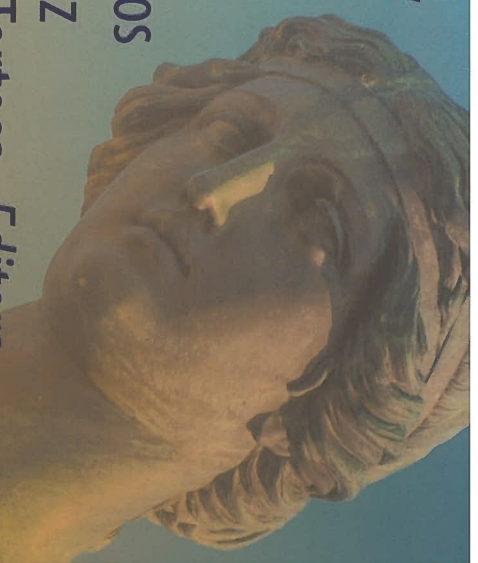


Frontiers in Economic History

Ana Cardoso de Matos
Alexandre Fernandez
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The Gas Sector in Latin Europe's Industrial History

Lighting and Heating the World




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Ana Cardoso de Matos •
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Antonio Jesús Pinto Tortosa
Editors

The Gas Sector in Latin Europe's Industrial History

Lighting and Heating the World

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Why Gas?

Ana Cardoso de Matos , Alexandre Fernandez,
and Antonio Jesús Pinto Tortosa 


Abstract The first part of the introduction aims at explaining the relevance of the gas industry in the history of the industrial revolution. Russian invasion of Ukraine on 24 February 2022 has awoken popular awareness on the World’s dependence on Russia’s gas supply. Therefore, it is required that experts in economic, industrial, and business history go back to identifying the moment when gas became a crucial energy source for Europe’s industrial take off, at the turn of the eighteenth century. Not only was gas relevant as an energy source to put the factories into motion, but it also made possible the take-off of other industrial sectors that depended on such energy source, for example, transportation and communications.

Keywords Gas industry · Economic history · Industrial history · Business history
· Engineering

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Entrepreneurial Initiatives, Foreign Investment and Marketing in the Implementation of Gas Services in the Portuguese Cities of Lisbon and Porto During the Second Half of the Nineteenth Century

Ana Cardoso de Matos , Diego Bussola  and Maria da Luz Sampaio 

Abstract The nineteenth century cities were marked by the concern with public hygiene, the embellishment of urban space and the existence of leisure spaces that would respond to the new standards of health and well-being of the urban population. The attention given to public health and the environmental conditions existing in cities were directly linked to the development of medicine and hygienic ideas.

The new conditions of security and welfare that were required for the cities forced the introduction and modernisation of urban infrastructure, including water supply networks, sewage, gas and electricity. In Latin European countries, they were mostly implemented by private companies, both national and foreign, which had won the concession to operate them in tenders put out by the Councils. This text addresses the above-mentioned aspects in the gas service in the cities of Lisbon and Porto in the second half of the nineteenth century. To ensure that they had the necessary consumption to guarantee the viability of the business, companies developed a series of commercial strategies aimed at encouraging private consumption of gas, notably in households. These initiatives included advertisements, notably in

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newspapers, the display of gas appliances and the granting of payment facilities for the gas appliances.

Keywords Private initiative · Lisbon · Porto · Gas supply · Marketing strategies

1 Introduction

In the nineteenth century, urban growth, the development of medicine and the hygienist ideas generated a greater concern about the spatial organisation of cities and the creation of urban infrastructures. The latter constituted a field of technical innovation, which, based on the principal European cities, extended to others through agents such as engineers or businessmen and vehicles such as the publication of books and periodicals, scientific academies, professional associations or international or universal exhibitions.

The creation of gas networks was an entrepreneurial initiative that required intensive and non-refundable capital investment, which is why foreign investment was crucial for the implementation of these services in countries where there was a scarcity of capital, as was the case in Portugal. Also, the installation of gas facilities required the use of technicians from cities where the existence of gas networks already had some tradition, although often the gas production and distribution processes had to be adapted to the geographical realities of the cities where such urban infrastructures were to be introduced. Therefore, the knowledge of the engineers had become indispensable both for designing the projects and supervising the installation works (Martínez-López & Mirás Araujo, 2022).

