

The gas companies in Spain, a long-run approach (1842–2018)

Mercedes Fernández-Paradas^a, Alberte Martínez-López^b and Jesús Mirás-Araujo^b

^aFacultad de Filosofía y Letras, Universidad de Málaga, Málaga, Spain; ^bFacultade de Economía e Empresa, Universidade da Coruña, A Coruña, Spain



ABSTRACT

The article aims to analyse the evolution of gas companies in Spain from their starting point in the middle of the nineteenth century (when the business was limited to public lighting), up until the complexity of the present day. This process is divided into three main stages according to the general context of the sector. In each period, the profile of the companies will be established, as well as their market and the institutional constraints and strategies that were adopted by the companies to overcome those challenges. We found that most of the peculiar features of the Spanish case history were shared with other Southern European countries. Among others, we outline the delay and low dissemination, the scarcity and high cost of coal, the lack of capital, the technology and know-how and the strong presence of foreign companies.

KEYWORDS

Gas; gas companies; foreign investment; strategy; energy; Spain; nineteenth to twenty-first centuries

Introduction

This article analyses the business history of gas companies in Spain from 1842 to 2018. From this perspective, we analyse the profile of gas companies and how and why they have evolved throughout this period. We also compare them with the gas companies of European neighbouring countries. We reflect on the causes of the predominance of private initiative and the role of foreign capital. The latter played a very important role until the early 1920s. In this regard, we analyse its origin and the reasons for its entry and departure from the country. Likewise, we examine the factors that conditioned the performance of the gas companies. We also consider the strategies they deployed with administrations, users and towards competition. This last issue is addressed from a double point of view, competition amongst gas companies and their competition with electricity firms.

The research is structured in three sections, each one dedicated to the three main stages that will be analysed: 1842–1935, 1936–1975 and 1976–2018. The stage between 1842 and 1935 was marked by the beginnings of the industrial activity of gas until just before the Spanish Civil War. This was a stage of globalisation, i.e. the internationalisation of companies, technology and capital (especially British and French), which were crucial for the arrival and subsequent extension of gas to Spain and a large part of Europe. The second was initially characterised by the progressive decline of manufactured gas and, since the 1950s, by the emergence of liquefied petroleum gases (LPG). This was a period of greater state intervention, including the nationalisation of the gas activity in some countries and the discovery of large deposits of natural gas in various locations in the 1950s. In Spain, state intervention was lower.

The gas sector was not nationalised (as occurred in France) and the action focused on LPG, not natural gas, since Spain did not have any deposits. The third stage (1976–2018) witnessed the impact of the first oil crisis. This was a stage of liberalisation which began in the 1980s. The main singularity of Spain was the slower diffusion of natural gas which only grew in intensity from the 1990s (Fernández-Paradas & Sudrià, 2018, pp. 125–126, 128, 133, 143). This chronological aspect coincides substantially with that indicated for southern Europe (Bartolomé, Fernández-Paradas, & Mirás, 2017, pp. 14–15). The differences come from the fact that in Spain the industrial development of gas was later than in France, the second period came earlier due to the Spanish Civil War and the diffusion of natural gas was delayed due to the significance of LPG.

1. From the monopoly of lighting to diversification due to the competition of electricity, 1842–1935

Coal gas technology began to develop in Britain and France in the late eighteenth century. It became an industrial activity in London in 1812. Three main periods can be observed as it spread in continental Europe. The first diffusion, from 1820s to 1830s, was led by Belgium and France. During the 1840s and 1850s, the gas industry began to develop in Swiss, Austro-Hungarian, Scandinavian, Spanish, Italian, Portuguese and Balkan cities. However, from the 1860s, gas even reached small and medium-sized settlements in Germany, Switzerland and in Scandinavia, while it only reached the main cities in Spain, Italy, and Portugal and in the Austro-Hungarian Empire. The third period of gas diffusion in Europe involved the Balkan states, where its greater extension took place from 1914 (Paquier & Williot, 2005, pp. 29–30).

In Spain, the origins of the gas industry are to be found in Barcelona in 1842, a service that was commissioned by the *Sociedad Catalana para el Alumbrado de Gas (La Catalana)*, founded in 1843. Between 1842 and 1935, four stages can be distinguished in the history of the gas industry in Spain at business level. The first, from 1842 to 1861, describes who introduced the gas as a product in Spain and how. They were the years of reception and implantation of a new industry, although its impact and extension were very moderate. The second, from 1862 to the beginning of the twentieth century, was characterised by a stronger progression of the activities that allowed the gas industry to reach maturity and by the start of competition with electricity. The third, from the early 1900s to the late 1910s, was determined by the difficulties derived from the competition of hydraulic electricity and the negative impact of World War I. The fourth, until 1935, was marked by the definitive exit of foreign capital, business concentration and the wider diffusion of gas.

In this first stage, from 1842 to 1861, two of the main characteristics of the sector at business level were shaped for a long time: the domination of private initiative and the preponderance of foreign capital. This presence still had major importance in Portugal, pre-dominating (like in Spain) French, Belgian and British companies. In Italy, the participation of foreign capital was also relevant, especially from France, Switzerland, Belgium and Great Britain. Conversely, in France, local capital predominated (Cardoso de Matos, 2017, p. 78; Giuntini, 2009, p. 143; Williot, 2005).

The chronic lack of the municipalities' economic resources explains to a great extent why they did not opt for municipalisation,¹ as they could not pay the gas companies. Spain was part of the group of countries, such as France, Belgium, Portugal or Italy (Giuntini, 2009, p. 50; Millward, 2005, pp. 18–20, 37–41), in which the private sector had great weight. The origin of the promoters of the gas factories illustrates two very different realities, that of Catalonia, where 82% of the promoters were local, and the rest of the country, where 71% were foreigners (Table 1) (Fàbregas, 2017, p. 32).

Among the causes that explain the importance of foreign capital, we must point out external and internal factors. As regards the latter, there was little experience in Spain in how to finance industries such as gas which required a large amount of money. When its course began in the early 1840s, there were no modern banks or savings banks (Fàbregas, 2017, p. 25). The external factor consisted of the wide availability of capital in countries such as France and Great Britain which were eager to invest. The target that propelled foreign investment was not exclusively financial but it also aimed to promote the construction of factories and networks including the provision of equipment. At this stage, capital came from France, Great Britain and Switzerland. In Spain, during the second half of the nineteenth century, France's capital represented 82.6% of the foreign investment (Costa, 1981).

As regards the initiatives by foreign entrepreneurs, some of them stand out in the early years: Charles Lebon from France and the Manby family and the *Compagnie Générale Provinciale du Gaz* from Great Britain. From 1856 onwards, the French companies *Crédito Mobiliario Español* and the *Compañía General de Crédito* also entered this business.

Charles Lebon, who introduced gas to France, Spain, Egypt and Algeria, had been interested in our country since at least 1840. With autochthonous partners, he obtained the public gas lighting concessions of Barcelona (1842), Valencia (1843) and Cadiz (1845). Shortly after, Lebon abandoned his activity in Spain due to disagreements with his Spanish partners and the change of economic cycle in France, where the serious economic crisis of 1848 was beginning. One year previously, he had founded the *Compagnie Centrale d'Éclairage par le Gaz, Lebon et Cie*, into which he incorporated his gas factories (Fernández-Paradas, 2009, pp. 35, 37, 110–111).

Aaron Manby was an engineer who founded *Horseley Ironworks* and who also had businesses in France in the metallurgy and gas business. In Spain, this family group was represented by his sons Edward and Joseph. They obtained concessions for gas lighting in several cities and promoted the creation of the *Sociedad Madrileña del Alumbrado por Gas de Madrid*, in 1846. Shortly afterwards, they promoted, with Spanish capitalists, the *Empresa General Peninsular del Alumbrado por Gas*, to extend to provinces, which they soon did in the municipalities of Seville, Valencia, Cadiz and Malaga. Together with Lebon's enterprise, they soon experienced difficulties due to the dispersion of efforts and the change of cycle that culminated in the aforementioned crisis of 1848. In that year, the British partners separated from

Table 1. Origin of the promoters of the gas factories in Spain, Catalonia and the rest of Spain, in percentage (1842–1861).

Promoter	Catalonia	Rest of Spain	Spain
Local promoter	81.8	14.3	44.0
Foreign technicians and local capital	18.2	14.3	16.0
Foreigners	0	71.4	40.0
Total	100	100	100

Source: Fàbregas, 'La estrategia', 32.

the company. The *Peninsular* went bankrupt and in 1851 it changed its name to *Compañía Madrileña para el Alumbrado por Gas*. Manby's activity was limited to Cadiz and Santander, as their gas lighting concessionaries until 1862, when gas activity ceased in Spain.²

During the 1850s, foreigners, especially French, continued to show interest in Spain. *York & Cia* obtained the contract from Seville which was later sold to Banco General Suizo in 1853. Under the Law on Limited Liability Companies which was approved by the Government in 1856, the *Compañía General de Crédito* and the *Crédito Mobiliario Español* were immediately founded. The latter, belonging to the *Crédit Mobilier* of Péreire brothers, took over the *Compañía Madrileña*. This purchase was part of the strategy of vertical integration of the group's businesses in Spain as it owned a railway company and coal mines which would provide for the gas business. A similar project was the *Compañía General de Crédito*, promoted by Alfred Prost. By the late 1850s this firm had six gas factories (Arroyo, 2002; Martínez, 2019).

We have little knowledge about the technology used in the factories of gas companies. Nevertheless, between 1842 and 1860, apparently most factories used direct fire furnaces which used coal as their raw material. In 1860, a method of producing gas without coal was used in the factories of Figueres and Manlleu, by the *Sociedad Humbert y Compañía* from Barcelona, developed by the patent of the Frenchman Alphons Humbert and Antonio Escubós from Barcelona (Alayo & Barca, 2017, pp. 151–154).

