Electric Power in the Paraíba Valley, Brazil: Companies, Entrepreneurs and the State in the Construction of the Electric Power Sector (1900–1970)

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Abstract

This article examines the transformation process undergone by the electrical system in the Vale do Paraíba in the state of Sao Paulo and discusses the possibilities for developing the cities located along the transmission lines between the metropolises of Rio de Janeiro and Sao Paulo. From the 1930s to the 1950s, the Vale do Paraiba went from a region whose electrical sector was fragmented and run by municipal enterprises, to one with an electrical system connected to the system of the Light company, and, finally, from the 1960s, the region began to receive its electricity from state companies. This study traces the trajectory of the electricity sector in this region and examines the relationship between this sector and economic development.

Keywords: Brazil; electric power; electrical industry; enterprises; state; state participation; public enterprises; economic development

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Siglas usadas

AMFORP	American & Foreign Power
CESP	Centrais Elétricas de São Paulo S. A.
Comepa	Companhia Melhoramentos de Paraibuna S. A.
CPFL	Companhia Paulista de Força e Luz
CSN	Companhia Siderúrgica Nacional
DAEE	Department of Water and Electrical energy (Departamento de Águas e Energia Elétrica)
DNPM	National Department of Mineral Production (Departamento Nacional de Produção Mineral)
Eletrobrás	Centrais Elétricas Brasileiras S. A.
HP	Horse power
kW	Kilowatt
MW	Megawatt
Peesp	Electrification Plan of the State of São Paulo (Plano de Eletrificação do Estado de São Paulo)

The development of the structure of the electricity sector in Brazil reproduced, to a large degree, the formation of the country's society, i.e., it was distributed in an irregular and unequal manner both between the coast and the interior of the country and in terms of access to modern patterns of consumption. While electrical energy reached Brazil at the same time as it did the industrialized countries – during the diffusion phase of the Second Industrial Revolution – it expanded only into the most populated and most economically developed regions of the country. As late as 2003, the federal government launched a program called "Light for Everyone" whose goal was to bring electricity to some ten million people who, more than a century after the introduction of electrical energy to Brazil, still did not have access to this service.

Lack of access to electricity is worse than just being in the dark. Since electrical energy is an essential input in economic development,[1] the unequal structure of the Brazilian electricity sector reinforces, over time, the tendency towards concentration of economic activities in a continental territory such as Brazil.[2] When this sector was first being established, the regions and cities with potentially larger markets attracted electric companies and, once they had electricity, they were able to stimulate economic development. This reflected the worldwide trend in the creation of the electricity sector; in the transition to the 20th century, the largest international electric companies promoted the expansion of electricity services around the world and possessed the autonomy to enter the desirable markets, especially through municipal concessions (Hausman *et al*. 2008; Clifton *et al*. 2011). In the Brazilian case, the electricity sector during this phase was established in 1930 with a dual structure; on the one hand, the most dynamic regions of the country were dominated by two foreign companies: the Canadian-owned company Light and the U.S. American & Foreign Power (AMFORP) and, on the other, a vast area of the country was served by local and very rudimentary (or virtually non-existent) local systems (Martin 1966).

On an international level provincial or national governments came to understand the centrality of electricity for economic development during the inter-war years and increased their roles in the promotion of the electricity sector. But in Brazil, the initiatives to transform the electrical system occurred during the 1930s and 1940s, when improvement in the technology for transmitting electrical energy made it possible to integrate ever-larger regions. In part, this process responded to the interests of large companies that were now

1. For some studies that analyze the importance of the electricity sector in transformations of economic and social life see: Hobsbawm (1989); Landes (2005).
2. For studies that demonstrate this tendency to concentrate economic activities in Brazil, see: Cano (1976, 2007); Negri (1996); Castro (1969-1971); Galvão (1987).

capable of searching for more distant regions in which to generate electric power through the construction of more complex and secure delivery systems. Additionally, this was also a demand made by the Brazilian government which, at the end of WWII, needed to guarantee the provision of electrical energy in order to support the processes of industrialization and urbanization that were already underway. Thus, while it put pressure on international companies to increase the generation of electricity in their concessions, the federal and state governments themselves became responsible for the provision of energy to unserved areas (*cf.* Lima 1984).[3]

In this context, the Paraíba Valley in the State of São Paulo was the object of a profound regional transformation from the 1930s to the 1950s: the valley fulfilled the role of a nexus between the two principal economic centers of the country – the cities of Rio de Janeiro and São Paulo – and became a strategic region for the company Light (Ricci 1996).[4] As a concessionary of electricity services in these two capital regions, at the beginning of the 1930s the Canadian company endeavored to ensure the connection of the two electrical systems through the control of the dams that supplied its own electrical system, thereby guaranteeing a more secure source of energy. Thus, the structure of the electrical system in the Paraíba Valley was rapidly altered through the concentration of the sector accomplished by the acquisitions of Light. In addition, considering that the interest of the Canadian company was to supply the two largest cities in the country – Rio de Janeiro and São Paulo – the Paraíba Valley functioned as a connection corridor between Light's two markets. Without investments in the other cities along this corridor, the electrical energy available was insufficient to stimulate the industrialization process, which only occurred decades later with the execution of state government projects. Thus, it is thanks solely to greater governmental presence in the region that the conditions were created to supply electrical energy to the cities that lie between São Paulo and Rio de Janeiro, and thus to stimulate economic growth in the Paraíba Valley, which had suffered economic stagnation for decades.

