



The logic of the valorization of natural resources in Brazil: historical relationship between the electricity sector and the mining industry in the Amazon

A lógica de valorização dos recursos naturais no Brasil: relação histórica entre o setor elétrico e o setor mineral na Amazônia

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Resumo

O presente artigo procura traçar uma análise do ponto de vista histórico para, posteriormente, compreender a relação econômica entre os fenômenos históricos ocorridos no Governo Militar e, recentemente, no governo do ex-presidente, Luiz Inácio Lula da Silva. Nestas condições, o artigo procura concentrar sua análise no entendimento da relação entre o setor elétrico e o setor mineral na Amazônia brasileira, principalmente na Amazônia Oriental. A principal conclusão é que a Amazônia brasileira e Oriental possui uma lógica econômica local específica, que impacta (in)diretamente no desenvolvimento do setor elétrico e no setor mineral do país. Contudo, há espaço para a promoção de uma conexão muito mais íntima entre esses setores e, é claro, um potencial intenso para a exploração de reservas minerais, inclusive, com a perspectiva de verticalização da produção e geração de emprego, renda e agregação de valor para a economia nacional e regional.

Palavras-chave

Setor Elétrico. Setor Mineral. Amazônia Brasileira. Amazônia Oriental. Verticalização da Produção.

Abstract

The aim of this article is to construct an historical analysis in order to understand the economic relationship between the historical phenomena that occurred during the Military Government and more recently, during the government of (former) President Luiz Inacio Lula da Silva. Accordingly, the article seeks to focus its analysis on understanding the relationship between the electricity sector and the mining industry in the Brazilian Amazon, especially in Eastern Amazon. The main conclusion is that both the Brazilian and Eastern Amazon demonstrate a specific local economic logic, which have impacted (in) directly on the development of the electricity sector and in the mining industry throughout the country. However, it has also been possible to promote a much closer connection between these two sectors and, likewise, a strong potential for exploiting mineral reserves, together with the verticalization of production and the generation of employment, income and added value to the national and regional economy.

Keywords

Electricity Sector. Mining Industry. Brazilian Amazon. Eastern Amazon. Verticalization of Production.

INTRODUCTION

At the outset, it is essential to highlight Brazil's extraordinarily high capacity to supply raw materials. Within this context, the first historical moments in which this may be observed occur within the period of military rule (1964-1985), with particular emphasis on both the Radar project in the Amazon, better known as RADAM, and the Mineral Resources Research Company (CPRM) implanted in 1970 and 1969, respectively.

Within these terms, the Brazilian Amazon assumes an important economic role in concentrating an enormous potential for mining and, as will be observed, energy. Following the historical context of the military regime, the aims of the abovementioned projects were considerably centered on locating areas in the Amazon that contained ore reserves, specifically in the eastern part of the region, i.e., in the so-called Eastern Amazon, which is composed of municipalities located in the states of Amapá, Maranhão, Pará, Tocantins and Mato Grosso, with the exception of municipalities in the Pantanal region of Mato Grosso.

Studies by Lobo (1996) demonstrate that the dynamics of mining in the state of Pará, especially near the region of Carajás, were driven and accompanied by the use of the Tucuruí Hydropower Plant (HPP), which was a key factor in intensifying the exploration and export of raw materials. Lobo (1996) also observes that the Tucuruí HPP, located in the municipality of Tucuruí, was initially planned in accordance with agreements made between international mining firms, and as such, was made effective through investments from the Brazilian government.

Under these conditions, therefore, it is possible to realize that in a partially exclusive manner, the Tucuruí HPP provided electric energy to support the production of the mining companies across the region and, conclusively, this is linked to production localization factors. This would seem to signify that the hydroelectric potential of electric energy production in Tucuruí was leveraged and potentialized as a result of the mining production in force during the period of the Brazilian military government.

According to research by Lobo (1996) and Silva (2011), from an historical viewpoint, during the military regime, both the mining industry and the electricity sector in the Brazilian Amazon were directly affected by the national economic development plans. The main aim was to increase the growth of the country's gross domestic product (GDP), as envisaged through the National Development Plans I and II (known as PND I and II), the Government Economic Action Program (PAEG) and the Strategic Development Plan (PED).

Once the Brazilian political structure had undergone a period of redemocratization, primarily after the 1988 Federal Constitution, the political and economic orientation adopted by Brazil in relation to the electricity sector and mining industry, both nationally and regionally, very closely approached that of the military regime.

In terms of Eastern Amazon, and knowing that historically both the electricity sector and the mining industry are regionally sensitive in relation to planning guidelines and macroeconomic governance, it is possible to relate these two sectors in the sense of only consolidating the national development megaprojects. In other words, this should be understood in its totality, one that encompasses scales of both national and regional development, in which megaprojects are directed towards logistics, mining and energy.

In recent studies by authors such as Monteiro (2005) and Coelho et al. (2011), it has been possible to verify that the national projects and plans proposed during the government of former President Luiz Inacio Lula da Silva (who was always simply referred to as Lula), such as the Growth Acceleration Programs I and II (PAC I and II), brought about the same impact on the electricity sector and mining industry as PND I and II, PAEG and PED.

