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INFRASTRUCTURE, COMPANIES, AND IMAGINARIES:

The Argentine Electricity System under State Control (1947–1989)

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This article analyses the trajectory of the Argentine electricity system under state control between 1947 and 1989. From a perspective linked to the field of science and technology studies, the research examines how policies, regulations, companies, and infrastructure were linked within the system during that period, specifying two distinct phases. The first phase (1947–76) was a period of construction and expansion, characterised by the consolidation of state-owned companies, regulation of the sector, and the articulation of a developmentalist imaginary linked to the industrialisation process. The second phase (1976–89) was marked by the beginning of the dismantling of the entrepreneurial state within the framework of a new model of accumulation oriented towards financial valorisation and a mercantile imaginary that redefined energy policy. Despite certain continuities in infrastructure and regulations, the lack of funding and indebtedness led to the deterioration of public companies and the electricity crisis of the late 1980s. The article shows how the contradictions between the inherited infrastructure and the new political-economic orientations paved the way for the privatisation reforms of the 1990s.

Introduction

In Argentina, electricity became widespread in the early decades of the twentieth century, but it was industrialisation and state intervention that enabled the consolidation of a national system under state control, which endured for more than four decades.

Drawing on a constructivist approach to technology, this article examines the trajectory of the Argentine electricity system during the period of public ownership, from the mid-1940s until the privatisation processes of the early 1990s. It addresses the historical problem of why and how the state-controlled electricity

system, which expanded and consolidated between 1947 and 1976, eventually entered into crisis and paved the way for the market-oriented reforms of the 1990s. This question guides the analysis of policies, institutions and infrastructure, and underpins the division of the period into two distinct phases. The first was a phase of construction, characterised by the expansion of infrastructure, the establishment of a regulatory framework, and the creation of institutional forms. The second was marked by continuities and ruptures, in which tensions between policy, institutions, and infrastructure redefined the system and laid the foundations for the transformations of the 1990s.

The article is structured as follows. The first section sets out the theoretical approach and methodology. This is followed by an analysis of the initial dynamic and its key dimensions. The subsequent section examines how transformations in these dimensions gave rise to a new mode of functioning. Finally, the two phases are compared, and the article concludes with a series of reflections.

Theoretical Approach

Since Thomas Hughes' seminal work on large technological systems and the origins of electrification,[1] various perspectives have emerged for analysing the construction and transformation of electricity systems. Several case studies have become particularly influential in this field. From the perspective of the history of technology, research has examined both early electrification processes and more recent reforms, highlighting the technological as well as the social dimensions of electrification. Hughes' main contribution was his notion of the integrated technological system, coordinated by a "system builder," which introduced a systemic approach to understanding electricity networks.

Building on this foundation, subsequent studies have expanded the analysis to include social history, emphasising the role of actors and the cultural meanings associated with energy. A notable example is Montaño's work on the history of electrification in Mexico,[2] which examines consumer practices and the ways in which electricity was understood.

Although this article does not focus directly on consumer perspectives, we draw on Montaño's concept of the electricscape as a useful framework for studying the relationships between infrastructure, public policy, and various actors, including their symbolic dimensions. Nevertheless, while Montaño's contribution is highly relevant for exploring social relations around electricity, the focus here lies on energy policy and its relationship with state-owned enterprises. Users are therefore

1 Hughes, *Networks of Power*.

2 Montaño, *Electrifying México.*

not the subject of this study, but rather the ways in which energy policy was conceived. For this reason, we adopt the concept of imaginaries related to public policy, discussed further below.

Another study related to this topic is Kale's *Electrifying India*,[3] which provides a long-term historical perspective. Kale shows how, despite ambitious national projects to electrify India after independence, significant disparities persisted in access across states, particularly in rural areas. Her analysis reveals how patterns of state intervention in earlier decades conditioned the later retreat of the state in the 1990s. Electricity emerges in her account as both an infrastructural instrument of power and a developmental tool, albeit implemented in decentralised and uneven ways. In this respect, her work offers parallels to the present study, as we are also concerned with how the characteristics of the electricity system, its policies, and infrastructures evolved through contradictions in their functioning.

In Argentina, the literature on these historical processes remains comparatively limited. For the early stages of electrification, there are some studies covering the late nineteenth century to the 1940s, which reconstruct the origins of the national electricity system. These studies reveal the decentralised nature of the sector, as examined by Lanciotti,[4] who emphasises the state's role as guarantor of activity, in contrast to the entrepreneurial role it assumed from the 1940s onwards, which forms the basis of our study. Further research by Macchione Saes and Lanciotti[5] analyses the role of foreign firms during this decentralised phase. These works, together with others,[6] shed light on the functioning of electricity provision before state control, highlighting concessionary systems and the influence of foreign companies.

When the state assumed a more central role in energy management, however, historical analyses largely shifted towards models of governance and economic policy, rather than electricity itself. In this respect, the key references are the studies of Belini and Rougier,[7] who conceptualise the state's transformation into an "entrepreneurial state" from the mid-1940s onwards. Their work focuses on economic models and policy frameworks adopted by successive governments. Lanciotti also employs this distinction between the state as guarantor and as entrepreneur in her research on public services, although her analysis is concentrated on the first half of the twentieth century and ends in 1955.

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3 Kale, *Electrifying India*.

4 Lanciotti, "Del Estado garante al Estado empresario."

5 Macchione Saes and Lanciotti, "La regulación de los servicios de electricidad."

6 For example: Bartolomé and Lanciotti, "La electrificación en países de industrialización tardía"; Lanciotti, "Ciclos de vida en empresas de servicios públicos."

7 Belini and Rougier, *El Estado empresario en la industria*.

While these approaches are highly valuable for defining governmental forms and the role of the state, our concern lies with energy policy specifically in the electricity sector, an area that has been comparatively underexplored for the second half of the twentieth century. Among the few exceptions, the studies of Ascencio and Navarro Rocha[8] provide important data on the trajectory of public electricity companies, addressing a significant gap in the literature. Castellani and Iramain,[9] meanwhile, examine the deterioration of the entrepreneurial state, focusing on the behaviour of public enterprises during the last Argentine dictatorship (1976–1983). Their work offers critical insights into how these companies functioned under authoritarian rule. In addition, specific studies by Furlán, García Heras, La Scaleia, and Pírez provide further perspectives on state roles and management forms.[10] Furlán's contribution is especially relevant here for its reconstruction of infrastructural developments in Argentina's electricity matrix between 1950 and 2014.