In Latin Europe, although many of the initiatives for implementing and modernising infrastructure networks, namely, those of gas and electricity, came from the municipal councils, they were implemented by private companies, both national and foreign, which had been awarded the concession to operate them throughout bids opened by the councils. In Spain, French investment was particularly important (Fernández-Paradas, 2009). In Andalusia, a region located in the south of Spain, the capital was mostly French, although British capital also participated and, to a lesser extent, that from Scotland and Belgium (Fernández-Paradas et al., 2021).

Foreign investment was also important because the foreign companies that invested in countries where there was still no gas network brought their know-how and technicians. Therefore, the companies formed solely by national capital encountered greater difficulties to establish an efficient gas network and to constantly update it.

Similarly, to other countries of Latin Europe, in Portugal the establishment of the gas networks began with some delay with respect to the principal European cities. Gas lighting was only introduced in Lisbon in 1848 and in Porto in 1855. In the following decades, several Portuguese cities opened tenders to assign gas lighting concessions, but many of the concessions granted never materialised.

significant number of possible private consumers. For this reason, in Portugal, the cities where gas lighting was first introduced were the most populated (Cardoso de Matos, 2011, pp. 118–119).

From the final decades of the nineteenth century, the increased interest of foreign entrepreneurs in the exploration of this type of business in Portugal, as well as in other countries of southern Europe, occurred within a period of internationalisation of companies, namely, gas and electricity companies, which, not finding a market in their own countries, sought to obtain a concession to explore these services in other countries in order to expand their business (Paquier & Williot, 2005). With this strategy, the companies were seeking to specialise in certain competences, whether on the level of gas and electricity production and distribution technology, or on the level of management and marketing techniques, which were not likely to be applied to other industrial branches.

Based on the study of the creation and development of the gas networks in the cities of Lisbon and Porto during the second half of the nineteenth century, this paper seeks to demonstrate the following hypotheses: (1) The first gas companies that were created in Lisbon and Porto were essentially formed with Portuguese capital and, therefore, had difficulties to hire foreign technicians due to their high salaries, having opted to train their technicians abroad, specifically through study visits. However, given the lack of production of the national machinery necessary to produce gas, they had to import it from abroad. (2) The existence of engineers and doctors in the senior management positions of the companies was a factor that favoured the introduction of new technologies. (3) In the construction of the gasworks and the distribution networks it was necessary to use foreign technology. (4) The marketing or promotional campaigns to extend consumption to private individuals implemented by the first gas companies were based mainly on the safety of this source of energy. (5) From the end of the 1880s, the competition of electricity pressured the gas companies to introduce improvements in their facilities.

2 National Business Interests and Foreign Investment in the Creation of Gas Distribution Companies in Lisbon and Porto

2.1 The First Companies to Provide Gas Supply Services in the Cities of Lisbon and Porto

The first Portuguese cities in which gas lighting was introduced were Lisbon and Porto, which were those with the highest urban population¹ and in which there was a greater commercial and industrial activity, favoured by the existence of seaports.

The existence of technical schools in both cities that trained engineers, together with industrial and trade associations, cultural clubs and the publication of different technical journals were all factors that fostered the existence of a political and business class that favoured the introduction of innovations in the country.

This favourable environment aroused the interest in gas as a source of lighting and from the 1830s different proposals were made to the City Council of Lisbon, including: that of the *Compagnie Générale Provinciale du Gaz et des Eaux* in 1841; those of Samuel Clegg & Co., one of the pioneers in this industry, in 1842 and in 1844; that of Blanchet Frères, of Paris in 1845; the following year, the proposals of the company *Éclairage du Gaz* of Cadiz, of the Firma Conde Farrobo, Carlos Cunha de Meneses e C^ª and of the entrepreneurs Claudio Adriano da Costa and José Detry (Bussola, 2022).

