

ENERGY AND CRYPTOCURRENCY IN PARAGUAY

Energy-intensive use of cryptocurrency mining
in the scenarios of the Review of Annex C of the
Itaipu Treaty in Paraguay

AN EXPLORATORY STUDY



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INTRODUCTION

2023 marks the 50th anniversary of the signing of the Itaipu Treaty, which allows a key legal aspect to be revised: Annex C and the financial and commercial conditions of the sale of the energy produced by the entity. Furthermore, according to the entity's official schedule, the payment of Itaipu's debt is completed in 2023, which is a fundamental part of the unit cost of electricity service (CUSE); therefore, the cost of the energy produced by the entity drops by 60%, which equals an average of USD 2 billion per year. This is a turning point that opens a unique economic opportunity for the country in terms of availability of funds. It makes the need to recover the analysis of the components of this debt, and make visible its proven illegality¹.

In this context, it is important to highlight that Itaipu is the top hydroelectric power plant in the world in energy production, and the second largest in installed capacity, with 14,000 MW from 20 power generating units. Since the beginning of hydroelectric production on May 5, 1984, the entity has generated more than 2,600 million megawatt-hours (MWh)² by the end of 2021. Since hydroelectric power is one of the main sources of clean, cheap and renewable energy, Itaipu stands³ as a key element in the international dispute over energy sources and production worldwide. This dispute takes on a new level in the context of the current economic crisis, both in Brazil and internationally, and in a broader context of the global energy crisis taking place in a scenario of deep climatic and ecological crisis.

Therefore, in addition to the key legal, diplomatic and economic dimensions in 2023, there are social and political elements where energy production in Itaipu is at the center of the political discussions regarding the development model that will shape the present and future of the country. In this exploratory study, energy is seen as a means of production and, consequently, as a commodity. As a commodity, it is part of the dynamics of production and reproduction of capital. The energy that is socially produced by the working class, in the case of Itaipu's energy, by the Paraguayan and Brazilian working class, has historically been privately appropriated by private monopolies, in this case, Brazilian and foreign monopolies based in Brazil, as a characteristic contradiction of this mode of production (Vuyk, 2013).

In this setting, companies engaged in cryptocurrency mining, an activity that requires high energy consumption, have positioned Paraguay as a key territory on the map for economic development of this activity. Therefore, the interest in regulating this activity by companies engaged in cryptocurrency mining in the country is situated at a point in time where legal, economic, financial, social, political, diplomatic and political scenarios are intertwined around the definition of energy policy and, with it, the national political economy. Disputes are developing between these positions of the different social sectors.

1 It is worth mentioning at this point that 8 months ago the Comptroller General of the Republic of Paraguay proved that this debt is illegal and that it has already been paid off. However, the government continues to pay it and has not yet claimed any justice.

2 Breaking the world record for annual energy production in 2016 with 103,098,366 megawatt-hours (MWh).

3 As it was from its very origin, as a result of the need for expansion of Brazilian and foreign monopolies.

Due to the relatively recent appearance of this activity in the public sector, there are few national studies on the subject. Therefore, the present study has been developed with an exploratory purpose, based on the following research question: *What is the role of energy-intensive cryptocurrency mining, considering the economic, legal and political context of the revision of Annex C of the Itaipu Treaty in Paraguay between 2019 and 2022?* Based on this question, the general objective is:

- Outline the role of energy-intensive cryptocurrency mining, considering the economic, legal and political context of the revision of Annex C of the Itaipu Treaty in Paraguay between 2019 and 2022.

For this purpose, the following specific objectives have been defined:

- Outline and analyze the legal agreements with cryptocurrency mining companies and ANDE/CLYPSA, and their political and economic impact.
- Document and provide visibility to the use of the energy-intensive industry for the implementation of cryptocurrency mining farms in Paraguay
- Outline and analyze the impact and on the economic, legal and political scenario that occurs with the amortization of the Itaipu Dam in the framework of the revision of Annex C of its treaty.

The methodological strategy used in the development of this exploratory study is one of mixed methods, combining quantitative and qualitative methods. Both secondary and primary sources were used. Secondary sources are made up primarily of official statistics on energy intensive industries and their appropriate tariffs - this provides a general background in order to detail how cryptocurrency mining may be implemented in Paraguay. Additionally, analysis was performed on documents of current regulation of energy intensive industry use within the country, and on legal agreements between mining companies and ANDE and CLYFSA. Included in this is both printed and digital media archives, and the exploration and subsequent outline of digital scientific repositories.

In-depth interviews were conducted with the following primary sources: 1. A skilled informant from ANDE, 2. A business representative of the cryptocurrency mining activity and promoter of the law that seeks to regulate the use of cryptocurrencies in the country, 3. A technician in computer systems programming, and 4. A researcher in the industrial-electromechanical field. Thus, for the exploratory purposes of the research, the interview sample was constructed in a purposefully theoretical manner.

The research hypothesis was formulated based on the following statement: cryptocurrency mining in Paraguay is an activity marked by the private appropriation of energy⁴, used as a commodity, and not as a factor of production capable of generating autonomous economic development; that is, crypto-mining activity in Paraguay deepens the current national energy matrix where the use of energy is oriented to private profit in foreign hands. The increase of this economic activity from its legal regulation would aggravate the current conditions of handing over sovereignty to foreign capital interests, in a scenario defined by the confluence of economic, legal and political elements from the revision of Annex C of the above mentioned treaty, which marks the disputes between the different social sectors in the definition of the Paraguayan economic matrix.

This report has five sections. The first seeks to define the main concepts of cryptocurrency mining activity and its energy consumption. The second starts by questioning the country's location for the development of cryptocurrency mining, "Paraguay: a paradise for cryptocurrencies?"; in which the national hydroelectric potential is described, the historical evolution of the energy matrix and the national electricity system, the composition of the current Paraguayan energy matrix and the historical framework of the dispossession of national hydroelectric sovereignty. The third section describes the potential scenarios for 2023.

The fourth section, entitled "Cryptocurrency mining farms and the use of energy-intensive industry in Paraguay", describes the background of this economic activity in the country, the characteristics of the companies operating in the national territory in terms of their energy-intensive use, energy tariffs and the employment opportunities generated by them. Subsequently, the fifth section analyzes the draft law that seeks institutional regulation of cryptocurrency mining in Paraguay and the possible impacts that its enactment would have in 2023 and beyond.

This study focuses particularly on cryptocurrency mining, and its limitation is that it does not consider the financial aspects involved in this activity. These are central elements for understanding the present and future socio-economic scenario.

4 As a commodity and factor of production, as defined in the theoretical discussion.

1. INITIAL DEFINITIONS: CRYPTOCURRENCIES, CRYPTOCURRENCY MINING AND BITCOIN

Understanding of cryptocurrencies has a high degree of complexity because it is developed in a new technological dimension, and in parallel, it has an impact on the structure of the financial system. Both dimensions are usually embedded in technical language, the precise implications of which will be illustrated in the following sections. For this purpose, initial approaches to the definitions of cryptocurrencies, bitcoin, and cryptocurrency mining are presented.

1.1. Cryptocurrencies

Cryptocurrencies are defined by the Financial Action Task Force (FATF) as: “*a decentralized, mathematically based, convertible virtual currency that is protected by cryptography*”⁵. That is, it embodies principles of cryptography to deploy a distributed, decentralized and secure information economy” (GAFI, 2015)⁶.

The Blockchain Spain community defines cryptocurrency as a digital medium of exchange that is used in public blockchains, for the exchange of records. It is characterized and differs from conventional currencies in the lack of a central body (government/bank) that controls it⁷. Julia Sánchez states that, although they are called “digital” or “virtual” currencies, they do not qualify as currencies, because they do not fulfill three basic functions: 1. To be a payment method, for which they should be widely accepted in the purchasing goods and services, with a sufficient fractionation. 2. To be a unit of account 3. To be a deposit value, maintaining the ability to pay over time. (Sánchez, n.d.)⁸

What are blockchains? Blockchains⁹ are the technology on which the development of cryptocurrencies is based. In Sánchez’s words: “*Blockchain is a gigantic distributed ledger in which the records (blocks) are linked to protect the security and privacy of transactions. It is a distributed and secure database thanks to the use of cryptograph algorithms.*” (Ibid) In other words, they could be defined as distributed transactional databases, made up of blockchains designed to prevent modification once a piece of data has been published.

5 Cryptography is an encryption or encoding technique intended to alter the linguistic representations of certain messages to make them unintelligible to unauthorized recipients. One of the recurring cryptographic algorithms when studying the Bitcoin protocol is SHA-256.

6 Available from: www.fatf-gafi.org/media/fatf/documents/Directrices-para-enfoque-basada-en-riesgo-Monedas-virtuales.pdf

7 Available from: <https://blockchainespana.com/glosario/>

8 Available from: <https://www.pj.gov.py/ebook/monografias/extranjero/civil/Julia-Sánchez-Criptomonedas.pdf>

9 Blockchains are either public (where there are no restrictions to read data from the blockchain or to validate transactions) or private (where the process of consultation, validation and participation is limited to a few nodes). In this regard, cryptocurrencies rely on public and private keys to transfer value from one person (an individual or an entity) to another and must be cryptographically signed each time it is transferred, according to the Financial Action Task Force (FATF).

Cryptocurrencies such as Bitcoin, Ethereum (ETH) and others, where a consensus is validated through a proof-of-work (PoW) algorithm and by linking blocks cryptographically, are achieved through peer-to-peer (P2P) networks^{10, 11}. P2P networks¹² are networks of computer equipment in which all or some aspects operate without fixed clients or servers. That is, they are a series of nodes that are shared as equals between them, acting simultaneously as clients and servers with respect to the other nodes of the network.

It is important to note that nodes are physical or virtual connection points where all kinds of data and information can be created, sent and received. From the standpoint of Blockchain technology and cryptocurrencies, the nodes are made up of all those computers that are interconnected to the network of a cryptocurrency, running the software that is responsible for all its operation¹³.

The so-called “*proof of work*” consists of a consensus mechanism, an algorithm that establishes the rules that blocks must comply with to be admitted to a chain¹⁴. In other words, they are the game rules that incorporate the necessary incentives for the development of the activity, where a highly complex mathematical operations called “hashing” is used. The hash has certain requirements to make it difficult for the miner to find.

What is a “*hash*”? The hash indicates a digital fingerprint of the content on which the function is applied. The fingerprint will have a fixed length that will depend only on the algorithm used and not on the length of the initial content¹⁵. The same hash will always be the result of the same data, but the modification of the information, even if minimal, will result in a completely different hash. A hash is very difficult to calculate in the context of cryptomining¹⁶, therefore, it requires a great computational capacity to solve the mathematical formula present in each hash or fingerprint from computer equipment that requires power consumption 24 hours a day. The process of providing computing power for cryptocurrency transactions is called mining.

In such a way, solving the formula in the mining process yields cryptocurrencies from that blockchain as a reward. In Bitcoin, a small amount of these newly created cryptocurrencies are called “block reward” and in some cases, they also receive transaction fees paid by the users as an incentive for the miners, so that they can include that profit in their transactions for the next block. Thus, the security, integrity and balance of cryptocurrency ledgers is guaranteed by a network of mutually distrusted parties (in Bitcoin, known as miners) who protect the network in exchange for the opportunity to earn randomly distributed fees. Thus, a cryptocurrency transaction works as follows: When a transaction is made, there are several users (nodes) who are responsible for verifying the transaction and recording it on the large ledger (blockchain).

10 Available from: <https://blockchainespana.com/glosario/>

11 The Ethereum cryptocurrency is currently migrating to a transaction validation method called “Proof of Stake” (PoS). According to the official blog of the Ethereum Foundation: “*the operability of its Blockchain will see a 99.95% reduction in terms of associated power consumption*” Available from: diariobitcoin.com/ethereum/fundacion-ethereum-asegura-que-consumo-de-la-red-se-reducira-en-un-9995-al-implementar-proof-of-stake-pos/

12 In terms of the underlying epistemology of this technological development, the P2P economy means that anyone can make transactions as producers and consumers without having to use intermediaries.

13 Available from: <https://academy.bit2me.com/que-es-un-nodo/>

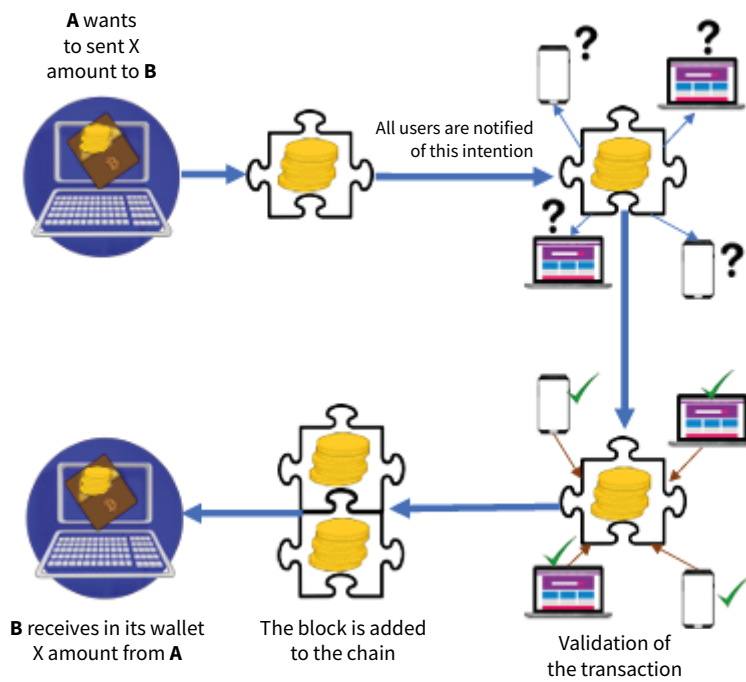
14 Distributed in a way that the string with the most support is the string with the most “work” or hashrate behind it.

15 This family of algorithms is often referred to as digest functions. The hashes are usually written in hexadecimal system (numbers between 0 and 9 and letters between A and F).

16 In the reverse direction

For example, a transaction of a certain amount of cryptocurrencies from user X to user Y develops as follows according to Sánchez: To begin with, no one will know who A or B is, only that from a digital wallet (equivalent to a bank account) they want to transfer an amount to another wallet. User X notifies other users of their intention through a message. They check that they have sufficient balance. With this confirmation, they provisionally record this transaction in the ledger that constitutes the blockchain in cryptograph language. From the passage of time and the end of other transactions, a block is formed. When the blockchain completes its capacity, it is validated. By means of complex mathematical algorithms that require high computing power, and therefore high energy consumption, the blocks are permanently recorded in the chain. As previously indicated, the slightest modification in a single block alters all those linked to it (Sánchez, n.d). This process is illustrated in the following Graph No. 1.