What was the level of gas extension in Spain at the end of this stage? In 1861, there were only 25 factories that supplied an equal number of municipalities, almost half of these in Catalonia, 12% in Andalusia and the remaining ones dispersed by coastal regions, with the exceptions of Madrid, Valladolid and Pamplona. In Catalonia, it was more present in small and medium-sized cities. Those with less than 20,000 inhabitants accounted for 83.4% of the total, while in the rest of Spain only 4% (Table 2). According to Sudrià and Aubanell, the main reason for the low gas spread was the low-income levels (Sudrià & Aubanell, 2017, p. 17).

Although in general the context for the development of gas companies in Spain was unfavourable, there were two advantages. Firstly, there was no competition between gas companies. And secondly, the regulatory framework was very weak and unclear. The infra-structure networks are usually considered a natural monopoly, characterised by expensive, durable and immobile investments and strong economies of scale. This feature discourages competitors from entering the market. There are several motivations for government involvement in infrastructure: monopoly, equity, externalities and assemble the right of way. Historically there has been a range of solutions for regulating monopoly, according to the relative roles that markets and politics play in determining infrastructure prices and service quality: from private contracts to public enterprises, with concession contracts and discretionary regulation as intermediate strategies (Gómez-Ibáñez, 2003, pp. 2–13).

Table 2. Cities with gas in Spain, Catalonia and the rest of Spain in 1861, according to population size.

Population size	Spain		Catalonia		Rest of Spain	
	Number	%	Number	%	Number	%
5000–9999	2	8	2	16.7	0	0
10,000–19,999	9	36	8	66.7	1	7.7
20,000–49,999	8	32	1	8.3	7	53.8
50,000–99,000	3	12	0	0	3	23.1
100,000–199,999	1	4	0	0	1	7.7
200,000–500,000	2	8	1	8.3	1	7.7
Total	25	100	12	100	13	100

Source: Sudrià, 'Notas sobre la implantación', 106; Fàbregas, 'La estrategia', 30–31; Reher, 'Ciudades'. Own elaboration.

Until the mid-1850s, the municipalities in Spain, under the supervision of the central government, granted the concession of street lighting via a public auction, in a monopoly regime. The concessions used to be granted for quite a few years as an example of long-term contract to protect against opportunism before making the relationship-specific investments (Gómez-Ibáñez, 2003, p. 10).

After that, the science progress clause was introduced, which allowed the concession to be cancelled if the company did not introduce improvements to enable price reduction and a better service. In 1860, the Government ordered the 'verification and mark' of gas meters which were installed and repaired. The mark guaranteed that the meter was a model recognised by the Government. Those in charge of the task (the verifiers), would be of Royal appointment, at the proposal of the provincial governor. From the 1860s onwards, they were also more concerned about the quality of supply (Fernández-Paradas, 2016, pp. 50–56).

As regards the second stage, between 1864 and the beginning of the twentieth century, there were relevant changes: (i) the strengthening of the French presence, the reappearance of British capital, the introduction of Belgian capital and the withdrawal of Swiss capital; (ii) the business concentration; (iii) the advances of gas thanks to the greater involvement of local capital; (iv) legislative changes aiming at a stronger control of gas activity; (v) an initial confrontation with electricity which was positive for gas companies; (vi) changes in gas production technology.

It is difficult to analyse the financial strategies of the gas companies due to the scarcity of business documentation preserved. In general, especially in the case of French companies (due to their easy access to the powerful Parisian stock market),³ a preference for financing investments through the issuance of bonds is seen. This meant payment commitments could be extended and the investment effort transferred outside the shareholding body. This strategy was not excessively burdensome during the second half of the nineteenth century because the positive business results, in a context of lack of competition, allowed them to tackle their financial commitments. The problems arose at the end of the century, due to the reduction of profits due to the competition of electricity and, in the case of foreign companies, due to the depreciation of the peseta.

During the last third of the nineteenth century, the factories used mostly French technology, specifically the Parsy furnaces and, above all, Lachomette. The Parsy furnace turned the home into a gasogen. The Lachomette furnace consisted of a gasogen and a gas recuperator and had the advantage that it was easy to clean and maintain (Alayo & Barca, 2017, pp. 146–147, 155). Likewise, some factories developed coal-free gas production systems. In addition to Humbert gas (used in Vic in 1872), two systems were implemented in some factories in Catalonia: Arbós gas and rich gas. The first, devised by Jaume Arbós, consisted of a gasogen without retorts that used carbonaceous substances of vegetable origin. Rich gas was produced by the decomposition of liquid hydrocarbons (Barca & Alayo, 2017, pp. 35–36). On the other hand, in 1881, Compañía Madrileña installed Siemens burners with greater power and the following year, along with other European gas installers, it created a laboratory of technological innovation.⁴

As in the previous stage, the supremacy of private enterprise continued to be overwhelming. Local capital accounted for 69% of the country as a whole, 92% in Catalonia, and 53% in the rest of the state (Fàbregas, 2017, p. 33). French capital increased its influence, mainly due to the return of *Lebon & Cie*⁵ and the purchase of the assets of the *Compañía General de Crédito* by *Crédito Mobiliario Español*.

The Compañía General del Crédito went bankrupt in 1864 because it took on excessive risks in the railway sector and because of the 1866 European stock market crisis. In 1865, its factories were transferred to the Dutch company of the *Stockmam Group*, and from there to the *Compañía Madrileña de Alumbrado y Calefacción por Gas* in 1880 (Arroyo, 2002).

British capital returned to Spain with a strategic priority towards medium and small municipalities. *The Huelva Gas Company* was founded in Glasgow in 1878 to handle the supply in Huelva. In addition, in 1886 the *Anglo-Spanish Gas Company Limited* was founded in London, which later obtained the contract of Denia (Alicante) and Xátiva (Valencia). In 1882, the Belgian company *Robert Lesage et Cie.* was established in Sanlúcar de Barrameda. These companies were representative of the model of the *free-standing companies*, very common in Great Britain during the Golden Age of international investment (Martínez, 2017b).

At the beginning of the twentieth century, we noticed a tendency towards business concentration. Three large groups had been set up in Spain: *Lebon & Cie*, the *Compañía Madrileña* and *La Catalana*. The French groups controlled 18 factories. From 1871, *La Catalana* also owned the factory in Seville (Arroyo, 2006).

Another outstanding novelty was the municipalisation of gas in Bilbao (1885) and San Sebastian (1889) (Fernandez, 2014). In Spain, at the beginning of the twentieth century, this type of firm represented a mere 3.8% of gas companies, a percentage that was similar to that of France, Italy or the United States (Matés, 2017, p. 70).

The development of gas activity changed sharply from 25 factories in 1861 to 81 in 1901. Most of this growth occurred until 1890, when electricity had barely begun to compete. Most of the new factories were initiatives of local capital. In 1901, almost all regions used gas, except Aragon, Extremadura, La Rioja and the Canary Islands. Catalonia continued with its concentration of the factories, almost 40% (Fernández-Paradas & Sudrià, 2018, pp. 132–133),⁶ followed by Andalusia (6.8%). In three regions, there was only local capital: the Balearic Islands, the Basque Country and Asturias. Virtually the same happened in Catalonia, with the exception of *Lebon & Cie*, which was present in Barcelona.

Competition among gas companies was almost non-existent, because there was still one per municipality, and the most significant exceptions to this pattern were Barcelona and Cadiz (Fàbregas, 2017, p. 37). Gas companies dealt with the competition from electricity firms by deploying the following strategies: firstly, the sector's specialised press attempted to discredit electricity, secondly, the firms initiated legal discussions with the municipalities on whether the contracts gave them the monopoly, thirdly, they began price wars which occasionally succeeded in ruining the electric companies and later they were able to purchase them, fourthly, gas companies sold electricity, a strategy for which *Lebon et Cie* decidedly opted,⁷ and fifthly, they adopted technological innovations that enabled them to be competitive until the early twentieth century.⁸

All this, combined with the deficiencies in the electrical technology, allowed them to outstrip the first endeavour of electricity. But these strategies still meant that large companies like *Compañía Madrileña* and *Lebon & Cie* received little benefit. The *Compañía Madrileña* reduced costs from the end of the nineteenth century until 1913, although this did not allow it to completely compensate for the impact of the fall in revenues caused by the decrease in electricity rates and the increase in the city councils' debts. Thanks to the agreements signed with power companies in Madrid from 1903 to 1909, economic profitability improved progressively between 1905 and 1910. From that year onwards, it declined due to the worsening of electrical competition and the impact of World War I.⁹

However, small factories, mostly located in Catalonia, required relatively reduced investment and expenses as compared to the sales of gas. This partly explains the greater implementation of this business format in this region (Sudrià & Aubanel, 2017, pp. 17–18).

Another factor that conditioned the performance of the gas firms was the regulatory framework. The Municipal Act of 1877 prohibited the city councils from granting the monopoly of the public lighting service, which favoured electricity companies. Accordingly, the municipalities saw their position strengthen in negotiations with the gas companies, when the possibility of competition arose which led to increasing conflict between these and the city councils (Fernández-Paradas, 2016, pp. 59–60).

In the third stage, from the beginning of the century until the late 1910s, the gas activity suffered a severe crisis. In 1901, 70 municipalities received gas, in 1919 there were 33.¹⁰ The causes of this weakening were the competition of hydroelectricity, the impact of World War I and the fact that foreign gas companies were starting to leave.¹¹

Competition from electricity and the weak demand caused the exit of *The Anglo Spanish* from Spain (Denia and Xàtiva). On the eve of World War I, in Galicia, the French company that managed the gas business in Vigo and A Coruña, handed over its assets to electricity companies that were joined by the *Sociedad General Gallega de Electricidad*, which was controlled by Galician banks. Since then, all the gas activity in the region has been in the hands of local capitals (Martínez, 2017a; Martínez, Mirás, & Lindoso, 2009, p. 134).