The purpose of this study is to understand the transformation process undergone by the electrical system of the Paraíba Valley in the State of São Paulo, through an analysis of the

3. Nivalde de Castro calls this movement a "fragmentation pact," that is, the market and the functions of the electricity sector were divided in such a way that the state did not interfere with the areas where foreign capital was present or even tap into the electricity generated there; this was usually the case throughout the 1950s (1985:5). For Hausman *et al.*, this process was the result of the "wave" of world domestication initiated in the center of capitalism in the post-WWI era (2008, Ch. 1).
4. For the history of Light in Brazil, see: Souza (1982); McDowall (1988); Armstrong and Nelles (1988); Saes (2010).

possibilities of developing the cities in the valley in-between the economic centers of Rio de Janeiro and São Paulo. In three decades (1930 to 1950), the Paraíba Valley went from being a region whose electricity sector was fragmented and organized through municipal enterprises to one integrated through Light's system, and then, finally, to receiving energy from government companies by the end of the 1960s. This article reviews the trajectory of the electrical sector in the region, establishing a relationship between this sector and economic development. While we cannot categorically affirm that the new industrial profile of the region was exclusively the result of government investments in the 1960s and 1970s, we seek to demonstrate that the local structure of electrical energy distribution created by private interests ended up becoming a considerable obstacle to the diversification of the local economy.

THE INTEGRATION OF ELECTRICAL NETWORKS: THE COMPANY LIGHT IN THE PARAÍBA VALLEY

The first experiences in the use of electricity in Brazil go back to the 1880s. These involved the public lighting of localized areas in a few municipalities using thermoelectric generators, or even very small hydroelectric generators. Electrical energy services for larger markets were established for residents of the most modern Brazilian cities during the first years of the 20th century, as a result of the beginning of the public service concentration and modernization process at the end of the 1890s. In this embryonic stage, legislation relating to electrical energy services did not yet exist. In addition, the provisions of the 1891 constitution, which was liberal and federalist, reduced the prerogatives of the federal government to regulate the electricity sector, leaving to municipalities the responsibility for contracts and oversight. The existing technical limitations on the construction of the electrical network restricted the areas served by concessionaires. Thus, the creation of the Brazilian electricity sector was left to the relationships that came about between entrepreneurs and local governments (Saes 2010: Ch. 5).

It is in this scenario that the first large Brazilian electric companies and the Canadian company Light became the most important generators and distributors of energy in Brazil. Parnaiba, the hydroelectric plant opened by Light, was the first such commercial plant established in the country (Lamarão 1997: 297). Light entered the city of São Paulo in 1899 and the federal capital, Rio de Janeiro, in 1904, acquiring many older companies and local concessionaires. Shortly thereafter and still in this initial stage, Light participated in two projects during the first decade of the 20th century: the creation of the São Paulo Electric Company in the interior of this state and the failed effort in the

city of Salvador involving the company Bahia Light.[5] But despite this failure, not long before 1930, Light — which provided electricity to the two principal markets in Brazil, the cities of Rio de Janeiro and São Paulo – was responsible for approximately 50% of the electricity generated in the country. The U.S. company AMFORP was the second largest producer, providing 20% of electricity generated (Szmrecsányi 1986: 133). The rest of the country, where there was limited economic activity, depended on electricity provided through local initiatives, whether municipalities or private groups with few resources. Consequently, the quality of services in these localities was poor, reinforcing the vicious circle of backwardness.

Despite the apparent division of the Brazilian market between large international companies, the 1920s was a decade that presented certain challenges to the managers of the São Paulo Tramway, Light and Power Company (popularly known as São Paulo Light). While, on the one hand, the demand for energy grew significantly in the city of São Paulo after WWI, on the other, at the end of the 1920s with the entry of the U.S. company AMFORP, the Canadian firm encountered a company with the capital and technological capacity to compete with it for the first time. In response and without foreseeing the New York stock market crash, the Canadian company embarked on an expansion project to increase its capacity to generate electrical energy and its concession areas. In addition, in the 1920s the city of São Paulo was securing its position as the principal industrial center in the country and its demand for electrical energy increased. During this period, the number of industrial, public, and domestic customers served by São Paulo Light increased exponentially: there were less than 10,000 customers in the first decade of

5. Other foreign companies that played a role in the formation of electric companies during this period were: Pernambuco Tramways and Power Co. (1913), Rio Grandense Light & Power Syndicate Lta. (1912), South Brazilian Railways Co. (1912), Pará Electric Railway and Lightining Co. (1905), and Manaus Tramways and Light Co. (1910). These companies all served state capitals and were all created with English capital. The first three companies were acquired by AMFORP in the 1920s.
In addition to these foreign companies, Brazil had cases that were unique for public services in underdeveloped countries. In the 1900s and 1910s, national companies were established which played important roles on the regional level, including: CPFL (1912), Empresa de Eletricidade de Araraquara (1912), Empresa de Força e Luz de Ribeirão Preto (1910), Empresa de Eletricidade de Rio Preto (1912), and Companhia Campineira de Tração, Luz e Força (1912). All were created in the principal cities of the interior of the State of Sao Paulo with the investment capital of local elites, who took advantage of the dynamics of the coffee trade. Other examples of national companies were to be found in Minas Gerais: Companhia Mineira de Eletricidade, Companhia Força e Luz Cataguazes Leopoldina, and Companhia Elétrica e Viação Urbana de Minas Gerais; and in Salvador and in cities in the State of Rio de Janeiro with the Companhia Brasileira de Energia Elétrica. Some of these companies were also acquired by AMFORP during the 1920s. For the creation of AMFORP see: Saes and Sasse (2012); for the electrical sector in the interior of the state of Sao Paulo see: Lorenzo (1993).

its existence, but by 1926, the number had reached 90,000 and three years later, it was 130,000 (Souza 1982: 157).[6]