GRAPH 1. Cryptocurrency transaction mechanism.



Source: Sánchez, n.d.

1.1.1. Bitcoin

The first block that began a blockchain was Bitcoin ¹⁷ on January 3, 2009. In doing so it provided the first fully implemented cryptocurrency protocol (Ibid). According to FATF (Financial Action Task Force), Bitcoins are:

Units of account composed of unique strings of numbers and letters that constitute units of currency. Their value is obtained through the disposition of users to pay for them. Bitcoins are digitally traded between users with a high level of anonymity and can be exchanged (purchased or withdrawn) in U.S. Dollars, Euros and other fiat or virtual currencies. Anyone can download the free, open source software from a website to send, receive and store Bitcoins and monitor Bitcoin transactions. Transactions (or fund flows) are publicly available in a shared transaction log and identified by the Bitcoin address, a string of letters and numbers not systematically linked to an individual (FATF, 2015) ¹⁸.

This cryptocurrency has a production limit of 21 million Bitcoins, although each unit can be divided into smaller parts. According to Sánchez, the value of the Bitcoin constantly fluctuates. It has increased considerably since its creation. In its beginnings it did not reach the dollar, the value in August 2018 totaled USD 6,000 and in May 2022 the value of this cryptocurrency dropped to historical levels when it was traded at USD 33,005, in the first days of May. This represents a drop in the price of bitcoin of 28.8% so far in 2022. With the plunge from its all-time high on November 10, the trend that the bitcoin price had previously maintained of a series of increasingly higher price floors was broken¹⁹.

The sociologist Edemilson Paraná states that, in epistemological terms, bitcoin is fundamentally based, on both Milton Friedman's idea of neutral and exogenous money, and on Friedrich Hayek's utopia of money without the State - with the idea that currency should be issued and used privately, so that everyone competes in the market with their currency. For this author, bitcoin reflects the movement of risky speculative assets in the market. It develops in a scenario of uncertainty, in which many analysts have recommended maximum diversification of their investment options. So in this context shaped by the hegemony of financial capital in a highly speculative, volatile and uncertain scheme, bitcoin became a repository of investment diversification strategies. Therefore, this author points out that the development of cryptocurrencies in general and bitcoin in particular is linked to the speculative dynamics typical of the way the current financial market operates²⁰.

17 Besides Bitcoin, there are other cryptocurrencies such as: Ethereum, Litecoin, Ripple, Dash, among others.

18 Available from: www.fatf-gafi.org/media/fatf/documents/Directrices-para-enfoque-basada-en-riesgo-Monedas-virtuales.pdf

19 Available from: <https://www.criptonoticias.com/mercados/6-semanas-consecutivas-baja-bitcoin-alcanza-precio-mini-mo-2022/>

20 Source: <https://jacobin.com.br/2020/12/as-armadilhas-e-contradicoes-do-bitcoin/>

1.2. Cryptocurrency mining

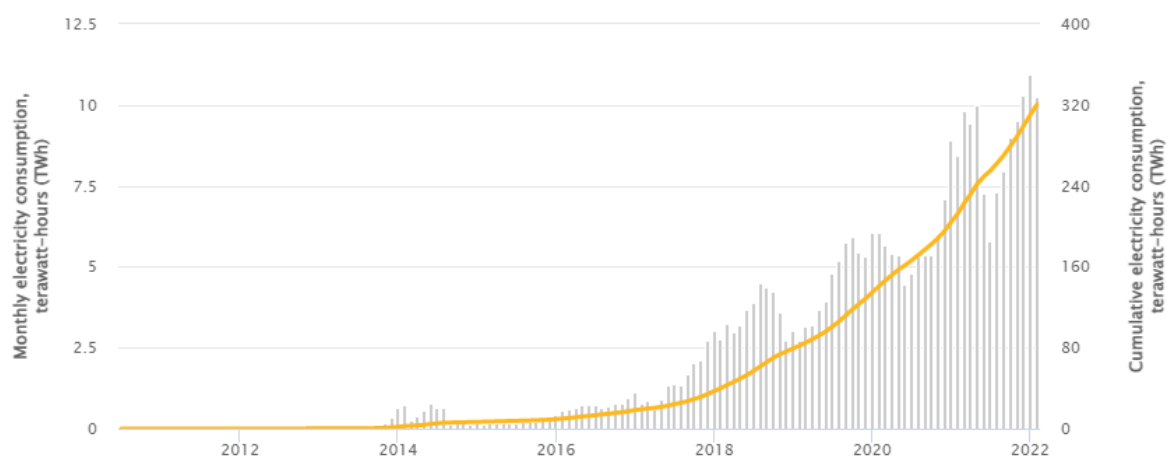
As noted previously, the development of cryptocurrencies uses “*mining*” as a form of network maintenance and stock distribution. In computing terms, this process aims to find a particular hash value that “solves” a block of transaction data, adding it to an ever-growing blockchain. Mining secures this distributed record of transactions.

This process requires high investments: the most successful miners operate warehouses full of specialized machines that are constantly being upgraded. As previously mentioned, solving a block of transactions rewards the miner with Bitcoins for their work, making it a potentially lucrative activity: the more computing power that can be gathered, the more rewards can be obtained.

1.2.1. Cryptocurrency mining and energy

Specialized equipment for mining Bitcoins are application-specific integrated units (ASICs) optimized to be more energy efficient when consuming power. However, they consume a significant volume of energy, as can be seen in Graph No. 2, which shows the overview of the evolution of the total electricity consumption of the Bitcoin network worldwide. People or companies engaged in mining activities connect specialized equipment to the cryptocurrency network 24 hours a day to obtain the necessary computing power to find the solution to the incredibly complex and randomly generated mathematical puzzles on which this financial digitalization technology is based (Technician in computer systems programming, 2022).

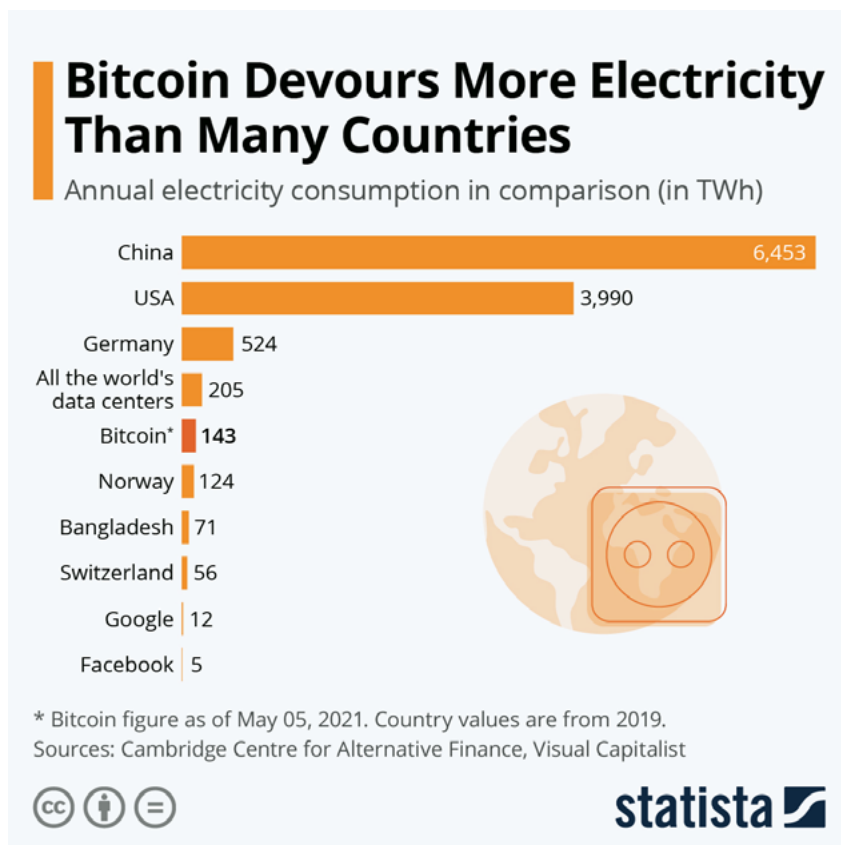
GRAPH 2. Total bitcoin electricity consumption.



Source: Bitcoin Electricity Consumption Index (CBECI)²¹.

²¹ Source: <https://ccaf.io/cbeci/index>

GRAPH 3. Annual electricity consumption by country.



Source: [Statista.com](https://www.statista.com)²²

Therefore, it is important to highlight the central importance of energy availability for the development of cryptocurrency mining. The main cost of this activity lies in energy consumption, since it requires high computing power to carry out the entire process, which is correlated with high electricity consumption. According to estimates from the Cambridge University's Bitcoin Electricity Consumption Index (CBECI), the entire Bitcoin network consumes around 112 terawatt hours (TWh) of energy, or more than the entire Netherlands. As such, if bitcoin were a country, it would rank 33rd in the world for annual electricity consumption²³.

In the current context of a climate and energy crisis, there is a massive exodus of cryptocurrency mining companies from China and other countries in the global north to peripheral countries. One possible explanation for this phenomenon lies in the cancellation of cryptocurrency mining in these countries due to the high environmental impact of this economic activity due to its high energy consumption²⁴.

22 Available from: <https://www.statista.com/chart/18632/estimated-annual-electricity-consumption-of-bitcoin/>

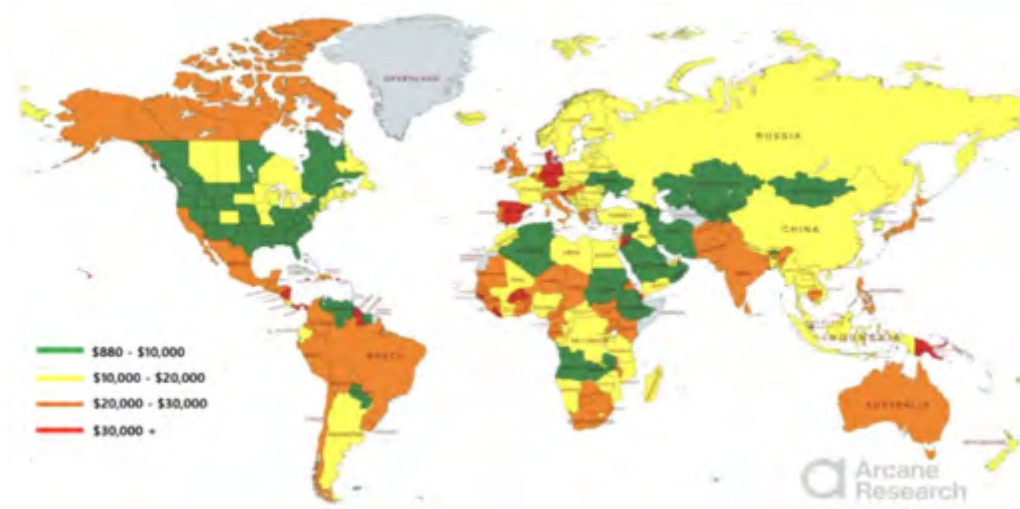
23 Available from: <https://ccaf.io/cbeci/index>

24 Available from: <https://www.redaccion.com.ar/por-que-china-prohibe-el-bitcoin/>

2. PARAGUAY: A PARADISE FOR CRYPTOCURRENCY MINING?

Paraguay is considered a paradise for the development of this economic activity because it has constant, renewable and clean energy. In addition, it is traded at a very low tariff compared to world market prices, due to the framework of Paraguay's economic model, based on three²⁵ fundamental supports: i) the production and export of agricultural commodities, ii) the re-export or triangulation of imported goods from outside the region and iii) the transfer of hydroelectric energy to neighbors (Masi, 2011). Thus, the wide availability of electricity in Paraguay has not been considered as a production factor for an industrially based economic plan. Instead, it has become a commodity, assigned to promote the industrial and productive development of neighboring countries.

GRAPH 4. Cost* of electricity to mine 1 bitcoin worldwide.



* With Antminer S19
Source: World Bank

Since 1870, after the War against the Triple Alliance (1864-1970), the Paraguayan state has been characterized by encouraging private and foreign appropriation of national resources. Throughout history it has taken on various institutional names. This process deepened since the 1970s with the signing of the Itaipu Treaty, a decade in which the delivery of cheap land to Brazilian agribusiness and members of the dictatorship²⁶, access to credit for them, low tax pressure on corporate profits, etc., also deepened. This scheme has been replicated up to the present day.

The national business sector views this development model positively, since it has been beneficial for foreign capital businesses. This political position is explained in the following way by a representative of a cryptocurrency mining company in Paraguay: *“Paraguay is a very stable country, with a very strong currency, inflation of 3% per year, we have never had runaway inflation. Paraguay has the time to do something right”* (Representative of a cryptocurrency mining company, 2022). In this sense, the key elements for the installation of foreign capital are: the lowest cost of electricity in the region (less than US\$ 0.05 KWh), energy from 100% renewable sources (hydroelectric), strategic geographical position, competitive tax regime for the private sector, which is one of the most inequitable in the region, under a macroeconomic discipline regarding the mandates of the International Monetary Fund.

25 According to sociologist and economist Fernando Masi *“These three supports explain both the cycles of economic stagnation, moderate growth and high growth of the last three decades.”* (Masi, 2011).

26 They are known as ill-gotten lands

This scheme is part of a global context marked by the main presence of non-renewable energy sources, in a scenario shaped by a major energy crisis in the context of a deep and general climate and ecological crisis. From 1973 to 2017, i.e. in 44 years, renewable energies increased from 12.3% to 13.8% of the total energy supply. At this rate, which is 0.034 percentage points of increase per year, only in 2528 years will the energy used on the planet be 100% renewable. However, in Latin America and the Caribbean, CO₂ emissions from electricity generation are lower than in other regions, because energy sources in the region are renewable in a higher percentage than in the rest of the world.

It is important to stress that we are currently witnessing a global decline in the non-renewable sources of energy that have prevailed in the energy matrix to date, like oil, and a rise in the search for clean and renewable sources of energy, where hydroelectric power is one of the main ones. Within the context of the international crisis of the current production -the capitalist mode of production- the dispute for the appropriation of energy sources and production is one of the central elements that summarize the international sentiment²⁷.