During World War I, the activity of gas companies was very negatively affected, since they reduced their revenues due to higher labour costs and raw materials, especially coal which was very scarce. This triggered an extraordinary rise in the price of gas. The quality of the service suffered a loss because of the lack of coal and having to resort to domestic coal, which was less adequate than the British, and even to other fuels. The general backdrop was the suspension of supply and/or closure of gas factories,¹² some of which were not reopened at the end of the war, including in 1919 *Robert Lesage et Cie* (Sanlúcar de Barrameda) and *The Huelva Gas and Electricity* (Bartolomé & Girón, 2018, p. 81; Martínez, 2017a). Faced with the problem of coal supply, the alternative that arose in countries of southern Europe was white coal. As Madureira points out, 'the diffusion of electricity represented an opportunity to counterbalance the dependence on imported coal and the high distribution costs to inland regions and to reduce the scope of action of foreign enterprises' (Madureira, 2014, p. 166).

On the other hand, during this period, there were significant developments in the regulatory framework. The Government hindered gas companies from cutting off supplies and allowed users to have meters in their property and created the industrial inspection system in charge of monitoring the gasometers (Fernández-Paradas, 2016, pp. 61, 65; 2017).

The stage between the early 1920s and the mid-1930s was characterised by the recovery of gas production,¹³ the leading role of Spanish capital, business concentration, and a stronger Government intervention in the regulation of the sector.

The outflow of foreign capital contributed to the business concentration. At the end of World War I, the presence of foreign capital was significant, with four French companies, one British, one German and one Belgian. *Lebon et Cie* stood out among the French. These companies left Spain mainly for the following reasons. Firstly, the Government passed legislation that restrained them. For example, only the companies that were considered Spanish could be concessionaires of a waterfall to produce hydroelectricity. And from 1924, the Government declared gas supply was a public service and municipalisation was allowed and companies could not raise tariffs without administrative authorisation.¹⁴

Secondly, at the beginning of the 1920s, the expiry date of most of the lighting concessions of the foreign gas companies (which could not compete with the large Spanish electricity companies), was coming to an end. And thirdly, the small volume of business of foreign gas companies. The exit of Lebon et Cie was due to the adverse nationalist 'climate', the negative consequences of World War I and the fact that there were greater prospects of growth in France and North Africa (Castro-Valdivia, Fernández-Paradas, & Matés-Barco, 2019).

For these reasons, between 1921 and 1927, several companies left Spain: *Lebon & Cie* (1921–1923), *Compañía Madrileña de Alumbrado y Calefacción por Gas* (1921),¹⁵ *Société Civile pour l'Éclairage de Málaga* (1923) and *Société pour l'Éclairage de Saragosse* (1927). From 1927 until 1935, only the company that managed the supply in Santa Cruz de Tenerife remained in Spain (Fernández-Paradas & Larrinaga, 2016).

The Catalan banking firm *Arnús-Garí*, which already controlled *Catalana de Gas y Electricidad*, led the business concentration. It took over the *Société Civile pour l'Éclairage de Málaga* (1923) and bought most of *Lebon & Cie's* assets, for which it created the *Compañía Española de Electricidad y Gas Lebon* (Martínez, Mirás & Lindoso, 2009, pp. 299, 304).

By the mid-1930s, *Catalana de Gas y Electricidad* accounted for 40.1% of total gas production, the *Compañía Española de Electricidad y Gas Lebon* 24.5% and *Gas Madrid* 17.4%, that is, they amounted to 82% (Fernández-Paradas, 2009, pp. 121–122). The Herfindahl-Hirschman Index went from 1,709 in 1901 to 2,456 in 1934.¹⁶

In 1935, there were 20 public limited companies which supplied gas lighting, of which 45% sold public lighting. The sum of capital paid and the obligations (basic resources) reached 941 million pesetas (an average of 47 million per company). Small sized companies (under 5 million pesetas) predominated (60%) (*Anuario Financiero y de Sociedades Anónimas de España*, 1935).

Between 1919 and 1935 the main factories were modernised. *Lebon & Cie* continued renewal with Lachomette furnaces. Its successor, *Compañía Española de Electricidad y Gas Lebon*, installed British Woodall-Duckham furnaces in its factory in Valencia between 1930 and 1934. In 1905, the *Sociedad Catalana para el Alumbrado por Gas* installed Bueb vertical retorts from the German company Didier. In 1935, *Catalana de Gas y Electricidad* installed furnaces with vertical chambers with continuous distillation from the German company Otto. *Gas Madrid* purchased Didier furnaces in 1926. And in some small Catalan factories, the recuperative furnace of the Yvern type was installed (Alayo & Barca, 2017, p. 149; Barca & Alayo, 2017, pp. 41–43; Fernández-Paradas & Larrinaga, 2016).

As for the distribution of production, in 1935, 66.1% was for domestic consumption, 13% for lighting, 2% industrial and the remainder for personal consumption and losses. Therefore, the progression of gas in households was very positive. On the contrary, industrial consumption was too small.¹⁷ The short extension of the gas transport and distribution networks, with only 2,314 km, was also an obstacle.¹⁸ The result was a very low level of production and, consequently, of consumption, about 7 m³ per capita, which placed Spain, a long way from the 12 m³ of Italy, 45 m³ of Germany and 196 m³ of Britain. Catalonia, with 28 m³, quadrupled the Spanish average and surpassed the Italian average (Sudrià & Aubanell, 2017).

2. The weakening of manufactured gas and the new fuels, 1936–1975

During the dictatorship, two sub-stages in the gas industry can be distinguished.

The first, 1936–1958, was characterised by the progressive decline of manufactured gas. The second, 1958–1975, was marked by the emergence of a new competitor, liquefied petro-leum gases (LPG). This product is the link that connects with the great innovation of this period, natural gas, which arrived in Spain in 1969, although its success was delayed until at least the 1980s.

The Civil War (1936–1939) caused serious difficulties to the gas industry. Several problems were affecting the sector. The lack of work, the deterioration of facilities (which was linked to the lack of maintenance of equipment and technology and constrained investments) and, above all, the scarcity of raw materials were factors that affected supply (Vidal, 1949).

Before the war, the input that was mostly used in the factories was coal. However, production and transportation bottlenecks forced companies to use alternative fuels. Lignites, firewood, pomaces and other substances were almost the only raw materials in some factories for the processing of the gas, with consequent deterioration of volume (due to its lower yields) and the quality of gas supply.¹⁹ These were scarce and inefficient, and the increasing demand as well as market anomalies raised their price and, consequently, the business costs, and even led to more and more frequent supply stoppages. The importation of foreign coal, with few exceptions, was not a viable option, but during the war domestic coal was not widely distributed since it was reserved for war purposes.

By the end of the war, the situation had not noticeably improved. Production costs had risen substantially. On the one hand, the autarkic economic policy of the Franco regime virtually blocked the importation of foreign coal and the authorities even confiscated a large share of the coal, diverting it to other major strategic functions. At the same time, in the domestic market, a system of distribution quotas was implemented, which were clearly insufficient for the gas industry (Vidal, 1949, p. 46), which, in addition, caused them to become more expensive. Added to this were increases in labour costs due to a compensatory wage policy that tried to stop the high inflation, which, in turn, had a negative impact on fuel prices. Finally, the Government exercised fierce control over gas tariffs (which was usual in an intervened economy such as in Spain), with the corollary of a dramatic deterioration in companies' balance sheets.²⁰ Although these were updated in the late 1940s and early 1950s, the rise of other costs (mainly labour costs) eroded the income statements. As a whole, this behaviour belongs within the conceptual framework of nationalism in the energy (and economic) policy which has been appreciated since the early twentieth century in southern Europe and which intensified in times of policies of autonomous growth in Spain but also in Portugal or Italy (Madureira, 2008, p. 2).

The changes in the structure of the sector that were foreseen in the 1930s because of the increasing competition of electricity were consolidated during the post-war period. The competition from electricity had been causing serious difficulties in the countries of the south (Italy, Portugal) since the European war, due to the afore-mentioned problems of the availability of coal (Cardoso de Matos, 2017, p. 84; Giuntini, 2009, pp. 47–49).

Gas (as well as by-products) production during the first post-war decade increased, albeit at the expense of its quality. However, it exhibited irregular behaviour (Table 3). As regards demand, domestic consumption continued to maintain its dominant position, while public lighting continued its downward trend as a result of the consolidation of competition by electric lighting (Figure 1).²¹ The most significant transformation was the growth of industrial consumption.

Table 3. Gas production in Spain (1930–1950), thousands of m³ and index numbers (1930 = 100).

Year	Gas production	Year	Gas production
1930	152,083 (100)	1941	118,742 (78)
1931	163,257 (107)	1942	157,227 (103)
1932	173,927 (114)	1943	179,590 (118)
1933	179,219 (118)	1944	198,200 (130)
1934	183,490 (121)	1945	189,322 (124)
1935	189,046 (124)	1946	200,751 (132)
1936	177,482 (117)	1947	214,313 (141)
1937	135,381 (89)	1948	233,397 (153)
1938	142,183 (93)	1949	255,391 (168)
1939	168,196 (111)	1950	267,400 (176)
1940	205,927 (135)		

Source: Datos estadísticos técnicos de las fábricas de gas españolas 1930–1950. Madrid: Sindicato Vertical de Agua, Gas y Electricidad, 1951, 26–27.