In May 1846, the concession was granted to Claudio Adriano da Costa and José Detry, who created the *Companhia Lisboense de Iluminação a Gás* (CLIG). The capital necessary to carry out the installation of the factory and gas distribution network was raised through the participation of Portuguese entrepreneurs in this company who had large fortunes or who were connected to important industrial establishments. This was the case of Manuel Alves do Rio, connected to the creation of the Banco de Portugal and whose presence in the two companies facilitated the obtaining of loans from this bank for the CLIG. In fact, in 1855, when Manuel Alves do Rio was promoted from deputy director of the CLIG to director, the loan with the Banco de Portugal was doubled (Cardoso de Matos et al., 2005).

The fact that these types of companies required a high amount of capital, which implied that they would only be profitable in the medium term, meant that the concessions of these services were granted for long periods, often as long as 50 or 60 years. However, although the creation of a gas network required a non-reimbursable large initial capital and was a high-risk business due to the uncertainty regarding the size of the private market, in the medium-term it was financially gratifying and enabled large dividends to be distributed, as shown by the financial results of companies operating in other European cities. In Portugal, this situation was demonstrated with the CLIG, which, in 1851, distributed a dividend of 6% among its shareholders which rose to 7.5% the following year (Cardoso de Matos, 2003, pp. 110–111).

Until the 1880s, this company continued to earn large profits, but despite this, in 1883, when the City Council of Lisbon issued a new invitation to tender, only CLIG was interested. The need to undertake large works in the factory and the pipe network discouraged possible bidders for the concession. The absence of other interested parties can also be explained by the expectations with regard to electricity as a form of lighting.

As the contract with the CLIG expired in 1887, the CML launched a new tender in the same year, which was published in newspapers in Lisbon, Berlin, Brussels, London and Paris. This tender initially covered the old quarter of the city of Lisbon and the concession for supplying gas to private consumers was not granted exclusively, as the CLIG had the right to continue supplying gas to the private consumers

offers from foreign companies, in a period when gas and electricity companies were implementing their internationalisation processes (Paquier & Willhot, 2005; Beltran & Carré, 1991), as they could not find a market in their own countries and were seeking concessions in other countries in order to expand their business.

Considering that the offer of the *Société Anonyme d'Éclairage du Centre*, of Brussels was the most favourable, in July 1887, the city council granted the company a concession for 30 years for public lighting and provided for the possibility that the company would light the city with electricity. In view of the large investments necessary to construct a new factory and the respective pipe network, the company opted to build a new company, the *Companhia Gás de Lisboa* (CGL) with the other companies that had presented a bid: S. A. *Crédit Général de Belgique*; *Banque d'Escomptes de Paris*; *Compagnie Générale pour l'Éclairage et le Chauffage par le Gaz*, of Brussels; and the *Compagnie Générale Française et Continental d'Éclairage* (Silva and Cardoso de Matos, 2004). The *Compagnie Générale pour l'Éclairage et le Chauffage par le Gaz*, commonly known as *Gaz Belge*, which established several gas networks across Europe, was founded in Brussels in 1862 by Joseph Oppenheim, who was born in Germany but obtained Belgian nationality in 1845 and was the first president of its board of directors (Moreau, 2010, p. 939). Its shareholders also included Khon Reinach & Co. This is how the last decade of the nineteenth century began: a period characterised by the strong presence of foreign capital and know-how in one of Lisbon's gas companies.

In the city of Porto, gas lighting was introduced in September 1855 by Hardy Hislop, an English entrepreneur residing in Porto, who created the *Companhia Portuense de Iluminação a Gás* (CPIG). Its shareholders included figures related to the large business, financial and industrial groups of northern Portugal, such as Alfredo Allen, who was one of the founders of the *Real Companhia Vinícola do Norte de Portugal*.