2.1. Hydroelectric potential in Paraguay

High-quality, low-cost, renewable electricity is a characteristic of Paraguay that only a few countries in the world have. In addition, hydroelectric power from large dams as our country has, offers higher quality, continuity and storage capacity than other forms of discontinuous renewable energy such as solar and wind power (Canese, 2020). Therefore, in order to understand the relationship between the advance of cryptocurrency mining and the energy advantages offered by Paraguay, it is necessary to make visible the way in which Paraguay has developed its energy matrix and which sectors have benefited the most in this context.

In some peripheral countries of the world economy, there is a lot of energy generated but little use: it is the curse of natural resources. This happens because energy can also be the object of “extractivism”, as is the case with the granting of electricity in Paraguay, or with energy-intensive production with minimal generation of employment, as is the case with aluminum (Canese, 2020).

Energy production in Paraguay has significant electricity surpluses²⁸. In terms of net exports, Paraguay is the largest exporter of electricity in Latin America and the Caribbean, and the third largest in the world. Germany exports in net terms 50,520 GWh, Canada 64,047 GWh, Paraguay 41,130 GWh and France 40,220 GWh. For its part, Itaipu had an electricity generation capacity of over 90,000 GWh/year on average in recent years.

The binational entity can deliver guaranteed energy to a figure of 75,000 GWh/year^{29, 30} which is what the plant could generate even in years of minimum flow, of intense drought. According to the treaty, the tariff contract for the electric companies is calculated based on this amount of guaranteed energy (Canese, 2016).

27 As it is currently being expressed - among other elements - the Russia-Ukraine war, as well as the wars that the oil consuming powers - the United States, Great Britain, France, Russia, China, Japan - have carried out against the oil producing nations - Iraq, Libya, Syria - and the different forms that disputes over the control of economic territory take, such as commercial and diplomatic wars - like Venezuela -, the new types of coups d'état, among other things.

28 With high quality renewable energy such as hydroelectric power from large plants, as previously mentioned.

29 Guaranteed energy. This is the energy that the Binational Entity guarantees to produce even when there is a minimum flow of the Paraná River.

30 The guaranteed energy is adjusted each year by Itaipu and is around 75,150 GWh/year, a figure that the author rounds up to 75 GWh/year.

Then, it could be inferred that ANDE will certainly have 37,500 GWh/year (75,000/2) in the worst hydric conditions of the Paraná River. In addition, it is very likely to have a total of 45,000 GWh/year (90,000/2), on average³¹; i.e., the ANDE will probably have about (45,000-37,500) 7,500 GWh/year, on average, of non-guaranteed energy. In some years it may have more non-guaranteed energy, in others less, and even in some cases with an extremely low level of river flow will not have any non-guaranteed energy at all (Canese, 2016).

Yacretá's generation capacity is currently around 20,000 GWh/year firmly (of which 10,000 GWh/year correspond to Paraguay), plus a non-guaranteed energy that can be estimated at about 2,000 GWh/year (1,000 GWh/year would correspond to Paraguay), which could be considerably expanded by installing more power in Yacretá, as it is proposed and analyzed later on.

Acaray has a capacity to generate about 800 GWh/year (guaranteed energy, largely based on the Yguazú river reservoir that gives stability to the flow toward the Acaray dam), although it could generate an estimated 200 GWh/year more (non-guaranteed energy).

Therefore, between the 3 dams, Paraguay could have a total of 48,300 GWh/year of guaranteed energy (37,500+10,000+800), even at times of lower flow of the Paraná River. On a non-guaranteed basis, Paraguay could also have 8,700 GWh/year (7,500+1,000+200) from the three power plants mentioned above. In total, although not guaranteed, our country would have 57,400 GWh/year (48,300+8,700).

2.2. Historical evolution of the energy matrix and the national electrical system

The development of the electrical system in Paraguay was at the beginning - as in many countries - exclusively in the main urban centers. In addition to Asunción, electricity supply services were installed in the cities of Concepción, Encarnación, Villarrica, Luque, and some others.

The process of nationalization of the public electricity service in Asunción and surrounding areas ended in 1964, under Law No. 966, which established the Organic Charter of ANDE. Under this law, the ANDE was in charge of the public electricity service throughout the republic, although it was established that existing concessions in other cities would be respected until they were terminated. ANDE, until the middle of the 20th century, supplied only Asunción and its surroundings, fed by the Puerto Sajonia wood-burning power station. This power plant used firewood to generate electricity until the 1950s, later transforming the boiler fuel intake system to use fuel oil, which was easier to use, but imported at a high cost (Canese, 2016)³².

This prompted plans to search for other sources of generation; studies with financing from the Inter-American Development Bank (IDB) began in the early 1960s, and focused on the Acaray River, where the feasibility study and executive project of what is now the Acaray Hydroelectric Power Plant was developed. This plant began to generate electric energy in 1968, and from that moment on, the expansion of the electric system began throughout the country. All the small and medium-sized cities began to demand their connection to ANDE's national electric system, and those that had a service based on wood-burning power, such as Encarnación, Concepción and Hohenau, among others, began to connect to ANDE's service, at the request of their own population, eliminating private concessions (with the exception of Villarrica and the Mennonite colonies of the Chaco³³) (Canese, 2016).

31 According to records of the last few years, Itaipu's generation has averaged slightly over 90,000 GWh/year.

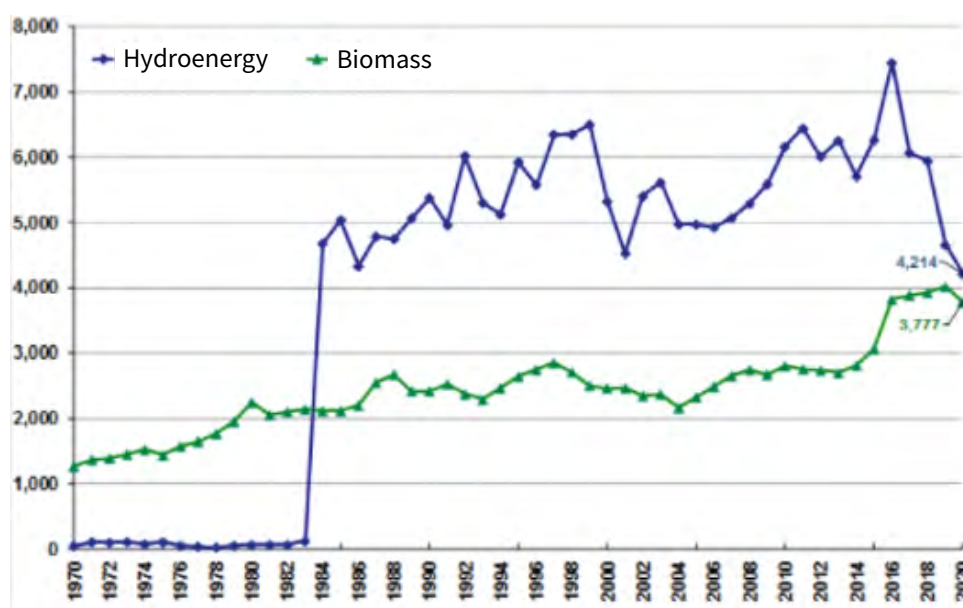
32 Canese, R. 2016. Electric Energy in Paraguay. Sovereignty, human rights and development

33 These concessions will be developed in more detail later on, as they are directly related to the object of study.

The construction of the Itaipú and Yacyretá hydroelectric power plants provided the national electricity system with sufficient hydroelectric generation sources for a long period of time, without major concerns about adding more generation capacity. The first began operating in 1984 and the second in 1994.

It is foreseen that Paraguay could be self-sufficient in hydroelectricity, without adding more generation capacity, until 2031 in the most promising scenario. Thus, the trend of decreasing hydroelectric production will deepen from the 2030s onwards, which will initiate the reduction of the power generation capacity of dams. According to ANDE calculations, with an average annual growth in electricity demand of 5%, Paraguay would be using all of its hydroelectric power production by the end of 2040. These calculations even take into account the construction of other dams in the interior of the country and the binational Corpus dam with Argentina (Masi, 2011). The decreasing trend in hydroelectric power production can be seen in the following graph.

GRAPH 5. Primary Energy Production: Hydroenergy and Biomass (ktoe).



Source: National Energy Information System (SIEN), of the Directorate of Primary Energy Resources of the Vice-Ministry of Mines and Energy.

The total energy supply in 2020³⁴ dropped by 5.9% compared to 2019, due to the fall in primary energy production (decreases by 7.9%), as a result of unfavorable hydrological conditions in the Paraná River, which have been maintained since last year, due to the decrease in the rainfall regime derived from massive national and regional deforestation³⁵ (Vice Ministry of Mines and Energy, 2021)³⁶.

34 It is calculated as: primary production + import - export ± stock variation - unutilized

35 “The production of raw biomass products decreased by 6.0% as a result of a decrease in the demand for these products explained by the reduction in the levels of activity in the manufacturing industry (1.5%), commerce (6.8%) and services in restaurants and hotels (32.0%). There has also been a reduction in the number of households using firewood as the main fuel in cooking food (over 30,000 fewer households in 2020 than in 2019). The decrease in the import levels of petroleum derivatives is explained by a lower demand for these products during 2020, which is manifested in all of these products but with greater impact (due to their high import volumes) in the case of diesel (with 2.9% below what was imported in 2019) and motor gasoline (with a reduction of 8.9% compared to 2019), both products closely related to the levels of transportation activity in all its forms”.

36 Available from: <https://www.ssme.gov.py/vmme/pdf/balance2020/Balance%20Energ%C3%A9tico%20Nacional%202020%20-%20V2.pdf>

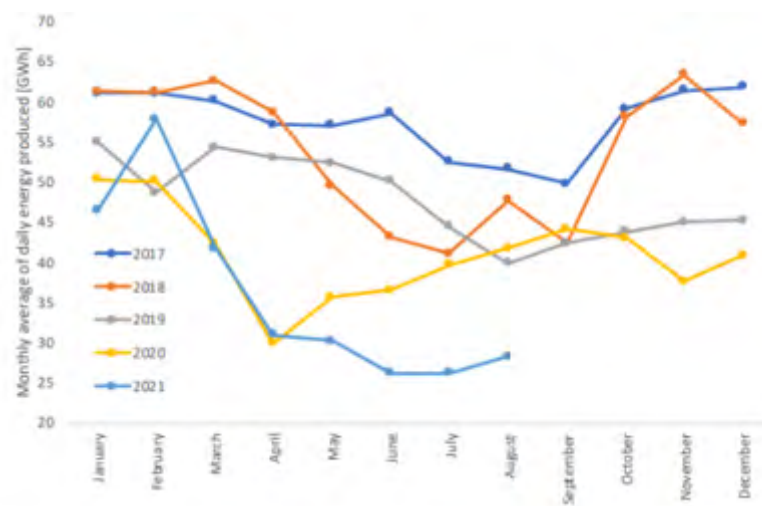
TABLE 1. National energy balance comparative statement 2020-2019.

	2019	2020	Variation 2020/2019 (%)
Primary Production	8.675,57	7.990,75	-7,89
Primary Imports	1,15	0,80	-30,78
Secondary Imports	2.606,90	2.437,44	-6,50
Export	-2.802,45	-2.480,66	-11,48
Stock variation	-2,98	-42,06	
Unexploited	-176,73	-95,46	-45,98

Source: ANDE, 2021

Therefore, it is necessary to highlight that the situation of droughts in recent years has greatly affected the production of hydroelectric power. The production of the Itaipu Hydroelectric Power Plant dropped almost 18% compared to the same period of 2021, but compared to 2016, the decrease was almost 42%³⁷. According to data from the Yacyretá Binational Entity, the hydroelectric power production decreased significantly in 2020 and especially in 2021, which can be seen in Graph No. 5.

GRAPH 6. Monthly average daily energy produced during the 2017-2021 period at the Yacyretá hydroelectric power plant.



Source: Yacyreta Binational Entity. Mentioned in: Naumann, G et al. 2022.³⁸

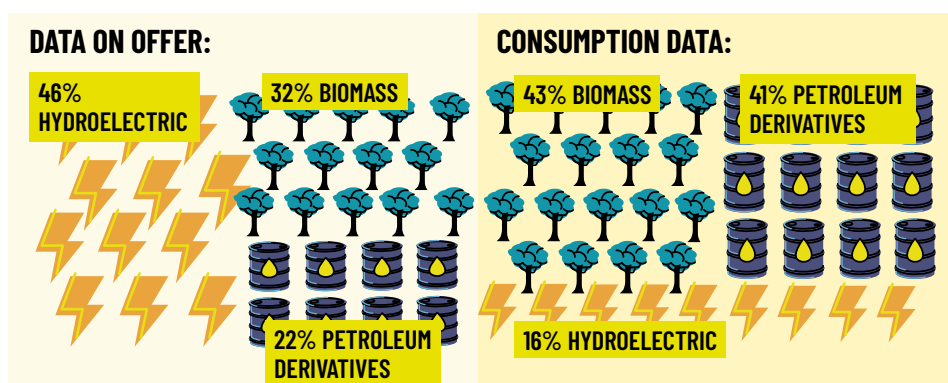
37 Available at: <https://www.abc.com.py/nacionales/2022/06/07/vinculan-menor-consumo-de-energia-a-nivel-pais-con-la-situacion-economica-adversa/>

38 Naumann, G. et al. 2022. El episodio de sequía extrema de 2019- 2021 en la Cuenca del Plata. P.32 Available from: <https://sisa.crc-sas.org/wp-content/uploads/2022/02/Informe-bajante-Parana-Espanol.pdf>

2.3. Composition of the Paraguayan energy matrix

Primary energy production in Paraguay consists of renewable sources (hydropower and biomass)³⁹, as previously mentioned. In 2020, about 53% of primary energy production was hydropower, which supplies the operations of the Itaipú, Yacyretá or Acaray⁴⁰. The same year, 60% of the gross generation of the hydroelectric power plants was destined to the Brazilian and Argentinian markets. Therefore, at the national level, the energy matrix for 2020 has as final electricity consumption of only 19%, while 42% is biomass and the remaining 39% is imported petroleum products. Paraguay is the country with the highest generation of hydroelectric energy per capita in the world. However, this ratio does not hold when it comes to energy consumption.