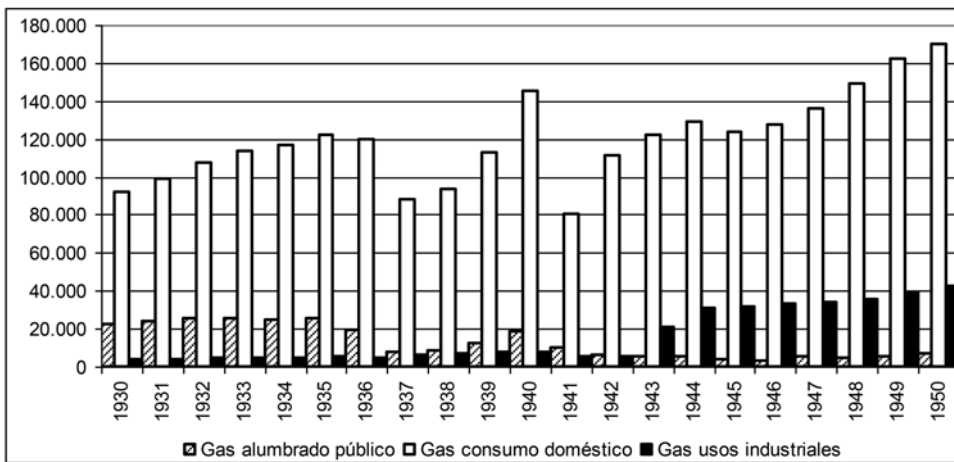


Figure 1. Gas consumption in Spain by categories (1930–1950), thousands of m³. Source: Datos estadísticos técnicos de las fábricas de gas españolas 1930–1950, 26–27.

With these parameters, the number of gas plants in the country underwent a progressive contraction. Between 1940 and 1960, only four new factories were inaugurated, all in Catalonia (Table 4) (Alayo & Barca, 2017).²² In 1947, there were 52 factories (of which 6 were still under construction), although only 40 were in operation. All of them were operated by private companies, except for the two municipal ones in Bilbao and San Sebastián. Nevertheless, by 1971, the figure had fallen to 30 factories in operation, supplying gas to 50 towns (half in Catalonia). By then, three large companies controlled the Spanish gas market. The largest was *Catalana de Gas y Electricidad S.A.*, with almost half of the national clients, followed by *Gas Madrid S.A.* and the *Compañía Española de Gas S.A.* (CEGAS), totalling 85% of the manufactured gas (Fàbregas, 2003, p. 166).²³ Therefore, the level of concentration of the sector was high, as the Herfindahl-Hirschman Index shows values of 2,778 for 1943 and 3,155 for 1960.²⁴

Given the challenge and seeking to guarantee a minimum survival, the gas companies responded by adopting several strategies. The most immediate recourse was to attempt to improve business results through rate increases, or through a reduction in costs by reducing the workforce. The second way was the diversification of gas uses, promoting domestic consumption (cooking, heating, etc.), albeit with some comparative delay.²⁵

Table 4. Gas factories built in Spain by periods (1842–1960).

1842–1850	6	1901–1910	4
1851–1860	18	1911–1920	2
1861–1870	20	1921–1930	0
1871–1880	9	1931–1940	0
1881–1890	23	1941–1950	0
1891–1900	11	1951–1960	4

Source: Alayo and Barca, 'Las técnicas de fabricación'.

The third way was vertical integration, although this was only within the reach of *Catalana de Gas*, *Gas Madrid* or *CEGAS*, which incorporated coal production activities through the acquisition of mining companies.²⁶

Fourthly, in the 1940s, several factories tried, as far as possible, to remodel their facilities (still within the traditional technical parameters) and distribution networks.²⁷

The fifth solution was the formation of alliances with electricity companies. This line of action was compatible with a strategy of growth and diversification that, however, was only within the reach of a few companies. This is where the main difference in the strategy of Spanish companies can be seen. Most focused on the local framework, at the level of supply, market, access to capital, etc. In fact, in the majority, the capital was of local scope, which entailed a weak capacity for expansion. In most regional markets the situation was one of oligopoly or monopoly. After the war, business concentration (which had previously been initiated) continued. In some cases, the process was led by the local banks, such as in Galicia, where the main regional bank controlled the two dominant companies, which meant financing for the concentration processes, which made it possible to increase their assets and equity. The problem was that investments were concentrated (as in the rest of the country) in the electricity segment, since the gas business suffered significant losses and was increasingly precarious.²⁸ This also explains the absorption of several gas companies by electricity companies, whose attractiveness lay almost exclusively in the fact that they had public lighting concessions, in addition to domestic consumption.

Conversely, the largest companies operated within a strategy of greater scope that, although initially could be regional, was later focused towards the national market. Thus, in Catalonia, the first step was the closure of small factories, which were then supplied from the Barcelona factories by gas pipelines built *ad hoc*.²⁹

To carry out the process, the critical variable was the companies' financial situation. Some tried to expand their social capital, to tackle greater dimensioning. But companies that were not part of any of the three large gas groups found it much harder. Thus, *CEGAS* expanded by absorbing other companies, including some subsidiaries.³⁰ However, it was *Catalana de Gas y Electricidad* which took command over the process, first in Catalonia and later in Spain, thanks to the fact that its economic resources and access to financing were more solid than those of the other competitors, even more focused on a classic resource in Spanish gas companies, the issue of bonds.³¹ Both expanded their social capital from the 1940s, until the first was absorbed by *La Catalana* in 1965. But the latter had an additional vital resource, its close link with the main Spanish industrial bank, *Banco Urquijo*. On the contrary, the Madrid company used bank credit with less profusion, resorting to its equity to deal with its operations, which limited its scope for action.³²

Finally, in all those cases whereby the above-mentioned changes could not be made in depth, the only viable alternative was to close the factories, hence the progressive decrease mentioned above.

However, in order to deal with this decadent panorama, the companies decided to undertake an important programme of expansion and modernisation of existing facilities. The era of gas manufactured from coal was ending (Bartolomé, Fernández-Paradas, & Martykánová, 2017, p. 103), so that the strategy had to go through an in-depth transformation of techniques and facilities. The factories were old and outdated, producing a gas of low calorific value. The objective was to improve the supply of city gas to quickly achieve the standards of European industry, both in quality and volume, as in those years, gas production in Europe was at a stage of extreme growth.

The main innovation was the introduction of gasification techniques using naphtha (a light gasoline), by catalytic or thermal cracking, at high or medium pressure, which was probably the most important change in gas production since the nineteenth century (Moyano, 2014, p. 13). The pioneer company was *Catalana de Gas y Electricidad*, which in 1956 set up its first catalytic cracking facility of fuel-oil ONIA-GEGI at its Barcelona plant, with a capacity of 37,500 m³/day of gas of 4,200 Kcal./m³ (Martos, 1972, p. 41).

Actually, *Catalana's* project was more ambitious, deploying a leadership strategy of the national gas sector from the mid-1950s that would allow it to become (in the long term) the business giant it is today, as *Gas Natural Fenosa*. The ultimate goal was to replace the different gas production methods that had been used until then with natural gas from North Africa. Thus, in 1961, coinciding with the arrival of a key figure in the history of the firm, Pere Duran i Farell, *Catalana* acquired the company CEGAS, laying down the foundations of the future, which would have to focus more on gas transportation and commercialisation rather than manufacturing (Fàbregas, 2014, pp. 189–194). Until the distribution infrastructure was completed, a transition stage (based on the use of naphtha as the raw material) was essential.

The next step was the shareholding control of several gas companies, first in Catalonia and, from 1965, in other areas of the country, mainly the *Compañía Española de Electricidad y Gas Lebon*. In that year, it signed a supply contract of natural gas with the American oil company ESSO, *Gas Natural S.A.* was founded, and the first liquefied natural gas regasification plant of Spain was built in the port of Barcelona, which came into operation in 1969 (Fernández-Paradas, 2014, p. 21; Romani, 1982, pp. 92–94; Sudrià, 1984, p. 93).

Shortly before the Barcelona company undertook the aforementioned reforms, a new competitor had settled in the Spanish gas market, completely altering its structure: butane-propane, a fuel derived from petroleum (LPG) which was packed in gas cylinders. Its antecedents are twofold and date back to 1947, when the Government reorganised the national oil monopoly which was managed by the company *CAMPSA* (1927), and to 1949, when it decided to intervene in oil refining. This was achieved by creating a mixed-owned public company, the *Refinería de Petróleos de Escombreras S.A. (REPESA)*, holder of the first modern refinery in the peninsula (1950), in Escombreras (Murcia). Butane was a waste gas produced at the refinery, whose manufacturing was monopolised by the firm *Butano S.A.*, which was set up in 1957 at 50% by *CAMPSA* and *REPESA* and started production in 1958 (Fàbregas, 2003, pp. 155–157).

Butane's success was immediate and overwhelmingly entrenched, particularly in the domestic market. The first impact it caused was the closure of many manufactured gas factories, some of which became its distributors but it also contributed to delay the diffusion of natural gas as compared to Europe (Martínez, Mirás & Lindoso, 2009, pp. 343–344). It spread throughout the territory, even to settlements that did not have gas, allowing the definitive transformation of the national energy model.

On the contrary, the history of natural gas in our country would be more tortuous. In Europe, it began in the 1950s, although the 1960s witnessed remarkable advances in production and consumption, which accelerated thanks to the construction of an extensive distribution network throughout the continent from the 1970s (Victor, Jaffe, & Hayes, 2006). However, in Spain it started with a certain delay due to several factors: (i) the lack of deposits; (ii) the lack of distribution infrastructures (which was aggravated by the considerable weight of manufactured gases); (iii) the solid position of butane-propane (which was sheltered by the oil monopoly and its lower comparative prices); (iv) the isolation that had caused the regime's economic policy which hindered the import of energy resources, etc. (Ballester, 2017, p. 21).