Thus, in order to meet this increasing demand, the Canadian company needed to guarantee the expansion of its generating capacity through the construction of new hydroelectric plants. This expansion was also necessary because during the first half of the 1920s, the city of São Paulo had to implement an energy rationing program. Until then, São Paulo Light relied on two hydroelectric plants: Parnaíba (1901) and Itupararanga (1914).[7] When these became insufficient to cover demand, two more were constructed in São Paulo in the 1920s: Rasgão in 1925 and Cubatão in 1926-1927. While Rasgão was constructed in record time, Cubatão was an example of an audacious and complex project that would resolve the issue of a potential energy shortage in São Paulo. This project involved not only the reversal of the course of the Pinheiros River but also the construction of pumped storage power plants and a dam and, as if this were not enough, a waterfall of some 700 meters, taking advantage of the geography of Serra do Mar (Seabra 1987). When it began operations in 1926, the Cubatão Plant produced 28,000 kW and, in 1927, the second turbine constructed produced another 28,000 kW. In total, the São Paulo subsidiary went from 57,500 kW of installed capacity in 1924 to 178,724 kW in 1928, with the Cubatão hydroelectric increasing the Canadian group's total electricity production by 50%. In short, in the second half of the 1920s, the increase in the energy produced by São Paulo Light was so large that it guaranteed the security of the energy supply to the state capital for some years.[8]

In addition to the construction of the Rasgão and Cubatão plants, the other part of Light's expansion project was carried out through the acquisition of new concessions. The control of the two mayor Brazilian cities, Rio de Janeiro and São Paulo, satisfied to some extent the firm's aims of expansion in Brazil in the first decades of the century. The considerable investments made by the group were not only related to the need to provide electricity to the two principal Brazilian markets but also had to do with its desire to conquer these markets, which was a somewhat conflictive process, but the group was able to consolidate its monopoly in the mid-1910s. Later, in 1920, the scenario had changed. The company's

6. The city of São Paulo, the principal concession of São Paulo Light in this state, grew significantly in population during the first decades of the 20th century: from 325,000 in 1908 to more than 750,000 in 1926 (Costa Faria *et al.* 1982: 37).
7. Paraíba plant reached its maximum electrical power output in 1912: 16,000 kilowatts (kW), while the Itupararanga plant started operations generating 30,000 kW (Souza 1982: 98-108).
8. By 1925, the Itupararanga plant reached its maximum electrical power output of 56,124 kW, while the Rasgão plant started operations with 22,000 kW (Souza 1982: 160-161).

investments created the possibility of gaining new concessions and Light noted the rapid expansion of the AMFORP group in the State of São Paulo: only two years after entering this market, it had acquired the plants of the Companhia Paulista de Força e Luz (CPFL), Southern Brazilian Electric Co., and Empresas Elétricas de Araraquara e Campineira de Tração, Luz e Força (Amforp 1930: 8-9). While this constituted a rapid expansion of the U.S. firm's concession areas in the interior, it did not threaten the strong dominance of Light in the generation of electricity in the State of São Paulo (Table 1)

Table 1
Installed electric power capacity by company, State of São Paulo, 1900–1940 (in kW)

Year	Light	AMFORP	Other Companies	Total
1900	1,000	-	1,500	2,500
1910	12,000	-	7,000	19,000
1920	57,500	1,200	12,000	73,200
1930	178,724	25,000	25,000	288,724
1940	366,739	44,870	45,088	496,080

Source: Lorenzo (1993: 102).

In this scenario, the strategy of the Canadian group became the integration of concessions owned by independent companies in neighboring areas and, above all, in the direction of the Paraíba Valley, continuing on to Rio de Janeiro. Thus, in 1927 and 1928, São Paulo Light acquired eight electric concessionary companies: in the interior of the State of São Paulo: Companhia Ituana de Força e Luz, Empresa Luz e Força de Jundiaí S.A., Empresa Melhoramentos do Porto Feliz S.A., and CPFL; in the Paraíba Valley: Companhia Força e Luz de Jacareí e Guararema (in the cities of Jacareí, Guararema, Salesópolis, and Santa Branca), Empresa de Eletricidade São Paulo e Río (in Taubaté, Tremembé, Pindamonhangaba, and Caçapava), Companhia Luz e Força de Guaratinguetá (in Aparecida do Norte and Guaratinguet), and Empresa Hidroelétrica da Serra de Bocaina (in Cachoeira Paulista and Cruzeiro) (Castro 1985: 39-46). Rio de Janeiro Light also followed this strategy and between 1929 and 1934, it increased its concessionary area by acquiring four companies that operated in 10 municipalities in the State of Rio de Janeiro, also in the direction of the Paraíba Valley.[9]

This scenario, which favored the expansion of electric power plants and distribution systems belonging to foreign groups, was completely reversed in the 1930s. On the international

9. These companies were: Empresas Força e Luz de Floriano, Usinas Quirino, Usina Hidroelétrica São João da Barra, Usina Hidroelétrica da Companhia de Fiação e Tecidos São José (Castro 1985: 47).

level, the Great Depression forced the financial downsizing of costly projects, not only because of a lack of foreign credit but also because of the uncertainties that existed at a time of declining economic activities. In addition, on the national level, changes in Brazilian policies when Getulio Vargas became president led to the promulgation of the first national laws regulating the electricity sector. These laws mandated, for example, the authorization of concessions by the central government and that foreign companies could no longer take advantage of the gold clause – a measure that was important for protecting income in foreign currency in countries with a history of monetary devaluations such as Brazil (Saes 2012: 420-425).

In this context, Light did not construct new plants but expanded older ones, especially the Cubatão plant which, taking advantage of its high potential, connected new turbines: No. 3 in 1936 (54.000 kW) and No. 5 and No. 7 in 1938 (65,000 kW each). Thus, thanks to the Cubatão project, which was constructed at the end of the 1920s, São Paulo Light was able to continue to meet the energy needs of the region by increasing the power generated through the expansion of existing plants, and without incurring in the high costs of constructing new plants. In the 1930s, São Paulo Light went from 178,724 kW installed capacity at the beginning of the decade to 366,739 kW in 1939 (Souza 1982: 161). In the case of Río Light, the company also met growing energy demands through the expansions of its plants: the Central de Fontes (1909) went from producing 24,000 kW in 1909 to 84,000 kW in 1940[10]; and the Central Ilha dos Pombos plant (1924) expanded its original capacity of 44,000 kW to 117,000 kW in 1937 (Dacorso 2008: 275; McDowall 1988: 406).