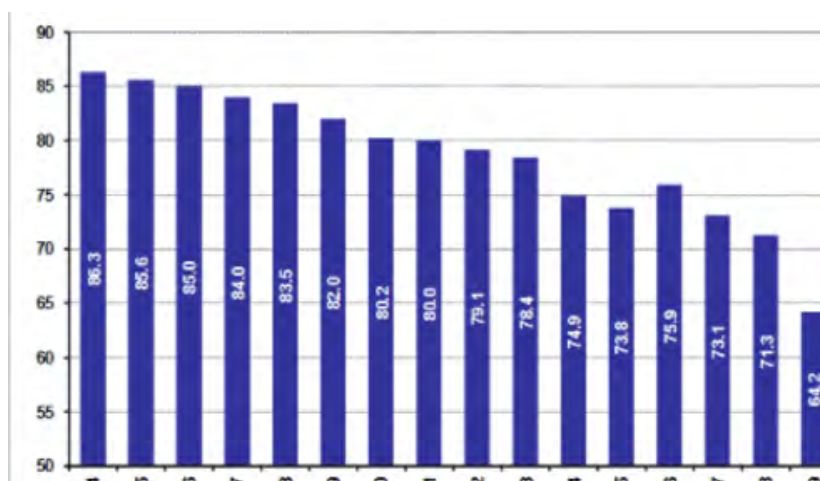
GRAPH 7. Energy matrix structure, year 2020.



Source: Vice Ministry of Mines and Energy: National Energy Balance, 2019. Created by El Surtidor⁴¹.

Although Paraguay still has high surpluses of energy available for cession to neighboring countries, the share of electricity generation destined for cession has decreased in recent years. Paraguay ceded 11.79% less electricity in 2020 compared to 2019.

GRAPH 8. Percentage of electricity generation destined for export.



Source: National Energy Information System (SIEN), from the Directorate of Primary Energy Resources of the Vice-Ministry of Mines and Energy.

39 It does not produce oil and the production of natural gas is local and marginal, and does not represent any contribution to the national energy matrix.

40 Available from: https://www.ssme.gov.py/vmme/index.php?option=com_content&view=article&id=1213&Itemid=598&show-all=1

41 Available from: <https://twitter.com/elsurti/status/1498599206377848832/photo/1>

TABLE 2. Comparative of energy transfers 2020 - 2019.

		2019	2020	Variation 2020/2019 (%)
In Thousands of T.o.e.	Electricity	2.730,32	2.408,41	-11,79
	Energy ceded to Argentina	639,59	495,73	-22,49
	Energy ceded to Brazil	2.079,52	1.899,90	-8,64
	NDE's exportations	11,21	12,78	14,02
	Charcoal	72,12	72,20	0,11
	TOTAL EXPORTS	2.802,44	2.480,61	-11,48

Source: ANDE, 2021

One of the reasons for this decrease is the 6.9% increase in the national electricity demand in 2020 (compared to the previous year). To meet this increase, the system increased the proportion of energy acquired from the net generation of the binationals to meet the national demand from 34.2% to 38.6%. The highest levels of electricity demand are centered in the services sector (commerce, government and others), followed in order of importance by the domestic sector⁴², the manufacturing industry and the agriculture, construction and mining sectors⁴³.

The demand of the industrial sector in 2021 was 1,374 GWh out of the 13,398 GWh available, which represents only 10% of the electric power, according to a report by ANDE⁴⁴. Industrial customers are considered industrial when they have a valid Industrial Registration Certificate issued by the Ministry of Industry and Commerce. This group also includes users classified as: high/very high voltage and energy-intensive⁴⁵. This data gives clear evidence of the low representation of the industrial sector in the national economic matrix, and that the existing industries at the national level use little electricity from dams as a primary energy source⁴⁶.

42 The growth in the national demand for electricity can be explained by the significant growth in the demand of the residential sector (15.7%). The Vice-Ministry of Mines and Energy considers that the measures adopted under the Covid-19 health emergency have had an impact on the growth of the sector's demand in the year 2020. The increase of the time people spend in their homes due to the use of tele-work modalities, the lower frequency of attending to workplaces due to the work teams system, the general restrictions on people's transportation and others, resulting in greater use of electrical equipment in the home, among others. He adds as another factor the increase in the use of electricity as the main fuel for cooking food. In 2020, more than 20,000 households opted for the use of electricity for cooking food (VCME, 2020).

43 The low level of diversification of electricity use in households causes poor employment and has an impact on the quality of life of the population and the satisfaction of their basic needs. Available from: https://www.ssme.gov.py/vmme/index.php?option=com_content&view=article&id=1213&Itemid=598&limitstart=3

44 For example, the soybean agroindustry carries out most of its industrial processing with biomass, putting additional damage to deforestation in the national territory. Available from: https://www.baseis.org.py/wp-content/uploads/2021/03/2020_Dic-Cadena-de-la-soja_compressed.pdf

45 Available from: <https://www.abc.com.py/nacionales/2022/02/10/el-consumo-industrial-de-energia-electrica-alcanzo-apenas-el-10-del-total-que-facturo-la-ande-en-2021/>

46 Per capita electricity consumption in Paraguay in 2019 was 154,378 kg, and 162,675 kg in 2020; meanwhile, per capita consumption of petroleum derivatives and biomass doubled the previous figure.

2.4. The dispossession of hydroelectric sovereignty in Paraguay

The national energy matrix, known for its high dependence on the use of biomass and the import of petroleum derivatives, despite having one of the most significant hydroelectric potentials in the world, is the result of the political economy imposed on the country with special emphasis since the Stroessner dictatorship⁴⁷.

A clear expression of this economic policy is the Treaty of Itaipu, the result of a military invasion carried out by the Brazilian army in 1965 after the coup d'état that set up the military dictatorship in Brazil. Looking to take over the territory to take unilateral advantage of its energy potential, the Brazilian army invaded Puerto Renato towards the Salto del Guairá area, and as a result of this process the Foz do Iguazu Act was signed in 1966. Later with the Itaipú Treaty in 1973, Brazil achieved in a diplomatic way what it had tried to achieve in a military way: to appropriate the hydroelectric potential of the area.

2.4.1. Binationality, territorial cession and the power of military invasion

The dictatorship of Alfredo Stroessner made a pact with the Brazilian dictatorship, handing over, through the Itaipu Treaty, the control of energy to foreign capitals, ceding Paraguayan territory⁴⁸ to Brazil under the figure of “condominium” and creating a “binational” entity⁴⁹ entity that is a State within the State and that cannot be controlled or audited by the people⁵⁰, thus guaranteeing the control of Brazilian and foreign interests of the entity⁵¹. So far, the actions demonstrate that the binational legal nature established in the treaty has created an entity comprised of the two States, but which operates above them, with the entity's funds not entering the national treasuries, not being accountable, not being directed, transparent or audited by the national agencies of each country⁵². This means that the

47 Military dictatorship of Alfredo Stroessner. It is also known as the stronist dictatorship. *Stronismo* or colloquially “the dictatorship”, was the dictatorial regime established in Paraguay during most of the second half of the twentieth century, for a period of almost 34 years and 172 days - between August 15, 1954 and February 3, 1989 - Paraguay.

48 The cession of national territory after the flooding of the Salto del Guairá, the Atlantic Forest and its surroundings in 580 km², and the transfer of that territory, the lack of boundary delimitation and the Paraná River along that route from being Paraguayan to being territory in condominium, that means “of both States” or in “shared sovereignty”, which is nothing more than the handing over of Paraguayan territorial sovereignty to Brazil. After an initial stage, in which the Paraguayan Government claimed its sovereignty over the territory militarily occupied since 1965 - as manifested, among others, in the note of the National Chancellery of December 14, 1965 -, Paraguay ceded the territory to the control of the Brazilian State through the Act of Foz do Iguazu under the figure of condominium, in which were included both the territory of the Guairá waterfalls - subsequently flooded - and the Paraná River from the waterfalls to the mouth of the Yguazu River. This cession of territory is the key point of the surrender and loss of sovereignty that continues to date. Research shows that around 50,000 hectares, which originally should be part of the protection strip, were no longer expropriated and are currently occupied by extensive soybean cultivation, cattle ranches, clubs and private condominiums. In addition, more than 250 clandestine ports on the Itaipu Lake were found to be used for smuggling and drug trafficking. At the same time, the 38 indigenous communities in Paraguay that were forced to abandon their lands did so without receiving fair compensation or land on equal terms, in breach of the provisions of the expropriation law. This continues, as in 2019 Itaipu filed an eviction action against the Tekoha Sauce indigenous community who, as a result of the struggle, part of their territory was returned to them. The lawsuit is still ongoing at the closing of this report.

49 The legal nature of the entity is officially called *sui generis* by Itaipu, since this legal concept does not exist in International Public Law.

50 A true democratic participation of all social sectors, including trade unions, farmers, students, women and indigenous peoples, among others.

51 The Binational Entity based on a bilateral treaty, with the management and administration conditions designed in that legal body, raises debates and controversies to this day, being -in reality- controlled and managed by foreign and Brazilian interests, with the consent of the Paraguayan authorities on duty.

52 An example of this is the refusal of Itaipu's Board of Directors to provide public information requested by several organizations about its meetings and resolutions, under the argument that “Itaipu's information and documents belong to the entity itself and, therefore, are not freely available to interested third parties or government agencies, beyond the provisions of the Treaty of origin.”

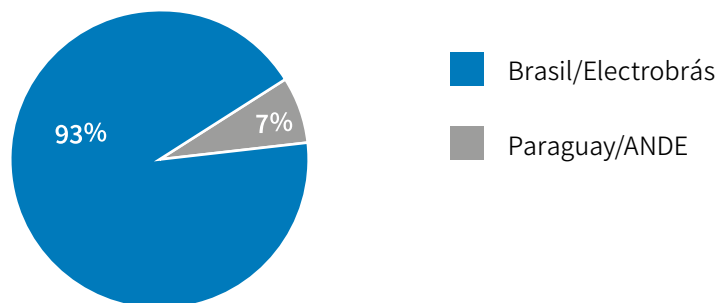
interests of the other High Party⁵³ continue to prevail over national interests, using the legal structure of binationality to guarantee this political control, maintaining a scheme of foreign domination over the territory, energy and funds of the entity.

The treaty—and its subsequent modifications via Reversal Notes—has established the power of unilateral actions in terms of police and security in the condominium territory, which prevails to the present day. This is a strong vulnerability factor for national security and the defense of the country's territory and resources.

2.4.2. Cession of hydroelectric power

The treaty also establishes the cession of hydroelectric energy. From 1984 to 2017, Paraguay ceded 85.7% of its energy to Brazil, with Brazil using a total of 92.9% of all the energy produced in Itaipu to date (Itaipu, 2018).

GRAPH 9. Use of energy generated at Itaipu - 1984-2017.



Created by the authors based on data from Itaipu.

In 2018, the Brazilian State used 84.4% of the total energy produced in Itaipu, while the Paraguayan State used 5.58% of the total, ceding 34.42% of the 50% that corresponds to it, at 9.8 USD/MWh (Itaipu, 2018). The main beneficiaries of the current energy production in Itaipu and cession of Paraguayan energy to Brazil are the Brazilian and foreign monopolies settled in Brazil in the Paulista ABC: mainly those linked to the steel, mining and petrochemical sector, who are the main energy appropriators. Some of these main beneficiaries are the petrochemical monopoly Braskem, the steel companies Arcelor JF and CSN, the mining company Vale S.A. and the metallurgical companies Albras, Gerdau and Anglo Niquel.

The energy produced by Itaipu is some of the cheapest in the Brazilian market, as well as being abundant, clean and safe. In 2017, the average cost of Itaipu energy for Brazil amounted to USD 40.86/MWh (including guaranteed energy, non-guaranteed energy and the payment of compensation for energy assignment).

53 High Contracting Parties of Itaipu: According to Article I of the Itaipu Treaty, the High Contracting Parties (the Paraguayan and Brazilian States) agree to jointly carry out, in accordance with the provisions of this treaty and its annexes, the hydroelectric exploitation of the hydraulic resources of the Paraná River.

From the beginning of energy production by the entity in 1984 until 2020, 92% of the more than 2.7 billion MWh produced by the entity have been used by Brazilian and foreign companies based in Brazil, mainly in the São Paulo area. Thus, for 36 years, the energy not used by Paraguay has been ceded to Brazil, in exchange for a compensation established arbitrarily without a parameter in the market prices (numeral III.8 of Annex C), and therefore, not being freely traded. Although with the increase of the remuneration in 2006 and 2012, where the amount received increased considerably, the cession of energy and, consequently, the control of the Brazilian State over it, as well as the impossibility of the Paraguayan State to freely dispose of it have remain intact until today.

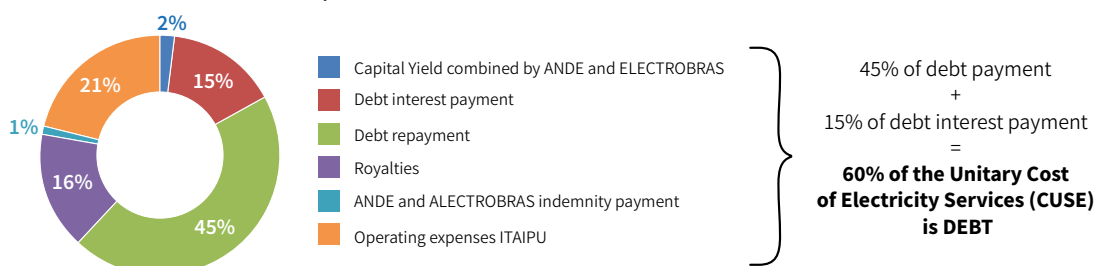
Studies suggest that the amount lost by the Paraguayan people by not freely disposing of their energy and being forced to cede it is around 74.5 billion US dollars (Carter, 2019)⁵⁴. This estimation offers a basis to have a quantitative dimension of reference. The central loss of the right to freely use the energy produced by the Paraguayan people due to the impossibility of sovereign resource management.

2.4.3. Debt: Itaipu is built with a loan paid by both countries

Itaipu’s debt, originating in 1975 from the loans contracted by the entity for the construction of the work, grew exponentially, from an initial US\$ 3,566 million to what would end up being more than US\$ 60 billion in 2023, representing a growth of 1700%. This growth is the result of subsidizing the cost of energy for the benefit of foreign companies, debt adjustments and refinancing, high interest on loans, double indexation and new loans acquired.

This irregular debt structure, the lack of transparency and audit procedures, and its systematic payment have been to the benefit of the creditors: large banks, mainly foreign. This is to the detriment of the users of electricity services in Paraguay and Brazil, who pay the debt through the payment for the service. Annex C establishes that the debt contracted to build the project will be paid through the cost of the energy produced in Itaipu, which is currently made up of 60% of the debt payment.