The inauguration of the natural gas supply in 1969 opened a new period. Yet, in addition to the modernisation initiative implemented by Gas Natural, the state began to play a stronger role in securing the distribution networks at national level, taking charge of the layout and characteristics of the basic network of gas pipelines. Besides, in 1972, the *Empresa Nacional del Gas (ENAGAS)* was founded, with an initial capital of 100% of the *Instituto Nacional de Industria* (a state-owned holding). In 1975, the former company acquired the aforementioned gas reception and gasification plant that belonged to Gas Natural, together with its contracts with Algeria and Libya. Operations started that same year, thus culminating the nationalisation of the importation and supply of natural gas (Enagás, 2012; García de la Fuente, 1996, pp. 154–156). By the late 1970s, only two companies operated in the sector, which distributed natural gas to 55 municipalities, Gas Natural y Gas Figueres S.A., although supply, regasification and transportation were controlled by ENAGAS (Fàbregas, 2012). The result of these processes was the peculiar Spanish energy structure, which was characterised by the strong dependence on oil and the low consumption rates of natural gas, as well as the reduced relative consumption of energy (Sudrià, 1984, pp. 79–81). In 1978, per capita energy consumption in Spain was 50% of Europe, the share of oil in primary energy demand was 68% in Spain (53% in Europe), while natural gas was only 3% in Spain (19% in Europe). As for the structure of demand, the domestic market absorbed a small percentage of energy demand (21% vs 40% in Europe) but industrial demand was higher than in Europe (44% compared to 32%) (Table 5). Finally, per capita gas consumption in 1979 (including manufactured gas, natural gas and LPG) in Spain was 16% of Europe, with packed in gas cylinders dominating (66%), while in Europe 93% was piped gas (Fàbregas, 1983, 2012).

3. From the oil crisis to the liberalisation of the gas market, 1976–2018

The oil crisis took its toll also on Spain in the form of a serious banking crisis that froze and made more expensive business financing in the long term. This particularly affected the energy sector, above all the electrical sector, which was heavily in debt and with high long-term financing needs, at a time when it was intended to expand the meagre infrastructure of natural gas in Spain (Sudrià, 2010, p. 54). This forced these businesses, including the gas companies, to seek syndicated loans in the European market. The survival strategy of the companies in the sector, such as *Catalana de Gas* as its main representative, consisted of concentrating on its central activity and the one which performed better (gas), getting rid of its electrical assets and other industrial shares.

Table 5. Structure of the energy market in Spain and the EEC (1978).

	Per capita consumption (Kec per capita)*			Per capita consumption (percentage)	
	EEC	Spain	% Spain/EEC	EEC	Spain
Domestic	1453	424	29.2	40	21
Industrial	1178	874	74.2	32	44
Transportation	763	547	71.7	21	28
Raw material	233	133	57.1	7	7
TOTAL	3628	1,979	54.5	100	100

Source: Fàbregas, 'Un ensayo'. * Kec (kilograms equivalent of coal).

On the other hand, this company, in which there were no very big shareholders, proceeded in the mid-1980s to a greater professionalisation of its management, replacing most of the independent directors by man-agers. It sought to better connect the company to the society (stakeholders) through the presidency (Pere Durán) of the General Shareholders' Meetings and its Advisory Committee (Fàbregas, 2014, pp. 220–252). In anticipation of a strong expansion of the natural gas market in Spain, ENAGAS renegotiated the supply contract with Algeria in the late 1970s, quadru-pling the amounts and tripling the price due to the inflationary context. This contract was negative in the medium term for the Spanish interests because the aforementioned expec-tations were not reached (Fernández-Paradas & Sudrià, 2018, pp. 145–146) and it forced them to renegotiate conditions, finally reaching an agreement in 1985 by which time the committed amounts were reduced to a third, adapting the later growth to the building of gas pipelines, in return for a compensation fee and a rise in prices (Ballestero, 2017, pp. 109–122; Fàbregas, 2014, pp. 239–241; Sudrià, 2010, p. 59). Once the conundrum of the natural gas supply was cleared, that same year the Protocol of Intentions for the development of gas in Spain was signed between the Government and the companies of the sector, and in 1987 the Gas Law was approved, establishing the new legal framework of the sector (Ballestero, 2017, pp. 122–132, Fàbregas, 2014, pp. 243–246, Sudrià, 2010, p. 59). The new regulation and the overcoming of the economic crisis propitiated a strong growth of natural gas in Spain.³³ This was helped by the start-up in 1996 of the Algeria-Spain gas pipeline.³⁴

On the other hand, Spain entered the EEC in 1986. This stimulated the government to initiate a first liberalisation of the energy market,³⁵ eliminating the oil monopoly of CAMPSA, which led to the creation of new companies, such as Repsol in 1987,³⁶ and facilitating third-party access to gas networks. In the future, Spain would be forced to open its energy markets, traditionally regarded as strategic, to the competition of European companies. To prepare for this, the Spanish companies undertook a process of reorganisation (distribution) of the sector,³⁷ and of business concentration, both internal and sectoral.³⁸ The process of business concentration led to the creation in 1991 of *Gas Natural SDG*, a giant of the sector, from the merger through absorption of *Gas Madrid* by *Catalana de Gas*.³⁹ This process of corporate concentration coincided with the third phase in the cycle of regulatory policies, which was preceded by a phase of liberalisation that was initiated by technological change in the late 1960s (Bel & Costas, 2010).

From 1992, the *Gas Natural SDG* group began to internationalise, especially in the Latin American market, taking advantage of the wave of privatisations of the moment and the traditional historical ties between Spain and the subcontinent.⁴⁰ Also in Spain a privatisation process began of the powerful industrial public sector that had been created during the Franco regime around the *Instituto Nacional de Industria* (INI). Along these lines, in 1994,

ENAGAS was privatised, with *Gas Natural SDG* acquiring 91% of its capital.⁴¹ As a result of the internationalisation of the activities and the liberalisation process, *Gas Natural SDG* was progressively entering new sectors of activity such as transport and trading, joint gas and electricity sales, combined cycles and renewable energies. In 1998, it became the second European gas company by market capitalisation and the fourth non-financial Spanish company (Fàbregas, 2014, pp. 287–290; Gas Natural SDG, 1998, p. 15).

The decade of 1995–2005 was characterised by a notable development of the Spanish gas sector, which changed from 7.7% of primary energy to 19.9%. However, it remained a long way from the European average (EU-15), which rose from 20.1% to 24.0% (Sedigas, 2000, pp. 19, 28; 2005, pp. 27, 40).⁴²

The 1990s were marked by European policies towards the single energy market and the liberalisation of activities in gas and electricity, based on the assumption that the degree of market power varies among the different stages of an infrastructure service (Gómez-Ibáñez, 2003, p. 8). The Hydrocarbons Law of 1998 initiated the liberalisation of the gas sector, decreeing the separation of transport, distribution and commercialisation activities (Ballesteros, 2017, pp. 191–199; Del Guayo and Ariño, 2004). The new law suppressed the consideration of public service of the gas sector and the regime of administrative concessions. It also created the Gestor Técnico del Sistema (System Technical Manager) to ensure the operation of the basic network and the secondary transport networks. Liberalisation of the gas industry was done very quickly.⁴³ The process had been completed in 2009, although the last resort tariff remained for small domestic customers who had not wanted to join the change. Liberalisation provided a strong boost to the sector, which in five years almost doubled investments, the network and the demand (Sedigas, 2006, pp. 115, 122, 126.).

However, privatisation and liberalisation have in many cases not produced the long-awaited competitiveness and efficiency.⁴⁴ The concentration of the sector has maintained a strong market power in the hands of the giant of the sector, *Gas Natural Fenosa*.⁴⁵ The high concentration of natural gas supply has made it difficult for new operators to enter,⁴⁶ in particular into the regulated market, which was worsened by the strong concentration also in the distribution sector. In conclusion, the liberalisation of the sector has not altered and has even reinforced, in the beginning, the traditional concentration of this sector,⁴⁷ results that have not been very different from those obtained in other European countries.⁴⁸ On the other hand, in terms of efficiency (expressed in consumer prices), the prices of natural gas in Spain, both for the industrial sector and, above all, for the domestic sector, were among the highest in Europe in 2005 (Jiménez, 2010, p. 85).

The liberalisation of energy markets forced the separation of transport and distribution in each subsector (gas, electricity) but did not prevent gas companies from entering the electricity market and vice versa. The approach of gas and electricity was favoured by its symbiotic nature, especially with the emergence of combined cycles (Ballesteros, 2017, pp. 229–240.), as well as by the strong presence of banking in both subsectors (De Guayo and Ariño, 2004, p. 142).

Within a short time, corporate operations began to take place in Europe, such as the merger of German electric utilities VEBA and VIAG in 2000, giving rise to EON which in turn absorbed the large German gas company Ruhrgas in 2003. The Belgian *Distrigaz* was acquired by *Suez*, while *Suez* and *Gaz de France* merged (Fàbregas, 2014, p. 296).

In Spain, corporate movements began in 1999 but for several years they did not thrive due to the opposition of the Government, the harshness of their demands and the political constraints (Del Guayo Castiella, Milla, & Hancher, 2006; Jiménez, 2010, p. 81). Finally, in 2007 the Italian public electric company ENEL acquired ENDESA. In turn, *Gas Natural SDG* absorbed *Unión Fenosa* in 2009. With this operation a new company emerged, which brought together the leader of natural gas in Spain and the fourth largest world LNG operator, with the third Spanish electricity company that also had gas activities. The change was very significant, increasing from activities in nine countries to 22, from 11.5 million customers to 20 million and 17 GW of installed electrical power, multiplying the previous 4 GW. The acquisition significantly increased debt being its progressive reduction one of the main objectives during the following years. *Unión Fenosa* provided expertise in hydraulic, coal and nuclear technology, as well as electrical transportation and distribution and a broad international presence. The merger reinforced the internationalisation of the group, especially in Latin America and the European Union (Gas Natural SDG, 2010; Fàbregas, 2014, pp. 304–306). In recent years, the company has sought to secure and diversify the supply of natural gas, signing off contracts with the state-owned Algerian company *Sonatrach* (with mutual entry in the shareholder) and US, Azerbaijan and Russia operators (Gas Natural SDG, 2010–2017; Fàbregas, 2014, pp. 327–335). In 2017 *Forbes* ranked *Gas Natural Fenosa* as the world's biggest gas company.⁴⁹

The liberalisation of the sector and the objective of creating a European energy market favoured the entry of foreign companies, with strong public participation, in the Spanish gas sector.⁵⁰ The European Commission has identified three sets of problems for the construction of a European gas market: the access to the transport network, prices and tariffs and interoperability between national systems (Maestro, García & Virgala, 2011, pp. 134–137). In the case of Spain, the formal legal separation between transport and distribution has not impeded the existence of common interests, with the consequent difficulty of access to the network for smaller operators, which has been reinforced by the lack of real autonomy of the national regulator, the *Comisión Nacional de Energía*. Secondly, the lack of transparency in the retail market has led to reduced mobility in domestic consumers. Finally, cross-border connections remain weak due to inadequate network investments which are often used as a means of reducing competition.

