014, ranges from R\$0.599/kW-month to R\$18.388/kW-month (USD\$0.272 – USD\$8.358/kW-month).
- TUST-RB On-Peak and Off-Peak Unregulated Customers:¹⁷ This schedule shows, for each connection point of the National Grid and corresponding busbar, the on-peak and off-

¹⁶ Generators covered under ANEEL's *Resolução Normativa nº 267* (currently repealed), whereby the solicitations used for auctioning new transmission projects (previous to the auction) presented a group of 10 TUST (one per year for each tariff cycle), adjusted during each tariff cycle and applicable to new generators that would be directly connected to the National Grid.

¹⁷ Covers not only unregulated customers, but also potential unregulated customers and self-generators that have load-taking capabilities directly from the National Grid.

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peak rate, also on a R\$/kW-month basis. For 2013 – 2014, the rate ranges from R\$0.398/kW-month to R\$2.052/kW-month (USD\$0.181 – USD\$0.933/kW-month).

- TUST-RB On-Peak and Off-Peak Applicable to Concessions: This schedule is the biggest of the TUST and presents specific rates for each of the concessions (transmission companies) by busbar and connection point. Rates are also presented on a R\$/kW-month basis and vary significantly, with most rates between approximately R\$0.90/kW-month and R\$1.50/kW-month (USD\$0.41 – USD\$0.68/kW-month).

The Transport Tariff of Itaipu for 2013 is a monthly payment of R\$15,259/MW (USD\$6,936/MW). This amount is calculated by dividing the revenue requirements for the Itaipu transmission line (inclusive of the adjustment component – Portuguese: *Parcela de Ajuste*) of R\$206,721,816 (USD\$93,964,462) by the 2013 expected capacity of 11,255 MW, and then multiplying by 12.¹⁸ The Transport Tariff of Itaipu is paid directly to the Itaipu transmission owner, FURNAS.

TUST-RB Impact on Retail (End-Customers)

In the previous sections of this report, we discussed the energy sector in Brazil, the SIN, and the tariffs, with an emphasis on the transmission tariffs (TUST). In this subsection, we will discuss the impact of the TUST-RB on retail customers.

All residential customers are subject to the same rate structure, except that they can voluntarily enroll to receive service under the rate structure white tariff – Portuguese: *modalidade tarifária branca*. Under this structure, available beginning in January 2014, residential customers would have the option to elect to be subject to on-peak, mid-peak, and off-peak pricing differentials. Consumption on the weekends would be considered off-peak (reduced pricing), while consumption during the weekdays would be considered either on-peak or mid-peak, depending on the different distribution companies. The on-peak hours pricing would occur at periods of higher load, generally during the evenings (6:00 p.m. – 9:00 p.m.). Mid-peak hours pricing would vary according to where the customer is located (by distribution company) and would be set for periods not during on-peak or off-peak hours.

Large commercial users receiving service via high voltage lines can choose one of three rate structures: conventional, green tariff – Portuguese: *modalidade tarifária verde*¹⁹, and blue tariff – Portuguese: *modalidade tarifária azul*. Conventional charges have constant rates throughout the year. The green tariff has a constant rate for demand charges (kW) and usage rates in kilowatt-hours (kWh) that vary depending on time of use and period of use. Since Brazil relies heavily on hydropower, the period of use allows for tariff differentiation consistent with the hydrological conditions of the country. Under the green tariff, the demand charges (kW) vary with time of use and the usage charges (kWh) vary depending on time of use and period of use.

The electric bill for retail customers in Brazil has two major components: Portion A – Portuguese: *Parcela A* and Portion B – Portuguese: *Parcela B*. *Parcela A* reflects the pass-through (unavoidable) charges that the Discos recover from their customers. These unavoidable charges relate to the costs the distributors incur to buy electricity from the generators, the Sectorial Charges

¹⁸ Exchange rate assumed of USD\$1 = R\$2.20.

¹⁹ The green tariff does not have any relation to the electricity generated from renewable sources. In the United States, green is often associated with renewable generation but this is not the case in Brazil.