Beyond these works, however, there remains a considerable gap in research that approaches electricity from a perspective integrating technology and society. It is within this context that the present study examines the period of state control through the lens of science and technology studies (STS). This perspective assumes that the links between technology and society are the outcome of construction processes. Accordingly, and following Pinch and Bijker,[11] we understand the electricity system not as a neutral object but as the product of interactions between actors, institutions, infrastructures, and resources. Technologies function not intrinsically but through the social and historical meanings attributed to them within networks of relations.

This study examines the elements that shaped the system's form, objectives, and materiality. The analysis concentrates on four dimensions: the role of the state and the models of accumulation that emerged; the socio-technical imaginaries embedded in energy policy; the institutions and regulatory frameworks; and the development of infrastructure projects. These dimensions provide the basis for analysing the evolution of electricity policy and infrastructure. While users are

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8 Ascencio and Navarro Rocha "Auge y declive de las empresas públicas argentinas en el sector eléctrico"; Hubert and Spivak L'Hoste, "Los imaginarios sociotécnicos de las políticas."

9 Castellani and Iramain, "El deterioro del Estado empresario."

10 Furlán, "La transición energética"; García Heras, "'Desarrollismo' e infraestructura energética"; La Scaleia, "Estado empresario, políticas públicas y económicas"; Pírez, "Relaciones de poder y modelos de gestión."

11 Pinch and Bijker, "The Social Construction of Facts and Artifacts."

undoubtedly central to electricity systems, the methodological focus of this article is restricted to the level of policy.[12]

Linked to the policies, the concept of socio-technical imaginaries, developed by Jasanoff[13] and adapted to the Argentine case by Hubert and Spivak L'Hoste,[14] is particularly relevant here. These authors use this category as an analytical tool to examine the collective representations that underpin the understanding of technological projects. Within these imaginaries, shared visions of desirable futures emerge, along with a relative consensus regarding the objectives of a specific social order.

We focus on the sociotechnical imaginaries of electricity policy proposed by Hubert and Spivak L'Hoste: the developmentalist and the mercantile. In the developmentalist imaginary, energy is conceived as a strategic sector for development and "energy sovereignty." Governments occupy a central role, public policy is presented as a key instrument, and risks are associated with technological dependence, import costs, and tensions with the private sector. The mercantile imaginary, by contrast, is "guided by and oriented towards the market",[15] with technological decisions in the hands of the private sector. Here, the role of public policy is to ensure market conditions, and risks are linked to conflicts of interest between public and private actors.

Although the authors focus on contemporary energy policy, their framework proves useful for the historical analysis of the development of the electricity system. We understand that these imaginaries, with nuances and not homogeneously, unfolded at successive moments in Argentine policy. The developmentalist imaginary was aligned with the industrialisation process, while the mercantile imaginary began to gain prominence from the period inaugurated in 1976.

Another concept that allows us to investigate electricity policy and its underlying energy conceptions is the accumulation model. By this we mean, following Basualdo, "the articulation of a certain functioning of economic variables, linked to a defined economic structure, to a particular form of state, and to the struggles between existing social blocs."[16] From this perspective, and following the author, we assume that two distinct accumulation models existed in Argentina during the period when the electricity system was state-controlled: the import-substitution industrialisation model (1947–76) and the model oriented towards financial valorisation (1976–89).

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[12] The ways of accessing and consuming electricity will be the subject of future research.

[13] Jasanoff, "Future Imperfect."

[14] Hubert and Spivak L'Hoste, "Los imaginarios sociotécnicos de las políticas."

[15] Hubert and Spivak L'Hoste, "Los imaginarios sociotécnicos de las políticas," 237.

[16] Basualdo, "Concepto de patrón o régimen de acumulación y conformación," 5.

Furthermore, analysing functioning as a construct also involves approaching infrastructure in this way. Thus, social studies of infrastructure emphasise the relational dimension, considering that technologies are not neutral and exercise agency.[17] In this sense, Star proposes different relevant dimensions of analysis, among which we highlight the idea that infrastructures are embedded in other structures, practices, and technologies, making it necessary to consider them in a field of relations.[18] As a result, they do not emerge in a vacuum but are built upon a sociotechnical base that includes various instituted elements.

Likewise, the author notes that infrastructures tend to become invisible, except when they fail. While this is often the case, we have observed in this research that the infrastructure and the electricity system maintained a dimension of visibility, especially in the first phase of this trajectory. In this case, this visibility existed at the time of planning and projection and was reflected in numerous ways around the works, in the form of expectations, conflicts, and resistance.[19]

Building on the texts discussed above, previous studies on the subject, and the theoretical contributions outlined, this article traces the historical trajectory of the Argentine electricity system under state control. We examine the system as shaped by multiple interacting elements, unfolding within a state-managed framework and characterised by two distinct dynamics in its functioning. Our analysis focuses, on the one hand, on the transformations and continuities across the dimensions under study, and on the other, on identifying—through these dimensions—the characteristics and dynamics that gave rise to an electricity crisis, which ultimately paved the way for privatisation in the 1990s.

Methodologically, the article draws on a wide range of sources, including journals, company publications, official statistics, regulations, and reports. The period under consideration begins with the creation of the first national public company, Agua y Energía, in 1947, when energy was first articulated as a public concern and explicit policies were introduced, and concludes with the conditions that prepared the ground for the privatisation process launched during the presidency of Carlos Menem in 1989.

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[17] Thomas and Santos, *Tecnologías para incluir.*

[18] Star, "The Ethnography of Infrastructure."

[19] These arguments can be found in Larkin, "The Politics and Poetics of Infrastructure," and in Velho and Ureta, "Frail Modernities."

1947–76: Construction of the Electricity System in Argentina

By the 1940s, Argentina's electricity sector was dominated by foreign monopolies operating in isolated urban centres under municipal concessions.[20] These arrangements reinforced the localised nature of electricity supply and shaped the methods of energy production. Thermal generation using fossil fuels—mainly coal imported from the UK—emerged as the most viable model for investors in a decentralised system, and large power plants were built in areas of high consumption, resulting in a predominantly thermal energy matrix. Despite the problems associated with dependence on fossil fuels, this pattern would continue until the 1970s.[21] In addition, large utility holding companies were plagued by corruption scandals, exacerbated by weak government oversight of utility regulation and pricing.[22] Growing energy demand and critical dependence on imported fuels compounded these problems.

This was the situation when a coup took place in 1943.[23] The new nationalist military government introduced energy planning policies and reviewed existing concessions, marking the beginning of a national electricity policy that would last for decades.