Within such conditions, the plans linked to the Initiative for the Integration of Regional Infrastructure in South America (IIRSA) also draw attention to the (in)direct mediation of an effectively singular relationship between the mining industry and the electricity sector in the Amazon Region, starting from an international context.

The present article therefore seeks to investigate the economic relationship between the historical phenomena, from a historical-theoretical perspective, i.e., the impact that the development of the mining economy in the Amazon has produced for structuring the electricity sector across the region and, consequently, the economic planning involved in the region, through the so-called constitutionally democratic Brazilian state during the Lula government, from 2003 to 2010.

This paper is divided into six sections, in addition to this introductory section and the final considerations presented in the last section. In the second section, the methodological aspects of the research are objectively presented; the third section discusses the electricity-mining sector situated within a national and regional macroeconomic context during the period of the military regime; the fourth section demonstrates a correlation between the national plans and the regional expansion of the Brazilian electricity sector during the democratic period of the Lula government (2003-2010); and the fifth section presents the

logic of the valorization of mineral resources and the centrality of the energy economy in the Eastern Amazon during the Lula administration.

1 METHODOLOGY

According to Carvalho (2005, p. 11), “methodological specification constitutes a mandatory part of academic research, which adopts a scientific method. However, it is necessary to distinguish between the method of approach and the said methods of investigation”. Carvalho (2005, p.11) observed that “the method of approach is related to the philosophical affiliation and the degree of abstraction from the studied phenomenon, since the research methods or the research procedures consist of concrete stages of investigation and the use of appropriate research techniques”.

In the social sciences, a methodological restriction is generally imposed: which is the need to confront a perceived reality, detached from that which is concrete, with the empirical reality, i.e., that which is perceived by our senses. On the other hand, as Lakatos and Marconi (1991, p. 106) observed, “practical knowledge is submitted to the need of an immediate connection with the reality to which it refers.”

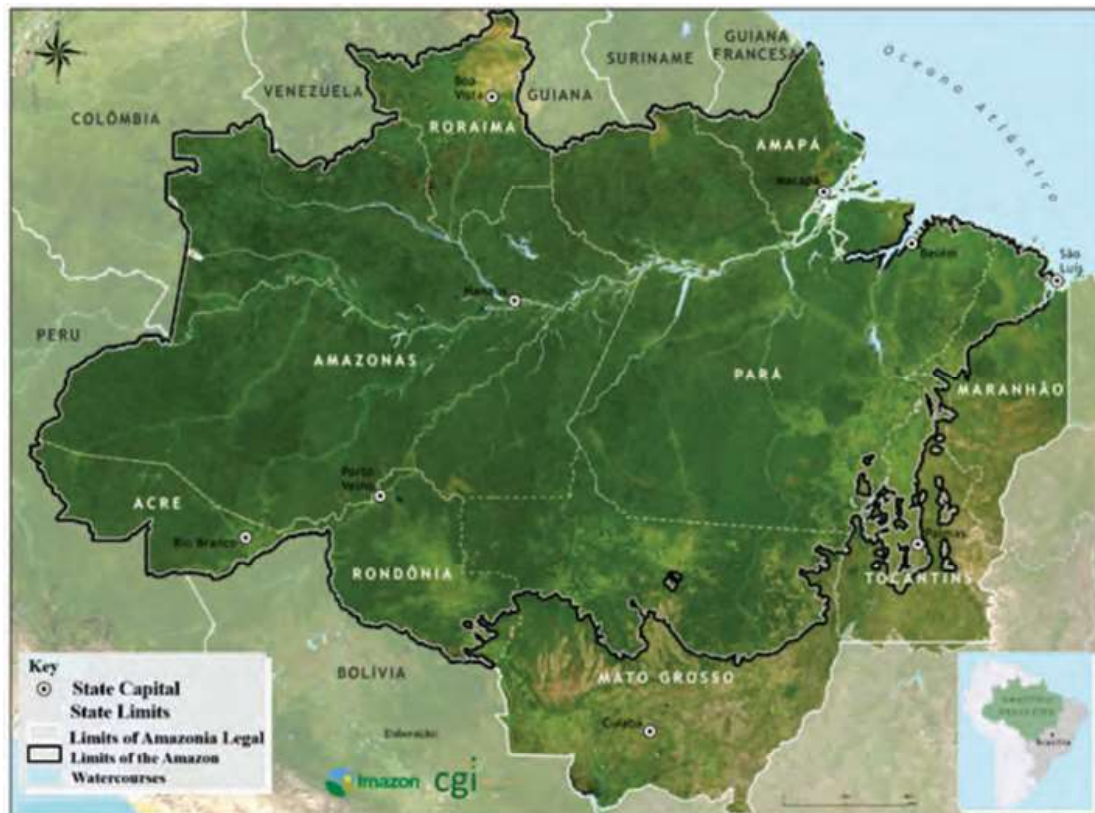
Therefore, in order to develop this article in the best possible manner, we have adopted a methodology involving a historical-theoretical analysis, which comprises the statistical data from the electricity sectors, based on the national and 10-year plans for developing energy in Brazil.