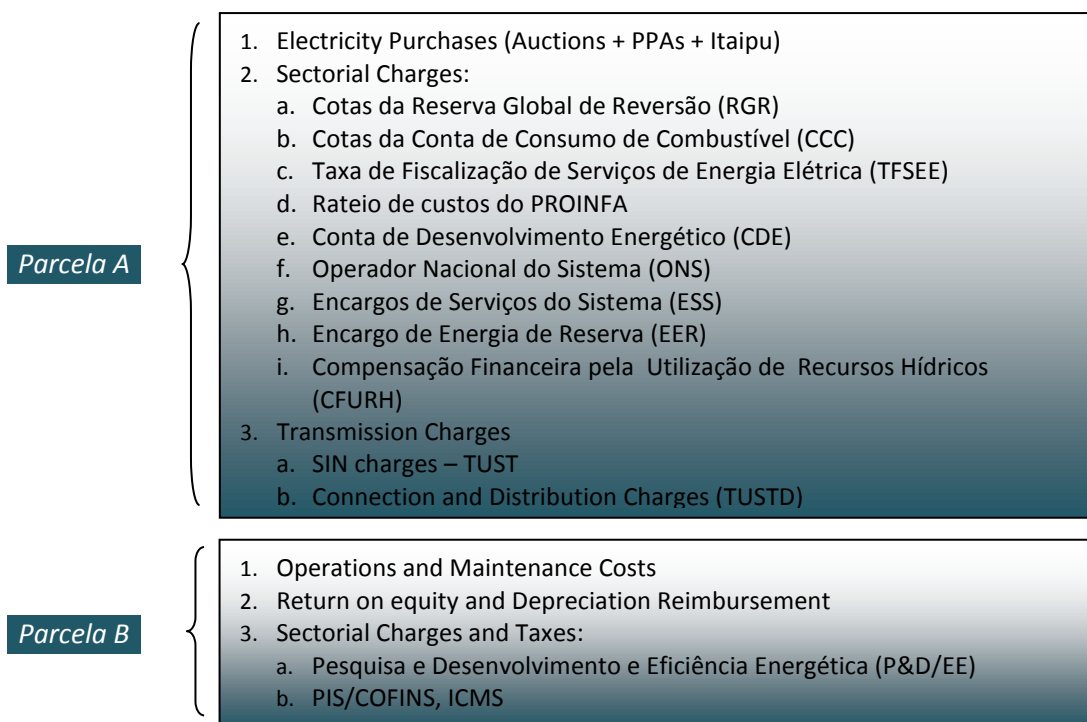
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(subsequently defined in this report), and the transmission charges. The Discos are prohibited from generating a profit on these charges.

Parcela B covers the prudently incurred operational, maintenance, and capital costs for the distributors. *Parcela B* includes: (1) all prudently incurred operating costs (e.g., personnel, materials, supplies, equipment, etc.); (2) return on equity and Depreciation Reimbursement – Portuguese: *Cota de Depreciação*; (3) Investments in Research and Development and Energy Efficiency – Portuguese: *Investimentos em Pesquisa e Desenvolvimento e Eficiência Energética* (P&D/EE); and (4) taxes and other fees such as the PIS/COFINS (subsequently defined in this report). These costs are referred to in Brazil as “management costs” because the distribution concessions have the ability to “manage” them. The return on equity ensures that the capital invested in the Discos is being compensated. ANEEL calculates the rate of return on equity which is applicable to prudently incurred rate base. The Depreciation Reimbursement ensures that the distributors have a mechanism to complete ongoing asset replacements on the plant-in-service. ANEEL calculates a depreciation rate that is applied to the prudently incurred rate base to calculate the Depreciation Reimbursement.

The charges from *Parcela B* are updated annually by the inflation index IGP-M, as developed by the *Fundação Getúlio Vargas*, reduced by a so-called “Factor X” which represents the productivity gains on distribution activities that are passed along to retail customers. A summary of the components of *Parcela A* and *Parcela B* are shown in Figure 3.

Figure 3. Components of Retail Service Bills



Source: *Por Dentro da Conta de Luz Informação de Utilidade Pública*, ANEEL.

As shown in Figure 3, retail customers pay four subsets of charges: charges for generation, charges for transmission and distribution, taxes (such as the PIS/COFINS, ICMS, etc.) and other

contributions such as the contribution for public lighting,²⁰ and Sectorial Charges – Portuguese: *Encargos Setoriais*.²¹ According to ANEEL, as of January 24, 2013, of each R\$100 paid by retail customers in Brazil, an average of R\$35.8 goes to the generators, R\$24.5 to pay taxes, R\$23.6 to the distributors, R\$9.5 to the Sectorial Charges and to cover other government regulated charges, and only R\$6.6 to the transmission companies.²²

Starting January 24, 2013, ANEEL published new retail service rates that have significantly decreased the costs to retail customers, with an average reduction on bills of approximately 20.2 percent. These savings were made possible due to: (1) the renewing of concessions with lower prices for generators that were set to expire (lower prices achieved by a new tariff regime that takes into account only operations and maintenance costs); (2) reduction of the Sectorial Charges and central government subsidies;²³ (3) revenue reduction of renewed transmission contracts; and (4) elimination of subsidies to the tariff structure. With these changes, the average bill of R\$100 was lowered to about R\$79.80. Transmission charges, for example, decreased from R\$6.6 to R\$2.6.