This section deals with what we understand to be the process of the construction of the electricity system in Argentina between 1947 and 1976. These three decades were characterised by chronic political instability—alternating legitimate governments, dictatorships, and restricted democracies—and recurrent ideological shifts amid internal strife within both civilian and military regimes. Despite the turbulence of the political arena, the issue of electricity remained central to all the governments of the period.[24]

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[20] One of the dominant groups was the Belgian-based *Société Financière de Transports et d'Entreprises Industrielles* (Sofina), which controlled the utilities in the largest cities. The holding company accounted for half of the country's installed electricity capacity.

[21] After coal, fuel oil was the main fuel used in power stations until the 1940s. By the 1980s, it had been replaced by natural gas.

[22] As analysed by Bartolomé and Lanciotti.

[23] The military government set up a commission to investigate the situation of the electricity concessions. This resulted in the so-called "Rodríguez Conde Report", published in 1943. It revealed bribes paid by companies, as well as abuses and violations of regulations by the electricity monopolies.

[24] This turbulent period was characterised by the intervention of the armed forces. A period of democratic government (1946–55) was followed by a series of coups (1955, 1962, 1966) and dictatorships (1955–58; 1966–73). In addition, between 1955 and 1973, the most popular political party was outlawed.

The Entrepreneurial State, the Accumulation Model , and the Imaginary

In Argentina, the accumulation model based on import-substitution industrialisation began in the 1930s. Broadly speaking, this process resulted from the international crisis of 1929, which locally affected agro-exports through falling commodity prices, a decline in fiscal revenues, and the protectionist measures adopted by industrialised countries. Initial responses to the crisis included currency devaluation and higher tariffs on imports. Although these policies were intended to mitigate the crisis, they encouraged industrial activity aimed at replacing imported goods. Following Belini and Korol,[25] industrial growth was a consequence of the crisis and the emergency measures taken in response, rather than the outcome of a deliberate and coherent government strategy.

From the 1940s onwards, however, import-substitution industrialisation was transformed into a state-led policy under the government of Juan Domingo Perón (1946–52 and 1952–55). During this period, the state began to exercise strong interventionism, implementing economic planning and the creation or nationalisation of companies. As Belini and Rougier argue, this process consolidated the role of the entrepreneurial state, a role that, with variations, would endure over the following thirty years.[26]

Alongside this economic model, a sociotechnical imaginary emerged that positioned energy as a strategic resource for national development. Based on a vision of an industrialised future marked by economic growth and rising demand, this imaginary can be associated with the one proposed by Hubert and Spivak L'Hoste as developmentalist.[27] Its central objective was linked to the construction of an electricity network and the extension of access to energy for both users and industry. The means to achieve this goal included the creation of specific public companies, the regulation of planning frameworks and the execution of major infrastructure projects. In this way, resources varied, but strong energy planning, various forms of access to finance and alternative productive development strategies were implemented.

In this phase, there were different moments with profound ideological variations, but despite the changes in means and resources, the essential objective of developing and expanding the electricity system remained constant.

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[25] Belini and Korol, *Historia económica de la Argentina en el siglo XX*.

[26] Belini and Rougier, *El Estado empresario en la industria*.

[27] Hubert and Spivak L'Hoste, "Los imaginarios sociotécnicos de las políticas."

Institutional Forms and Public Companies

There were three national public companies through which access to energy was extended: Agua y Energía, Segba, and Hidronor.

Agua y Energía. Regarding institutional forms, we first refer to the creation of the Directorate of Agua y Energía in 1947. This entity was established by the merger of the General Directorate of Irrigation of the Ministry of Public Works and the Directorate of State Power Plants, which was part of the Ministry of Industry and Trade. It was established as the country's main electricity company. It had a federal structure and operated across almost the entire territory. Its initial objective was to explore and exploit the resources available for the development of hydroelectric power in the country.[28] During this period, the company built most of the high-voltage lines, controlled the distribution networks in almost all provinces, and reached more than 30% of the country's generation capacity.

The territorial presence of Agua y Energía was reflected not only in physical expansion but also in a narrative that exalted its role in national development. Under the slogan "*Agua y Energía, factor de progreso*" (factor of progress), the company presented its activities with a heroic tone, highlighting its contribution to the country's advancement. Later, in *Primera Plana*, a widely circulated political and economic weekly, Agua y Energía was presented as being responsible for carrying out a "second desert campaign."[29] This term alluded to the policy of extending the frontier to the south, which oppressed the indigenous population in the last decades of the nineteenth century. This process was conceived by the liberal elites as the advance of civilisation over barbarism. In this case, the company had a civilising purpose, which was now interpreted as the inclusion of the rest of the country in the progress of electricity.

Segba. Servicios Eléctricos del Gran Buenos Aires was the second-largest electricity company in the country. It was founded in 1958 as a mixed-capital enterprise and was subsequently nationalised in 1961.

The rationale behind nationalisation was to establish a transparent company with the necessary legal guarantees to qualify for international financing of large-scale infrastructure projects.[30] Segba's incorporation into the public sector was linked to the need to obtain a World Bank loan for the completion of the Dock Sud power plant, which until then had been managed by Agua y Energía. Financial constraints, combined with its legal status as a state enterprise and other concerns

[28] Chévez and Ruggeri, "La energía en Argentina durante la industrialización."

[29] Agua y Energia, *Factor de Progreso*; *Primera Plana*, no. 476.

[30] García Heras, "'Desarrollismo' e infraestructura energética."

surrounding its management, disqualified Agua y Energía as a potential borrower in the eyes of the Bank.

As a result, Agua y Energía was compelled to transfer to Segba both the distribution network covering fourteen municipalities around the Federal Capital and responsibility for the unfinished construction of the Dock Sud plant.

It was responsible for the generation,[31] transmission, and distribution of electricity in the city of Buenos Aires and twenty-eight surrounding districts, an area that had been placed under national jurisdiction to guarantee supply. In the territory of the Federal Capital, supply was shared with one of the few private companies in the sector, Compañía Ítalo Argentina de Electricidad.

Hidronor. Hidroeléctrica Norpatagónica was the third major national company, founded in 1967 during the dictatorship of Juan Carlos Onganía (1966–70). Its creation reflected the importance of hydroelectricity within national energy planning and marked the culmination of a complex trajectory in the execution of large-scale works, a process constrained by financial difficulties since the establishment of Agua y Energía.[32]

Despite the existence of that enterprise, and in a manner like the creation of Segba, Hidronor was organised as a joint-stock company specifically to exploit the water resources of the Comahue region, in the provinces of Neuquén and Río Negro. This was to be achieved through the construction of large hydroelectric plants and their associated transmission lines. Its flagship project was the El Chocón hydroelectric plant, which will be discussed in greater detail later.