1.1 DATA SOURCE

First, it should be emphasized that the study object of this research is Eastern Amazon. Therefore, in order to analyse the mining industry in question, we will use a database, referring to the exportation of iron ore, obtained from the Ministry of Industrial Development and Foreign Trade (MDIC) and, also, from the Brazilian Mining Institute (IBRAM).

According to decree-law nº 291/1967 and nº 356/1968, Eastern Amazon is geographically composed of the states of Pará, Amapá, Maranhão, Tocantins and Mato Grosso, as illustrated in Figure 1. The most outstanding cities/municipalities in Eastern Amazon that present significant levels of mineral reserves of iron, magnesium, aluminium, alumina and bauxite are located in the states of Pará (PA), Maranhão (MA) and Amapá (AP).

Figure 1 – The Brazilian states that constitute Eastern Amazon



Source: IMAZON (2016). * Legend Adapted by the authors.
Source of Images: Modis, NASA.

The states that make up Western Amazon on the other hand are Amazonas, Acre, Rondônia and Roraima. However, the main difference between Eastern Amazon and Western Amazon lies precisely in its economic terms. While the economic strength of the western side is concentrated in the Manaus Free Trade Zone (ZFM), ecotourism, the petrochemical complex of Urucu-Coari-Manaus and vegetal/mineral extractive activities, Eastern Amazon is mostly centered on the metallic and non-metallic mineral economy, livestock farming and on the production of primary goods and food – even being low value-added activities – for exportation.

2 THE ELECTRICITY-MINING SECTOR IN THE NATIONAL MACROECONOMIC CONTEXT: SECTORAL GROWTH MODELS DURING THE PERIOD OF THE MILITARY GOVERNMENT (1964-1985)

According to Gomes and Vieira (2009), the electricity sector, to a certain extent, played a leading role in the Brazilian economy during the military government, specifically when this merger resulted in the creation of a “state

model” for economic performance, i.e., when Brazil actually began to operate within the electricity sector. In the words of Gomes and Vieira (2009: 300), “ELETROBRAS entered as the main institutional medium, as well as the company that induced the nationalization and state control of the electricity sector”, thereby enabling the distribution of large investments to the sector throughout the country.

Silva (2011) outlines three historical stages that may be used to establish a chronological understanding of the impacts of the macroeconomic planning on the electricity sector during the military government. They are as follows: 1) seeking the recovery of public finances and economic stabilization (1964-1967); 2) the economic miracle (1968-1973); and 3) depletion of the model (1974-1985).

Table 1 presents the macroeconomic development plans, their objectives and the impacts on the Brazilian electricity sector. In the historical conception of several authors, such as: Gomes et al. (2002), Gomes and Vieira (2009) and Silva (2011), the first stage was marked by the need to fund government spending, and expenses were thus centered on infrastructure, and consequently on the infrastructure of the electricity sector.

Table 1 – The macroeconomic plans and their impacts on the electricity sector

Plan	Method used	Changes in the electricity sector and projects
The Government's Economic Action Plan (PAEG) - 1964	Increased government spending on economic and social infrastructure, with emphasis on public investment.	New financing mechanisms according to Laws 4,357/64 and 54,936/64, which related the obligations of the National Treasury and the monetary correction of fixed assets to sectoral investment. (LIMA, 1999).
The Strategic Development Plan (PED) - 1968	Consolidation of the internal market and price stabilization for greater participation on the international market.	An increase in international investments within the sector and tariff reforms due to tax and fiscal changes.
The National Development Plan (PND I and PND II) – 1972-1979	Developing the production of capital goods and increasing industrial production in response to the international crisis.	The creation of "Plan 90", aiming at a scaled-up expansion of the electric sector for the growth in energy demand brought on by industrialization.

Source: Silva (2011).

In the first stage it is possible to identify the dominant presence of the Government's Economic Action Plan (PAEG), while simultaneously, the second stage is linked to the National Development Plan (PND) and, in accordance with the third, we may identify an attempt to restructure the Brazilian electricity sector.

The second stage is characterized by a significant expansion of the electricity sector, which was marked mainly by PND I and PND II. The major milestone of this stage involved the creation of state-owned companies in the Brazilian electricity sector, which were subsidiaries of ELETROBRAS, such as Centrais Elétricas do Sul do Brasil S.A. (commonly referred to as ELETROSUL), and later, Centrais Elétricas do Norte do Brasil S.A (ELETRONORTE).

During the third historical part of the military government, the most outstanding central aspects regarded the changes in absorbing investments related to the inability of ELETROBRAS to self-fund and, consequently, its gradual loss of significance, besides several other problems connected to electric energy tariffs, as defended by Silva (2011).

Indeed, all these situations during the third historical part arose in reaction to the Brazilian macroeconomic environment, which, in an inflationary environment with high interest rates, was an extremely unfavorable context for many enterprises. On the other hand, the Brazilian electricity sector during the period of the military regime, demonstrated a significant expansion of its supply, particularly in its institutional activities.