Actualization of Major Revenue Requirements Over Time

As shown earlier in Table 9, there are several components that comprise the revenue requirements forming the base for calculating the TUST. The major components are: the RAP, which represents about 95.2 percent of the total revenue requirements,²⁴ the recovery of a portion of the ONS budget which represents about 5.7 percent, the international interconnect revenue requirements which represent about 3.5 percent, and other adjustments worth about -4.4 percent of the total revenue requirements. In this section, we will explore the process by which the RAP gets updated annually for each new tariff cycle.

RAP Actualization

Each year, coinciding with the new tariff cycle starting July 1, the individual concession RAP gets updated by inflation factors pursuant to the specific terms contained in the concession agreement entered into the transmission Company and ANEEL. Additionally, the individual RAP gets updated through periodic tariff revisions around every four years or so, also pursuant to the terms included in the concession contract and through extraordinary tariff revisions, as needed.²⁵ The extraordinary revisions, as the name implies, can be performed at any given time to address cases in which there is a gross disequilibrium between costs and revenue requirements.

Using the Notice of Auction – Portuguese: *Editais do Leilão* No. 02/2013-ANEEL from June 2013, which is the latest auction process in which a concession winner has been declared, specifically as set

²⁰ The *Programa de Integração Social* (PIS) is a 1.65 percent social contribution tax, payable based on gross revenues of the electric companies, and targeted to pay for unemployment insurance and aid to low-paid workers. *Contribuição para Financiamento da Seguridade Social* (COFINS) is a 7.60 percent tax payable based on gross revenues of the electric companies. *Imposto sobre Circulação de Mercadorias e Serviços* (ICMS) is a state tax.

²¹ Sectorial Charges are a set of approximately nine charges imposed on retail customers to fund certain government programs (e.g., to fund the ONS, to fund renewable generation, to pay state and federal government for the use of water to produce electricity – 6.78 percent of the total value of the monthly energy produced, etc.)

²² *Por Dentro da Conta de Luz Informação de Utilidade Pública*, ANEEL.

²³ The Brazilian government, through the Treasury, provides direct funds to lower the charges. In fact, the federal government has already used R\$9.2 billion between January and July 2013 – which is a significant increase compared to R\$1.9 billion over the same period in 2012 – in direct subsidies to achieve the bill reductions.

²⁴ Inclusive of: value added to the RAP as an incentive, RAP for RBNI, RAP for RBSE, and anticipated RAP for new transmissions before June 30, 2014 (reference Table 9).

²⁵ Some of the new concessions have the RAP updated every five years.

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forth in Clause Six – Portuguese: *Cláusula Sexta* of the concession contracts, the periodic annual tariff revision is performed pursuant to the following equations and considerations:²⁶

(1) $RAP_i = RPB_i + RPC_i$

Where:

RAP_i = *Receita Anual Permitida* for the annul period i ;

i = Annual Period (July 1 – June 30 of the subsequent year);

(2) RPB_i = Parcela of RAP for the period i ;

RPC_i = Component of RAP for the period (i) for other equipment that is not part of the SIN, referred to in Portuguese as *Demais Instalações de Transmissão* (DIT),²⁷ calculated as follows:

(3) $RPC_i = RPEC_i + RCDM_i$

Where:

(4) $RPEC_i = RPEC_{i-1} \times IVI_{i-1}$

(5) $RCDM_i = RCDM_{i-1} \times IVI_{i-1} + (RCDMA_{i-1} \times IVI_{i-1}) \text{ pro rata}$

Where:

$RPEC_i$ = Component of RPC_i regarding DITs; for the first adjustment period the value of this installment in the *data de referência anterior* corresponds to 2.13 percent of the RAP.²⁸ In the absence of any DIT, the value is zero.

IVI_{i-1} = Quotient of the Broad Consumer Price Index – Portuguese: *Índice de Preços ao Consumidor Amplo* (IPCA) index, calculated by the Brazilian Institute of Geography and Statistics – Portuguese: *Fundação Instituto Brasileiro de Geografia e Estatística* (IBGE), or, in the event of its dissolution, the index defined by ANEEL to succeed it, calculated for the month of May from the period ($i-1$) to the period ($i-2$).

$RCDM_i$ = Component of RPC_i corresponding to the installation, substitution, or renewal of the transmission installation's equipment [Renewal and Replacements (R&R)] targeting increases of transmission capacity or reliability on the SIN authorized by ANEEL resolution. In the absence of any DIT, the value is zero.