During the early years, consumption was not very high, which led the company into a loss-making situation, obliging it to announce the lease or sale of its establishments in 1864 and the temporary or definitive transfer of the lighting contract. Three proposals were received: one from Clark & C^ª of London, another from João Eduardo Ahrends, who had been the technical director of the gas factory of Lisbon since 1857, and a third from James Aberdein Methuen, native of Portsmouth. The contract was signed with the latter, but his death three years later meant that a new tender had to be issued and, after analysing the different proposals, the board of the CPIG decided to grant the concession to George Wilson Stevenson and Alfred Penny, with whom it signed a contract for seven years on 11 November 1867. George W. Stevenson had been a member of the Gas Institute since 1852, of which he became president in 1882, and acted as consulting engineer for gas, water and sewerage matters and designed new gasworks for several places.

After seven years, the factory and pipeline network returned to the hands of CPIG, which managed this service until 1889, the year when its contract ended and the assets of the company were transferred to the municipality, as stipulated in the contract.

In November 1888, the city council issued a tender for an exclusive concession of the gas supply for the city for a period of 25 years. Twelve offers were presented, including that of the company Dalhaise, Magerman & Van Hulle, Charles Georgi, León de Somzée and CGL. After analysing the different bids, the concession was granted to Charles Georgi, with whom the contract was signed on 27 March 1889. In order to exploit the gas network, Georgi created the Companhia do Gás do Porto (CGP) with the rest of the bidding companies.

2.2 Lisbon and Porto: Foreign Capitals, Merger and Long-Term Contracts

As previously mentioned, the CGL was created in 1887, but this company did not have the necessary infrastructures for producing and distributing gas. Therefore, the city council began negotiations with the CLIG for it to sell the gas necessary for public lighting to the new concessionaire. The CLIG accepted the proposal which was found advantageous as it made its factory and distribution network more profitable, given that private consumption was insufficient to use all of the gas produced.

When the CGL finished the construction of its plant and pipe network, it began to operate in the supply of gas for public and private lighting, while the CLIG also supplied gas for private consumption and had a large number of clients. This sharing of a market with a limited capacity for expansion in a competitive system compromised the financial results of both companies. Furthermore, the contract with the CGL provided the possibility of lighting the city also with electricity, the company installed a small electricity plant which lit the Avenida da Libertdade from 1891.

And so, the negotiations to merge the two companies began and the Companhias Reunidas de Gás e Eletricidade (CRGE) was constituted on 21 October 1891. The new company took over the factories and gas pipelines of the former gas companies and assumed the existing contracts.

The CGP was created in 1889 with the objective of assuming the concession of the public lighting of Porto. Mobilising national and foreign capital, the members of the board of the first three-year period represented the different interests involved in this company: Barón George de Soubryan, Eugéne Brettmayer, Wilhelm Pfismayer, Lucien Guinotte, Tecelin Monjot, Leon de Somzée, Adolpho da Cunha Pimenta, Domingos Alves Moreira, José Ribeiro Vieira de Castro and Manoel Pinto Gomes de Menezes.

The CGP bought the gas factory from the former concessionaire, but its deteriorated state obliged it to undertake major works to improve the factory and renovate and extend the pipelines in order to respond to the increase in private demand, favoured by the fall in prices. Therefore, while in 1887 private consumption did not surpass 1,300,092 m³, in 1890 it amounted to 3,121,731 m³, exceeding all the expectations of the Chamber. From 1889 to 1890, private consumption became significantly larger than public consumption.

Despite the increase in gas consumption, the large investments made by the CGP to modernise the factory and extend the pipelines, which exceeded the amounts initially forecast, created a difficult financial situation. In an attempt to recover, in 1893 the directors of the company requested the City Council to extend the contract which was accepted after the Council heard a specialised commission.

After this ruling, on 7 February 1894 a new contract was signed for 45 years between the Chamber and the CGP for the concession of public gas lighting. However, this contract reinforced the obligation of the CGP to progressively replace gas lighting with electrical lighting.

In order to recover its financial situation, the company issued new shares which enabled it to reinforce its capital. The directors of the CRGE, the company that exploited the supply of gas to the city of Lisbon, considered that it was a good investment, and in 1897 it acquired 16,100 shares of the CGP, becoming the majority shareholder.