Accordingly, table 1 shows the evolution of the installed capacity of the three companies throughout the period they remained under state control. It reveals that, from the 1960s onwards, roughly 70% of Argentina's electricity matrix was controlled by these companies.

In addition to the creation of companies, the other relevant event of the period that reflected energy as a strategic sector was the creation of the National Atomic Energy Commission in 1950 and the development of the Nuclear Plan, which led to the construction of the first nuclear power plant in Latin America, Atucha I, which went into operation in 1974.

In this phase, most of the utilities were nationalised and absorbed into new state-owned companies. As Lanciotti observes in her study of public utilities,[33] the state's role was transformed from the 1940s onward. While her analysis focuses on the Peronist era and public services broadly, this shift is also clearly seen in the

[31] Segba controlled about 30% of the installed generation capacity in the country.

[32] Bandieri, "Hidroelectricidad y empresa pública en la Norpatagonia argentina."

[33] Lanciotti, "Del Estado garante al Estado empresario."

electricity sector. The state's expanded role began under Perón and continued even after his fall in 1955, lasting at least until the last dictatorship in 1976. This period established direct state management of electricity services.

Table 1. Installed capacity by national companies and total in MW.[34]

Year	Agua y Energía	Segba	Hidronor	Total system
1947	33			1,228
1950	89			No data
1955	278			1,618
1960	982	693		2,287
1965	1,154	1,472		3,754
1970	1,555	1,843		4,861
1975	2,479	2,110	800	7,281
1980	3,173	2,809	1,650	10,086
1985	4,100	2,543	2,770	13,999
1990	4,891	2,704	2,770	15,406

Regulations

In the 1950s, construction of new power plants began, but the lack of national regulations hindered the effective organisation of the energy system. Meanwhile, electricity demand surged constantly, driven by the expansion of the internal market and the country's industrialisation process. This rising demand created significant supply challenges, particularly throughout the 1950s, which manifested in power shortages and necessitated planned electricity cuts.[35]

The government of Arturo Frondizi (1958–62) began efforts to regulate the existing fragmentation, and in 1960, the Energy Law (15.366) was passed. This was the first comprehensive legislation on the electricity sector. The regulation had been discussed the previous year, with intense debate and points of conflict.

It declared electricity a public service and regulated the three activities of generation, transmission, and distribution. The National Interconnection Network was set up and a centralised coordination unit for Agua y Energía operations was established.

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[34] Agua y Energía, *Memoria y Balance*; *40 años*; Secretaría de Energía, *Anuarios de Energía* Eléctrica 1957, 1960, 1965, 1970, 1975, 1980, 1985, 1990.

[35] García Heras, "'Desarrollismo' e infraestructura energética."

The initial problem was the shortage of energy supply. The expansion of power generation required large investments in infrastructure, which the government sought to finance with the help of the international lending agencies. This, in turn, meant that the government had to meet the demands of these institutions, which, in order to be able to grant loans, pressed for the establishment of a regulatory system. It was with this intervention that the law was formulated.

The law was drafted with international technical assistance, financed by loans from the World Bank, which from then on played a significant role in the construction of the electricity system. In this case, the World Bank promoted the creation of a centralised and unified system, which it considered to be a more efficient model. Part of this arrangement was the creation of Segba as a public limited company to receive loans.[36]

The law was promoted by the ruling party and met with strong opposition, which questioned several points. At the time, it was considered to be "the most passionate issue in Parliament in recent times."[37] These points were mainly related to the possibility of foreign investment and the intervention of international lending agencies. On the other hand, an extension of the executive power over the provinces for the operation of dams was denounced, since the issue of hydroelectricity was a constant point in the debate, in which this energy was presented as an alternative for development.[38]

Infrastructure: employees, major works and loans

The growing demand for energy in Argentina drove, over several decades, the need to undertake major engineering projects. This phase was characterised by intensive planning and the projection of power plants and transmission lines.

During the Peronist government, Agua y Energía was responsible for initiating these projects but faced various obstacles, such as a lack of financing, political instability, and recurrent economic crises. These factors produced oscillations between the planning, execution, and operation of the works. With the strong organisational drive during Frondizi's government, several credit agreements were concluded to carry out major projects. Subsequently, during the dictatorship that lasted from 1966 to 1973, the execution of infrastructure works intensified, particularly in the expansion of hydroelectric power.[39]

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[36] World Bank, *Institutional Development in Electric Power*.

[37] Clarín, "Energía fue aprobada con estricto quorum."

[38] Cámara de Diputados, *Debate parlamentario de la Ley 15.366*; Consejo Federal de Energía Eléctrica, *Los 50 años del Consejo Federal de la Energía Eléctrica*.

[39] García Heras, "'Desarrollismo' e infraestructura energética"; Gomes, "Las casas del Onganiato."

As far as technicians were concerned, the training of engineers was an objective in the process of developing large works. Throughout this period, the state was forced to train new technicians and to upgrade existing ones. In the 1950s, President Perón said: "We will send many young Argentine engineers abroad to specialise in short and useful courses in order to train the generation of experts in hydroelectric power."[40] This was essential because Argentina did not have the capacity for developments of this magnitude. The first president of Agua y Energía, engineer Maggi, pointed out that initially "everything had to be improvised because there was no technical background . . . We were at zero."[41] Initially, from the 1940s, military technicians and engineers were trained.[42] The issue of energy was closely linked to the armed forces, and the creation of these companies was connected to the ideal of national defence, the engineer stated.[43]

Throughout this period, state-owned companies steadily increased the number of professionals and technicians in their workforce. In the 1970s, both Segba and Agua y Energía employed around twenty-five thousand workers each. Staff levels reached their peak in 1975, after which they began to decline steadily.[44] It is difficult to determine the specific tasks performed by these employees, and we lack information regarding their training.

In the case of Agua y Energía, staff were distributed across the country according to the eight regional management divisions into which the territory was organised.[45] The enterprise maintained training centres across different regions,

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[40] *Mundo Peronista*, cited in La Scaleia, "Estado empresario, políticas públicas y económicas."

[41] *Primera Plana*, no. 189.