$RCDMA_i$ = Component of $RCDM_i$ corresponding to R&R targeting increases of transmission capacity or reliability on the SIN that enters commercial operation in the period ($i-1$), authorized by ANEEL resolution. This revenue will accrue from the month of entry into commercial operation of the respective installation, and the value for the period ($i-1$) will

²⁶ Please note that each concession contract may have different methodologies for calculating the updated RAP. The methodology covered herein is applicable only to concessions pursuant to Notice of Auction No. 02/2013-ANEEL. Exeter did not review RAP updating methodology for older concessions which may be different from what is shown herein.

²⁷ Other transmission installations include transmission lines, busbars, transformers, and power equipment substations at any voltage when used as part of power plants. Facilities and associated equipment, at any voltage level when used exclusively for the import and export of electricity and not designated as transmission facilities for international interconnections, and transmission lines, busbars, transformers, and power equipment substations at voltages below 230 kV, irrespective of location.

²⁸ *Data de referência anterior* denotes the reference date of the last adjustment or revision in accordance with the terms of the concession contract.

correspond to the annual revenue authorized for the new installation, updated for the *data de referência anterior* and calculated pro rata.

AND;

$$(6) \text{ RPB}_i = \text{RBL}_i + \text{RBNL}_i$$

Where:

$$(7) \text{ RBL}_i = \text{RBL}_{i-1} \times \text{IVI}_{i-1}$$

$$(8) \text{ RBNL}_i = \text{RBNL}_{i-1} \times \text{IVI}_{i-1} + (\text{RBNIA}_{i-1} \times \text{IVI}_{i-1}) \text{ pro rata}$$

RBL_i = Component of RPB_i regarding substations, transmission lines and its terminals, transformers and their connections, and other equipment designed to fulfill functions of voltage regulation, power control flow, or frequency conversion. During the first readjustment period, the value in *data de referência anterior* would correspond to 98.7 percent of the original RAP.

RBNL_i = Component of RPB_i corresponding to R&R targeting increases of transmission capacity or reliability on the SIN authorized by ANEEL Resolution.

RBNIA_{i-1} = Component of RBNL_i corresponding to R&R targeting increases of transmission capacity or reliability on the SIN authorized by ANEEL Resolution which went into operation in the period (_{i-1}). This portion of revenue will be payable beginning in the first month of commercial operation of the respective installation. The amount calculated for the period (_{i-1}) shall correspond to the authorized annual revenue for the new installation, updated for the *data de referência anterior* and calculated pro rata.

The RAP for the year (_i) would then be increased or decreased by a *parcela de ajuste* (PA) which would correspond to the difference between the revenue billed by the transmission company for the period (_{i-1}) for providing its transmission services and the algebraic sum of the RAP on the year (_{i-1}), with the adjustments established for such period. The monthly difference is updated by the IPCA accumulated up until the month of May of the period (_{i-1}). This updated RAP is invoiced by the transmission company in 12 monthly installments (one installment per month) to the users of the SIN pursuant to the conditions of the CPST. The RAP is subject to monthly reductions reflecting conditions of service pursuant to the methodology set forth in the CPST.

For example, concession Contract No. 018/2010 of December 23, 2010 was granted to *Empresa de Transmissão de Várzea* to build and operate approximately 850 meters of a 230-kV transmission line, and two substations. The project was expected to commence 24 months after the concession was adjudicated; it was energized on December 16, 2012. This meant that the first year that the RAP corresponding to this project was included in the TUST calculations was for the 2012 – 2013 cycle. It was included as an anticipated RAP for transmissions anticipated to be connected between July 1, 2012 and June 30, 2013. The amount of the original RAP given at the time of the concession was R\$2,960,000. The RAP was adjusted from the date of concession of December 23, 2010 to the 2012 – 2013 cycle by the IPCA index for two years. The RAP for the 2012 – 2013 cycle was established at R\$3,397,541, approximately 14.8 percent higher than the original auction RAP, and was subsequently increased for the 2013 – 2014 cycle by the IPCA index for that year of 6.50 percent to R\$3,614,522, which is the amount included for this project on the TUST for this cycle.

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As an example, Contract No. 018/2010 is rather simple in that the only RAP adjustments incorporated were related to inflation adjustments. This example is shown to present two important considerations: (1) the RAP is only included in the TUST for the cycle when the project is anticipated to be energized; and (2) the RAP during the first cycles, and to the extent that there are no ANEEL authorized improvements on the project, only gets updated by the inflation indexes (IPCA or IGP-M, depending on the provisions of the concession contract).²⁹

Exeter wanted to include the RAP update for more complex situations, but unfortunately this information is not easily available as the cost recovery for installations in service before 1999 is performed through the RBSE, not through the RAP. Also, older RAP concessions may use a different actualization methodology.