2.1 THE POSITION OF THE ELECTRICITY SECTOR IN EASTERN AMAZON AND ITS RELATIONSHIP WITH THE MINING INDUSTRY DURING THE MILITARY GOVERNMENT

According to Lemos (2004), during the military government, the electricity sector in the Brazilian Amazon served as an incentive for regional industry, i.e., the manner in which the military government handled the sector was directly linked to industry. During the first and second phases of the military government, the management and planning of the electricity sector was under the responsibility of the Superintendency of the Amazon Economic Recovery Plan (SPVEA) and later the Superintendency of the Development of the Amazon (SUDAM).

However, it may be stated that the electricity sector in Eastern Amazon only received its due attention and importance, through the receipt of national investments, after the third historical moment of the military government, specifically with the creation of ELETRONORTE, in 1973. Initially, it is possible

to confirm that the connection between the electricity sector and the mining industry was also possible due to the facilities made available to the federal government through the legislative apparatus.

In 1967, for example, the new Brazilian Mining Code was introduced, which implemented the *res nullius* regime, providing mining and electric energy companies with incentives in order to exploit natural resources. During this historical interval in the military government, certain important events took place, especially the discovery of ore reserves around the Trombetas River in the 1960s, specifically in the municipality of Oriximiná in the state of Pará, and in other places with equally strategic mining potential, such as Serra do Navio-AP, Marabá-PA, São Luís-MA, Paragominas-PA and Carajás-PA.

According to Lobo (1996) and Gonçalves (2015), the period 1974-1975 was characterized by the creation of the Program for Amazonian Agricultural/Livestock and Agromineral Centres (POLAMAZONIA) and the Amazon Radar Project (RADAM), which prompted a number of geological surveys on water and mining potentials in Eastern Amazon.

In general, the POLAMAZONIA and RADAM occurred in the same period as the so-called “Plan 90”. According to Gonçalves (2015), there was as yet no demand in Eastern Amazon for an electric supply capacity that would fully support the industrial sector of the time, however, it was only because of these events that the region’s electricity sector received the due and legitimate importance in national economic planning.

Silva (2011) emphasizes that “Plan 90” contained the same premises as PND II, and thereby not only aimed at expanding sectoral arrangements of electric energy, but also at bringing about a significant change in its energy production base and, on the part of the federal government, there was an initiative to execute megaprojects throughout the region. Given this context, it is therefore possible to verify that the development of electric power in Eastern Amazon was effectuated according to the growth of mining in the region.

As Gonçalves (2015, p.76) states: “the dynamics of the region’s electricity sector were due to the expansion of the industrial production capacity of mining”. The first large-scale plant built in Eastern Amazon was the Coaracy Nunes HPP in the state of Amapá. According to Lemos (2004), the primary objective of this HPP was to meet the demands of the mining companies in the region, as was the case, for example, with the Industry and Trade of Ore Company, known as ICOMI.

In 1980, with the introduction of the Grande Carajás Program (PGC), ELETRONORTE became responsible for conducting several research

projects, with the objective of expanding its energy production base owing to the exploitation of aluminum, alumina and iron in the region between Carajás and the state capital of Maranhão, São Luís. Amongst the main companies that demonstrated a keen interest in the region, and especially for these developments in particular, the most significant were Japanese companies such as Nippon Amazon Aluminum Corporation (NAAC).

Lobo (1996) and Gonçalves (2015) stress that these foreign companies required a significant contribution from public investments in infrastructure and energy to complement their investments. In 1985, the construction of the Tucuruí HPP was successfully completed in the state of Pará, becoming one of the largest Brazilian hydropower plants - with an operating capacity of 8,370 MW – just slightly less than the Itaipu HPP, in the state of Paraná.

According to Pinto (2012), the aim of the Tucuruí HPP was to meet the demand of companies such as NAAC, and other Japanese companies in association with the Vale do Rio Doce Company (CVRD), Alumínio Brasileiro S.A. (ALBRAS), the Alumina do Norte do Brasil S.A. (ALUNORTE), and the Aluminum Consortium of Maranhão (ALUMAR).

It may therefore be seen that the national macroeconomic plans assumed during the military government eventually took on a very particular, unique significance through the regional-territorial binome of Eastern Amazon. These programs promoted a significant growth in mining production and enabled a broad expansion of supply and institutional arrangements for the electricity sector within the region.

3 THE NATIONAL DEVELOPMENT PLANS AND THE REGIONAL EXPANSION OF THE ELECTRICITY SECTOR DURING THE DEMOCRATIC PERIOD OF THE LUIZ INÁCIO LULA DA SILVA GOVERNMENT (2003-2010)

The basic premise of the historically inherited model for the electricity sector, identified in the government of the former president of Brazil, Luiz Inácio Lula da Silva, was the adoption of a previous sector model termed the Project for Restructuring the Brazilian Electricity System (RESEB), instituted through Law 9.648/98, in 1998.