[42] At the early stages of industrialisation, the practice of pursuing training abroad, whether in Europe or the United States, was widespread. In her study on dam construction, "Del desierto al vergel: Los diques de la Dirección General de Irrigación del MOP (Argentina, 1900–1930)," Anahí Ballent observes that during the 1930s there were engineers within the Directorate of Irrigation who had received training abroad. In a similar vein, Facundo Picabea, in *Apogeo, inercia y caída del proyecto metalmecánico tecno-nacionalista*, examines the education of military engineers at foreign aerotechnical institutes during Peronism.

[43] *Primera Plana*, no. 476.

[44] Agua y Energía, *40 años de Agua y Energía*; Segba, *La empresa pública como elemento de política*; Ascencio and Navarro Rocha, "Auge y declive de las empresas públicas argentinas."

[45] Towards the end of this paper's period of analysis, in 1989, we know that the staff composition at Agua y Energía consisted of 20% university-trained professionals, mainly engineers. However, we do not have sufficient data to infer that the same proportion applied earlier.

offered courses, provided scholarships for overseas training, and fostered links with national universities.[46]

Regarding Segba, in a 1975 company report, a distinction was made between senior staff, referring to hierarchical and managerial positions, who experienced a steady increase over the period, exceeding that of the other categories in percentage terms; graded staff (*escalafonado*), which included most employees ranging from engineers and technicians to administrative personnel and other support activities; and personnel associated with health services. The detailed data are presented in table 2.

Table 2. Staff employed at Segba, 1958–75.[47]

Year	Senior Staff	Graded Staff	Healthcare Personnel	Total
1958				12,716
1960				14,755
1965	1,173	23,591	303	25,067
1970	1,337	22,021	313	23,671
1975	2,062	23,925	352	26,339

The technical developments were accompanied by international support in the form of agreements and loans. The case of Segba in the 1970s was very significant. There, the company generated a strong interest in technological development. With the encouragement of its president, Jorge Sábato,[48] it set up a research and development laboratory and worked out productive cooperation strategies with suppliers to promote national industry as a substitute for imported goods.[49]

In terms of generation, when the system began to be built, most of the power installed was thermal, dependent on fossil fuels, which were in short supply. In any case, large thermal plants were built, such as the "super plant" of San Nicolás, carried out by Agua y Energía. With an unprecedented capacity of 300 MW, it was inaugurated in 1958 and was the largest in the country. Meanwhile, Segba took over the control, construction, and expansion of large plants such as Costanera and Puerto Nuevo.

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[46] Agua y Energía, *Factor de Progeso*; *Memoria y Balance*; *40 años*.

[47] Segba, *La empresa pública como elemento de política tecnológica*.

[48] Jorge Sábato was a renowned physicist and technologist. His relevance was found in his positions on economic development and technological autonomy, he was part of the Latin American Thought in Science, Technology and Society (PLACTS) group.

[49] Segba, *La empresa pública como elemento de política tecnológica*.

Although the increase in thermal capacity was greater, hydroelectricity emerged in the years of industrialisation as a viable alternative to achieve "energy independence,"[50] as part of the Peronist discourse. In Perón's words in 1949: "As long as we do not have hydroelectric energy, for which we are working tirelessly to replace thermoelectric energy, there is no possible economic solution."[51]

There were great expectations for hydroelectricity, which seemed like a huge potentially renewable resource given the country's geography.[52] In 1947, the total installed capacity was 1,228 MW, of which only 42 MW was hydroelectric, the rest thermal.[53]

Previously, studies had been carried out, particularly on large dams, such as the Salto Grande project, which was shared with Uruguay. But with the creation of Agua y Energía, the company began to systematically evaluate the country's water potential. Studies, design, and construction of works throughout the country began. Initially, a potential capacity of 11,000 MW was estimated, but these studies continued during the period and by the end of the 1960s, it was estimated to be three times as much.[54]

Until the creation of Hidronor, major works were carried out by Agua y Energía, which came to control the whole of this generation. For example, Los Nihuiles hydroelectric complex, in the province of Mendoza, consisted of three plants built between 1942 and 1977 (250 MW), a fourth was planned for 1975 (30 MW), but was not completed until the 1990s, by which time it was already privatised.[55]

Among all the hydroelectric projects, the El Chocón was the most emblematic. The complete project envisaged the construction of five dams that would reach a capacity of nearly 3,000 MW and included a high-voltage transmission line from this region to Buenos Aires. Studies were initiated by Agua y Energía in 1951, but the project required an immense investment, which led to a winding path to its realisation. It took fifteen years to get the work started, during which time El Chocón was built as a flagship of technological development. It was promoted as "the work of the century"[56] and proposed as a solution to the problem of power supply using water resources.

The visibility of this project, promoted by the state, transcended the technical sphere and became embedded in broader spaces of symbolic circulation that

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50 *Hechos e Ideas*, no. 66–67.

51 Cited in La Scaleia, "Estado empresario, políticas públicas y económicas."

52 *Primera Plana*, no. 5.

53 Agua y Energía, *Memoria y balance*.

54 *Primera Plana*, no. 476.

55 Agua y Energía, *40 años*.

56 *Primera Plana*, no. 5; Cámara de Diputados, *Debate parlamentario de la Ley 15.366*.

sought to construct a narrative of technological progress, while also demonstrating the state's presence in energy development. El Chocón project circulated through advertisements, audiovisual productions, press campaigns, postage stamps, and promotion at football matches, among other channels.[57]

The imminent construction phase began in the 1950s with tenders and contracts. Then there was a partial paralysis in the search for funding, and finally an organisational reform for its development. The World Bank's requirements to facilitate access to credit necessitated the ad hoc creation of a new company, as it considered Agua y Energía to be in financial difficulty. Hidronor was then created to carry out the projects as part of the government's Public Works Plan (1967–69).[58]

Thus, the search for energy diversification marked this period. According to Furlán,[59] a new stage in the electricity matrix began in 1973 (with the inauguration of El Chocón), characterised by a constant increase in hydroelectricity, which was maintained until the privatisation in the 1990s. In addition to El Chocón, other large hydroelectric plants were planned. These were the binational plants of Yacyretá, shared with Paraguay, and Salto Grande, with Uruguay. Nuclear power generation also began.

In this regard, towards the end of this period, the beginning of a hydrothermal matrix took place, which would only be consolidated in the following years, simultaneously with the dismantling of the state-owned enterprise sector starting in 1976. During the last dictatorship, construction works continued, but the long-term electrical planning process was interrupted. Thus, all the hydroelectric capacity that came into operation from the late 1970s had been planned or initiated during the industrialisation period, as can be seen in the following section.