For the concession pursuant to the Notice of Auction No. 02/2013-ANEEL, the RAP is scheduled to be revised every five years starting with the fifth July after signing the concession contract.³⁰ The revisions scheduled for the fifth, tenth, and fifteenth years would include a recalculation of the cost of capital by the IPCA and the *Taxa Referencial de Mercado* (TRM), as well as an adjustment for cost reductions from efficiency gains.

The cost of capital for third-party capital is recalculated based on the following equation:

$$(1) \text{ rD} = [\alpha * (\text{TJLP} + \text{s1}) + (1-\alpha) * (\text{TRM} + \text{s2})], \text{ where:}$$

TJLP = Average of the last 60 months of the representative interest rate deflated by the IPCA. Also calculated based on the average of the prior 60 months up to the second month before the revision date. For Auction No. 02/2013, for example, the TJLP parameter as shown earlier in Table 7 was 6.03 percent.

TRM = Reflects the TRM as set forth in the concession contract. For example, for Auction No. 02/2013, the rate was established as 0.00 percent.

s1 and **s2** are also as established in the concession contract. For Auction No. 02/2013, s1 = 3.0 percent and s2 = 0.0 percent (see Table 7).

For the periodic revisions (every five years) of the RAP pursuant to the terms of the concession contract, the following equations and considerations are used. The RAP is recalculated using discounted cash flow methodology by estimating the annual cash flow that would equate to the liquid present value – Portuguese: *valor presente líquido* (VPL) of the cash flow of the project (FCP) to zero according to the following equation:

(1) Liquid Present Value Calculation:

$$\text{VPL (FCP; } r_{\text{WACC}}; n) = 0$$

Where:

FCP = Project Cash Flow

²⁹ From the equations previously shown, for this example, the equation that reflects the RAP change is equation (6) $\text{RPB}_i = \text{RBL}_i + \text{RBNL}_i$; specifically, the subcomponent RBL_i as calculated pursuant to equation (7) $\text{RBL}_i = \text{RBL}_{i-1} \times \text{IVI}_{i-1}$. The RBL_i was adjusted during construction and the first year of operation by the IVI_{i-1} (IPCA index).

³⁰ Certain old concessions do not include periodic revisions, e.g., COPEL's concession pursuant to concession Contract No. 075/2001 does not contain a clause of tariff revision.

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r_{WACC} = Average cost of capital (discount rate)

n = Number of years of the concession

The discount rate to be used (r_{WACC}) is calculated in accordance with a WACC methodology pursuant to the following formula:

(2) WACC calculation:

$$r_{WACC} = \frac{P}{P+D} \cdot r_P + \frac{D}{P+D} \cdot r_D$$

Where:

r_P = Own capital cost

r_D = Debt cost

P = Own capital

D = Third-party debt capital

Therefore, the cash flow of the project is given by the following equation:

(3) Discounted Cash Flow Calculation:

$$FCP(t) = EBIT(t) - T(t) + d(t) - INV(t)$$

Where:

$EBIT(t)$ = Annual revenue in the year (t) before taxes and interests

$T(t)$ = Taxes for year (t)

$d(t)$ = Depreciation for year (t)

$INV(t)$ = Capital investments for year (t)

(4) Earnings Before Interest and Taxes Calculation:

$$EBIT(t) = RAP(t) - E(t) - COM(t) - d(t)$$

The total of taxes (T) for the year (t) is calculated by applying the rates of social contribution on net income (CSLL) and the tax obligation for the company (IRPJ) applied on the taxable income (LT) as set forth by the equations below:

(5) Taxable Income and Total Taxes Calculation:

$$LT(t) = EBIT(t) - JCT(t)$$

$$T(t) = (IRPJ + CSLL) * LT(t)$$

Where:

JCT = Interest on third-party capital

Depreciation (d) on year (t) is calculated pursuant to the following equation:

(6) Year Depreciation Calculation:

$$d(t) = \delta * I$$

Where:

δ = Average regulatory depreciation

I = Regulatory initial investment Itaipu

The charges (E) to be considered are set forth in the following equation:

(7) Charges Calculation:

$$E = TF + RGR + P \& D$$

Where:

TF = Fiscal rate for the services of the electric system

RGR = Global reserve of the reversal

P&D = Research and development

The Operations and Maintenance costs (COM) for the year (t) are calculated as follows:

(8) Operations and Maintenance Calculation:

$$COM(t) = \theta * I$$

Where:

