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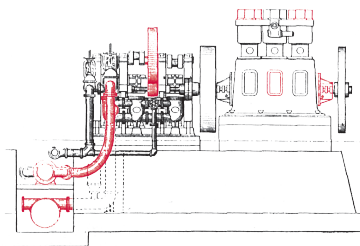
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LA INDUSTRIA DEL GAS EN EUROPA

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Presentación.

La industria del gas en Europa

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La industria del gas nació en Gran Bretaña, la cuna de la Primera Revolución Tecnológica, a principios del siglo XIX, como resultado de diversos avances científicos y tecnológicos perfeccionados a finales del siglo XVIII. En Gran Bretaña su difusión fue rápida, de tal manera que en 1846 las poblaciones con más de dos mil habitantes tenían gas. En el Viejo Continente su extensión fue más lenta. Le siguieron en las décadas de 1810 y 1820 Francia y Bélgica. Su implantación fue más tardía en las ciudades austro-húngaras, suizas, escandinavas, italianas, portuguesas, españolas y balcánicas, en torno a unos veinte años, desde 1840-1850.

En sus inicios la industria del gas ofrecía numerosas ventajas, puesto que la red de tuberías podía adaptarse al territorio, al tiempo que su carácter general y acumulativo y su capacidad de interconexión posibilitaban transportarlo a distancia de modo continuo. Asimismo, en comparación con anteriores sistemas de alumbrado era más eficiente y estable y mejoraba la seguridad ciudadana. Igualmente, contribuyó decisivamente a poner fin a un ritmo de vida hasta entonces condicionado por la luz solar. Además, primero como sistema de iluminación y más tarde como fuente de movimiento —motor de gas— incrementó la productividad de la industria, al mecanizar algunas operaciones que requerían una potencia menor que la máquina de vapor y al hacer posible desempeñar la jornada laboral durante la noche. Posteriormente fue extendiéndose el uso del gas en los hogares. Hoy día, el gas, en sus diversas formas, es vital para el funcionamiento de nuestras sociedades, y es potenciado por la Unión Europea —sobre todo el gas natural— por su menor impacto medioambiental en comparación con otros hidrocarburos y por la necesidad de una mayor diversificación en la estructura energética.

Desde los años ochenta del siglo pasado la historiografía sobre la industria del gas en Europa ha experimentado un extraordinario desarrollo, si bien todavía hay un desfase importante en el nivel de conocimiento de esta, entre los países: mayor en Gran Bretaña, Francia y Alemania, menor en los países mediterráneos y del Este. El presente monográfico, «La industria del gas en Europa», pretende contribuir a mejorar dicho panorama historiográfico, presentando investigaciones sobre diversos espacios europeos —Francia, Portugal, España y Cataluña—, y profundizando en aspectos apenas explorados. Para ello, se da a conocer parte de los resultados del proyecto I+D «Origen, consolidación y evolución de la industria del gas en España (siglos XIX-XXI)», HAR2014-52141-P, financiado por el Ministerio de Economía y Competitividad.

El monográfico se estructura en cinco trabajos. El primero se centra en Portugal; en concreto, en una fábrica muy relevante, la del barrio de Belén de Lisboa, y su traslado a la zona este de la capital. Analiza la construcción de la nueva factoría y las consecuencias que se derivaron desde el punto de vista organizativo y en la evolución de la distribución y el consumo de gas en el periodo comprendido entre finales del siglo XIX y 1957. El artículo de Alexandre Fernandez examina un tema novedoso, el descubrimiento del yacimiento galo de gas natural Lacq-Mourenx y el surgimiento de una región industrial en el suroeste de Francia entre 1957 y 2012. Los siguientes trabajos se centran en el Estado español y se refieren a un estudio de caso relevante y enfoques más generales. Así, Isabel Bartolomé estudia el nacimiento de esta actividad en Sanlúcar de Barrameda, desde 1882, hasta 1920, cuando desapareció, como consecuencia de la competencia de la electricidad. Es un ejemplo significativo porque el negocio lo impulsó una empresa extranjera y por la relevancia de esta ciudad portuaria, que vivía de la industria del vino. En cuanto a la investigación de Alberte Martínez y Jesús Mirás, analiza un tema crucial, la transición energética en España desde el punto de vista de la difusión y el consumo de gas y electricidad en el primer tercio del siglo XX. Por último, el texto de Mercedes Fernández-Paradas y Carles Sudrià aborda un asunto de suma importancia, la transición del gas de carbón al gas natural en Cataluña y España.