The main aim of this model was to allocate the sector into its respective functionalities, to divide the respective tariffs of each service into the generation, transmission and distribution of electric power and, finally, to bring strong competition onto the market, which provided the conditions for the appearance

of a new economic agent: the energy marketer, whose role, as Silva highlighted (2011), was to make the market more “liquid”.

In 2013 – with the interruption of the RE-SEB - a new sectoral growth model was established based on new structuring, and with differentiated aspects. In 2004, however, Law nº 10,848 became institutionalized, and promoted the Regulated Contracting Environment (ACR) and the Free Contracting Environment (ACL) in the electricity sector, whereby both contracts had to be duly registered with the Chamber of Commerce for Electric Energy (CCEE).

Thus, the basic aims of these contracting environments were defined as a means of conducting electric energy auctions, which thereby enabled greater dynamics for the economic sector and, above all, veracity. It should be noted that the ACL was inserted into the scope of distributing electric energy to the ACR, which included free consumers and traders in electric energy.

However, Silva (2011) observes that the ACR demonstrated an important capacity for maintaining safety in stabilizing tariffs from the forms of market competition. However, the basic assumptions of both the ACR and the ACL were in the electric energy trading agent and also in the flexibility of raising funds for the sector, which eventually formalized the Wholesale Electric Energy Market (MAE).

Thus, the change from RE-SEB to the ACR and ACL standards altered the way in which electric energy in Brazil was traded, thereby enabling a fully competitive market for the generation of electric power, and allowing the auction prices of the Brazilian energy sector market to become better established.

In other words, a fertile field was established for a high level of competition between companies in the sector. In addition, in 2004, alongside this, the Energy Research Company (EPE) was created, and was responsible for conducting studies to take greater advantage of energy in Brazil.

During the Lula administration, the Brazilian electricity sector eventually underwent a great degree of structuring through the National Energy Plan 2030 (PNE 2030), launched in 2006 through the EPE, which stipulated a diversity of investments for the electricity sector. Therefore, the national electricity sector felt the need to consolidate a funding base, which duly took form through the following agents: the National Bank for Economic and Social Development (BNDES), the Ministry of Mining and Energy (MME) and, lastly, the National Electric Energy Agency (ANEEL), as adopted by Brazil (2007).

Thus, with a well-defined funding base, more significant conditions were potentiated and integrated into the electric sector so that it was able to adopt an investment capitalization model through energy auctions per Megawatt (MW).

Silva (2011) upholds that this historical framework gave the Brazilian electricity sector a much more dynamic structure than the previous - instituted in RE-SEB - with a more dynamic, broader financial capacity.

Tolmasquim, Guerreiro, and Gorini (2007) address this issue when discussing contracting for the electric sector after the enactment of Law N^o 10.848, which legitimized the sale of energy as either a regulated contract or a free contract within the National Integrated System (SIN), and Law N^o 10,847, which gave broader responsibilities and competencies to the EPE, as may be observed through data from Brazil (2007).

Examples of this new dynamization in the sector may be observed in the contracting that took place between 2005 and 2010. During this period, thirty-seven contracting events were held, where 6,237 TWh (terawatt-hour) of energy were traded, bringing the installed capacity in 2010 to approximately 113.3 GW (gigawatt) of power.

Tolmasquim, Guerreiro and Gorini (2007) considered that this new model for the Brazilian electric sector enabled the generation of a large capacity so as to expand energy production. As a result, it became a potential force for attracting investment, which brought a reasonably safe stability to the supply and distribution of electricity in Brazil.

3.1 EXPANSION PLANNING AND PROJECTS IN THE ELECTRICITY SECTOR IN EASTERN AMAZON DURING THE LULA GOVERNMENT: THE REPRESENTATIVE CASE OF THE BELO MONTE HPP

In the view of Gonçalves (2015), the series of blackouts that occurred in the years 1999, 2001 and 2002 were, in fact, decisive for creating major plans and forms of planning for the Brazilian electricity sector, which eventually also encompassed the Amazon Region as a target for future investments. Gonçalves (2015) indicated that a region calculated as being “underused”, according to the Ten-Year Energy Expansion Plan 2022 (PDE 2022), instituted in 2013, presented in the region of twenty-three hydroelectric projects destined for the hydrological exploration of the Brazilian Amazon Growth Acceleration Programme (PAC).

From the perspective discussed in Brazil (2013), the PDE 2022 states that the execution of works in the Amazon is divided into two stages: 1) Period 2013-2018, forecasting a future potential of 20,683 MW; 2) Period 2018-2022,

forecasting a future potential of 19,917 MW and possibly an increase of 41,000 to the National Interconnected System (SIN)¹. As a result, a further 12,283 MW of capacity will be added and consequently made available to the North - including the states of Amazonas, Amapá, Sergipe, Goiás, Acre, Roraima and Mato Grosso - which together will total 4,110 MW until the year 2022.