θ = Rate of costs considered

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The capital expenditures (INV) taking place in the years $t_1, \dots, t_n$ after signage of the contract (t_0) are distributed in a linear manner during the period of construction. Starting with the period following the completion of construction (t_{n+1}), the cash flow becomes part of the revenue stream and is incorporated into the RAP as follows:

(9) Capital Expenditures Calculation:

$$\frac{FCP(1)}{(1 + r_{WACC})} + \frac{FCP(2)}{(1 + r_{WACC})^2} + \dots + \frac{FCP(30)}{(1 + r_{WACC})^{30}} = 0$$

Finally, the model is restricted to conform with the fact that the RAP must be constant during the concession period. The first cycle of tariff revisions was conducted between 2003 and 2006, the second for the years 2007 – 2010, and the third currently under way and anticipated to culminate in 2014. The component Q of the Factor X provides for a financial incentive to the transmission companies for uninterrupted service (reference Table 11 that shows the amount of R\$5,351,323 for the cycle 2013 –2014).

5. SIN Maps by Region and Voltage

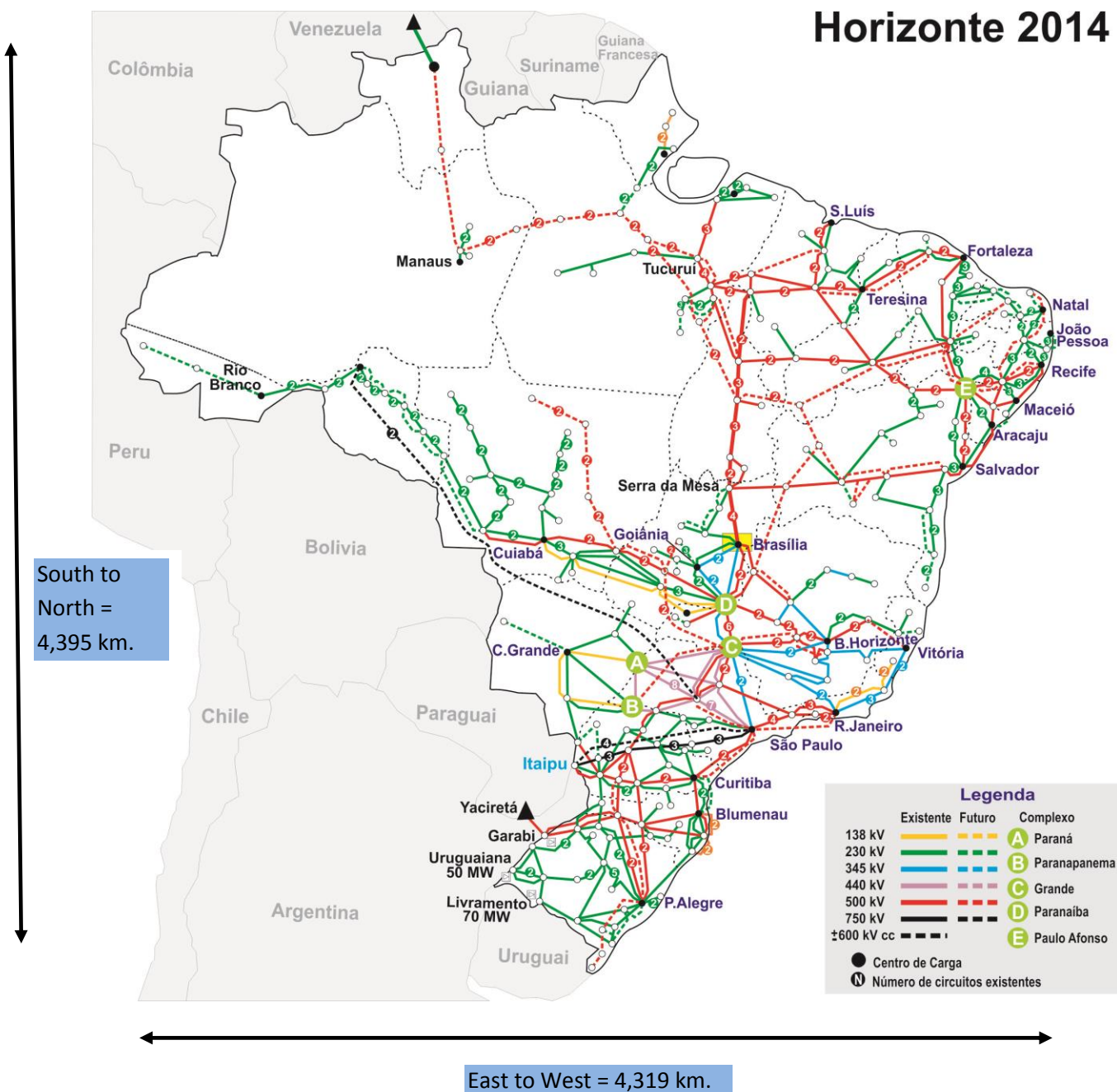
As previously mentioned, the Brazilian National Grid spans the Itaipu Dam and six regions: Intercâmbio Internacional, Sul, Sudeste, Centro-Oeste, Nordeste, and Norte (International Exchange, South, Southeast, Center-West, Northeast, and North). The National Grid transports about 96.6 percent of the entire energy production in the country.