The increase in production was accompanied by the construction of Agua y Energía's high-voltage interconnection network. As soon as the Hidronor plants began generating energy, the management of the hydrothermal dispatch system became more complex. These new complexities stemmed from the growing number of power plants, the expansion of available capacity, and the development of a system transitioning from purely thermal to hydrothermal. Likewise, the increased interconnection between regions via high-voltage lines required more precise management, sometimes over long distances, as in the case of El Chocón, located 1,220 km from the main consumption area, Buenos Aires. This created the

[57] Mariano Basso and Nicolás Padín, "Hierro, hormigón y gambetas: a 50 años del partido entre los trabajadores de El Chocón y Boca Juniors," *Más Neuquén*, 2020, accessed May 15, 2024, https://masneuquen.com/hierro-hormigon-y-gambetas-a-50-anos-del-partido-entre-los-trabajadores-de-el-chocon-y-boca-juniors/; Castro and Castro, "Narrativas e imaginarios geográficos."

[58] Castellani, "La gestión estatal durante los regímenes políticos burocráticos-autoritarios."

[59] Furlán, "La transición energética en la matriz eléctrica argentina."

need to establish an operations centre linking all regions of the country for the coordinated management of energy. To this end, a form of centralised management, the National Power Dispatch, was established in 1972.

A final issue related to infrastructure was the intervention of international organisations, mainly the World Bank and, to a lesser extent, the Inter-American Development Bank (IDB).

As mentioned above, the creation of Segba, and also that of Hidronor, was linked to the World Bank's requirements for the establishment of institutions to provide loans for major works. The World Bank became a player in the electricity system in the 1960s, and its interests were partly reflected in the characteristics of the system.

In this regard, Segba received three loans from the World Bank: in 1962, 1968, and 1969. Each of these was intended to finance work plans and had to comply with conditions that included, for example, a reduction in the workforce, an increase in tariffs and a reorganisation of the management.[60] While Hidronor was set up in 1967 as a company to obtain the loan for the El Chocón work that had been refused to Agua y Energía, the latter had applied to the IDB for several smaller loans during the 1960s.

In summary, over these decades, both installed capacity and transmission networks expanded. The process was not linear, yet it remained sustained. The means of carrying out the works depended on Argentina's economic and political cycles. Throughout this period, government instability resulted in shifts in policy orientations and economic plans. Several economic crises occurred, linked to the limits of industrial development and dependence on foreign currency, which constrained the possibilities for state investment and access to loans. By the early 1960s, however, once a regulatory framework had been established, the country was able to embark on major works that laid the foundation for a diversified energy system.

1976–89: Transformation of the System

This section briefly examines the transformations and continuities between these two dynamics. The last dictatorship in Argentina (1976–83) inaugurated a political and economic transformation that marked the first steps of what was to become, in the 1990s, the privatisation process. It was the beginning of the dismantling of the entrepreneurial state, as Belini and Rougier argue.[61]

[60] *Primera Plana*, no. 195; World Bank, *Power—Argentina—Segba*; La Scaleia, "Estado empresario y desarrollo eléctrico"; García Heras, "'Desarrollismo' e infraestructura energética."

[61] Belini and Rougier, *El Estado empresario en la industria*.

The model that was installed was conceived by some authors as liberal-corporative and was embodied in an accumulation model based on financial valuation.[62] The new dictatorship distinguished itself from the two previous ones (1955–58 and 1966–73) in its intention to implement a profound reform of the economic model, based on the defence of the free market, combined with the use of repressive force at unprecedented levels.[63] The new policy implied trade liberalisation, deindustrialisation, and a shift towards the financialisation of the economy.

The reforms that were implemented were aligned with a liberal conception of the role of the state and, at the same time, of energy. Associated with the new economic measures, a mercantile imaginary began to take shape in public policies, one that regarded energy as an activity that should not be managed by the state. This perspective was framed through the so-called "principle of subsidiarity," a concept invoked by the government to emphasise that "the State must not do what a sector such as the private sector does better," in the words of José Martínez de Hoz, Minister of Economy between 1976 and 1981.[64]

Martínez de Hoz was a central figure in the consolidation of the dictatorship and in the implementation of its liberal economic plan, which he explained in the following terms:

> The two basic pillars on which we have based the execution of the economic program have been the principle of subsidiarity of the state and the opening of the economy . . . Five major avenues can be identified: first, the rationalisation of public administration; second, the reorganisation of state-owned enterprises; third, the privatisation programme of public companies; fourth, the transfer of public works and services to the provinces and municipalities; and fifth, the reorganisation and planning of public investment. With respect to the first avenue, this involved the rationalisation of public administration and the elimination of redundant personnel.[65]

In the case of enterprises, transformations took place along different lines. On the one hand, the government created support mechanisms for industries belonging to the most concentrated economic groups aligned with it, for instance, in the realm of public works. In this way, privileged spheres of accumulation sustained by the state were established. At the same time, peripheral privatisations of public

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[62] This is discussed in detail in Pucciarelli, *Empresarios, tecnócratas y militares*.

[63] Águila, *La historia de la última dictadura.*

[64] Martínez de Hoz cited in Zícari "Contra el dirigismo."

[65] Martínez de Hoz, *Speech*.

companies were initiated, with certain companies[66] divesting specific activities through sales, transfers, or concessions to large economic groups.

Local industrial areas of concentrated economic sectors linked to the state were promoted, conceptualised as privileged areas of accumulation.[67] At the same time, there was a peripheral privatisation of public enterprises. This meant privatisations of some activities of large public enterprises.[68]

In a process of deindustrialisation, energy ceased to be a strategic resource. However, the electricity companies went in different directions. An exception to the national energy policy was the case of Segba. In 1979, the Compañía Ítalo Argentina de Electricidad, which shared the Federal Capital electricity distribution with Segba, was nationalised and taken over by Segba. As Ascencio and Navarro Rocha point out, this process was not guided by a nationalist vision, but also by the particular interests of the Minister of Economy, who was a shareholder in the Ítalo.[69] The overvalued amount for which he was paid was linked to the officials' business dealings, which also exceeded the income of all the privatised companies at that time.

The process of expanding Segba had already been proposed in the previous decade. In fact, the World Bank, when approving the loan in 1962, had demanded that the entire region's services be consolidated under a single company in order to eliminate overlaps and, in its vision, achieve greater productivity.[70] However, the Argentine authorities resisted, arguing that absorbing all these users would overwhelm Segba, which was not prepared for the task.