Conclusions

In Spain, the gas industry progressed slowly between 1842 and 1861, with foreign capital playing a key role. Between 1862 and the beginning of the twentieth century it progressed, driven by the Spanish capital, and managed to successfully face the first challenge of electricity. From the beginning of the century until 1918, it suffered a deep crisis as a result of its inability to compete with large-scale hydropower and the negative impact of World War I. Between 1919 and 1935, it recovered, with increased clientele and consumption in homes. Likewise, the gas sector became more concentrated and foreign companies withdrew. However, its development was limited by very small transport and distribution networks.

During the Civil War and the immediate post-war period, the sector faced serious inconveniences. The number of companies underwent a slow but gradual reduction as a result of difficulties in the supply of raw materials and higher costs of production. Until 1958, the parameters of the sector were similar to those of pre-war, even in terms of the strategies followed to face the competition of electricity. Since then, the sector entered a path of

technological modernisation, through a double strategy. The first was personified in the upsurge of liquefied petroleum gases, concretely butane-propane, through state monopoly. The second was headed by *Catalana de Gas* (through the adoption of cracking methods) as an intermediate step of the great innovation of the period, natural gas, whose penetration would nevertheless still slow down until the 1990s.

The oil crisis prompted the take-off of natural gas in Spain, which was very underdeveloped. However, it also hampered the necessary investments due to the increase in business financing. Gas companies opted to divest their assets in other sectors and professionalise their management.

The entry of Spain into the EEC in 1986 forced it to liberalise the gas market, with the separation of transport, distribution and marketing. Paradoxically this reinforced, in the beginning, the concentration of business in the sector around *Gas Natural Fenosa* in order to deal with foreign competitors and the difficulties in practice for the entry of new operators.

Notes

1. *Local governments did not have sufficient income to face their costs. This problem worsened as a result of the conversion of town property to private, especially after the General Disentailment Law of 1855. This loss of heritage meant lower income from rent. It also meant that the local elite successfully resisted paying more local taxes and the subordination of local tax offices to a central tax office (Del Moral, 1984).*
2. Archivo Municipal de Cádiz, boxes 2597 and 2602.
3. Compagnie Madrilène du Gaz, Rapports.
4. *Revista Minera* 8/7/1887: 49.
5. In those years, it supplied gas to 10 municipalities (Fernández-Paradas, 2015, pp. 69–70).
6. The greater development of the gas activity in Catalonia was due to various factors: (i) the greater dynamism of its economy, especially of the province of Barcelona (the country's main industrial area), founded in a powerful fabric of local capital; (ii) higher rent levels than those of Spain; (iii) more profitability of small factories of Catalan gas, based on higher consumption (Fernández-Paradas & Sudrià, 2018, pp. 132–133).
7. *Revista Minera, Metalúrgica y de Ingeniería*, 8/2/1887, 1/2/1890 and 16/10/1896. In the countries of southern Europe, public authorities were not very involved in the installation of electricity. Conversely, local governments of northern Europe participated directly, either through direct investments or through companies with public and private capital (Madureira, 2008).
8. *Journal des Usines à Gaz*, 5-12-1926.
9. Compagnie Madrilène du Gaz, Rapports 1890–1917.
10. Dirección General de Rentas Públicas. Estadística del Impuesto sobre el consumo de luz, 1901 and 1919.
11. With the exception of the gas factory that was established in 1906 in Santa Cruz de Tenerife by the German Carl Francke. Since 1931, it has been controlled by American capital (Rodríguez, 2010, pp. 23, 47).
12. At the start of 1918, Madrid's gas factory had to interrupt the supply of public gas lighting due to the scarcity of coal (Ayuntamiento de Madrid, 1918, p. 3). The scarcity of coal also affected *Catalana de Gas y Electricidad*. Archivo Histórico de la Fundación Gas Natural Fenosa, Actas de las Juntas Generales de Accionistas de Catalana de Gas y Electricidad, 30/3/1916. The same occurred in Portugal (Alves de Costa, 1996, pp. 62–63).
13. The number of localities with gas supply increased from 33 in 1919 to 50 in 1934. Dirección General de Rentas Públicas. Estadística del Impuesto sobre el consumo de luz, 1919 and 1934.
14. *Gaceta de Madrid*, 15/04/1924.
15. It was controlled by Gas Madrid, which was founded in 1921 by large hydroelectric companies. *Estatutos de la Sociedad Gas Madrid S.A 1921*.

16. Dirección General de Rentas Públicas. *Estadística del Impuesto sobre el consumo de luz*, 1901 and 1934, own elaboration. American Agencies generally classify markets into three types: Unconcentrated Markets (HHI below 1500), Moderately Concentrated Markets (HHI between 1500 and 2500), Highly Concentrated Markets (HHI above 2500). <https://www.justice.gov/atr/horizontal-merger-guidelines-08192010#5c> consulted on 11/2/2019.
17. *Datos estadísticos técnicos de las fábricas de gas españolas 1930-1943*. Madrid: Sindicato Vertical de Agua, Gas y Electricidad, 1947, 28.
18. Union International de l'Industrie du Gaz (1949). *Les Statistiques Européens de l'Industrie du Gaz*. Spain was different from other countries such as France, Belgium and Germany where the distribution networks and gas transport networks were denser. Moreover, in those countries the plants of coke oven gas and other furnaces generated most of the gas produced, which was not the case in Spain (Brion and Moreau, 2005, p. 211).
19. Most of the old factories had retort furnaces. But while total gas-to-tonne fuel yields were higher in the late 1940s than in 1935, the heat power of the gas produced had fallen from 4500 calories to less than 3500, partly because it was mixed with water gas. *Estudio técnico-estadístico sobre la industria española de gas*. Madrid: Sindicato Vertical de Agua, Gas y Electricidad, 9–10, 13.
20. Gas tariffs in Spain were approved by the Ministry of Industry. But the system of authorisation of tariff updates generated inflexibility because they were approved with substantial delays with respect to the price increases of the fuel (Arroyo, 2001).
21. As in Portugal, where public lighting diminished, increasing the importance of domestic uses (Cardoso de Matos, 2017, pp. 90–91). In Italy, conversely, the chronology is somewhat different due to the Second World War and to the relatively early start (1930s) of the use of natural gas (Giuntini, 2009, pp. 50–52).
22. On the contrary, between 1940 and 1954 at least 16 factories closed temporarily or partially (Fàbregas, 2003, p. 152).
23. Including the company Gas y Electricidad S.A., among the four represented 93% of the city gas market, which included manufactured gas and natural gas. In 1971, in addition to the 29 localities with a gas factory, from the facilities located in Barcelona, Madrid and Valencia, gas was supplied to the three capitals and to several localities in their respective metropolitan areas. CEGAS was a company which was founded in Madrid in 1923, initially as the *Compañía Española de Electricidad y Gas Lebon*, adopting the new name in 1965 (Martos, 1972, pp. 50, 52; Vidal, 1949, pp. 27–29).
24. *Datos estadísticos técnicos de las fábricas de gas españolas 1930–1943. Datos estadísticos técnicos de la industria del gas. Producción, distribución y consumo*, 1961, own elaboration.
25. The use of gas for other purposes, such as cooking, was quite late, remaining mainly restricted to high income households. It became more popular by the 1920s, when the oven thermostat was invented (Bijker, Hughes, & Pinch, 1993, pp. 257–259).
26. Compañía Española de Electricidad y Gas Lebon, *Memoria. Ejercicios de 1943-1944*. Madrid, 1944–1945, 3. Catalana de Gas y Electricidad, S.A., *Memoria-Balance. Ejercicio de 1960*. Barcelona, 1961.
27. Compañía Española de Electricidad y Gas Lebon, *Memoria balance-inventario y cuenta de pérdidas y ganancias. Ejercicio de 1948*. Barcelona, 1949.
28. Fábricas Coruñesas de Gas y Electricidad, *Memoria. Año de 1945*. La Coruña, 1946, and following years. Sociedad General Gallega de Electricidad, 1940s annual reports.
29. *Datos estadísticos técnicos de las fábricas de gas españolas 1930-1950*, 26-27. *Datos estadísticos técnicos de la industria del gas. Producción, distribución y consumo. Año 1962*. Madrid: Sindicato Vertical de Agua, Gas y Electricidad, 1963.
30. Compañía Española de Electricidad y Gas Lebon, *Memoria. Ejercicio de 1957*. Madrid, 1957, 5–6.
31. The company's profits exhibited a solid and upward trend during the 1960s. Catalana de Gas y Electricidad, S.A. *Ejercicio 1965. Memoria*. Barcelona, 1966. Catalana de Gas y Electricidad, S.A. *Ejercicio 1969. Memoria*. Barcelona, 1970.
32. Gas Madrid annual reports, 1940s and 1950s.