Gonçalves (2015) predicts that the potential for the generation of electricity in Eastern Amazon will correspond to a higher average of 57,410 MW, or approximately 48.03% of all electricity capacity in the country. Gonçalves (2015) highlights that the Amazonian electricity distribution system contains two subsystems: the Northern subsystem is composed of the states of Pará, Tocantins and Maranhão, and the isolated subsystem is composed of the states of Amazonas, Amapá and Roraima².

In this context, the expansion of SIN in the Brazilian Amazon became a higher priority objective, especially regarding the need to increase the distribution networks, as well as the region's capacity to generate electric energy. The national interconnected system was of extreme importance since it sought to integrate the Brazilian Amazon into a macro supply of electric energy, which represented an alternative attraction for companies and other activities such as metallic and nonmetallic ore.

Within the logic of expanding the electricity sector in the Amazon, in addition to planning the distribution and the interconnection of networks based in the Amazon region, the main outstanding construction works were the Belo Monte HPP, the Jirau HPP, and the Santo Antônio HPP. According to Coelho et al. (2011), the Belo Monte HPP project originated from the time of the military regime, but was only actually implemented in 2015, after several attempts throughout the process to remodel it and reorganize it structurally. The capacity of the Belo Monte HPP is around 11,223 MW, which represents a greater energy production capacity than that of Tucuruí, making it the third largest hydropower plant in the world.

According to Coelho et al. (2011, p.90), "The estimated value of the project cost around R\$28.5 billion, way above the official forecast of R\$19 billion". Moreover, the companies involved in the enterprise were divided into a) management: the National Electric Energy Agency (ANEEL), ELETROBRAS;

¹ The National Interconnected System (SIN) is responsible for connecting the transmission and production of energy in which the hydroelectric and thermoelectric plants function, both of which are interconnected through an electric energy transmission network.

² According to the Ten-Year Energy Expansion Plan, between 2006 and 2015, the basic premises for understanding the interconnection of subsystems are precisely through the inclusion of the Acre/Rondônia system in the SE/CO subsystem (Southeast and Central-West) and the isolated Amazonas/Amapá/Roraima isolated system - termed the "N" subsystem.

b) the construction companies: Andrade Gutierrez; and c) the consumers: mining companies such as Vale and Alcoa. Amongst these categories of companies that make up the Belo Monte Construction Consortium (CCBM), we would highlight CVRD, ALCOA, the Companhia Siderúrgica Nacional (CSN), the Votorantim Group and other “commodity producers”.

Furthermore, decisions taken by these companies occurred within a financial environment, more precisely where the central financing structure of the Brazilian electricity sector functions, i.e., within the Wholesale Energy Market (MAE), thereby enabling the CCBM to enter the configurations of the ACR and ACL types.

4 THE LOGIC OF THE VALORIZATION OF MINERAL RESOURCES AND THE CENTRALITY OF THE ENERGY ECONOMY IN EASTERN AMAZON DURING THE LULA GOVERNMENT

Also, within the scope of the federal government, there was a profound change in the format of regional development. During the period of the military regime, the fundamental aim of the planning model was to modernize the Amazon Region. However, as Monteiro (2005) emphasizes, after 1990, regional development took a new direction: that of the structural axes for national and international integration, which promoted a sophisticated mining logic within the region.

These axes provided a better link between the different regions through an increase in the flow of transport, which responded to the actions of opening highways and waterways in order to improve the competitive capacity of the market. The significance of this action was termed by Monteiro (2005, p.195) *apud* Brasil (1997a, p.106) as being a “generation of productive integration chains”.

A key factor in the political decisions of this new model, through Constitutional Amendment nº 6, was to permit the entry of foreign capital, and allow it to have a majority participation in the mining companies. For Monteiro (2005, p.195), “one example of the ease with which this capital entered was given in relation to the rights of chromium ore reserves in the municipality of Mazagão-AP, which were acquired by the Norwegian company Elkem, and which started to run activities for the company Mineração da Vila Nova. “

Within this context, as a fundamental determination, the government of (former) President Lula presented a policy based on the logic of the valorization of mineral resources. Thus, the direction and execution of the National Regional Development Plan (PNDR) aimed to “keenly explore the endogenous potentials

of the magnificent, diversified regional base of development, in accordance with the current social foundations of a more diversified production,” as may be confirmed in Brazil (2003a, p.12).

The Brazilian government’s incentive in exports and market integration culminated with extreme balances for companies such as ALUNORTE, which had a significant jump in its exports from 730 thousand tons to 1.4 million tons a year. In 2004, this situation was repeated with the company CVRD, which in the Carajás-PA region over the next two decades became responsible for the annual commodification of 140,000 tons of copper ore in the Sossego/Sequeirinho complex. According to Monteiro (2005: 197-198):

The government’s objective was to valorise the surplus and its participatory expansion in the trade balance. The logic behind mining-metallurgy in the region was to ensure its economic viability based on the guarantee of using the comparative advantages arising from the possibility of accessing environmental resources and services at a low cost.