Maps depicting the entire SIN and each of the sub regions are presented on the following pages. Map 1 shows the physical transmission infrastructure of the SIN. As shown in Map 1, Brazil extends about 4,000 km from south to north and east to west. Also worth mentioning is the fact that the SIN is expected to extend in the next few years to Venezuela with the purpose of expanding the potential for exporting electricity and enhancing the National Grid's reliability.

Map 2 shows the SIN for the *região sul* (south region) of Brazil. Map 3 shows the SIN for the *região Sudeste – centro-oeste*. Map 4 shows the SIN for the north, northeast of Brazil. Map 5 shows the SIN for the west, center-west of Brazil, while Map 6 reflects the south of the SIN.

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Map 1. SIN as of July 2013 with Projected Additions through 2014



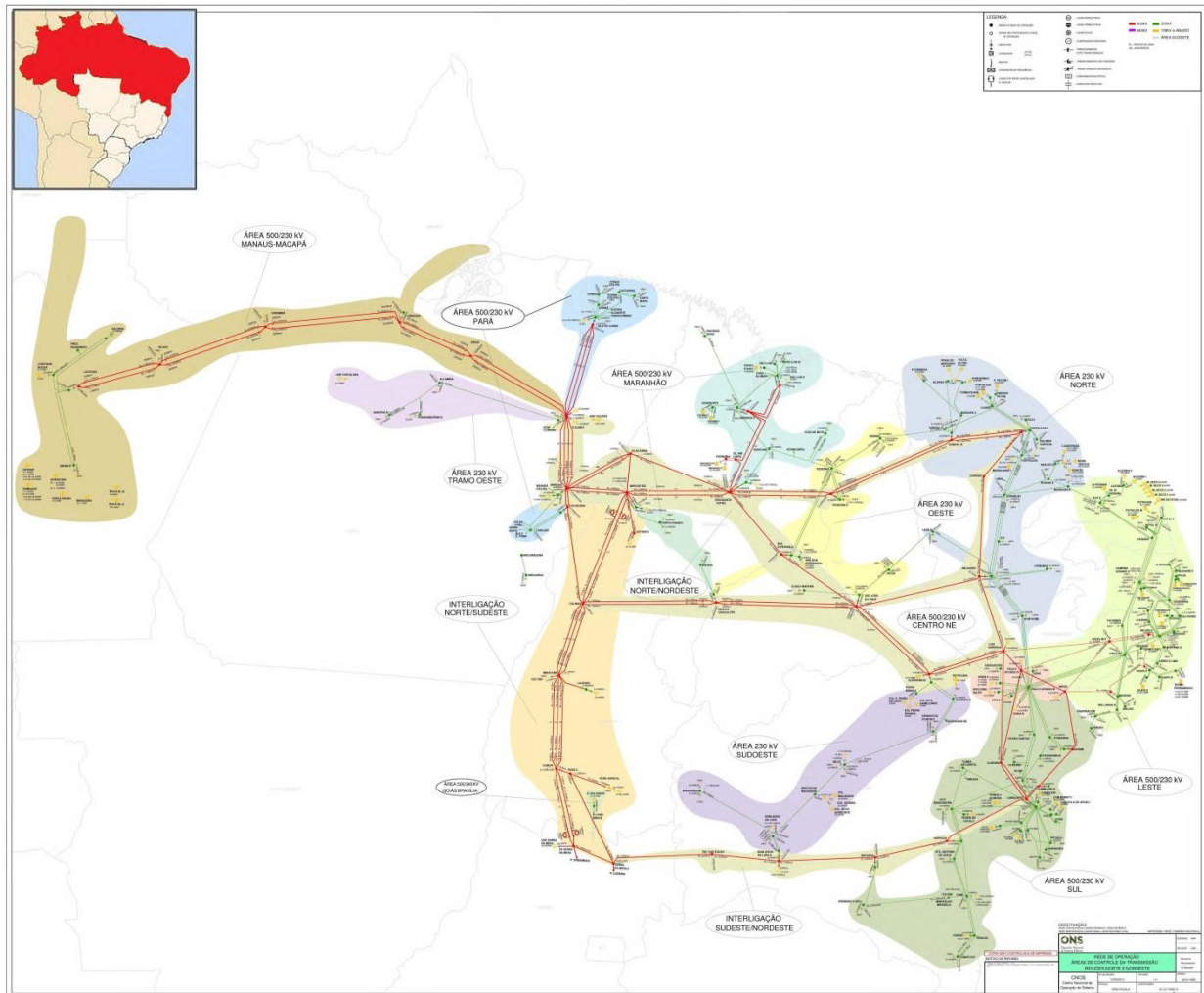
Existente = Existing transmission lines

Futuro = Future transmission lines

Source: ONS website: *Conheça o Sistema > Mapas do SIM*, http://www.ons.org.br/conheca_sistema/mapas_sin.aspx#

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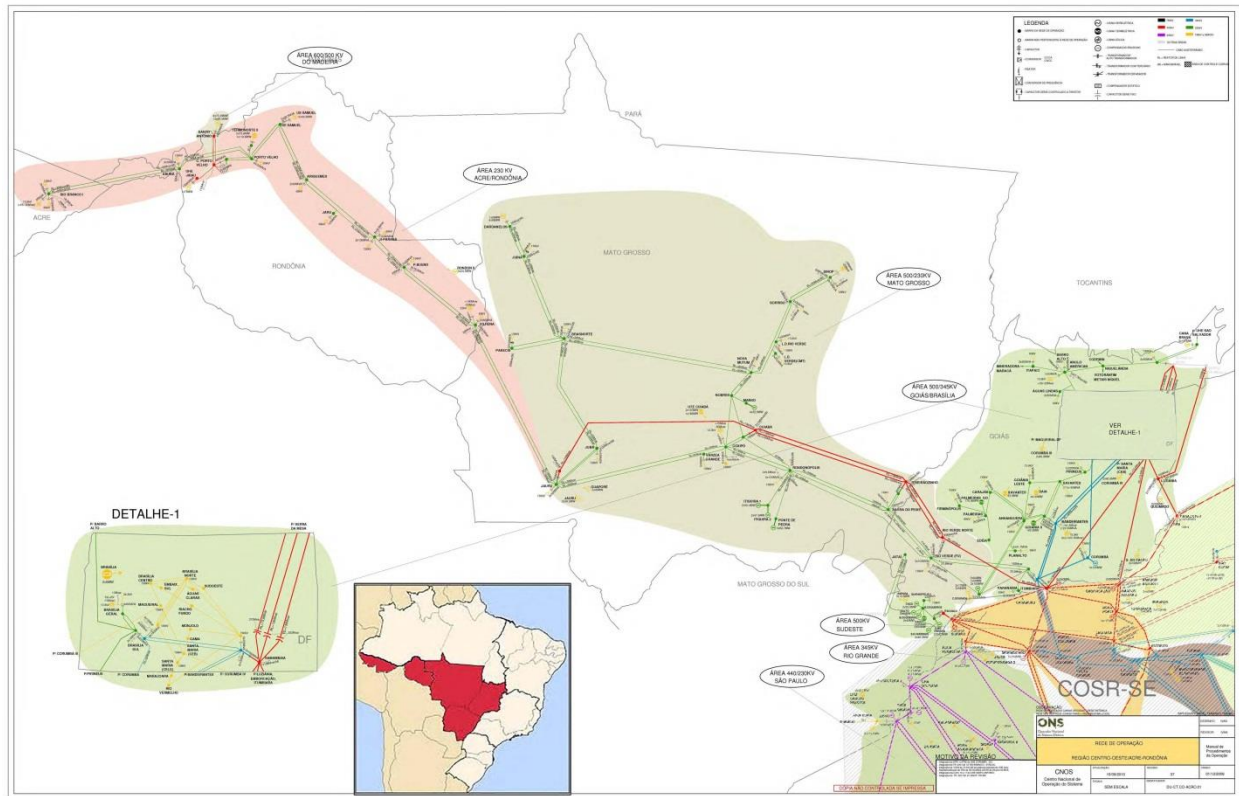
Map 4. SIN (Regiões Norte/Nordeste) as of September 2013



Source: ONS website: *Conheça o Sistema > Mapas do SIM*, http://www.ons.org.br/conheca_sistema/mapas_sin.aspx#

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Map 5. SIN (Regiões Centro-Oeste/Acre-Rondônia) as of September 2013



Source: ONS website: *Conheça o Sistema > Mapas do SIM*, http://www.ons.org.br/conheca_sistema/mapas_sin.aspx#

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