When the service was finally nationalised in Buenos Aires, it occurred in the context of the defunding of public companies, a process that would deepen in the following years. Thus, although part of the system passed into state hands, this did not form part of a strategic plan by the state.

What happened with Agua y Energía was more in line with government policy. It was during this period that their dismantling began. However, in 1979, through a joint resolution of the Ministries of Economy and Interior, it was decided that Agua y Energía would transfer distribution and irrigation services to the provinces free of charge.

The transfers were made to sixteen provinces, and the service was maintained

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66 For example, with the national oil company (Yacimientos Petrolíferos Fiscales, YPF) or the national gas company (Gas del Estado).

67 See Castellani, "Gestión económica liberal-corporativa."

68 Águila, *La historia de la última dictadura*; Menazzi, "¿Una comunidad profesional de la obra pública?"; Zícari "Contra el dirigismo."

69 Ascencio and Navarro Rocha, "Auge y declive de las empresas públicas argentinas."

70 *Primera Plana*, no. 195.

in five. In two cases, the resolution was exceeded and a thermal power station and, in Cordoba, high-voltage lines had to be also transferred.[71] In the case of Los Nihuiles hydroelectric complex in Mendoza, for example, there was a long conflict between the national state and the provincial government, the latter demanding the transfer of the power plants, as had happened in the other case.[72]

In line with the World Bank, the United Nations Economic Commission for Latin America and the Caribbean (ECLAC)[73] argued that this transfer benefited the company because it "focused on the exploitation of large hydroelectric dams, the transmission of 500 kV and unified load dispatch, which optimised the production and distribution of electricity".[74] In the opposite position, from the perspective of Agua y Energía, the engineers identified three moments of dismemberment, with this one being the most severe:

> Other divisions, such as that of the 14 districts of the province of Buenos Aires in 1961 or that of El Chocón, did not affect the company as much as these transfers, which affected its economic and financial operations to such an extent that it became difficult for it to transfer resources from its profitable districts to the weaker or unprotected areas, as was the fair method of distributing its investments, in the interests of the country as a whole.[75]

As a result of losing distribution services in the provinces, Agua y Energía no longer controlled its own cash collection, and the payment chain was disrupted. According to Agua y Energía professionals, the situation had been complicated since the early 1980s, but became critical from 1986, leading to a "state of anarchy" in 1989.[76] This was part of a process of sharp deterioration of the electricity companies in the 1980s, with unprecedented peaks in liabilities and high levels of internal and external debt, as shown by Ascencio and Navarro Rocha.[77]

In the case of infrastructure, the period of the dismantling of the entrepreneurial state was followed by an increase in installed power. Many of the planned infrastructure projects were started at that time, but the planning impulse was limited. On the one hand, no new developments were proposed to those already established, and on the other hand, throughout the 1980s, the allocation of funds to works, as well as to companies in general, decreased. This trend is evident in table 3, which draws on data from Castellani and Iramain.

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71 Agua y Energía, *40 años de Agua y Energía*.

72 *Revista Única*, no. 48.

73 In Spanish: Comisión Económica para América Latina y el Caribe, or CEPAL.

74 ECLAC, *Las empresas públicas en la Argentina*.

75 Agua y Energía, *40 años de Agua y Energía*.

76 *Revista Única*, no. 48.

77 Ascencio and Navarro Rocha, "Auge y declive de las empresas públicas argentinas."

Table 3. Investment of Agua y Energía and Segba.[78]

Years	Segba		Agua y Energía	
	Base Index	% Difference from Previous Year	Base Index	% Difference from Previous Year
1974	100		100	
1975	104.1	4.1	128.3	28.3
1976	94.5	-9.2	103.8	-19.1
1977	91.4	-3.2	93.5	-9.9
1978	70.7	-22.7	57.7	-38.3
1979	59.7	-15.6	51	-11.7
1980	96.7	62.1	99.2	94.8
1981	81.1	-16.2	76.7	-22.7
1982	69	-14.8	54.8	-28.5
1983	60.1	-13	44.8	-18.2
% Change 1974–83		-39.9		-55.2

The deterioration was also reflected in the number of technicians and professionals in the system, which began to decline. This process was part of the dictatorship's policy of reducing the number of employees in public companies and was not reversed with the return to democracy. For example, between 1975 and 1983, as noted by Ascencio and Navarro, the number of employees in SEGBA decreased from 26,334 to 20,130, while in Agua y Energía it dropped from 26,044 to 10,567. By 1989, the latter company employed only 6,880 workers.[79] The case of Hidronor followed a different trajectory: as a smaller company, it sustained growth and, by 1983, had reached 1,057 employees.[80]

The issue of salaries also became part of the demands, especially those of the professionals. Similarly, at the end of the 1980s, Agua y Energía created a trade union training centre to compensate for the company's inactivity due to a lack of resources to continue routine training. From the trade union, they demanded an end to the emptying, referring to the 1940s, "we are returning to a disorder that

[78] Castellani and Iramain, "El deterioro del Estado empresario."

[79] As we mentioned, by 1989, of the 6,880 employees, 20% were university-trained professionals, mainly engineers. *Revista Única*, no. 52.

[80] Data extracted from Ascencio and Navarro Rocha, "Auge y declive de las empresas públicas argentinas."

has increased in the last ten years . . . they want to make it appear that it originates in the companies . . . when it is a reaction to the absence of a valid policy for many years."[81]

A process of deterioration and infrastructural paralysis began, and the contradiction of the elements of the system became evident, where the functioning was no longer guaranteed.

Energy in Different Systems

The evolution of the electricity system in this period shows two different dynamics. The dimensions identified and analysed show changes and continuities; at both moments, these elements were part of the co-construction process that gave shape to the system. Table 4 presents an approach to the main results.

Table 4. Comparison of sociotechnical dynamics. (Source: Authors' elaboration.)

	Phase 1: 1947–76	Phase 2: 1976–89
Role of the state	Entrepreneurial state	Principle of subsidiarity
Accumulation model	Substitute industrialisation	Financial valuation
Energy imaginary	Developmentalist	Mercantile
Institutions	Growing public companies. International lending agencies	Underfunded public companies. International lending agencies
Infrastructure	Planning and construction of major works. Valuation of hydroelectricity. Seeking diversification	Continuation of some works, paralysis in others.

The main transformations between the two phases are marked by different roles of the state, patterns of accumulation framed in sociotechnical imaginaries with different valuations of energy. In phase 1, the state was the driving force behind developments to promote industrialisation, despite ideological variants and political instability, energy was constituted as a public issue[82] and the vision of it as a strategic good was maintained.