At the end of the 1940s, Light was working rapidly to construct a large electrical system of unprecedented scale in Brazil, whose hydroelectric plants would supply power to an increasingly large area. With the acquisitions of concessions in the Paraíba Valley — both in the states of São Paulo and Rio de Janeiro — at the beginning of the 1950s, Light completed its electrical grid connection project with the start-up of its converter substation, which converted frequency from 60 to 50 cycles and had a capacity of 50,000 kW. This substation made it possible to integrate São Paulo's electrical system, which operated at 60 cycles, with that of Rio de Janeiro which operated at 50 cycles. Until then, the two systems, despite their proximity, could not be connected. In this period, then, the Paraíba Valley was a strategic region for Light, which was now able to provide power to its two principal

10. In the first half of the 20th century, the generation capacity of the Fontes plant expanded as follows: in 1913, 49,000 kW; in 1940, 84,000 kW; in 1942, 119,000 kW; and in 1947 it reached 154,000 kW (Castro 1985: 45).

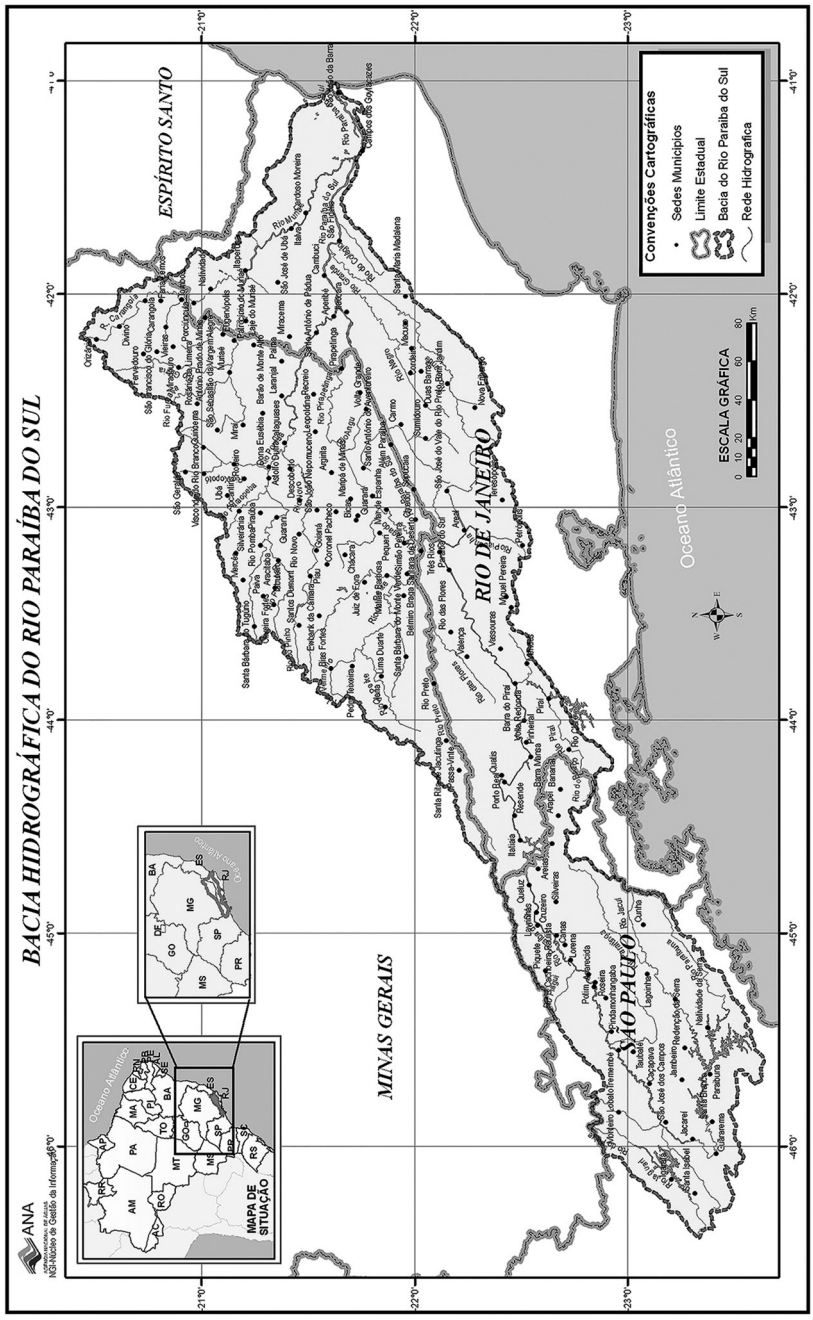
concessions. The local-level concessions existing in the valley were not commercially relevant for the company.

To sum up, between 1930 and 1950, the so-called Light system underwent a large construction phase, which entailed works intended to transfer and store water from the Paraíba River and, later, to transmit power. For Light, the fact that the valley was in two states led to a differentiated strategy on the occupation and use of the hydrographic basin of the Paraíba. In São Paulo, its plants were located either on the São Paulo-Sorocaba axis, taking advantage of the Tietê River, or in Cubatão, in the Serra do Mar. Meanwhile, in order to be able to provide power to the city of Rio de Janeiro, its main plants took advantage of the slope of the Paraíba River and its tributaries. Thus, in the State of São Paulo, the primary role of the municipalities incorporated into Light's concessions along the Paraíba Valley was to guarantee the connection of the company's plants with Rio de Janeiro and its reservoirs. Consequently, the issue of supplying electrical energy to the cities in the valley was not a priority for Light, and thus the demand for electricity in the region was not met by the arrival of the Canadian company. Despite the presence of the largest electric company in Brazil, the Paraíba Valley was not viewed as a priority since the firm's projects catered for the cities of São Paulo and Rio de Janeiro and thus served to reinforce economic concentration in the country. The region would only be able to recover its relative growth when the government began to provide infrastructure and development projects for various localities, thereby reversing the private sector's legacy of disinterest. In the case of the electricity sector, projects aimed specifically at the Paraíba Valley were initiated with the creation of public enterprises by the government of the State of São Paulo via the construction of plants to support the regional development project.