3 Knowledge and Technology Transfer in the Construction of Gas Factories and the Installation of Distribution Networks

The gas industry was a business area that required technical engineering and chemical knowledge. Therefore, for the assembly of factories, the gas companies in Portugal often resorted to foreign technology and sought to ensure that the directors of the factories and even the members of the board had a certain level of technical training. The examples of Lisbon and Porto illustrate this concern.

3.1 The CLIG (1848–1887)

Some of the members of the board of directors of the CLIG, such as Joaquim Simões Margiochi and Francisco da Ponte e Horta, were engineers and conducted technical studies and inspections of the factory in order to detect problems in the production of gas. Other managers of the company also had technical training, such as the doctor Francisco Silva Torres and the mathematician Daniel Augusto da Silva. The shareholders included the chemist Agostinho Vicente Lourenço, who, in 1853, obtained a diploma in chemical engineering from the École Centrale de Paris (Cardoso de Matos, 2003, p. 117).

The technical training of several members of the management bodies of the company contributed to the technical nature of the company reports, which regularly refer to both the examples and options followed in the principal gasworks of England and France and to the scientific and technical advances in gas production. This com-

changes in the production processes and, on the other hand, to support the discussions with the local authorities on the way in which gas was produced and distributed.

Therefore, when in 1857 the City Council sought to transfer the factory to another place, the company expressed its disagreement considering that the location of the factory in Boavista beside the Tagus River, attested "The criteria of the skilful engineers who directed the works" (CDFEDP, CLIG, Annual Board Report, 1857-58, p. 18). In fact, the location of the plant in one of the lowest points of the city facilitated the entrance of coal from Newcastle used in gas production, the distribution of gas to the highest parts of the city without the use of high pressure and the orientation of the smoke from the plant towards the river, reducing the effect of pollution in the residential areas.

Foreign engineers participated in the construction of this factory, which began in 1847, such as the Frenchman Béraud, who assembled the first machines. On 28 June 1850, an important works contract was signed with Luís João Gosse from Paris, who had previously worked in French gas companies (CDFEDP, CLIG, Annual Board Report, 1851, pp. 11r-11v). In the following years, the directors and technicians of the company made several study trips to learn *in situ* about the technical advances in the production and distribution of gas made in other countries. These included the study trip to England and France in 1857 by the technical director of the company João Eduardo Ahrens. During his trip, Ahrens visited: 28 gas factories in London, Liverpool and Newcastle; six factories in Paris; and several of the engineers and chemists, such as Régault (CDFEDP, CLIG, Annual Board Report, 1858-59, 12). Based on the knowledge acquired, he reformulated the organisation of the factory and introduced technical improvements that enabled costs to be reduced by more than 33%. In 1859, the system of purifying gas with lime was replaced with the use of iron peroxide. Beale apparatus purchased in London were installed together with English system cast iron wells to evacuate the liquids formed by the effect of condensation. In 1860 and 1861, the gas company constructed a new gasometer with a capacity for 6000 m³ of gas, installed new pipes and undertook other works that improved the quality of the gas "bringing it closer to the standards existing in Paris and London". This fact was confirmed by the shareholder and director of CLIG, Francisco Maria da Silva Torres, during his trip to these cities (Cardoso de Matos, 2003p. 115).

The presence of Portuguese engineers in the managing bodies of the CLIG contributed to supporting the training of the technicians, specifically through trips abroad. They knew the importance of this imported know-how for reducing production costs and, therefore, they promoted the trips for visiting factories, such as the previously mentioned trip made by Ahrends.

During the time in which the factory was operated by the CLIG, its extensions were determined by the increase in the consumption of gas by the population of Lisbon. Many of the works carried out required the use of foreign technology, as was the case of the gasometer constructed in 1882 and adjudicated to the company

C. & Walker of London, specialised in this type of construction. This year, the company acquired, also in England, a machine for purging tar from the gas.

When, in 1887, the CLIG began to sell gas to the CGL, the management of the company decided to improve the deteriorated state of the factory so as to increase and improve the quality of the gas produced. Therefore, it sought an engineer in England, but due to the high costs of this service it opted for Emílio Dias, graduated from the Instituto Industrial e Comercial de Lisboa, where he had specialised in the construction of precision instruments and chemical analyses and had discovered a more efficient method for manufacturing gas. For this new production process, a privilege was signed for a period of 15 years (CDFEDP, CLIG, Annual Board Report, 1888, p. 7; 1889, p. 15). In summary, the selection of Portuguese engineers was also related to the high costs of hiring English and French engineers.