In the state of Pará, access to natural resources was key to the dynamization process of the region around the logics of the valorization of mining. Data by Monteiro (2005), for example, demonstrates that the amount of mineral-metallurgical exports in 1976 amounted to approximately US\$109.83 million of the trade balance of Pará. In addition, in 2004, total exports reached US \$ 3.8 billion, or 77% of the total value of exports from the state of Pará, which displays the importance of this sector to the local economy.

4.1 THE MINING-ELECTRICITY SECTOR BIOME: THE INTERESTS OF THE INTERNATIONAL MARKET IN EASTERN AMAZON AND THE CONTINUITY OF THE MEGAPROJECTS

From a historical viewpoint, changes in the production and distribution models of electric energy have sought to place great emphasis on the production of the infrastructural capacity of hydropower plants, with the aim of maintaining greater dynamism in the generation of electric energy, mainly supported by SIN and, by vast incentives to the electricity distribution companies across the country.

These profound structural changes in the national electricity sector have allowed the development of the Amazonian electric sector, alongside the mining industry, inducing them towards possible mergers in the market. Under these conditions, the question that immediately springs to mind is, how? The main hypothesis, arising from this question, is that the effect of the electric energy marketer provided investment flexibility in order to provide funding for the sector, which led to the possibility of achieving a greater flow of circulating capital.

From the perspective of Castro (2012) and Coelho and Monteiro (2013), it is possible to state that the mining companies are affiliated to the electric power companies in Eastern Amazon, indicating future mergers between the two sectors, i.e., it is clear that this opening for mergers between these two sectors is not limited to any one region.

For Castro (2012), national policies, especially PAC I and PAC II, are harnessed to the intervention of the Initiative for the Integration of the Regional Infrastructure in South America (IIRSA)³, which has sought to adopt modernization models based on megaprojects, especially in the sense of “competitive integration”, whereby both are linked by the integration and development axes⁴.

The electric energy integrations with the ore deposits in the Brazilian Amazon are directly connected to the Tucuruí hydropower plant in the state of Pará and, in the future, will be interconnected by the electric power transmission system with the Belo Monte HPP, also in the state of Pará. Authors such as Coelho and Monteiro (2013, pp. 36-37) state that:

Transmission lines run from Tucuruí practically in a straight line, to the municipality - Barcarena, located on the Marajó basin, directly in contact with the Atlantic Ocean - for the prime purpose of supplying Albrás with electric energy. In addition to the Tucuruí-Barcarena line, there is another heading south - where the mining companies are located, Mineração Buritirama in Marabá, MRN on the Trombetas River and CVRD in Parauapebas. From this last line, at Marabá, there is a branch that stretches east, in the direction leading to Alunorte, in São Luís [...].

In general, the IIRSA consists of several axes of integration, totalling ten in all. However, Castro (2012, p. 49) focuses his discussions on only three that interconnect the Amazon, which are:

The Amazonian axis (Brazil, Colombia, Ecuador and Peru) along which there are two hydropower projects on the Madeira River in Brazil (Jirau and Santo Antônio), and in the same basin another two hydropower plants in Bolivia and four in Peru. The Guiana Shield axis, which is situated in eastern Venezuela, in the extreme north of Brazil (the states of Amapá and Roraima), and through the Guianas and Suriname, in which there are reference cities for transportation logistics and services such as Manaus, Georgetown, Paramaribo, Boa Vista, Cayenne etc. and finally the Brazil, Peru and Bolivia axis in the direction of the Pacific.

³ The IIRSA was created in 1999, and is made up of 12 Pan American countries, but it was only in 2004 that the investment strategies were approved.

⁴ The concept of integration brings with it the presupposition of state actions in a supranational sphere, therefore, the integration of the region's market is suggested.

Boyer (2006), however, stresses that BNDES investments, and the interconnection of this financial institution to international capital, have been of paramount importance to demonstrate the local position of Eastern Amazon within an international perspective and also within the financial entities involved in these enterprises. In the words of Chesnais (1996, p. 80):

The World Bank, the International Monetary Fund, the Inter-American Development Bank (IDB), the European Commission (EC), the Organization for Economic Co-operation and Development (OECD), the Economic Commission for Latin America and the Caribbean (ECLAC) and the International Maritime Organization (IMO). [All] support the territorial physical infrastructural integration of the Amazon to the world market.

In addition to these important factors - such as flexible credit mechanisms that allow a greater flow of funding - Castro (2012) draws attention to another differentiated factor, which involves financial capital and its circulation, the development of the means of transportation. For Castro (2012, pp. 51-52), “the main objective is the integration of the transportation infrastructure to potentialize market integration in the Amazon”, as presented in Table 2.