EVOLUTION OF THE ELECTRICAL INFRASTRUCTURE IN THE PARAÍBA VALLEY IN THE STATE OF SÃO PAULO

Light built the infrastructure of its inter-connected electrical system in the hydrographic basin of Paraíba River to serve the mayor cities that were included in this concession: São Paulo and Rio de Janeiro. Thus, the Paraíba Valley not only had strategic value as a nexus between the two cities, but also as a reservoir for Rio de Janeiro's hydroelectric plants. As can be seen in Map 1, the basin of the Paraíba do Sul River, which occupies an area of about 60,000 km2, stretches through the states of São Paulo (13,500 km2), Rio de Janeiro (22,600 km2), and Minas Gerais (20,900 km2).

Map 1
Hydrographic basin of the Paraíba do Sul River



Source: Agencia Nacional de Aguas (2010).

To evaluate the evolution of hydroelectricity usage in the Paraíba do Sul river basin, information about the existing plants in the region was compiled from the bulletin of the National Department of Mineral Production (Departamento Nacional de Produção Mineral [DNPM]) from December 31, 1941 (Ministerio de Agricultura, DNPM, and Servicio de Aguas 1942). Before 1926, all the small power generators in the Paraíba Valley were installed by local companies as part of the extension of Light's concession area in the region through the incorporation of local electric power companies. The most important information found through this research is discussed below.

Electric lighting was first installed in the Paraíba Valley in the State of São Paulo even before the 20th century: in 1895, a small thermoelectric plant was opened by the Companhia Força e Luz Jacareí-Guararema which provided electric light to the municipality of Jacareí (Lorenzo 1993: 65). The first hydroelectric generator, the Sodré plant of the Companhia Força e Luz de Guaratinguetá, was inaugurated 10 years later in the town of Guaratinguetá. Starting in the 1910s, other plants were constructed in the region but they generally shared one characteristic: they were capable of generating only a limited amount of electricity (Table 2).

Table 2
Generation capacity of power plants, Paraíba do Sul River Valley, State of São Paulo, 1941

Range of capacity	Number of plants	Installed capacity (in kW)
Up 100 kW	11	572
101-1,000 kW	10	5,400
More than 1,001 kW	2	7,060
Total	23	13,032

Source: Ministerio de Agricultura, DNPM, and Servicio de Aguas (1942).

In comparison to other regions in the State of São Paulo, the Paraíba Valley played an insignificant role in the generation of the electrical energy, reinforcing the economic decadence of an economy that had once been vibrant as a result of the coffee trade. Though in the 1910s the plants established in the valley represented 7.6% of the power generated in the State of São Paulo, from the 1920s to the 1940s, installed capacity did not even account for 4% of the total generated despite the fact that the local population made up 15% of the total population of this state. Thus, the first decades of the 20th century marked a fall in the per capita provision of electrical energy to the inhabitants of the valley. The region comprised by the capital of the state, on the other hand, accounted for an average of 40% of installed capacity and the central region, in the area of Campinas, accounted

for 20%.[11] This means that the most dynamic regions of the state naturally attracted the most investment thus increasing economic inequality and the services provided among the municipalities of the State of São Paulo.

It is worth recalling that while the installed capacity of the entire Paraíba Valley in the State of São Paulo was 13,000 kW, the first turbine of the Cubatão plant, which provided electricity to the state capital, produced 28,000 kW by itself. Of the 23 plants that were in operation in the Paraíba Valley, according to the 1941 census (Ministerio de Agricultura, DNPM, and Servicio de Aguas 1942), 17 had been built before 1926. Thus, it was the older plants that provided power to the cities in the State of São Paulo. This represented a contrast with the plants in Paraíba Valley in the states of Rio de Janeiro and Minas Gerais, only 50% of which were built before 1926. In addition, the plants in the State of São Paulo were the smallest in the valley (Table 3).

Table 3
Generation capacity of power plants, Paraíba do Sul River Valley, 1941

Range of capacity	Numbers of plants	Installed capacity (in kW)
Up to 100 kW	63	2.335
101-1,000 kW	44	16.275
1,001-10,000 kW	19	53.240
More than 10,001 kW	4	292.200
Total	130	364.050

Source: Ministerio de Agricultura, DNPM, and Servicio de Aguas (1942).

Of the four plants with the capacity to generate more than 10,000 kW at the beginning of the 1940s, three were located in the State of Rio de Janeiro: two were the property of Río Light: Ribeirão das Lages with a capacity of 95,000 kW, and Ilha dos Pombos with 170,000 kW capacity; and the third, belonging to AMFORP, was the Alberto Torres plant with 17,000 kW capacity. The fourth plant with a capacity over 10,000 kW was the Marmelos II plant, with a capacity of 10,200 kW, in the city of Juiz de Fora in the State of Minas Gerais. Meanwhile, the remaining hydroelectric generators were to be found in very small plants, which provided power to small companies and some municipalities on a precarious basis. This meant that in the 1930s and 1940s, with low investment in new undertakings,

11. This data is from the thesis of Helena Lorenzo (1993). In this thesis, regional borders are based on those in Sérgio Millet's classic study and the distribution of capacity only includes plants generating more than 1,000 HP (Lorenzo 1993: 57). According to Millet, the population of the Paraíba Valley in 1920 was 490,000 and constituted 13.43% of the total population of the state (1982: 22).

the electrical potential of the plants in the valley, or even of the consumer market in the region, were of little importance to large companies such as Light. Even so, the Canadian company made efforts to acquire the connection from São Paulo to the market of Rio de Janeiro (Ministerio de Agricultura, DNPM, and Servicio de Aguas 1942).