3.2 CGL (1887-1891)

In 1887, after the granting of the concession for the distribution of gas in Lisbon, the CGL was obliged to construct a new factory, having opted for a plot of land close to the Belém Tower.

The importance of foreign capital in this company and the fact that in the board of directors there were several representatives of these capitals was a determining factor in the preference for the purchase of machinery from abroad and, although we do not know who the engineer responsible for the factory was, it was probably a foreign engineer.

Therefore, on 9 January 1888, the company requested the Government to authorise the import of different machines for the factory, alleging that the Portuguese factories did not have the capacity to supply them in the terms stipulated in the contract for the construction of the factory. This request caused a reaction from the Portuguese companies, but, despite this, the authorisation was granted. The works began in May 1888 and the CGL opted for a partial tendering system with different contractors, many of which were foreign. Therefore, the construction of the gasometer, with a capacity for 20,000 m³, was awarded to Bonnet Spazin of Lyon; the five furnaces, with eight retorts each, were constructed by Leclair, of Dijon; the condensation, cleaning and gas purification system was awarded to Walker of London; by the Companhia Générale pour la Fabrication des Appareils à Gaz, of Paris (Martins & Coelho, 1998, pp. 27-30).

The 250 km of pipes that were constructed followed the Somzée system, which was already used in Germany, England and Belgium and all of the pipes of more than 4 cm were imported from abroad.

3.3 *The Factories in the City of Porto (1853–1891)*

In 1853, when Hardy Hislop obtained the concession for the gas service in the city of Porto, one of his first concerns was to evaluate whether the land that the city council had made available for the construction of the factory was suitable for its installation. He assigned the task of studying the feasibility of the locating company on this site to the engineer Geddle Pearse. In his report, Pearse considered that the land proposed by the city council, while being of the necessary size and located beside the river, also had several disadvantages, such as the fact that it was in a place that required a complicated unloading process of the coal, there was a risk of the land collapsing under the weight of the large gas tanks and the fact that the path of the pipeline was too winding and rocky. In spite of this report, the plant was built on the land proposed.

The construction works of the factory concluded in 1854, but after only 3 years it was necessary to reform the gasometers and pipelines. In a report presented in 1863, errors in the construction of the factory were indicated, namely, the close proximity between the retorts, the condensers and the purifiers (Cardoso de Matos et al., 2003, p. 34).

The factory was initially directed by an English engineer, but the problems that arose during the first years of its operations led to his replacement in 1858 by the industrial chemical engineer, Albano Abílio Andrade, who, however, only remained in the factory for 1 year. French engineers were hired to replace him, but they too remained in their positions for a very short time. In 1860, the technical director's position was filled by the engineer António Maria Tavares, who, in an attempt to reverse the deteriorated state of the factory, introduced a series of improvements in the gas manufacturing process, which immediately translated into a reduction in costs. In order to evaluate the quality of the gas produced in 1863, the management of the company requested the engineer Boyd Miller and the Portuguese chemist Agostinho da Silva Vieira for their expert technical opinion. They detected a series of defects in the gas production process, many of which were due to errors in the construction of the factory (Cardoso de Matos et al., 2003, p. 34).

Similarly, to the CLIG, engineers also held senior management positions in the CPIG. In 1887, the engineer Augusto César Justino Teixeira participated in the commission that evaluated the factory. According to this commission, significant improvements had been made to the factory: the coal distillation furnaces had been protected from flooding; there were seven retorts and laminated iron barrels; another telescopic gasometer had been introduced with a capacity of 5000 m³, supplied by Alexandre Trifect de La Louvière. At this time, the distribution network had 2359 public streetlamps and 2599 Glowler meters in the homes of private consumers (CMP/AHMP, Louvação² CPIG, 1887, p. 9).