33. Imports of natural gas rose from 24,412 million therms in 1985 to 59,522 in 1992, and the pipeline network from 1476 kms to 3866. Carreras and Tafunell, *Historia económica*, 408, 571. The 1984 PEN forecast for 1992 a 4.1% share of natural gas in primary energy production in Spain; it finally reached 6.4% (Sudrià, 2010, p. 60).
34. Imports of natural gas rose from 91,367 million therms in 1996 to 132,178 in 1997 (Carreras and Tafunell, 2010, p. 408). In 2017, Algeria remained the main supplier, with 48% of the market share (Enagás, 2017, p. 51).
35. On the regulatory framework of the Spanish energy market see Díaz, Villar, González & Hernández (2012).
36. Repsol was created by the *National Institute of Hydrocarbons (Instituto Nacional de Hidrocarburos, INH)* to bring together and boost public companies in the oil and gas sector, except Enagas. It promoted the creation of new gas distributors, took over Gas Madrid, and entered into the shareholding of *Catalana de Gas* (Fàbregas, 2014, p. 256). In 1989 it began privatisation which was completed in 1997. <https://www.repsol.energy/es/conocenos/historia/primeros-pasos/index.cshtml> consulted 7/8/2017.
37. *Catalana de Gas* was in charge of Catalonia, Butano and Repsol of Madrid (where natural gas came in 1987), collaborating in other regions. On the other hand, in the Basque Country the *Sociedad del Gas de Euskadi*, which was owned by the Basque Government, was operating (Fàbregas, 2014, p. 251).
38. In *Catalana de Gas* its hard-core stock group was formed, around La Caixa and Repsol, so that in 1990 four shareholders controlled 61% of its share capital, replacing executive directors by corporate advisers. La Caixa had designed a strategy of investing in public utility companies in which its entry into the gas company was an example (Ballester, 2017, pp. 221–227; Fàbregas, 2014, pp. 252–254).
39. According to Fàbregas (2014, p. 259), the integration of cultures was complex, coming from very different traditions.
40. Argentina (1992), Brazil, Colombia and Mexico (1997), Puerto Rico (2003) (Gas Natural SDG, 1998, 6; Fàbregas, 2014, pp. 270–295).
41. However, the start of liberalisation from 1998 forced *Gas Natural SDG* to gradually divest of its entire shareholding in ENAGAS, between 2002 and 2009 (Ballester, 2017, pp. 169-175; Enagás, 2012, p. 3; Jiménez, 2010, p. 78).
42. The natural gas consumption in Spain went from 8.6 to 33.2 billion m³, Statistical review of world energy, 2017.
43. In 2000, only 9.6% of the gas supply came from the liberalised market, in 2004 it was 80.0% (Sedigas, 2005, p. 94).
44. The regulation theory has shifted from the emphasis on competition and efficiency to the concern for dynamic growth based on technological innovation, new organizational forms, and learning and qualification of the human capital (Midttun, 1997, p. 33).
45. 80% of the regulated market and 50% of the liberalised market (Jiménez, 2010, p. 77). A more positive view of the results of liberalisation, albeit with a less temporal perspective, in Del Guayo and Ariño, 2004, p. 138–142.
46. In fact, only the tender of 25% of the gas contract with Algeria, forced by the Government in 2001, allowed the entry of new operators in this activity (Jiménez, 2010, p. 77).
47. The Herfindahl-Hirschman Index went from 4105 in 1994 to 4828 in 2003, what indicates a high degree of concentration. However, it dropped to 1885 in 2018. SABI, 1994; Comisión Nacional de Energía, Boletín informativo sobre la evolución del mercado del gas natural. Cuarto trimestre año 2003, 16, 18; Comisión Nacional de los Mercados y la Competencia, Informe trimestral de super-visión del mercado minorista de gas natural en España. Tercer trimestre de 2018, 6.
48. Own elaboration. On the liberalisation of the gas market in other countries (Correljé, Van der Linde, & Westerwoudt, 2003; Gao, 2010; Giuntini, 2009).
49. <https://www.forbes.com/global2000/list/#industry:Natural%20Gas%20Utilities>, consulted 20/4/2018. In 31/12/2017, its stock market capitalisation was 19,263 million euros (Gas Natural SDG, 2017, p. 3).
50. In 2003 there were 11 companies, most of them Portuguese, Italian and French (Del Guayo and Ariño, 2004, p. 121).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This article has benefited from the research project «La industria del gas en España: desarrollo y trayectorias regionales (1842–2008)», HAR2017-82112-P, sponsored by Ministerio de Ciencia, Innovación y Universidades del Gobierno de España and Fondos FEDER.

Note on contributors

Mercedes Fernández-Paradas is Lecturer of Contemporary History at the University of Malaga, Spain. She is author of several books on the history of the gas industry in Spain, such as *La industria del gas en Córdoba (1870-2007)* (2009) and *La industria del gas en Cádiz (1845-2015)* (2015).

Alberte Martínez-López is Professor of Economic History at the University of A Coruña, Spain. His main research field are utilities. He has published several books and articles about these subject such as (with Jesús Mirás) “The City as a Business: Gas and Business in the Spanish region of Galicia, 1850-1936”, *Continuity and Change* (2012), and “The Conquest of Urban Mobility: the Spanish Case, 1843-2012”, Routledge (2015).

Jesús Mirás-Araujo is Lecturer of Economic History at the University of A Coruña, Spain. He is author of numerous articles on the history of public utilities in Spain. He is the co-editor (with Mercedes Fernández-Paradas and Isabel Bartolomé) of *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina, siglos XIX-XXI* (2017).

ORCID

Jesús Mirás-Araujo  <http://orcid.org/0000-0003-3049-1106>

References

- Alayo, J. C., & Barca, F. X. (2017). Las técnicas de fabricación utilizadas en las fábricas de gas españolas (1842-1972). In I. Bartolomé, M. Fernández-Paradas, & J. Mirás (Eds.), *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina (siglos XIX-XXI)* (pp. 141–171). Madrid: Marcial Pons.
- Alves de Costa, J. (1996). *Gás en Lisboa. Da iluminação pública a gás na Lisboa Romântica ao gás natural*. Lisboa: Lello Editores.
- Anuario Financiero y de Sociedades Anónimas de España (1935). Anuario Financiero y de Sociedades Anónimas de España. Madrid: Anuario Financiero y de Sociedades Anónimas de España.
- Arroyo, M. (2001). Banca, infraestructuras urbanas y estrategias empresariales. *Scripta Vetera*, 84.
- Arroyo, M. (2002). El Gas de Madrid y las compañías de crédito extranjeras en España, 1856-1890. *Scripta Nova. Revista Electrónica de Geografía y Ciencias Sociales*, 131.
- Arroyo, M. (2006). Los cambios en el proceso de producción y de distribución de gas en Barcelona y su hinterland (1930-1961). Entre el gas de hulla y el gas natural. *Scripta Nova. Revista Electrónica de Geografía y Ciencias Sociales*, 218.
- Ayuntamiento de Madrid. (1918). *Memoria de la Administración Municipal de la Fábrica de Gas presentada al Excmo*. Madrid: Imprenta Municipal.
- Ballester, A. (2017). *El gas natural en España*. Madrid: LID Editorial Empresarial.

- Barca, F. X., & Alayo, J. C. (2017). Las técnicas de producción de gas utilizadas en las fábricas de gas españolas. El caso de las fábricas catalanas: 1842-1960. *TST. Transportes, Servicios y Telecomunicaciones*, 32, 28–51.
- Bartolomé, I., & Girón, A. (2018). Privilegio' o condena. La Compañía de Gas y el Ayuntamiento de Sanlúcar de Barrameda. *Revista de Historia Industrial*, 71, 57–87.
- Bartolomé, I., Fernández-Paradas, M., & Martykánová, D. (2017). La crisis de la industria del gas en Málaga: Del gas de carbón al de nafta (1950-1968). *TST. Transportes, Servicios y Telecomunicaciones*, 32, 120–123.
- Bartolomé, I., Fernández-Paradas, M. & Mirás, J. (2017). *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina (siglos XIX-XXI)*. Madrid: Marcial Pons.
- Bel, G., & Costas, A. (2010). Market liberalisation and firm concentration. In J. L. García Delgado & J. C. Jiménez (Eds.), *Energy regulation in Spain: From monopoly to market* (pp. 495–517). Pamplona: Civitas.
- Bijker, W. E., Hughes, T. P., & Pinch, T. J. (1993). *The social construction of technological systems. New directions in the sociology and history of technology*. Cambridge MA: The MIT Press.
- Brion, R., & Reau, J. L. (2005). Jalons pour une histoire du gaz en Belgique aux xixe et xxe siècles. In S. Paquier & J. P. Williot (Dir.), *L'industrie du gaze en Europe aux XIXe et XXe siècles* (pp. 197–224). Bruxelles: Peter Lang.
- Cardoso de Matos, A. (2017). A industria do gás em Portugal: Uma primeira tentativa em comparação com Espanha. In I. Bartolomé, M. Fernández-Paradas, & J. Mirás (Eds.), *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina (siglos XIX-XXI)* (pp. 75–95). Madrid: Marcial Pons.
- Carreras, A., & Tafunell, X. (2010). *Historia económica de la España contemporánea (1789–2009)*. Barcelona: Crítica.
- Castro-Valdivia, M., Fernández-Paradas, M., & Matés-Barco, J. M. (2019). Las empresas extranjeras de agua y gas en España (circa 1900-1923). In A. Torres-Rojas, J. M. Matés-Barco (coord.), *Los Servicios Públicos en España y México* (pp. 51–74). Madrid: Silex. (siglos XIX-XXI).
- Correljé, A., Van der Linde, C., & Westerwoudt, T. (2003). *Natural gas in the Netherlands. From cooperation to competition?* Amsterdam-Zuidoost: Oranje-Nassau Groep.
- Costa, M. T. (1981). Iniciativas empresariales y capitales extranjeros en el sector servicios de la economía española durante la segunda mitad del siglo XIX. *Investigaciones Económicas*, 14, 45–83. Del Guayo Castiella, I., Milla, J. L., & Hancher, L. (2006). *Competencia y regulación: Un análisis de la OPA de Gas Natural sobre Endesa*. Madrid: Diles.
- Del Guayo, I., & Ariño, G. (2004). Liberalización y competencia en el sector del gas. Balance 1998-2003. In G. Ariño (Ed.), *Privatizaciones y liberalizaciones en España: Balance y resultados (1996-2003). La liberalización de la energía (gas, electricidad, petróleo)* (Vol. 2, pp. 1–143). Granada: Editorial Comares.
- Del Moral, J. (1984). *Hacienda central y haciendas locales en España, 1845–1905*. Madrid: Instituto de Estudios de Administración Local.
- Díaz, J. M., Villar, F.J, González, A.M. & Hernández, F.M. (2012). The legal framework of the energy sector in Spain. In J. M. Díaz (Ed.), *Energy grids in Europe* (pp. 29–135). Pamplona: Thomsons Reuters Aranzadi.
- Dirección General de Rentas Públicas. (1901–1934). *Estadística del Impuesto sobre el consumo de luz de gas, electricidad y carburo de calcio. 1901-1934*. Madrid: Nueva Gráfica S.A.
- Enagás (2012). *40 años, 1972–2012. Un liderazgo basado en la experiencia*. Madrid: Enagás.
- Enagás (2017). *El sistema gasista español*. Madrid: Enagás.
- Fàbregas, P. A. (1983). Un ensayo de estructura energética comparada: España y la C.E.E. *Oilgas*, 187, 37–47.
- Fàbregas, P. A. (2003). *La Globalización en el siglo XIX: Málaga y el gas de Málaga*. Sevilla: Universidad de Sevilla-Ateneo de Sevilla.
- Fàbregas, P. A. (2012). El Gas Natural en España: De los últimos 50 años (1960-2010) a los caminos del futuro. In *Encuentro "Los recursos energéticos y naturales: Pasado, presente y futuro"*. Torremolinos: Universidad Internacional de Andalucía.
- Fàbregas, P. A. (2014). *Gas Natural Fenosa, de Barcelona al mundo. Los primeros 170 años de historia*. Barcelona: Gas Natural Fenosa.