Light's concentration of concessions intensified starting in the 1920s. The company not only tried to control the best markets, but also the best plants in the region. In 1940, of the 130 plants in the Paraíba Valley of São Paulo and Rio de Janeiro, Light controlled eight, while its competitor, AMFORP, controlled two. This seems like very few given that there were 130 plants, but the total installed capacity of these 10 plants, which were controlled by foreign groups, constituted 80% of the total installed capacity in the region. Evidently, this concentration was mainly due to Light's Fontes and Ilha dos Pombos plants which served the Rio de Janeiro market. In 1940 they together produced more than 200,000 kW of the 364,140 kW generated in the whole Paraíba Valley (Table 4). Consequently, there were few plants with the capacity to provide power to local consumer markets. This constituted the main challenge in the cities of the Paraíba Valley in the State of São Paulo, whose available power was provided by companies that resisted Light's attempts to acquire them but whose generating capacity was very limited in comparison to that of the Canadian company, which centered its strategy on connecting its transmission grids.

Table 4
Quantity and installed capacity of power plants located in the Paraíba do Sulo river basin, by company, 1941

Concession company	Installed capacity (in kW)	Percentage	Number of plants
Light	277,490	76.2	8
Amforp	23,000	6.3	2
Otras	63,650	17.5	120
Total	364,140	100.0	130

Source: Ministerio de Agricultura, DNPM, and Servicio de Aguas (1942).

In order to make its integration project viable, Light gave priority to the acquisition of concessionary companies and their respective concession areas along the Paraíba River. Those acquired during this period included the Bocaína plant in Cachoeira (780 kW); the Putim plant in Guararema (850 kW); the Turvo plant in São José dos Campos (750 kW); and the Sodré plant in Guaratinguetá (860 kW), while the largest, located in Pindamonhangaba, was the Isabel plant (4,560 kW installed capacity). Thus, for the Canadian company, the strategic value of the region lay not in its consumer markets but rather in its reservoirs of water and in the possibilities it provided for connecting its principal concessions.

After this series of acquisitions, Light began to interconnect these various isolated systems and to integrate them into its concession area and, later, into a single network between Rio de Janeiro and São Paulo (CDPH-Unitau 1928). The search for new markets and its concern for protecting the area that it had consolidated allowed the Canadian company to obtain usage privileges throughout the whole Paraíba Valley (*DOU* 1926). Then, in the 1950s, Light interconnected its system with the inauguration of its Aparecida converter substation. The Rio de Janeiro and São Paulo systems were now integrated, something that was essential to meet the expanded use of electrical energy in the two state capitals, since one of the principal obstacles to urbanization and industrialization in post-WWII Brazil was the limited availability of electric power (Tavares 1972). Private companies and the government were at loggerheads on a daily basis over this issue in the political media and newspapers: the former complaining of declining profits due to government intervention; the latter denouncing the low level of investment in the sector, which was leading to power outages.

Thus, the priority of private enterprises was to provide power to areas where there were large concentrations of consumers, as a consequence of which small concessions – in areas where the population had little clout when complaining about very poor service – were left without power. In the case of Light, it was the concessions located on the banks of the Paraíba River – on the Rio de Janeiro-São Paulo axis – that continued to experience poor service because, as engineer Plínio Branco explained: "The Light Company built a 50,000 kW transmission line through the Paraíba Valley and connected two money-losing plants (Cubatão and Lages). But the voltage of the transmission line is 220,000 volts which makes it impractical to connect to the small consumers along the way"[12] (Branco 1951: 39).

The integration of the Rio de Janeiro and São Paulo systems, which should have favored the supply of energy for the region, ended up isolating it. Light, despite holding concessions in many municipalities, did not invest in new power plants and preserved the archaic infrastructure in the valley that it had inherited. Thus, as the press noted at the time, the project of "revitalizing" the Paraíba Valley depended, among other things, on increasing the provision of electrical energy.

This plan to revitalize the region was transformed into the banner for the regional development of the valley starting at the beginning of the 1950s. When it came to the electric sector, the Department of Water and Electrical energy (Departamento de Águas

12. Translation by *Apuntes*.

e Energia Elétrica [DAEE]) and the Legislative Assembly of the State of São Paulo played a leading role. As early as 1951, studies were presented for the construction of a power plant in Caraguatatuba that would generate up to 1,000,000 kW. The project would have required the regulation of the Paraíba River, with the construction of six dams. According to the daily *O Estado de S. Paulo:* "The Caraguatatuba plant would be the solution for the economic revitalization of the Paraíba Valley, on its northern side, south of Minas and a part of the State of Rio de Janeiro"[13] (1949: 5, 1966: 22).

But the project did not get far in the following two decades (*O Estado de S. Paulo* 1972: 43). Its paralyzation was the result of interference by Light in order to block the construction of these public works and thus avoid any adverse effect on the generation of power in Rio de Janeiro, at the Lages plant, prompted by fears that the new dams could reduce the volume of water in the already existing reservoirs. The Canadian company's plants depended on water from the Paraíba River that if dammed upstream, could diminish the flow to the Río reservoirs. On the other hand, the company did not want to lose a project that it had first conceived: the Caraguatatuba project was similar to a 1937 Light proposal for the expansion of the energy supply to the region. This project had been abandoned because of the crisis of the 1930s, which raised the costs of new projects, and because of the company's conflicts with the government, which could have put its concessions in jeopardy.

Thus, in the 1950s, Light showed no interest in investing in new plants and throughout the decade this task was taken over by the government. As a result, the demand for power grew larger than supply, putting in jeopardy plans for the industrialization of this region. In the mid-1950s, the population of Paraíba Valley in the State of São Paulo had already reached 600,000, but this did not provide sufficient incentive for the implementation of electric projects in the region. In 1955, it was estimated that the regions of the state capital and the Paraíba Valley had an energy deficit of 309,000 kW, which made clear the abandonment of consumers in the Paraíba Valley due to Light's policy of guaranteeing an energy supply to the city of São Paulo. The dam projects, so fundamental for any new hydroelectric plant in the region, continued to exist only on paper and *O Estado de S. Paulo* demanded the immediate initiation of work on the project in order to fight the deficit (1955: 9). Local politicians tried to attract companies to towns in the valley, taking advantage of the proximity of the two important consumer markets but they faced the problem of insufficient local infrastructure. Thus, given the energy supply impasse, the revitalization of the valley was postponed for almost two decades.