GRAPH 10. Structure of Itaipu’s Debt.



Created by the Itaipu Ñane Mba’e Campaign, 2019.

54 Available at: <https://www.abc.com.py/edicion-impresa/economia/paraguay-perdio-en-itaipu-us-754-mil-millones-en-33-anos-1802860.html>

This means that the energy users, of ANDE and ELECTROBRAS, i.e. the Paraguayan and Brazilian people, are the ones who pay for the entity's loans. The official debt in 2018 amounted to US\$ 7.5 billion. Thus, the Paraguayan people, through the payment of the debt of an energy that they did not use and that they ceded mainly to foreign monopolies, subsidizes and injects a significant sum of money to Brazilian and foreign financial capital.⁵⁵

The commoditization of this means of production and its insertion into the global financial market circuit has distanced it from its development function, becoming a mechanism for large-scale profit, both for industrial and, mainly, financial monopolies. The case of Itaipu's debt is an outstanding example of this situation: a debt that would have grown 1700% of its initial value, mainly due to interest and the addition to the liabilities of external elements, such as the subsidy to the cost of Itaipu's energy implemented by the entity between 1985 and 1990, known in the literature as the spurious debt (Pozzo, 2014; Canese, 1996).

The payment of the debt is one of the central elements of the monopolies' and financial capitals' domination through Itaipu. The support of the debt payment scheme of Itaipu has allowed the income from the sale of energy to serve the interests of its creditors, instead of becoming autonomous resources in Itaipu to finance development in both countries that own the dam. (Vuyk y Costa, 2021)

2.5. Open scenarios for 2023

In 2023 there is a historic opportunity to break with the various mechanisms of dispossession detailed above, which up to now have only favored foreign interests, along with the power groups that serve them in Brazil and Paraguay. In 2023 it will be 50 years since the signing of the treaty, and this opens a key legal aspect: the revision of Annex C of the Itaipu Treaty. This Annex states: *"The provisions of this Annex shall be reviewed, after the course of a period of fifty years from the entry into force of the Treaty, taking into account, among other aspects, the degree of amortization of the debts contracted by ITAIPU for the construction of the utilization and the relationship between the powers contracted by the entities of both countries"* (Numeral VI - Review of Annex C, Itaipu Treaty, 1973).

Consequently, the High Parties —the Paraguayan State and the Brazilian State— must open a negotiation for the revision of this Annex. Financial and economic elements are added to this, since, according to the official schedule of the entity, the payment of Itaipu's debt is concluded, which is a constituent part of the unit cost of electricity service (CUSE) according to items III.2 and III.3 of Annex C. Thus, while complying with the provisions of Annex C for its revision, the operating cost of the entity decreases by 60%, an amount that today corresponds to the payment of the debt, in an average of USD 2,000 million per year. This represents the turning point that opens a unique opportunity in economic terms (Costa and Vuyk, 2021).

55 For more information on the historical spurious debt access the open library of the Itaipu Ñane Mba'e campaign. Available at: <https://www.dropbox.com/sh/nfalxedfmtz8ba5/AABXrRdl6j-FCMP5RjE7bDeSa?dl=0&fbclid=IwAR2plnYIruSRMYRu6wiO9nbBb-VGv7GobUoOi2Qng9YMUqPPKUPy-felfCJE>

In the scenario opened by the revision of Annex C, it is possible to include other points of negotiation, among which there are socio-political elements, since Itaipu is the focus of both national attention -of both countries- and of the international community. Therefore, in this context, the specificity of the revision of Annex C is transcended, making this legal element the least important one, as observed in the public agenda of most of the social sectors. It opens the possibility of creating a key factor in which the Treaty of Itaipu may be modified in order to benefit development based on national interests - and so that these legal, financial, economic, socio-political and diplomatic issues which make up a development model influenced by the use of national energy resources may be at the center of public debate (Ibid).

The amortization of the cost of production of the entity, together with the issues on the political and social agenda, leads to the discussion of the underlying management problems of Itaipu. The dispute over the maintenance of it has been a hindrance to national productive development or to moving towards a comprehensive solution, where the nullity of the treaty is the most appropriate path of sovereignty for national development (Ibid).

Therefore, this historic opportunity allows a review of the entire management scheme of the entity, which for almost 50 years has benefited foreign companies and banks, through Brazil. Specifically, it is essential to review: a) the decision making and management of Itaipu's budget (binationality), b) the free commercialization of energy (sale and substation), c) the territorial problem (condominium and military power) and d) the corruption involved in the debt (the debt of Itaipu)⁵⁶.

It is also essential to consider the economic and energy crisis as a key economic-political aspect in the current international and regional context, which places Itaipu's energy in an even more strategic place of centrality for the partners that are part of the entity. This context of international and regional crisis makes Itaipu's Paraguayan energy an element of greater interest and attention, mainly by Brazilian and foreign companies based in Brazil and, therefore, by the Brazilian State and government, for whom energy —including Itaipu's Paraguayan energy— is a strategic issue of national security⁵⁷ (Ibid).

The central positioning of the Itaipu issue is also linked to the deepening of the management crisis of the current order of capital, a context in which the debates on human exploitation and oppression are added to elements such as climate change and the promotion of energy transition and development based on renewable energies -such as hydroelectric power. It is essential to point out that Itaipu is the top hydroelectric power plants in the world in production of energy, and the second largest in terms of installed capacity, with 14,000 MW from 20 power generating units. Since the start of hydroelectric production on May 5, 1984, the entity has generated more than 2,600 million megawatt-hours (MWh) by the end of 2018, beating the world record for annual energy production in 2016 with 103,098,366 megawatt-hours (MWh). Since hydroelectric power is one of the main sources of clean, cheap and renewable energy, Itaipu rises —as it was from its very origin, as a result of the need for expansion of Brazilian and foreign monopolies— as a key element in the international dispute over the sources and production of energy worldwide. This dispute takes on a new level in the context of the current economic crisis, both Brazilian and international.

56 Available from: <https://www.abc.com.py/edicion-impresa/suplementos/economico/2022/06/05/itaipu-2023-hechos-consumados-y-escenarios-posibles/>

57 This places Paraguay in a favorable position in terms of national interest.

The presidential elections and change of government in Brazil (October 2022 and January 2023) and, likewise, in Paraguay (April and August 2023) are in this context. The political projects embodied by the future governments will determine the actions that each High Party will undertake, with different competing proposals in both countries⁵⁸. The starting point is marked by the decisions taken by Mario Abdo's government. He has given his consent to the interests of foreign companies through the Brazilian State in all the key opportunities. As a result, foreign interests have been advancing, both in the control of the binational entity and in the local use of our energy, without any official negotiation. The scenarios for the revision of Annex C are determined by the *fait accompli* policy of Mario Abdo's government, which includes the following points:

2.5.1. Local use of energy, for foreign interest

The government of Mario Abdo presents the proposal to promote the local use of electric energy to generate a supposed "clean" development that generates "greater social welfare." In this context, ANDE has expressed interest in granting permits for the intensive use of energy for the installation of foreign companies. On May 3 of this year a contract was signed with one of them -ATOME Paraguay S.A.-, and it opened the presentation of written statements of interest to acquire high voltage electric energy for a total of 1,000 MW⁵⁹.

ANDE closed the period for interest submissions last May 31. It received 23 written statements, for a total of 5,862 MW of power. Among the submissions: 3 companies are planning to use 1,000 MW, 2 are interested in 500 MW, 3 companies are targeting 300-400 MW, 2 companies 200-300 MW, 3 are looking for 100-200 MW, and 10 are interested in using less than 100 MW. The main companies aim to use the energy for: cryptocurrency mining, data center operation, green hydrogen production⁶⁰ and fertilizer.

With the installation of foreign companies with an energy-intensive use destined to the mentioned activities, the so-called "*local use of energy*" would have as main characteristic the delivery of large blocks of energy to private foreign companies that, in turn, will transfer the profit outwards, from the favorable productive conditions of the country for enrichment and development of foreign companies and countries, without considering the need to enhance the domestic market, production and technology in the country. In this context, the alert is raised about the ceiling in terms of the total use of energy generated in the country, estimated for the next decade. At this rate, the country would end up with the need to import energy from abroad.

58 Available from: <https://www.abc.com.py/edicion-impresa/suplementos/economico/2022/06/05/itaiapu-2023-hechos-consumados-y-escenarios-posibles/>

59 Available from: <https://www.abc.com.py/edicion-impresa/suplementos/economico/2022/06/05/itaiapu-2023-hechos-consumados-y-escenarios-posibles/>

60 "The case of green hydrogen production, for example, aims to generate a new source of renewable energy using as its main source another renewable energy (hydroelectric) that has historically never been used in a sovereign way in the country, and directing it to the international green hydrogen market." Available from: <https://www.abc.com.py/edicion-impresa/suplementos/economico/2022/06/05/itaiapu-2023-hechos-consumados-y-escenarios-posibles/>

2.5.2. Commercializing Paraguayan energy for private profit

The government has stated that part of the Paraguayan proposal in Itaipu is to modify the Treaty to commercialize Paraguayan energy from this hydroelectric power plant that is not consumed in the country. In December 2020, the Board of Directors issued a statement declaring the entity as a “border node”, which means that entities outside Itaipu (ANDE or private companies) will be able to use the entire infrastructure of the entity to commercialize energy, mainly to the Brazilian market⁶¹. This form of energy commercialization is equivalent to the attempt perpetrated by the company Leros in 2019, which sought to buy Paraguayan energy from Itaipu to sell it to the Brazilian market, by being installed directly at Itaipu’s right bank substation and using the already existing 500 kW transmission lines, keeping the profit in the company’s private hands⁶².

2.5.3. Low tariff for Brazil, high tariff for Paraguay

Despite the statements of Mario Abdo’s government about maintaining Itaipu’s tariff until 2023 and leaving the negotiations of the revision of Annex C to the next government⁶³, we have reached the middle of the year without a defined tariff. Instead, there is a sui generis proposal that establishes for each High Party the payment of a tariff “*to be considered*”, in order to adjust the accounts once the negotiation is closed. However, the negotiation of the tariff has not progressed, nor are the general negotiations⁶⁴.

Meanwhile, Paraguay continues to pay 22.60 USD/kW-month, and Brazil is paying 18.95 USD/kW-month. The neighboring country issued the resolution in which it approves the provisional reduction of the tariff produced by Itaipu for Brazil, to be applied as from January 1 until the Council of the binational resolves the definitive tariff for 2022, through ANEEL (Agência Nacional de Energia Elétrica: National Electric Power Agency). This shows the tendency for Paraguay to accept a reduction in the tariff, leaving the remainder of the overpayment made by Paraguayan families to Itaipu through ANDE, and the decision of what to do with it; or a decision to have differentiated tariffs, which would change the internal management of the entity.

61 That is what Leros had already attempted a year before that statement. Available from: <https://www.abc.com.py/edicion-impres/suplementos/economico/2022/06/05/itaipu-2023-hechos-consumados-y-escenarios-posibles/>

62 Presented in the prequalification note No. 637 of the call for expression of interest to purchase electric energy from ANDE.

63 “The initial position of the Paraguayan government, presented to the National Commission for the study and monitoring of the negotiations for the revision of “Annex C” of Itaipu Binacional of the National Congress, on May 25, 2021 through the National Chancellor, was to have an intermediate tariff of approximately 15 USD/kW-month. This position was changed after public pressures that demanded to maintain the tariff until 2023, as a negotiation strategy.” Available from: <https://www.abc.com.py/edicion-impres/suplementos/economico/2022/06/05/itaipu-2023-hechos-consumados-y-escenarios-posibles/>

64 “The new Chancellor - the fifth of this government -, upon taking office on May 2 of this year, stated that 3 institutional notes have already been sent to Brazil to initiate the negotiations, with no response whatsoever. Likewise, the presidential meeting scheduled for December 13, 2021 and cancelled on the same day, was supposedly moved to January, but to date it has not been held.” Available from: <https://www.abc.com.py/edicion-impres/suplementos/economico/2022/06/05/itaipu-2023-hechos-consumados-y-escenarios-posibles/>

Therefore, it is not possible to rule out that the proposal of a presumed country position to maintain the tariff is just an illusion, and that the de facto agreement, that is to say, outside the public and official instances, is to lower the tariff to an intermediate tariff. Nor is it possible to rule out that the differentiated payment made is the agreement reached -also outside the public and official instances- to settle the different needs of two governments facing a crisis of legitimacy and on the verge of presidential elections where they seek to keep their political-economic groups in power.

This set of elements takes on central dimensions in the projection of the model of society for the present and the future. The dispute over the control of energy resources is, therefore, central to the perspective of structuring the energy matrix in the medium and long term, and to the definition of the national economic-political model. The interest in cryptocurrency mining in the country is placed within this framework of disputes.

3. CRYPTOCURRENCY MINING FARMS AND THE USE OF ENERGY-INTENSIVE INDUSTRY IN PARAGUAY

3.1. Background of cryptocurrency mining in Paraguay

As a background to the development of cryptocurrencies in Paraguay, the representative of one of the mining companies mentions the arrival of digital wallets of the main telephone companies, between 2008 and 2009. He mentions this process as part of the first steps of electronic money, or exchange of values through digital in the country.

In 2012, the first activities related to cryptocurrencies were carried out, starting with the commercialization of Graph cards and the first web domain of this economic activity was registered. In 2014 a business meeting was held on the development of bitcoin in Paraguay with a significant presence of private sector representatives, including directors of telephone companies. Between 2017/8 the commercial expansion in the development of cryptocurrency mining in the country began. One of the companies installed 1000 machines with the use of 1.5 MW.

“All this, obviously, was something very small at the beginning, and now Paraguay is seen as something interesting, it asks for a lot of energy, Paraguay has to continue offering its energy, and selling, and generating income.” (Business representative, 2021)

According to the interviewee *“a year in crypto is like 10 years”*, in reference to the speed with which technological processes are developing and the advance of the digitalization of the financial system. Within this framework of technological boost, the interviewee expresses: *“the hosting concept was born”*, which at first was aimed at Paraguayans. However, *“we realized that what we have to do is to export the energy we have, and the way to export the energy we had and the way to export it is to sell to foreign customers so that they can consume the energy in the country, because you cannot store the energy in a giant battery and send it to their country. The mindset change was: let’s sell the surplus energy we have at a very low price, because Paraguay’s price is totally comparative and competitive with Russia, Georgia, China, let’s export Paraguay’s electric energy.”* (Business representative of cryptocurrency mining in Paraguay, 2021).