- Fàbregas, P. A. (2017). La estrategia de la implantación de la industria del gas en España (1826-2010). In I. Bartolomé, M. Fernández-Paradas, & J. Mirás (Eds.), *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina (siglos XIX-XXI)* (pp. 21–44). Madrid: Marcial Pons.
- Fernandez, A. (2014). 1885/1889: La municipalización de las Fábricas de gas de Bilbao y San Sebastián. In *XI Congreso Internacional de la Asociación Española de Historia Económica*. Madrid.
- Fernández-Paradas, M. (2009). Empresas y servicio de alumbrado público por gas en España (1842-1935). *TST. Transportes, Servicios y Telecomunicaciones*, 16, 108–131.
- Fernández-Paradas, M. (2014). El dilema de la industria del gas en la Andalucía de los años 1960: Renovarse o morir. *XI Congreso Internacional de la Asociación Española de Historia Económica*. Madrid.
- Fernández-Paradas, M. (2015). *La industria del gas en Cádiz (1845-2012)*. Sabadell: LID Editorial-Fundación Gas Natural Fenosa.
- Fernández-Paradas, M. (2016). La regulación del suministro de gas en España (1842-1935). *Revista de Historia Industrial*, 61, 49–68.
- Fernández-Paradas, M. (2017). La crisis del alumbrado de gas en las ciudades españolas durante la I Guerra Mundial. Unpublished.
- Fernández-Paradas, M., & Larrinaga, C. (2016). Gas industry in Spain in interwar period. In *XXXVI Encontro da Associação de História Económica e Social (APHES)*. Porto.
- Fernández-Paradas, M., & Sudrià, C. (2018). La transición del gas de carbón al gas natural, dos modelos, España y Cataluña. *Revista de Historia Industrial*, 71, 123–151.
- Gao, A. M. Z. (2010). *Regulating gas liberalization: A comparative study on unbundling and open access regimes in the US* (Vol. 14). Europe: Kluwer Law Internacional.
- García de la Fuente, D. (1996). *Del gas del alumbrado al gas natural en Castellón de la Plana, 1870–1995*. Valencia: CEGAS.
- Gas Natural SDG (1998, 2010-2017). *Informe anual corporativo*.
- Giuntini, A. (2009). La parábola del gas in Italia del carbone al metano dale origini ottocentesche ad oggi. Aspetti economici, tecnologici e finanziari in chiave comparativa. *TST. Transportes, Servicios y Telecomunicaciones*, 16, 38–60.
- Gómez-Ibáñez, J. A. (2003). *Regulating infrastructure: Monopoly, contracts, and discretion*. Cambridge: Harvard University Press.
- Jiménez, J. C. (2010). A decade of profound changes in the Spanish energy sector. In J. L. García Delgado, & J. C. Jiménez (Eds.), *Energy regulation in Spain: From monopoly to market* (pp. 65–89). Pamplona: Civitas.
- Maestro, G., García, M. A. & Virgala, E. (2011). El mercado energético español. In G. Maestro, García, M.A. & Virgala, E. (Eds.), *La construcción del mercado europeo de la energía* (pp. 101–137). Granada: Editorial Comares.
- Madureira, N. L. (2008). When the South emulates the North: Energy policies and nationalism in the twentieth century. *Contemporary European History*, 17(1), 1–21. doi:10.1017/S0960777307004250
- Madureira, N. L. (2014). *Key concepts in energy*. London: Springer.
- Martínez, A. (2017a). Transición energética y capital extranjero: Huelva, 1878-1919. In I. Bartolomé, M. Fernández-Paradas, & J. Mirás (Eds.), *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina (siglos XIX-XXI)* (pp. 215–236). Madrid: Marcial Pons.
- Martínez, A. (2017b). La Anglo-Spanish Gas and su actuación en España, 1886-1910. *TST. Transportes, Servicios y Telecomunicaciones*, 32, 78–100.
- Martínez, A. (2019). Capital extranjero y energía: Madrileña de Gas, 1846-1935. *Investigaciones de Historia Económica*, forthcoming. DOI: <https://doi.org/10.1016/j.ihe.2018.04.002>
- Martínez, A., (coord.), Mirás, J., & Lindoso, E. (2009). *La industria del gas en Galicia: Del alumbrado por gas al siglo XXI, 1850–2005*. Barcelona: Lid Editorial-Fundación Gas Natural.
- Martos, F. (1972). Aportación para una historia de la industria del gas en España. *Economía Industrial*, 104, 33–52.
- Matés, J. M. (2017). La regulación de los servicios públicos de gas y agua en Gran Bretaña (1800-1914). In I. Bartolomé, M. Fernández-Paradas, & J. Mirás (Eds.), *Globalización, nacionalización y liberalización de la industria del gas en la Europa latina (siglos XIX-XXI)* (pp. 45–74). Madrid: Marcial Pons.

- Midttun, A. (1997). *European electricity systems in transition. A comparative analysis of policy and regulation in Western Europe*. Oxford: Elsevier.
- Millward, R. (2005). *Private and public enterprise in Europe. Energy, telecommunications and transport, 1830–1990*. Cambridge: Cambridge University Press.
- Moyano, F. (2014). La planta de aire propanado de Reus (1969-1977). Cambio tecnológico a partir de la concentración empresarial de La Catalana. *XI Congreso Internacional de la Asociación Española de Historia Económica*. Madrid.
- Paquier, S., & Williot, J.-P. (2005). Origine et diffusion d'une technologie nouvelle au XIXe siècle. In S. Paquier, & J. P. Williot (dirs.), *L'industrie du gaz en Europe aux XIXe et XXe siècles* (pp. 21–51). Peter Lang: Bruxelles.
- Reher, D.-S. (1994). Ciudades, procesos de urbanización y sistemas urbanos en la Península Ibérica, 1550-1991. In M. Guàrdia, F. J. Monclús, & J. L. Oyón (Eds.), *Atlas Histórico de las ciudades europeas. Península Ibérica* (pp. 1–29). Barcelona: Salvat.
- Rodríguez, M. (2010). *La fábrica de gas de Santa Cruz de Tenerife*. Las Palmas de Gran Canaria: Idea.
- Romaní, M. (1982). *La industria del gas en España*. Madrid: Index.
- Sedigas (2000, 2005, 2006). *Informe anual*.
- Sudrià, C. (1983). Notas sobre la implantación y el desarrollo de la industria del gas en España, 1843-1901. *Revista de Historia Económica*, 1, 97–118.
- Sudrià, C. (1984). Atraso económico y resistencia a la innovación: El caso del gas natural en España. *Documents d'Anàlisi Geogràfica*, 5, 75–96.
- Sudrià, C. (2010). A historical outline of energy in the industrialization of Spain. In J. L. García Delgado & J. C. Jiménez (Eds.), *Energy regulation in Spain: From monopoly to market* (pp. 39–63). Pamplona: Civitas.
- Sudrià, C., & Aubanell, A. M. (2017). *Història de la indústria del gas a Catalunya*. Sabadell: Fundació Gas Natural Fenosa.
- Union International de l'Industrie du Gaz. (1949). *Les Statistiques Européennes de l'Industrie du Gaz*. Londres: 4ème Congrès Internationale de l'Industrie du Gaz.
- Victor, D., A. Jaffe, & M. Hayes (Eds.). (2006). *Natural gas and geopolitics. From 1970 to 2040*. Cambridge: Cambridge University Press.
- Vidal, F. (1949). *La industria del gas en España*. Barcelona: Ariel. doi:[10.1086/ahr/79.4.1196-a](https://doi.org/10.1086/ahr/79.4.1196-a)
- Williot, J.-P. (2005). De la naissance des companies à la constitution des groups gaziers en France (années 1820-1930). In S. Paquier & J. P. Williot (Eds.), *L'industrie du gaze en Europe aux XIXe et XXe siècles* (pp. 147–179). Bruxelles: Peter Lang.
- (années 1820-1930). In S. Paquier & J. P. Williot (Eds.), *L'industrie du gaze en Europe aux XIXe et XXe siècles* (pp. 147–179). Bruxelles: Peter Lang.