In 1888, when the CGP purchased the gas factory from the former concessionaire, the company's engineer Frederico Van Hulle carried out an inventory which clearly revealed the use of foreign technology. At that time, in the factory there were 32 gas production furnaces built at different times and divided into three groups: a battery of six condensers, two aspirators with their respective fixed and horizontal steam engines, one of them supplied by Gwvine & Co.; two boilers, one from Gwvine & Co. of London and another more modern one with no indication of its origin; two feed pumps, one with a double effect from Gwvine & Co., and another supplied by Alexandre Wilson & Co. of London; two aspirators of the Gwvine & Bealee system from the Gwvine & Co. factory (CMP/AHMP, Louvação CPIG 1888).

The dilapidated state of the factory required major works. At the same time, the pipeline network was improved and extended from a length of 115,889 m with the replacement of 33,043 that had deteriorated and the construction of a further 15,503 m of pipes, which enabled gas lighting to expand to other areas, such as Foz do Douro (Porto Statistical Yearbook, 1890, pp. 340–341).

From the moment when the CRGE became the majority shareholder of the CGP, it had direct intervention in this company. With the objective of improving the operations of the factory, Paulo Collart was named director. He was an engineer and inspector of the CGP and he was asked to conduct an evaluation of the situation of the factory. The evaluation carried out by this engineer revealed that it was necessary to purchase machinery to increase the production capacity of the factory and replace the most degraded elements (CDFEDP, CRGE, Management Board Minute Book, 1900–07, pp. 29–32).

4 **The Marketing Policy as a Way of Promoting Consumption: The Transfer of Foreign Models and Local Adaptations**

At the beginning of the 1850s, the majority of the private consumers were different kinds of retailers: wineries, shops, confectioneries, hairdressers and apothecaries that had on average two gas outlets.³ On the other hand, private homes, although small in size, had an average of seven outlets per house (Cardoso de Matos et al., 2005, p. 47). During this decade, the principal concern of the CLIG was to reassure the public about the potential dangers of gas. They refuted the ideas circulating in society about the dangers of the gas smell and explosion by publishing newspaper articles that explained that many of these fears were unfounded (CDFEDP, CLIG, Annual Board Report, 1856–1860).

Until the 1870s, the London gas companies were almost exclusively engaged in the sale of gas for lighting (Goodall, 1993, p. 544). The same was the case of the

CLIG in Lisbon. However, in the 1880s, the threat of electrical public lighting modified the objectives of the company.⁴ In this period, the decreasing value of gas opened up the possibility of other uses. In 1882, the price of gas was reduced for private individuals from 60 to 55 reis in order to attract more consumers and foster greater consumption (Cardoso de Matos et al., 2005, p. 50).

The contract signed in 1887 by the CGL for the supply of gas and electricity constituted a threat to the CLIG, which lowered the price of gas that year from 55 to 45 reis in an attempt to prevent the flight of private consumers to the new company. Furthermore, the CLIG attempted to increase the number of consumers laying the pipes up to the homes and enabling individual consumers to pay for the installation in quotas or by renting (CDFEDP, CLIG, Annual Board Report, 1887, p. 11; 1889, p. 6).

The CGL also developed strategies to attract private consumers and promote their consumption. It signed a contract with each private consumer for who it installed the pipes outside of the buildings free of charge and offered a free stove⁵ which had to be returned to the company at the end of the contract. In order to carry out these types of initiatives, it was necessary to have enough capital (in this case foreign) to enable the existence of *sunk costs* rarely intended for a context such as this one, namely, the laying of pipes to the home and the rental of stoves.⁶

After the merger of the two companies in the CRGE the strategy of the CGL was continued and in June 1893 a total of 4970 cookers had been rented. In order to promote the use of gas in cookers and other domestic appliances at the end of the nineteenth century, the CRGE held an exhibition of "the best appliances for lighting, heating and ventilation; there you find the most perfected types of nozzles, cookers, bath heaters, cookers and many other appliances, all of great use" (CDFEDP, CRGE, Annual Board Report, 1892–93, p. 6). The majority of Lisbon residents could not afford these types of artefacts, particularly if the total payment had to be made in full. Therefore, in 1892, the CRGE decided to create a service of payments in instalments.