3.2. Description of the type and number of cryptocurrency mining companies in Paraguay and their energy consumption

The cryptocurrency mining business representative who was interviewed pointed out that the name of this activity *“is an analogy to traditional mining where energy is spent to find precious minerals. In Bitcoin mining, it is computers that work using their computing power to validate and record transactions on the network, where a fraction of bitcoin is received as a reward”* (Business representative, 2022).

The interviewee’s company imports equipment manufactured in China and provides hosting services for the equipment in the data center where his company carries out cryptocurrency mining. They are also engaged in the purchase and sale of digital assets.

The data center managed by the businessman has 3 million Watts (MW) of electrical power. This company has a new data center under construction, which will also use 3 MW of energy. The construction of the data centers is done strategically, close to ANDE's substations and requires a very high upfront investment. Regarding the energy consumption of the mining equipment, he says: *"1 MW is enough for 250 Bitmain Antminer S19 devices. Each one of these devices consumes an average of 3000/3500 watts"* (Businessman representative, 2022).

The energy potential of 3MW installed for the data center taken as an example, can be compared with 12 transformers of 250Kva that can supply energy to 12 blocks of a neighborhood, considering that this comparison does not take into account that residential houses do not use all the installed energy potential, and this energy consumption does not occur 24 hours a day, as in the case of companies dedicated to cryptomining (Cano, 2022).

According to the statements of the qualified informant from the cryptocurrency mining business sector in Paraguay, there are 8 cryptocurrency mining companies in the country with a high level of development, among which there are several with foreign capital from China, Canada, Italy, and other countries, mainly from the global north. These companies use an average of 1 to 3 MW of energy, and in some cases up to 6 MW. In this regard, the interviewee said: *"This is happening, there are already people from China, Canada, USA, who are setting up their own farms, doing things on a large scale [...] They take advantage of the low cost of energy"* (Businessman, 2022).

These companies are members of the FinTech Chamber, whose main objective is the regulation of mining activity in the country. There are also informal enterprises, mainly in Ciudad del Este (including some with foreign capital, mainly Brazilian⁶⁵), as well as in Villarrica, where there are already more than 30,000 machines⁶⁶ operating in cryptocurrency mining. According to the interviewee's estimations, the cryptocurrency mining activity as a whole (formal and informal companies) currently consumes 100 MW. (Ibid).

3.2.1. Tariff for the use of energy-intensive industry in Paraguay

The commercial activity of cryptocurrency mining is based on the tariff regime established by ANDE according to the current Tariff Sheet (Sheet 21). It contains the information regarding the cost of energy per KWh according to the consumption group in which the company is established, based on the power ranges requested and established in said tariff sheet.

ANDE has a special tariff for locally produced electricity for energy-intensive industries (EII)⁶⁷. These tariffs were established by Decrees No. 7406/11, No. 6371/16 and No. 7551/2017. In order to benefit from the EII tariff regime established by the executive decrees, a Supply Contract must be executed with ANDE according to the type of EII and the power requested.

EII industries are those with a monthly load factor equal to or greater than 85%. That is, they are those companies in which the price of electricity has a significant impact on their final cost. Thus, companies supplying electric power at 66,000 volts and 220,000 volts voltage levels are considered feasible by ANDE. Depending on each case, and depending on the technical conditions, ANDE will deliver the power to the line, substation or station.

65 Available from: <https://restofworld.org/2022/paraguay-represa-bitcoin/>

66 Available from: <https://www.abc.com.py/nacionales/2021/06/20/minas-de-bitcoin-en-guaira-se-suman-a-las-de-oro/>

67 In many cases, foreign companies make the decision to settle or not in the country based on this information..

Those companies connected at the high voltage (66,000 Volts) and very high voltage (220,000 Volts) levels must enter into a Special Power Supply Contract with ANDE. For the 66KV and 220KV categories, ANDE requires that their maximum power demand does not exceed 10,000 KW; while for the latter, they will be subject to ANDE's availability. For those EII's that are connected in either of these two categories, ANDE requires them to build all the electrical infrastructure that will be necessary for their inter-connection to ANDE's National Interconnected System (SIN). Likewise, they will be responsible for the construction of all the accessory installations (for example: control, protection and/or communication systems, or others) that are necessary for the operation of the EII's. In both cases, their connection to the SIN will be subject to ANDE's availability. In both cases, their connection to ANDE's SIN will depend on the availability and technical conditions of ANDE in the area where they wish to be installed.

According to the statements made by the interviewee owner of a data center in the country, the tariff category in which his company dedicated to cryptocurrency mining is registered is high voltage. According to the official data provided by ANDE in its 2019 annual report, there are 12 high voltage billed customers, 4 very high voltage billed customers, and 1 energy-intensive industry customer, as shown in table No. 3.

TABLE 3. Billed Customers by Consumption Group, Year 2019.

Consumption group	Invoiced customers (number)	Structure (%)
Residential	1.281.498	87,2
Industrial	480	0,0
Other	179.444	12,2
Governmental	7.582	0,5
Differential	168	0,0
High Voltage	12	0,0
Very high voltage	4	0,0
Energy-intensive	1	0,0
Public lighting	0	0,0
Total National	1.469.190	100,0

Source: ANDE, 2020

For users in the high voltage category, the current general tariffs would be: the price of energy at peak load is 0.044 USD and off-peak is 0.030 USD⁶⁸. It is important to note that the tariffs mentioned for the type of power that each EII will actually need are for reference only, since they are negotiated with ANDE on a case-by-case basis. These prices should be included in a supply contract with ANDE according to the type of energy-intensive industry and the reserved power.

TABLE 4. High Voltage Tariffs.

Delivery facility	: Station or Substation
Supply voltage	: 66,000 Volts

Concept	Tariff	Unit
Reserve Power	34,761	G/kW-month
Peak Load Energy	245.8	G/kWh
Off-Peak Energy	169.5	G/kWh
Excess Peak Reserved Power	113,646	G/kW-mes
Excess Off-Peak Reserved Power	73,000	G/kW-mes

Source: ANDE, 2020

TABLE 5. Very High Voltage Tariffs.

Delivery facility	: Station or Substation
Supply voltage	: 66,000 Volts

Concept	Tariff	Unit
Reserve Power	31.033	G/kW-month
Peak Load Energy	232,2	G/kWh
Off-Peak Energy	165,4	G/kWh
Excess Peak Reserved Power	111.426	G/kW-month
Excess Off-Peak Reserved Power	65.708	G/kW-month

Source: ANDE, 2020

68 The energy prices for users in the very high voltage category, on peak load is 0.041 USD and off peak load is 0.029 USD.

3.2.2. In the case of CLYFSA

In the case of CLYFSA (Compañía de Luz y Fuerza S. A.), the subsidized tariff it obtains from ANDE would encourage the settlement of crypto-mining companies⁶⁹. Thus, this company offers extremely low tariffs, which will imply an increasing subsidy from ANDE, that is, from the Paraguayan State, since the tariff of 17.6 US\$/MWh (in 2019), or only 16.5 US\$/MWh (January 2022), does not allow covering the minimum costs of ANDE (Interview with Mercedes Canese, 2022).

Currently, the tariff paid by CLYFSA to ANDE is US\$16.5/MWh; according to Mercedes Canese, the payment should be at least US\$56.3/MWh. Therefore, at the current tariff, ANDE subsidizes CLYFSA a total of US\$39.8/MWh. For a consumption of 163.99 GWh/year, ANDE's subsidy to CLYFSA would amount to US\$6.5 million/year (39.8×163.99 GWh/year)⁷⁰.

The more cryptocurrency mining companies that set up in Villarrica —there are already more than 30,000— the greater the subsidy that ANDE and, ultimately, the Paraguayan State and the taxpayer will have to pay⁷¹.

3.2.3. Calculations of the economic costs of energy-intensive cryptocurrency production in Paraguay

A cryptocurrency mining company like the one we have been analyzing, uses on average about 2 MW of electric power. Applying the current tariff structure of ANDE and assuming that the consumption of the mining company does not exceed the reserved power, it can be estimated that the monthly cost of electricity use would amount to more than 300 million guaraníes (Interview with Cano, 2022). According to the interviews conducted, most crypto mines consume around 6MW. Following this researcher and assuming that the company's consumption does not exceed the reserved power, the monthly cost of electricity use would amount to more than 900 million guaraníes (Cano, 2022).

According to analysts such as Mercedes Canese, Ricardo Canese and the Ministry of Industry and Commerce, this level of energy consumption could be allocated to industrial activities that generate added value and quality jobs.

According to the representative of the mining company, the electricity tariff represents about 20% of its costs in the conditions of development of his company, which is characterized by high quality electrical installations and new generation equipment. According to the statements of this qualified informant, cryptominer activity in Paraguay is highly profitable, stressing that the national energy cost is one of the lowest in the world (Mining company representative, 2022).

It has been pointed out that cooling is an element that adds to the cost of energy, so the temperature increase caused by the effects of climate change would affect the final costs of this economic activity. The representative of the mining company stated that the new generation equipment has internal cooling processes, which has a positive impact on energy efficiency and the monthly cost of electricity, but involves high initial investments (Mining company representative, 2022).

69 Available from: <https://restofworld.org/2022/paraguay-bitcoin-dam/>, ver también en: <https://www.ultimahora.com/andepierde-mas-usd-2-millones-al-ano-clyfsa-n2811955.html>

70 Information provided by the “Itaipu Causa Nacional 2023” campaign.

71 It is worth mentioning that one of the promoters of the bill “THAT REGULATES THE INDUSTRY AND COMMERCIALIZATION OF VIRTUAL ASSETS - CRYPTOACTIVES” is Engineer Cristaldo of CLYFSA, one of the main spokesmen of the Electricity Industry Bill and of the bill of the National Electricity Commercialization Company of the Binationals (CONEBI).

It is possible to note a link between cryptomining and environmental impact, considering an analysis of international trade, where the use of hydropower will have to be inevitably replaced by the use of biomass and the import of oil derivatives that generate a strong impact on greenhouse gas emissions, and a strong dependence on foreign capital in economic terms. This scenario is aggravated by the decrease in hydroelectric production as a result of droughts, which impacts both the supply and the increase in the cost of the tariff for ANDE users.

In addition to the highly dependent and subordinated to foreign capital characteristics of the country's energy matrix, it is important to consider certain climatic factors that must be taken into account when considering Paraguay as "environmentally friendly" for the expansion of mining industries. On the one hand, there is evidence that our country is suffering the hottest years in its history. According to Grassi, 2020⁷², 2019 was the hottest year since temperature records have been kept in our country.

The same author notes that of the 10 years with the highest heat in the country, most were from 2000 onwards. Jara (2020)⁷³ states that *"The number of heat waves in Paraguay is increasing. From 1.1 heat waves per year on average in the period 1980-1989, it increased to 2.9 on average in the period 2010-2019. This implies that the number of heat waves almost tripled in the last 40 years."* (Jara, 2020)

These two elements (the droughts of the last few years, and the increase in hot years) play a fundamental role when analyzing the possible impact of the expansion of mining companies in our country, based on the principle that the more heat waves there are, the more investment will be needed for cooling (which as mentioned above is an important part of the investment), and the lower the production of hydroelectric energy, the higher the cost of the tariff will be. It is therefore important to underline that the use of significant amounts of energy in EII related to cryptocurrency mining implies a strong environmental impact. This is illustrated by the following example: if resources, technology, infrastructure and, above all, the energy from the dams were allocated to environmentally sustainable national industries, and with this, a radical transformation of our energy matrix were to take place based on the sovereign management of national resources, Paraguay would become a country less dependent on biomass and the different petroleum derivatives.

72 Available from: <http://dncc.mades.gov.py/wp-content/uploads/2020/10/Estudio-del-Clima-Paraguay-2019-1.pdf>

73 Mentioned by Grassi, 2020

3.3. Employment generation by cryptocurrency mining companies

Cryptocurrency mining activity generates 6 jobs per 1 MW contemplating 8-hour working days in companies that operate 24 hours a day, i.e. two jobs for each working shift (3 in total) of 8 hours (in the event that the regulations in force in terms of labor rights are complied with), according to what was stated by the owner of a cryptocurrency mining company (Mining Company Representative, 2022).

According to the interviewee, technical qualifications are not necessary for hiring workers for this economic activity, although preference is given to people with computer training (Mining company representative, 2022). With this, and taking into account the labor conditions in the country, it could be inferred that the salary of these workers would be around the existing minimum wage (Mining company representative, 2022).

The representative of the cryptocurrency mining company stated that this economic activity generates employment in the construction phase of the data centers, in addition to the security and cleaning necessary for the optimal development of the activity. He also included the trade and logistics jobs involved in the imports of technological equipment, together with other indirect jobs in the service sector, mainly in IT and foreign trade (Mining company representative, 2022).

In this regard, the Ministry of Industry and Commerce (MIC) in its report on the study of the bill that seeks to regularize cryptocurrency mining in Paraguay, states that this economic activity generates few jobs in relation to the level of energy consumption they require, being also prone to possible scenarios of uncertainty and volatility by not being regulated by the Central Bank (BCP)⁷⁴.

The mining company representative pointed to the tax revenues generated by this economic activity, from the importation of technological equipment, 10% of the corporate income tax (Mining company representative, 2022).

This situation can be compared to the economic dynamics and the generation of jobs in the four stages of the soybean agroindustrial chain⁷⁵. In these, direct labor is scarce and mainly of poor quality, while indirect jobs are seasonal and highly informal; furthermore, their development is tied to the importation of technology from abroad, the tax burden represents only 1.8% of what is collected by the State, they are dominated by foreign capital and about 60% of what is produced is exported with no added value other than freight. This set of characteristics is called “extractivism”. Therefore, it is possible to state that cryptocurrency mining has elements typical of extractivist activities⁷⁶.

74 Available from: <https://www.abc.com.py/nacionales/2021/12/16/sin-venia-de-entes-reguladores-senado-aprueba-ley-que-regula-criptomonedas/>

75 As a concrete expression of the agro-export model on which the national economy is based

76 For more details on this issue we recommend reading Leo Rubín's article Itaipu, debt, sovereignty and integration (Itaipú, deuda, soberanía e integración), 2020.