13. Translation by *Apuntes*.

THE ECONOMIC REVITALIZATION OF THE PARAÍBA VALLEY: THE STATE AND ECONOMIC DEVELOPMENT

It was only after WWII that the Brazilian government began to create more direct mechanisms for intervention in the electrical sector. The idea was that electrical energy, because it was a key input for economic development, should be provided by the government not only in order to meet increasing demand resulting from industrialization, but also to provide power to regions where there was little or no supply, thereby potentially creating mechanisms to stimulate economic growth in these areas. Thus, if the first wave of expansion of the electricity sector guaranteed a supply of power to the largest urban centers, reinforcing growth in specific regions, government intervention could create stimuli for reversing the process of concentrating economic activities in these areas, still observable today.

At the end of the second Vargas government (1951-1954), the National Electrification Plan (Presidência da República 1954a) was launched. At the same time, the federal holding Centrais Elétricas Brasileiras S.A. (Eletrobrás) (Presidência da República 1954b) was created, though it did not begin operations until a decade later. In any case, increased government intervention was justified by the waning interest on the part of foreign groups in financing new projects. Consequently, the importance of public enterprises in the various states was more evident when the electricity sector was viewed as a whole, and not just from the point of view of investors, especially given the capacity that state governments had acquired with the creation of electrification taxes. In São Paulo, after the creation of the DAEE in 1951, the state government was responsible for developing its own electrification plan (Governo do Estado de São Paulo 1956: 1).

Despite the DAEE studies prepared starting in 1951, the Electrification Plan of the State of São Paulo (Plano de Eletrificação do Estado de São Paulo [Peesp]) was not presented to the state government until June 22, 1956. In order to fulfill its energy goals, 11 state enterprises were created, which were merged in 1966 to create the Centrais Elétricas de São Paulo S.A. (CESP). Since its creation, CESP has added various concessions in the State of São Paulo to its own concession area, the most important being CPFL, originally a subsidiary of AMFORP, which was taken over through control of its shares on July 16, 1975 (Almeida 1980: 105-106).

Among the recommendations of Peesp, priority E was the construction of the Paraibuna and Paraitinga reservoirs in the Paraíba Valley, channelizing the river and its flow. According to this same document, this regularization would be achieved through the construction

of the Santa Branca, Jaguari, Buquira, and Funil reservoirs (Governo do Estado de São Paulo 1956: 401-402). The Paraitinga reservoir was to supply a 100,000 kW hydroelectric plant to be constructed in the future (Governo do Estado de São Paulo 1956: 18-19). In order to implement the project, government resources were defined through the Federal Electrification Fund of 1954 (Law N° 2,308), which mandated an additional 3.75% on all the state government taxes linked to investments in the electricity sector (Presidência da República 1954c).

The Paraíba Valley would feel the effects of this change in the structure of the sector in the mid-1950s. The new electrical system created by Light through to the beginning of the 1950s profoundly altered the structure of its regional system by integrating it and converting it into simply a means of communication between its two principal markets. It was only with the creation of CESP – in the early 1960s, still under the name of Companhia Melhoramentos de Paraibuna S.A. (Comepa[14]) – that the valley came to be seen as a region that also consumed energy. While for Light the small local plants became even more obsolete in comparison to hydroelectric plants such as Cubatão and Ilha dos Pombos, among others belonging to the group, for CESP these local efforts came to be seen as possible solutions for the provision of power on the regional level.

The planned reservoirs were built. Paraitinga and Paraibuna were merged into one, thus guaranteeing the initiation of construction of the Jaguari and Paraibuna plants. There were also plans to construct the Caraguatatuba plant, which would follow the example of the Cubatão plant, taking advantage of the slope of the Serra do Mar and generating, according to plans, 680 megawatts (MW) (Almeida 1980: 106). Thus, with state government investment, the generation of electrical energy (which was a secondary objective for Light) became a priority for the region, starting with the regularization of the flow of the Paraíba River, so as to provide water for the population and for industrial and agricultural uses. As a result, the Paraíba Valley in the State of São Paulo, stagnant for almost 30 years, once again began receiving investments for the construction of new plants as well as for other economic activities.

The growth in the availability of hydroelectric power in the region at the end of the 1970s can be seen in Table 5, which lists the principal investments in power plants through to 1979. On the one hand, Light company plants Nilo Peçanha and Pereira Passos were located in the region of Rio de Janeiro and were intended to provide power to the nation's capital;

14. Comepa was created in 1963 and was absorbed into CESP in 1966 (Almeida 1980: 106).

on the other hand, the state government-run Furnas and CESP plants were instrumental for the provision of electricity to the Paraíba Valley.

Table 5
Principal power plants, Paraíba do Sul River basin, 1979

Name	Concessionary company and year	Capacity (in kW)
Paraitinga-Paraibuna	CESP (SP), 1978	86,000
Jaguari	CESP (SP), 1973	27,000
Funil	Furnas (MG), 1963	222,000
Fontes Velha	Light (RJ), 1909	26,000
Fontes Nueva	Light (RJ), 1940	107,000
Nilo Peçanha	Light (RJ), 1954	380,000
Pereira Passos (Rib. Lages)	Light (RJ), 1962	100,000
Ilha dos Pombos	Light (RJ), 1924	170,000
Total		1,118,000

Notes
- SP: São Paulo
- MG: Minas Gerais
- RJ: Río de Janeiro

Source: Eletrobrás (1979: 9).