Understanding the role that advertising could play in promoting gas consumption, the CRGE regularly published advertisements in several newspapers. Also, with the objective of promoting domestic gas consumption in the 1890s, the CRGE published the leaflet "O GAZ" in which, through drawings and colloquial language, the advantages of gas were exalted and the readers were recommended to visit the exhibition that had been installed in its warehouse in *Rua da Boavista*, where they could observe different appliances in operation and where the employees of the company explained how they worked (Cardoso de Matos & Bussola, 2021).

⁴As Falkus states, "hiring cooking and heating apparatus to consumers, can be attributed in part to a commercially inspired reaction against the threat posed by electricity" (Falkus, 1977, p. 158).

⁵In the 1880s in the UK gas companies often rented the cooker to private consumers, while in the US they did not (Goodall, 1993, pp. 546–547).

In the city of Porto, current surveys, based especially on the press at the time, do not allow us to obtain information on promotional or marketing actions used by the companies responsible for supplying gas. In fact, the articles compiled point more towards mishaps and problems caused by floods or collapse of walls than to the dissemination of this lighting system. It should be noted that unlike Lisbon, in Porto the two branches, gas and electricity, did not remain united. While the gas network and the respective power plant were experiencing operating problems, in 1907 the Sociedade de Energia Eléctrica do Porto was set up to build Porto's the first thermal power station in Porto right next to the gas factory and its gasometers, clearly showing that a new alternative energy source was being launched.

5 Conclusions

In this chapter we have shown the development of Lisbon and Porto gas companies in the second half of the nineteenth century. Although in the case of Lisbon it ended up as a typical electricity holding company from 1914 onwards, the trajectory was complex and shows how the gas industry developed in a Southern European country. We have found that when analysing the investment, know-how and marketing strategies during the second half of the nineteenth century, it is necessary to divide the period at around the end of 1880s, which can be summarised as follows.

From the beginning of the exploitation of gas in Lisbon (1848) and Porto (1855) until the 1880s, national capital and management were dominant. In this first phase, the profits of the companies were not invested but were mainly distributed in the form of dividends. Therefore, when the concessions of the gas companies ended, the factories and the networks were dilapidated. Furthermore, although the machinery was imported, many of the projects and technical know-how applied in the factories were national due to the high costs of hiring foreign technicians. The management was in the hands of Portuguese directors who had graduated in chemistry, engineering and medicine and the company sent its employees on study trips abroad. At a time when gas was only used for lighting, the marketing policies to sell it to individuals were limited to newspaper articles which explained that gas was safe.

At the end of the 1880s, the new concessions of Lisbon (1887) and Porto (1889) for public gas lighting were awarded to companies that had a strong presence of foreign capital. As previously mentioned, this arrival of foreign capital took place when gas companies were implementing their internationalisation processes. The unique feature of these new concessions is that they included the possibility of lighting cities with electricity. In Lisbon, the CGL used foreign materials and technical know-how to construct the factory of Belém, the gasometer and the pipelines. The competition between the CLIG and the CGL obliged them to offer cheaper gas and other facilities, such as the free laying of pipes or the payment in instalments or the renting of cookers. Meanwhile, in Porto, the reduction in gas prices fostered private consumption, nevertheless, since the early years of the twentieth century the distri-

The CRGE (1891), born from the merger of the CLIG and the GCL, extended the marketing policy with the installation of a store of appliances where their use was demonstrated and customers were given the option of purchasing in instalments. These and other strategies were developed throughout the twentieth century (Cardoso de Matos & Bussola, 2021).

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The Role of the Technical Press in the Diffusion of Gas in Europe: The Case of *Le Gaz Journal* (1857–1886)

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Abstract The gas industry emerged in Europe at the end of the eighteenth century. Since the middle of this century, scientific and technical advances were disseminated, among other ways, through treatises and periodicals. Journals evolved from having an initial generalist nature to a more specialised one. The gas industry was no exception to this trend and the first specialised gas journals appeared in the 1840s. These magazines acted as disseminators of the main advances in gas-related

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