4. THE LEGAL REGULATION OF CRYPTOCURRENCY MINING AND ITS IMPACT ON THE REVISION OF ANNEX C OF THE ITAIPU TREATY

4.1. Features of the bill regulating cryptocurrency mining in Paraguay

The cryptocurrency mining activity in Paraguay is developed under the legal figures that govern the “data centers” of telephone companies that offer technological hosting services. Since 2017 there has been discussion about the possibility of a specific regulation of cryptocurrency mining activity to create a legal, economic and fiscal framework that legalizes this economic activity. (Representative of Paraguayan mining company, 2022).

4.1.1. Background

According to the business representative of the cryptocurrency mining activity in Paraguay, the official presentation of this bill had as an effect or immediate antecedent the enactment of the law that gives legal course to cryptocurrency in El Salvador, and the legislative discussions present in countries such as Mexico and Argentina. The interviewee states in this regard:

“It seemed that Paraguay was riding this wave, and when the project came out in July 2021, it became clear that it was nothing like El Salvador. What happened with El Salvador was a precedent” (Cryptocurrency mining company representative, 2022).

Unlike the process of institutional regulation of cryptocurrencies in El Salvador, where bitcoin was legalized as legal tender, the main objective of the bill presented in Paraguay is to recognize virtual asset mining as an industry. In this sense, it considers cryptocurrencies as a Virtual Asset or Cryptoasset, that is, it defines them as a digital representation, value or rights, which can be transferred, stored or traded electronically, by means of decentralized registry technology or a similar technology.

4.1.2. Bureaucratic procedures involved in the Bill “Regulating the industry and commercialization of virtual assets - crypto-assets”

In July 2021, the bill “*Regulating the industry and commercialization of virtual assets - cryptoassets*” was presented in the Upper House with the objective of “*regularizing the legal, fiscal and economic management of cryptocurrency mining.*” It was presented by senators Fernando Silva Facetti (PLRA), Antonio Apuril (HAGAMOS) and Juan Bartolomé Ramírez (PLRA). It was approved by the Senate⁷⁷ on December 16 and was sent to the Chamber of Deputies for its consideration⁷⁸.

77 Available from: <https://www.ultimahora.com/senado-da-media-sancion-proyecto-que-regula-negocio-criptomonedas-n2976973.html>

78 Senator Silva Facetti had drafted another bill together with Congressman Carlos Rejala. The bill presented and approved by the Upper House has elements of the Silva Facetti - Rejala bill, although several articles have been cut from it, it kept the same imprint, with fewer definitions. Read more in: <https://pdfcoffee.com/proyecto-de-ley-activos-virtuales-y-su-proceso-industrial-paraguay-pdf-free.html>

Senator Fernando Silva Facetti, promoter of the bill, announced that the bill seeks mainly to “guarantee the legal, economic and financial security of businesses that in one way or another are related to cryptoassets”⁷⁹. Under this framework, it is proposed to recognize virtual asset mining as an industry, guarantee stability in the access to electricity and the formalization of this sector.

The approval of the bill in the Upper House was granted despite having received negative opinions from the Ministry of Industry and Commerce (MIC), due to the low level of job creation generated in relation to ANDE’s consumption of electricity. As previously mentioned, the BCP also decided not to support the bill because it is a high-risk investment that could lead to fraud, tax evasion, money laundering or financing of terrorism. This institution also pointed out that the benefits that this economic activity would have for the country are not clear, compared to the high costs in terms of energy consumption that it entails. ANDE suggested modifications to several articles.

TABLE 6. Opinions drawn up by public institutions regarding the Bill “Regulating the industry and commercialization of virtual assets - crypto-assets” in December 2021.

Ministry of Industry and Commerce (MIC)	It does not support the project because it generates a low impact on job creation, in relation to the level of energy consumption required, and is prone to possible scenarios of uncertainty and volatility, since it is not regulated by the Central Bank.
Secretariat for the Prevention of Money or Asset Laundering - SEPRELAD	Suggests that a technical round table be held with the Ministry of Industry and Commerce (MIC), Undersecretariat of State for Taxation (Subsecretaría de Estado de Tributación - SET), Comisión Nacional de Valores (National Securities Commission), SEPRELAD, Central Bank of Paraguay (Banco Central del Paraguay - BCP), ANDE to analyze the project in depth. Two round tables have already been held, but none of them were attended by all the institutions involved.
Central Bank of Paraguay (BCP)	It does not support the project because it is a high-risk investment, susceptible to fraud, tax evasion, money laundering, terrorist financing (activities normally associated with crypto-assets), and would threaten the integrity and stability of the financial system. It is not clear the benefits for the country with this type of activity. Costs in terms of electricity consumption, loss of reputation and significant tax liabilities.
ANDE	There are comments regarding the clarity of the articles and suggest modifications in several articles.
National Securities Commission (Comisión Nacional de Valores)	No legal opinion has been received from this entity yet, and in the draft law, it is one of the authorities for the implementation of the project.
Vice Ministry of Energy (Vice Ministerio de Energía)	No legal opinion has been received yet from said entity and in the bill.

Source: Abc color, 2021⁸⁰

In view of the positions against the enactment of this bill, on May 3, 2022 this document was analyzed in a public hearing convened by the committees of Economic and Financial Affairs, Legislation and Codification, Industry, Commerce, Tourism and Cooperativism, Fight against Drug Trafficking, and Science and Technology of the Lower House. It was attended by specialists in the area, representatives of public institutions, business and technology associations, among others.

79 Available from: <https://cripto-avances.com/paraguay-aprobara-la-ley-de-regulacion-de-criptoactivos/>

80 Available from: <https://www.abc.com.py/nacionales/2021/12/16/sin-venia-de-entes-reguladores-senado-aprueba-ley-que-regula-criptomonedas/>

In the Lower House, the Budget Committee, headed by Representative Tadeo Rojas (ANR-Central), has issued a rejection report. He explained that this refusal is based on the high risk without benefit for the State that this activity represents, a conclusion drawn from the reports submitted by the Central Bank of Paraguay (BCP). This institution pointed out: “*cryptocurrencies are an uncontrollable business, it has no records and is risky for banks; there is also the strong possibility of laundering; it is considered a high risk project and without benefit for the State, consequently an opinion for the rejection was issued*”⁸¹.

At the time of writing this study, the Lower House, in an extraordinary session, approved the bill “Regulating the industry and commercialization of virtual assets - crypto-assets” with modifications based on opinions issued by the advisory committees of Economic and Financial Affairs and Science and Technology. With this, the bill returns to the Senate for its study⁸².

4.1.3. Main provisions of the draft bill

Under the draft bill, the enforcement authority of the Law is the Ministry of Industry and Commerce (“MIC”), with the following powers, among others: (i) to grant the Mining license; (ii) to supervise Mining activities; and (iii) to sanction those persons who carry out Mining activities outside the regulatory framework. The MIC as enforcement authority of the Law will coordinate the licensing, registration, supervision and control activities with the following entities:

- a. National Securities Commission: it is in charge of determining which Virtual Assets will be accepted for trading in the stock market. The Bill establishes that the CNV will only regulate the public offering of Virtual Assets that generate rights and are similar to a security and will have the power to regulate and supervise the issuers, offerors, custodians and intermediaries of Virtual Assets. Likewise, it shall establish the requirements for registration and public offering of Virtual Assets.
- b. Secretariat for the Prevention of Money Laundering (SEPRELAD): SEPRELAD (i) will establish the registration requirements for Virtual Asset Providers and will establish the mechanisms for monitoring and controlling transactions involving Virtual Assets.
- c. ANDE will: (i) authorize the supply of electricity to mining projects; (ii) grant industrial consumer status to those requesting energy supplies for mining projects; and (iii) guarantee the supply of electricity for a minimum period of 3 years, which may be renewed.
- d. Undersecretary of State for Taxation (SET): Will regulate Virtual Assets in tax matters.

The bill establishes that domestic cryptocurrency trading companies must register in the Registry of Virtual Asset Providers. It also establishes possible sanctions for those who carry out this activity without being duly registered before the regulator.

81 Available from: <http://www.diputados.gov.py/index.php/noticias/proyecto-sobre-regulacion-de-criptoactivos-sera-analizado-en-audiencia-publica>, read more in: <https://www.ultimahora.com/convocan-audiencia-publica-proyecto-regulacion-criptomonedas-n2998751.html>

82 Available from: <http://www.diputados.gov.py/index.php/noticias/aprueban-con-modificaciones-proyecto-que-regula-la-industria-y-comercializacion-de-criptoactivos>

TABLE 7. Summary of the main characteristics of the Bill “Regulating the industry and commercialization of virtual assets – cryptoassets”

Bill ‘REGULATING THE INDUSTRY AND COMMERCIALIZATION OF VIRTUAL ASSETS - CRYPTO ASSETS’	
Bureaucratic stage	The bill regulating the production and commercialization of virtual assets or crypto-assets, presented by Senators Fernando Silva Facetti (PLRA), Antonio Apuril (Partido Hagamos) and Juan Barlolomé Ramtez (PLRA), was introduced on July 21, 2021. The Chamber of Senators approved it on December 16, 2021. It was sent to the Chamber of Deputies for its consideration. A public hearing was held on May 3, 2022.
Key definitions	Virtual Asset or Cryptoasset: A digital representation, value or rights, which can be transferred, stored or traded electronically, by means of decentralized registry technology or a similar technology.
	Mining: It is the process of producing the recording and validation of transactions on the network or blockchain using the computing power of machines to solve mathematical algorithms that solve the blocks. For carrying out said work, in exchange, it receives a reward, in the same type of Crypto-assets.
	Providers of Virtual Assets: shall be individuals or legal entities that undertake activities of Mining or its equivalent, exchange, transfer, storage and/or administration of virtual assets.
Enforcement authority	The Ministry of Industry and Commerce (“MIC”), which will have the following powers, among others: (i) to grant the Mining license; (ii) to supervise Mining activities; and (iii) to sanction those persons who carry out Mining activities outside the regulatory framework.
State entities in charge of licensing, registration, supervision and control activities	National Securities Commission (“CNV”):
	Secretariat for the Prevention of Money or Asset Laundering (“SEPRELAD”):
	National Electricity Administration (“ANDE”):
	Undersecretariat of State for Taxation (SET):
License for Mining of Virtual Assets or Cryptocurrencies:	The Bill establishes that those wishing to engage in mining must apply for two licenses: (i) first, an authorization for industrial electricity consumption by ANDE, and (ii) then, an authorization license for the industrial exploitation of Virtual Asset Mining by the MIC. These licenses are independent from other licenses that may be required (e.g. municipal license, environmental license, etc.).
	Virtual Asset Providers shall inform the acquirer that the Virtual Assets are not recognized as legal tender and therefore are not backed by the Central Bank of Paraguay.
Sanctions	The Bill contemplates sanctions ranging from warnings, fines, suspension of the license to perform Mining or Virtual Assets services to definitive cancellation of the license. Sanctions will be established according to the seriousness of the infraction.

The bill “THAT REGULATES THE INDUSTRY AND COMMERCIALIZATION OF VIRTUAL ASSETS - CRYPTO-ACTIVES”, presented by Senators Fernando Silva Facetti, Antonio Apuril and Juan Barlolomé Ramirez, dated July 14, 2021⁸³, has the political intention of identifying mining farms as an “industrial” activity, which makes them have an even lower rate. The intention to consider them as industries, allows this activity to be contemplated within the framework of the law 60/90⁸⁴ of stimulus of direct foreign investment (this law is a direct inheritance of the Stroessner’s dictatorship), which gives even more benefits to foreign capitals.

4.1.4. Position of the FinTech Chamber

The presentation of this law had the support of the FinTech chamber, from where they expect that after the enactment of the law it will be possible to “take advantage of and sell the surplus to foreign companies in the national territory.” The business representative stated in this respect:

“This was done to make use of and sell the energy surplus to foreign companies in the country, instead of exporting to Brazil or Argentina. Paraguay has a very large energy surplus with the presence of three dams, one of which is the largest in the world. We have 8800 megawatts available and we consume 3300 megawatts, so there are 5500 megawatts of surplus energy available. In addition, energy is very cheap, while in Spain energy costs 42 cents, in Paraguay it costs 5 cents” (Cryptocurrency mining company representative, 2022).

In this sense, the interviewee expressed that foreign capitals put as a necessity the existence of a legal framework to develop the mining activity, since the absence of regulation to have the possibility to operate legally implies a limitation for their installation in the country. In this respect, he affirmed:

“The concept is to create a legal, economic and fiscal framework so that foreign investors can come to Paraguay with complete peace of mind and security” (Cryptocurrency mining company representative, 2022).

He pointed out that foreign capitals expressed their interest in the country’s energy potential as follows: *“We are going to consume 100MW from you, that is, a large scale and they are looking for a good price. So, they need that energy.”* It is important to note that 100MW represents 50% of what is produced by the Acaray hydroelectric dam, so specialists in the area predict that it could be necessary to build substations to supply energy to these companies.

According to the business sector of this economic activity, another objective of the law is to recognize the cryptocurrency mining activity as an industry in order to access the benefits of the sector, such as, for example: access to cheaper energy than domestic and commercial energy. The industrial electric power tariff has all the necessary elements to attract foreign capitals: it is at 4.5 cents per KW/hour of non-polluting renewable electric power.

Fernando Arriola, FinTech’s blockchain manager, defined cryptomining as an industrial activity based on the following statement: *“part of a digital transformation: they use energy, import machinery and produce computing capacity that is then exported. Energy transformation that is an export of assets”* (Arriola, 2022).

83 Available from: <https://www.uip.org.py/wp-content/uploads/2021/07/antesedentes-regulacion-industria-activos-virt.-cripto-monedas.pdf>

84 Available from: <https://www.mic.gov.py/mic/w/industria/ddi/index.php>

With the legalization of cryptocurrency mining, it will be possible to prevent the informal practices that currently govern the activities of international trade, mainly related to the import of equipment and the payment of taxes on them, as well as to ensure the conditions for the electrical installation of data centers, and prevent money laundering. In this regard, the interviewee said:

“You are going to stop shipping equipment and putting them in as parts, when you have to ship them as Antminer s19 equipment and you have to pay taxes for the importation of all this, you are going to be regulated by someone who is going to control if your electrical installation is the proper one that you have to have, cables that have to be, no more tied with insulating tapes: standard of electrical installation and you have to have it well done, like any industry: security. Money laundering prevention register.” (Cryptocurrency mining company representative, 2022)

Finally, the interviewee representing the business sector of cryptocurrency mining in Paraguay considers the objective of recognizing cryptocurrencies as digital assets, which can be understood as a product, i.e., as goods or commodities. The perspective of this sector is summarized in the following expression of the interviewed representative:

“In the future this could be the basis to recognize it as an industry, to be able to sell the country’s energy to foreigners who want to use it. Paraguay could have resources from dispatch income, from the sale of energy, and whoever sells their bitcoin should pay the income tax, which is only 10%” (Cryptocurrency mining company representative, 2022).