Table 2 – IIRSA investments on the Amazonian, Guiana Shield and Peru-Brazil-Bolivia Axes

Integration Axes in Pan-Amazonia	Allocated Resources (R\$)	Intended connections and areas of interest
Amazonian Axis	R\$ 91,323,220.000	Access to the Solimões-Amazonian Waterway Access to the Ucayali Waterway Network of Amazonian Waterway
Guiana Shield Axis	R\$ 1,098,000.000	The Guiana-Suriname-French Guiana -Brazil Interconnection The Venezuela-Brazil Interconnection The Brazil-Guiana Interconnection
Peru-Brazil-Bolivia Axis	R\$ 835,592,293.930	The Porto Velho-Rio Branco Corridor- The Pacific Assis-port Maldonado-Cusco/Juliaca-ports (Brazil/Peru The Rio Branco-Cobija-Riberalta-Yucumo-La Paz Corridor (Brazil/Bolivia) The fluvial corridor on the Madeira-Madre de Dios-Beni Rivers (Brazil/Peru)

Source: Castro (2012, p. 50) *apud* IIRSA (2011).

Over recent years, according to the Brazilian Mining Institute (IBRAM), national investments in the mining industry have grown steadily, especially in the period from 2007 to 2014. At first it obtained US\$ 28.3 billion and subsequently reached its goal of US\$ 55 billion, with productivity rising from US\$ 5 billion in 2001 to US\$ 44 billion in 2013, according to IBRAM (2014a) data.

In sum, there has been a large-scale growth of mining productivity in the region of Eastern Amazon, since the megaprojects were introduced by the IIRSA. In addition, there was a significant increase in the Brazilian trade surplus as well as in that of the states in the mining economy in the years 2003, 2007 and 2010, as demonstrated in Table 3.

Table 3 – Trade exports and the relative weight of the trade balances of the states (Pará, Amapá and Maranhão) in 2003, 2007 and 2010*

State	2003	(%)	2007	(%)	2010	(%)
Pará	1,680,234,517.00	62.81	5,320,685,645.00	67.17	10,666,288,302.00	83.13
Amapá	-	-	79.543.889,00	62.15	281,101,916.00	79.63
Maranhão	495,867,949.00	67.02	1,859,853,362.00	85.42	2,407,799,795.00	82.45

Source: Ministry of Industry, Foreign Trade and Services (MDIC), in 2016. *Values in US\$.

Table 4 illustrates the significant amount of investments directed towards the Belo Monte HPP and the Carajás Iron S11D project. The S11D is characterized by an iron ore project in the region of Canaã dos Carajás-PA, which expects to produce 90 million tons of iron per year starting in 2016.

Table 4 - Regional Bulletin of Financial Investments

Investment (R\$)	Sector
R\$ 30 million	Belo Monte HPP
R\$ 24 million	The Carajás Iron Project S11D
R\$ 5,200 million	Logistics for the Carajás Railway

Source: ENERGIA (2012) and VALE (2014).

With regard to this, according to data obtained from Vale (2014, p. 13):

The production flow, which includes the construction of a railway branch, linking the S11D processing plant to the Carajás Railway (EFC) [...] One of the main innovations is the adoption of the truckless concept. In this system, about 100 off-road trucks, which would be responsible for transporting the sterilized ore, will be replaced by a gigantic 37km structure of conveyor belts.

The problem, however, denotes a greater dependence of the regional economy on the commodities market, with the share of commodities in the Brazilian economy growing since 2006, where its share corresponded to 41%, then 48% in 2008 and, finally, 54% in 2009. In 2010, dependence was accentuated, mainly in the participation of metallic and agricultural products within total national exports of commodities, corresponding to more than 60%, as verified in Brazil (2014).

FINAL CONSIDERATIONS

Within this context, Eastern Amazon is not only characteristic of having an autonomous local position in terms of economic growth, but also a local position in terms of the interests of the national and international economy, i.e., from the entry of international capital into the region, with related interests to many countries and economic blocs, such as the U.S., China and Europe.

For Bunker (2003), therefore, the Amazonian Region becomes a central point of action of these countries and blocs, since all global interests point towards themselves. On this issue, the fundamental deduction is that the national plans for regional and national development closely resemble the parameters of the plans developed in the period 1964-1985, as already observed in analysing the directives of action during the Brazilian military government.

This can be conceptually encircled by central common aspects, such as: 1) the presence of international market interests; 2) the manner in which the Brazilian government should assume responsibility for investments in logistics and energy infrastructure across the country; and (3) the sectoral objectives of the regions, which should be in line with the national development plans of the time.

Hence, the national plans for sectoral development in electric specificity gain a logic all of their own when located in Eastern Amazon. This signifies that the electric sector is subject to the logic of the valorisation of resources from the Brazilian Amazon, and thus begins to direct its forms of growth, with emphasis on the participation of mining companies such as Vale, in the electric energy auctions, and with interest in the Belo Monte HPP project, which indicates the importance of the electricity sector for mining production, and vice versa.

Therefore, the Amazon Region represents a kind of escape valve for the flow of investments, especially in the electricity sector and mining industry. With the development of local hydropower plants, according to PNE 2030, with the construction of more than 30 HPPs in the Brazilian Amazon, an even greater

impulse is expected for a more intimate connection between the electricity sector and the mining industry, and also a much more intense potential for the exploration of mineral reserves, including the perspective of verticalizing production with the generation of employment, income and added value, as defended by Carvalho (2005), Carvalho (2012) and Carvalho et al. (2017).

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