Direct and indirect government investments were responsible for the recovery of the previous economic dynamism of this region through the establishment of large industrial plants, especially in the State of São Paulo. The company that was a symbol for this process was the Companhia Siderúrgica Nacional (CSN), in Volta Redonda, in the middle of the Paraíba Valley in the State of Rio de Janeiro (Rodrigues et al. 1992). Even so, what made the valley attractive for new projects were the government investments in infrastructure. For instance, the old road between Rio de Janeiro and São Paulo built in 1928 ran along the coast, while the new Presidente Dutra highway between the two cities permitted far higher volumes of vehicle traffic. At the same time, improvements were made to the Central del Brasil railway line (Vieira 2009). Later, in the 1950s, the Technological Institute for Aeronautics (Instituto Tecnológico de la Aeronáutica) and the Technical Center for Aeronautics (Centro Técnico de la Aeronáutica) were created. This was followed in 1961 by the establishment of the National Institute for Space Research (Instituto Nacional de Pesquisas Espaciales). The creation of these institutions reinforced government stimuli for regional economic and technological development. At the same time, vocational training institutes were established through the universities in Taubaté, São José dos Campos and Guaratinguetá (Januário 2007).

Through these investments, industrial activity expanded greatly in various cities in the State of São Paulo. In Taubaté, Indústrias Químicas de Taubaté (1954), Mecânica Pesada (1957) and Willys (1959) were particularly important (Vieira 2009). Other companies that came to the region starting in the 1950s included: Materiais Ferroviários S.A. (1957) in Caçapava, and Johnson & Johnson (1953), Rodhia (1946), Ericsson (1954), Fiação e Tecelagem Kanebo (1956), and General Motors (1959) in São José dos Campos. In Cruzeiro, the Fábrica Nacional de Vagones (currently Iochpe-Maxion) was established. Later, in the 1960s, São José dos Campos created its own high-technology military-industrial center with the Embraer, Avibrás, and Engesa companies (Januário 2007). In the 1970s, various other industrial companies came to the region including Volkswagen in Taubaté and, with the financing of the BNDE, in Pindamonhangaba: the Villares foundary, Alcan, and Confab Industrial. In addition, in Caçapava, laminated glass factories opened and in São José dos Campos, the Henrique Lage refinery was built (Abreu 1985).

Through the support of the government, both in the form of investments in infrastructure as well as inducements for the creation of technological and educational institutes, the Paraíba Valley was able to increase its share in the total industrial production of the State of São Paulo. And, following the pattern of industrial decentralization that began in the 1970s, the valley was able to reinforce its economic activity with these new investments, becoming one of the principal industrial centers in São Paulo (Table 6).

Table 6
Industrial GDP by selected areas, 1959, 1970, 1985 (in percentages)

	Year		
	1959	1970	1985
State of São Paulo (percentage of Brazil)	53.34	56.45	43.58
State of São Paulo	100.00	100.00	100.00
Percentages of the State of São Paulo:			
- Municipality of São Paulo	54.30	48.32	31.06
- Metropolitan Region of São Paulo	73.10	71.88	56.21
- Provinces of São Paulo	26.90	28.12	43.79
- Metropolitan Region of São José dos Campos	1.97	3.48	7.43

Source: Negri (1996).

In sum, during the 1970s, the Presidente Dutra highway became the main axis of regional economic activity and São José dos Campos emerged as the regional economic center as part of the decentralization of industry in the State of São Paulo. The proximity of the state's capital and the reduction in the costs of production led companies to transfer their production units to the region, as was the case of the automobile and electronic industries. Jacareí, São José dos Campos, and Taubaté welcomed durable goods industries, while Pindamonhangaba was the last in attracting investments in basic industry. On the other hand, the aeronautics hub led to the establishment of a variety of industries supplying machines and equipment. Thus, at the end of this period, the region was one of the most industrialized in the country and its power was provided primarily by CESP.

FINAL CONSIDERATIONS

The purpose of this article was to describe the transformation of the electrical system in the Paraíba Valley region between 1930 and 1950. Despite the fact that this region had traditionally been an economic development zone in the states of São Paulo and Rio de Janeiro and even after the construction of small hydroelectric plants throughout the area before WWI, its cities were not able to guarantee the provision of power to meet daily demand during the 1950s. This was largely due to the process of concentrating the provision of electrical energy in São Paulo and Rio de Janeiro for almost a half century, especially because of the acquisition of some important local companies by the Canadian company Light. This company's strategy was to guarantee its hold on the market in the Paraíba Valley, not so much for its commercial importance but rather because of the possibilities it created for the integration of the two largest markets in Brazil: the cities of Rio de Janeiro and São Paulo.

Light's strategy should be seen as the principal reason for the deficient provision of power in the region in the mid-20th century. The company did not lack the technical expertise nor the resources necessary for providing power to the municipalities in the Paraíba Valley where it had concessions. However, while it stifled the growth of local public service companies and concentrated on connecting and meeting the demand of the two largest Brazilian markets, the cities that were located between Rio and São Paulo had difficulties in meeting the demand for electricity in their areas. These problems were resolved years later with the creation of CESP and its entry into the market in the Paraíba Valley. Thus, after three decades, investments poured in for new hydroelectric plants, ending the hegemony of Light, and the valley went from being strategically important only for communications to a market with a large electrical generation system. Consequently, the economic revitalization of the region took place through increasing investment and the establishment of large industrial

plants, starting in the 1960s. Clearly we cannot ascribe all the challenges to economic development in the region to the quantity of power available, but we also cannot deny that the conditions for economic development came into existence only when the government started to coordinate the project to stimulate economic activities in the Paraíba Valley.

In sum, according to this analysis, the trajectory of the Paraíba Valley, despite its location very close to the center of economic activity in Brazil, is an example of how the interests of private groups do not always benefit diverse social demands. In the case of electric power, which is a fundamental good for the economic development of a modern and industrialized economy, leaving this service solely in the hands of the private sector can lead to incompatibilities between the financial projects of companies and local needs.

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