Since the last dictatorship, with the dismantling of the entrepreneurial state, a liberal financial model was established, which led to a process of deindustrialisation.[83]

[81] *Revista Única,* no. 48.

[82] Oszlak and O'Donnell, "Estado y políticas estatales en América Latina."

[83] Castellani and Iramain, "El deterioro del Estado empresario."

The promotion of private activity and privileged areas of accumulation was reconciled with a new role for the state.

At other levels of analysis, the ruptures were less evident. During the construction period, there was a continuous drive to create, organise, and expand the system—a time marked by profound transformations. This dynamic was far from static; what defined phase 1 was a sustained trend towards expansion, guided by a shared vision of a desirable future and the means to achieve it, closely linked to the state-led promotion of industrial development.

On the other hand, companies were created in a non-organic way. Faced with different needs, all three emerged. Agua y Energía showed the predominance of the state in the energy sector and a national presence. Segba and Hidronor were created because of the World Bank's requirements for loans to conduct works. The involvement of international agencies in energy planning was maintained throughout the period.

It was in this constructive flow that the greatest changes took place; the co-construction of these elements resulted in a system in which they were aligned. The need to organise the system resulted in a regulatory framework that established the form that the system should have, based on what existed, dependent on the state.

This movement stopped in phase 2, partly because of the changes mentioned above, but also because the system had reached a certain stabilisation. In other words, the general regulations were in place, there was a network with a central authority, and some of the larger works had been completed. Although changes were implemented in the regulations concerning companies, there were no major changes to the overall regulatory framework and the structure of the system remained constant.

It was at the institutional level that significant changes occurred. Segba expanded in defiance of government policy, while the crisis began in Agua y Energía. The years of dictatorship were reflected in the indebtedness of the companies, which could not be resolved with the return to democracy in 1983. The critical economic situation of the Raúl Alfonsín government (1983–1989) was never reversed, and throughout the decade, public companies were depleted.[84] This was illustrated by electricity shortages of the summer of 1988–89, which combined structural and contingent elements and made the energy crisis a public issue.

Infrastructure developed at its own pace. In the first phase, there was a period of enthusiasm for large engineering works, and the visibility of a construction process was constant. However, the promotion of technological development was not uniform. The cycles of economic growth and recession were reflected in the delays, and comings and goings between the planning of major works and the start

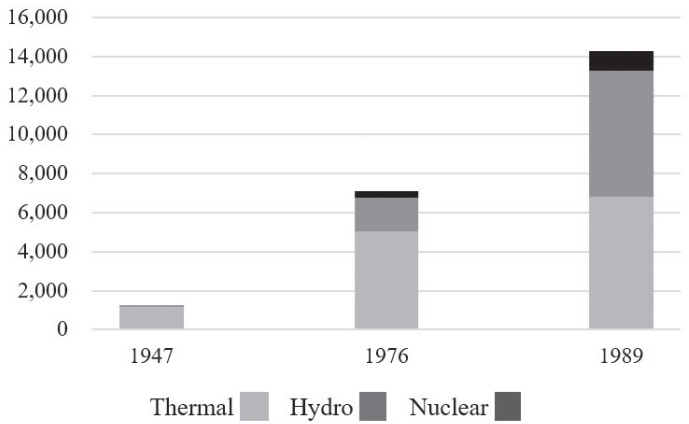
[84] Ortiz and Schorr, "La economía política del gobierno de Alfonsín."

of their construction. Financing problems were constant, as was the search for and access to international credit, which influenced the institutional organisation of the system.

At that time, in a context of technological optimism, hydroelectricity was seen as an ideal of progress to which the state should direct its efforts. El Chocón was one of the great milestones. It appeared as the unfolding materialisation of a high level of scientific and technological progress and was key in the process of diversifying the matrix.[85]

However, this hydrothermal matrix, which predominated in phase 2 (figure 1), was the result of previous processes that materialised in an energy model under a different dynamic. Thus, during the dismantling of the entrepreneurial state, the highest number of public projects were reaching completion.

Figure 1. Electrical matrix expressed in MW.[86]



In these infrastructures, the social meanings of an era, the priorities and goals, as well as desirable visions of the future, were embedded.[87] The characteristics implied that the ways of conceiving, projecting, and constructing a system or a major work exercised agency over long periods of time. The temporalities of the infrastructures meant that an important part of the materialisation of the imaginary of the first dynamic took place under a different model.

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[85] Furlán, "La transición energética en la matriz eléctrica argentina."

[86] Agua y Energía, *Memoria y balance*; Secretaría de Energía, *Series Histó*ricas de Energía Eléctrica, 2024, https://www.argentina.gob.ar/economia/energia/energia-electrica/estadisticas/series-historicas-de-energia-electrica.

[87] Howe *et al*., "Paradoxical Infrastructures."

Thus, in phase 2, a new accumulation model took shape, one that fostered a liberal energy imaginary while leaving public enterprises underfunded and national infrastructures heavily reliant on past investments. The major works completed during this time corresponded to the previous model of system functioning. From the last dictatorship onward, the system was marked by public intervention that no longer aligned with the new political orientation. Although certain aspects of state-owned companies were reformed, a comprehensive restructuring of the sector was not pursued. Large power plants remained in operation, but maintenance and investment—both dependent on state resources—began to deteriorate.

The contradictions within the system, where infrastructures and companies built under a public logic persisted under the control of a state that was simultaneously defunding them, led to a supply crisis by 1989. Within a few years, this situation paved the way for a complete restructuring of the sector through the privatisation process launched in 1991.

Conclusion

In this paper, we have examined the characteristics of the Argentine electricity system during its evolution under state control, between 1947 and 1989. We have presented two different dynamics of operation, based on the elements that have co-constructed its functioning. We have outlined the dynamics based on the analysis of these dimensions: the role of the state, accumulation models, imaginaries, regulations, public companies, and infrastructure.

In this way, the electricity system underwent an operational dynamic that was characterised by a period of construction and expansion. This did not mean that it was homogeneous, but that the shape the system took reflected an alignment between these dimensions.

Between the two dynamics, some dimensions were partially maintained, while others were profoundly transformed. The rules, the institutional features in the second dynamic, responded to a role of the state that no longer existed. The infrastructures carried the seal of the state. Of course, the service remained necessary and constant, but it announced the failures that were soon to come.

The new dynamics of operation generated a different system that would eventually begin to fail in service, paving the way for privatisation. This would transform the normative and institutional forms to finally adapt them to the role of the state, the accumulation model, and the imaginary.

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