In terms of financial commerce, Arriola expressed: *“in Paraguay there is no compensatory method supervised through a financial activity, so there is no way to show how much stays in the country. That would be achieved by law, because this type of operations should stay in the country. At this time, to attribute to energy and labor costs would be only 30 to 50% and the rest goes outside in international banks that accept cryptocurrencies in their coffers.”* (Arriola, 2022)

4.1.5. Position of public institutions

Rody Rolón, from the National Electricity Administration (ANDE) commented on the changes suggested by the state entity in a context where ANDE understands that, if today Paraguay consumes 50% of the available energy, with the massive consumption the period of time of energy availability will be shortened, and the country will be conditioned to import energy. In this sense, ANDE was concerned about the provision of energy to energy-intensive industry activities such as cryptomining. In this sense, the changes suggested by ANDE include a power limitation, in reference to Art. 8 of the Bill under study, so it suggests the incorporation of the power limitation power that could be granted to these companies; it also points out the need to include a defined term for energy concession, since if it is granted sine die, it increases the risk of consuming the power currently available earlier.

ANDE also suggests changing the industrial characterization of companies engaged in cryptomining, due to the high energy consumption it requires. With the provisions of the bill under analysis, this industry will have a special tariff like all the industries in the country. Regarding this, Rolón stated: *“Electric energy has to produce economic development, it has to generate jobs. According to consultations from ANDE, this activity does not generate much employment, which should be the destination of our energy.”*

He pointed out that ANDE currently receives a large number of requests for electricity connection from mining companies, which they identify due to the load factor of more than 80% used. The current tariff schedule does not foresee the intensive consumption that characterizes cryptomining, therefore, they do not have an official record of them, although they do have a list of companies that they suspect are engaged in this activity, all of them quasi confirmed by the load factor. In this context, he stated that ANDE is preparing a tariff schedule for this tariff group and announced that in the next few days the institution will release the final text.

Fernando Filártiga, from the Central Bank of Paraguay (BCP), briefly explained the consumer risks, and added that under no circumstances they can be equated to legal tender, since they do not comply with several parameters and have a tremendous volatility. The risks that are associated with cryptoassets/cryptocurrencies are important: 1. the consumer risk, although it is addressed with an informative transparency article in the bill exists, because there is a false association with legal tender money in the collective imagination. These cryptoassets cannot be equated with legal tender because they do not fulfill the basic functions of money: 1. unit of account 2. medium of exchange 3. store of value. They have an important volatility, one of the most important cryptocurrencies had a quotation of 68 thousand US dollars at the end of 2021, that dropped to less than half in the first half of 2022.

4.1.6. Position taken by technical professionals at the public hearing on the draft bill “Regulating the industry and marketing of virtual assets – cryptoassets”

The public hearing was held on May 3, 2022, in the Chamber of Deputies, the second constitutional instance of the legislative process⁸⁵. The first speaker of the day was the engineer Ricardo Canese, who exposed the risks of cryptomining in relation to the environmental problems it has generated due to the high energy consumption it requires and the pollution that this business brought to the countries that implemented the use of cryptoassets. He also predicted that cryptomining will force Paraguay to import electricity at very high prices.

Engineer Canese referred to subsidies: *“There is a great risk, subsidies can be enormous, and if measures are not taken, we will have to pay enormous subsidies: the countries that have given subsidies to energy-intensive industry companies (Brazil, Venezuela, Africa) cannot remove these companies. If here they give “free flowing”, they are tied, because they are bound by the investment protection law, we have to be very careful.”* (Canese, 2022)

Engineer Canese presented a proposal for the regulation of this activity which consists of the elimination of the bill that has been approved by the Senate, and replacing it with a proposal that includes a cryptomining tariff equivalent to the highest low voltage electricity tariff, regardless of the supply voltage of the cryptomining user; without any type of open or hidden subsidy; in the event that ANDE is forced to import energy, the tariff will be composed of the cost of importing electricity plus the transmission costs. As for penalties, it suggests penalties of 10 times the amount earned by those responsible for the illicit act.

Mercedes Canese stressed that the energy subsidy is a real problem for an economic activity that is not industrial. The non-industrial character of cryptomining is defined by the latter through the characteristic of not generating added value of this activity, but based on a financial asset. *“The financial sector does not generate wealth, what it does is to take resources from other sectors that generate wealth in their production process. Therefore, it cannot have subsidy.”* (Mercedes Canese, 2022)

85 Available from: <http://silpy.congreso.gov.py/expediente/123935> (Parte Audiencias públicas).

In this context, she referred to the generation of employment that characterizes the industrial sector, and mentioned the ceramics industry as an example. This industry “consumes a quarter of the energy consumed by a cryptomining plant, but hires and employs more than 200 workers registered in the IPS (Instituto de Previsión Social: Social Security Institute) with all its benefits. A cryptomining company uses four times more and has a security guard and a computer scientist who does the maintenance of the equipment. That is the relationship that exists in employment.” (Ibid)

At the same time, it made visible the environmental effects of this activity, understanding the energy exchange on a regional and global scale, since the consumption of hydroelectric energy in cryptomining will necessarily have to be substituted with petroleum derivatives, emitting greenhouse gases as a global effect.

Luis Benítez, from the National University of Asunción, stated that users must be protected by the State and he warned that the regulation approved by the Chamber of Senators does not reflect any protection whatsoever. “We support any regulation that protects the citizen, but we believe that this regulation does not reflect that; as it is written now, it deserves a deep revision and modification for the benefit of all”, he pointed out.

4.1.7. Position of the business and technology sector

Guillermo García Orué, multi-business advisor, stated that conceptual clarity is key for the discussion of the project, as well as to determine the natural supervisor. In this sense, he analyzed some of the articles in which he identified the lack of conceptual clarity: In Art. 1, he pointed out that it only talks about production and commercialization, which may allow supposedly non-burdensome operations to remain outside the law. He indicated that the definition of crypto-assets in Art. 3 could be improved since there are clearer conceptualizations, such as the one developed by FATF.

Similarly, there is concern about the lack of a natural supervisor under the bill, which could generate potential chaos regarding the anti-money laundering law. While in Art. 5 it states that the MIC will have the responsibility to “Supervise the activities of Virtual Asset Mining” in Art. 7 it says that it is the SEPRELAD, which generates a dissonance with the anti-money laundering law. This also generates problems in relation to Art. 19, which establishes the sanctions, and could generate a deregulatory arbitration with Law No. 1015, which establishes its own catalog of sanctions. In such a way, if someone breaches the law, a catalog of law could be invoked that contemplates less strong sanctions.

Diego Oddone, representative of the Industrial Union of Paraguay (UIP), pointed out that the business association is concerned about the characterization of digital mining as “industry”. He pointed out that the industry is designed to generate jobs mainly in urban areas, so it is necessary to point out the added value generated by industrial activity from the generation of jobs in various types of jobs and related activities. In addition, they understand that control and investments are needed in the electricity sector, in order to give it sustainability, therefore, this activity also has to pay taxes. Finally, the third point was that ANDE should have the possibility of defining a new tariff for cryptomining, and that it should be able to control the concession and the use of electric energy in this modality, with a defined timeframe⁸⁶.

⁸⁶ At this point, he stressed the necessity of even initiating new energy generation projects, as is part of the proposals of the private sector and the associations that represent it.

4.2. Impact of cryptocurrency regulation on political, economic, social, social, political, diplomatic scenarios in 2023

As it can be inferred from the statements made by the representatives of the FinTech Chamber and its main political representatives in Parliament, the intention pursued by the promoters of the bill that seeks to regulate cryptocurrency mining as an industrial activity, is to obtain an even cheaper electricity tariff cost than the current one, in order to attract foreign capital to the country, as a substitute to the traditional energy export. This could lead to higher energy consumption by cryptocurrency mining in the hands of foreign capital, an activity that generates little employment, and the jobs produced by this activity tend to be precarious since they do not require technical or professional qualifications.

In addition to the explicit intentions of the FinTech Chamber regarding the need to “*export energy in the country*”, it is noted that the high investment required for the development of cryptocurrency mining represents a vein of business only for large capitals. In addition to this, there is the constant need to access new technologies to maintain competitiveness in the business, guided by the logic of capital accumulation. This implies an increase in the number of mining companies and, therefore, a growing energy demand in the context of the deep dependence that characterizes the national energy matrix. At the same time, this faces a very concrete physical limit in the context of the current energy crisis, due to the decline in energy production as a consequence of the drought.

As previously observed, the technological development proposed for the accumulation of capital from cryptocurrency mining would lead to an ever-increasing consumption of electricity, since the greater the volume of blockchain decryption and decoding operations, the greater the energy consumption requirements, due to the conditions of development of the technological complex that requires operating at a higher speed from the “proof of work”. The digitalization of economic operations under the hegemony of financial capital, represent a new risk factor of energy collapse, within the framework of the extractivist dynamics of capitalism in peripheral countries. This would aggravate the situation of the national economic policy in a context of high labor precariousness, on the one hand, and gradual decrease of the electric power generation capacity aggravated by the consequences of climate change and the ecological crisis (See Graph No. 6).

The discussion on the regulation of cryptomining activity in Paraguay takes place in a framework in which many of these companies, mainly of foreign capital, have already been installed de facto, with low tariffs and without clarity with respect to the terms of the energy concession contract. As a result, this sector is currently seeking the institutional regulation of its economic activity based on the de facto consummation by the private appropriation of important volumes of energy. This deepens the current conditions of the Paraguayan energy matrix, based on the stimulation of this activity with the installation of foreign capital.

Furthermore, it means a deepening of the scheme of handing over our resources in general and the hydroelectric potential to foreign capitals, based on an economic activity that does not produce added value. It implies a worsening of the characteristics of the scheme for the use of energy as a commodity, contrary to its consumption as a production factor that would make possible the generation of decent employment and respect for nature.

In this way, the de facto installation of energy-intensive cryptocurrency mining companies has annulled the possibility of debate by the various social sectors about the destiny of the use of hydroelectric energy in the national territory which, basically, implies a dispute about the development model that is at stake in the economic, social, political, legal and diplomatic scenario opened in 2023 from the revision of Annex C of the treaty and the completion of the debt schedule of the Itaipu hydroelectric power plant.

CONCLUSIONS AND FINAL CONSIDERATIONS

Paraguay has particular electric power conditions, which enable significant disproportionate benefits to be obtained by cryptocurrency mining farms, especially those that mine bitcoin. One of the main points identified in this research is the extremely low tariff compared to countries in Latin America and Europe. This makes the national territory even more attractive for national and foreign investments.

Along the same line, other elements on the current situation of cryptocurrencies in Paraguay are identified and are as follows:

1. The deepening of foreign ownership and the commoditization of the commons.

As observed throughout the research, the massive installation of cryptocurrency mining farms in Paraguay means an appropriation of the national energy income, as well as the foreignization of the natural commons. Mainly for three reasons:

- a. **Low taxes.** According to a mining company representative interviewed, on average, legally established mining farms only pay 10% income tax.
- b. **Low energy tariff prices.** The Paraguayan electricity tariff is one of the lowest in the region, as a result of the historical dispossession of the national energy power, based on the hindrance to national development. In the case of energy-intensive mining, they are considered as an industrial activity, and receive an even lower tariff than the one that already exists. This favors a private and mostly foreign appropriation of energy, with high profits, whose externalities will have a social impact on the future consumption of all people living in the country.
- c. **Capital investment paradise in cryptomining.** To date there is a legal, economic and political scheme in the country to make it an investment paradise. This situation is comparable to agricultural extractivism because it generates little employment and depends on external inputs. That is to say, it requires the import of advanced technology, it pretends to receive concessions or tariff benefits, and it is also profitable because there is a historical background of dispossession and privatization in the country in energy matters. As was the signing of the Itaipu Treaty in 1973 and conditions imposed after its signing.

Thus, the conditions of the national energy matrix, which shapes the production, marketing and consumption of energy in the country, have been determined by the Itaipu Treaty, tying hand and foot the possibilities of sovereign development. This is why it is important to analyze the context of cryptocurrencies in Paraguay from an energy extractivism perspective.

On the other hand, it is vital to mention that the current composition of the energy matrix in Paraguay is highly dependent on biomass and oil derivatives, since most of the electricity produced is ceded to Brazil, even though it is one of the largest producers of hydroelectric energy *per capita* globally. In other words, the main sources of energy used at the national level are not related to mega dams.

2. The context of the renegotiation of Annex C in 2023.

On August 13, 2023 will be the 50th anniversary of the entry into force of the Itaipu Treaty, and Annex C in its paragraph VI, which establishes the financial basis and the provision of electricity services. This is the only date established in the treaty that allows the countries parties to review this treaty and its annex. In addition to this, there is the corrupt and illegal debt that completes to be paid that same year, which would cause a further decrease in the tariff and greater advantages to the extractivist energy market in the country. This means that the profits of national and foreign investors interested in cryptocurrency mining would be even greater.

The debate around the approval of the regulation of cryptocurrency mining activity in the National Congress and the emergence of the high level of illegal and informal use of energy for this purpose, shows that this activity replicates the same scheme of energy use for the profit and exploitation of a few. The installation of these companies does not imply significant changes in the current energy or economic matrix, but a deepening of the same economic project that has been keeping the country in backwardness and generating great inequalities.

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Field work: in-depth interviews with qualified informants

13. Computer systems programming technician. March 2022. Interview about blockchain technology and its energy use (G, Achucarro and L. García, interviewers).
14. Mercedes Canese. Engineer specialized in energy matters. March 2022. Interview on the national energy matrix (G, Achucarro and L. García, interviewers).
15. Representative of a cryptocurrency mining company and promoter of the law that seeks to regulate the use of cryptocurrencies in the country. March 2022. Interview about the operation of cryptocurrency mining companies at the national level and the interests involved around the enactment of the law that seeks to regulate cryptocurrency mining in Paraguay (L. García, interviewer).
16. Arturo Cano. Researcher in the industrial-electromechanical area. March 2022. Interview about the energy circuit for cryptocurrency mining activity at national level and estimates about the cost of energy consumed by this activity (L. García, interviewer).