MERCEDES FERNÁNDEZ-PARADAS

ARTÍCULOS

From Belém to Marvila: the transfer of the gas plant and changes in the production process (1887-1957)*

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Introduction

In this article we analyse, for the period lasting from 1887 to 1957, the following aspects: the reasons for installing a gas plant in Belém; the opposition raised against that location; the decades-long negotiations for transferring the plant from Belém to the eastern part of Lisbon; the construction of the new gas plant in Matinha; the organization of its production process, and, finally, the evolution of gas distribution and consumption in the period covered by our analysis.

The time span chosen for this study is explained by the following motives: 1887 was the year when Lisbon promoted a public tender for the public lighting concession, allowing for the appearance of a new gas company and, therefore, creating the need to build a new gas plant. And 1958 was the year in which the exploitation of the *Fábrica de Gás da Matinha* (Matinha Gas Plant) was taken up by the *Sociedade Portuguesa da Petroquímica* (Portuguese Petrochemical Society), signalling the end of gas production from coal.

* This paper was developed within the framework of the R&D project “Origin, consolidation and evolution of the gas industry in Spain (19th-21st centuries)”, HAR2014-52141-P financed by the General Directorate of Scientific and Technical Innovation of MINECO. The translation of this text was supported by the project CIDEHUS - UID/HIS/00057/2013 (PO-CI-01-0145-FEDER-007702). Thanks go to Mercedes Fernández-Paradas for her comments and suggestions on the text.

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The birth of the *Companhia Gás de Lisboa* (Lisbon Gas Company) and the *Fábrica de Belém* (Belém Plant)

Origins of the plant, location and construction

Since 1848, when gas production and distribution began in Lisbon —both for public lighting and private consumption— the exploitation of this service had been in the hands of a company which held its monopoly: the *Companhia Lisbonense de Iluminação a Gás* (Lisbon Gas Lighting Company).¹ In 1887, however, when a new tender was organized to award the contract for the gas-powered public lighting of the city, the internationalization of the great gas companies was already under way. These companies —namely French, Belgian, or English— sought to conquer new markets in those countries where the exploitation of this service was not yet saturated, both inside and outside Europe.² Thus, several foreign companies presented their bids, and the winner of the concession was the *Société Anonyme d'Éclairage du Centre*, from Brussels. To obtain the large capital needed for the construction of a new plant and piping network, the company made an association with some of the other contestants and put together the *Sociedade Gás de Lisboa*. Participating in this new firm, in addition to the *Société Anonyme d'Éclairage du Centre*, were the *S.A. Crédit Général de Belgique*, the *Banque d'Escomptes de Paris*, the *Compagnie Générale pour l'Éclairage et le Chauffage par le Gaz* (also known as *Gaz Belge*),³ and the *Compagnie Générale Française et Continentale d'Éclairage*.

The concession of public lighting having been assigned to *Companhia Gás de Lisboa*, the exploitation of gas production and distribution in the city was now done in an environment of competition, although an imperfect one, as the new company, lacking the infrastructures needed to guarantee gas supply in the assigned time, was forced to resort to the services of the *Companhia Lisbonense de Iluminação a Gás*. Very quickly, however, both companies with an interest in the business realized that the Lisbon market was not big enough for them to exploit the same service in an economically sustainable way. So, in 1891 the boards of both companies decided to merge them, the result being the *Companhias Reunidas de Gás e Electricidade* —CRGE (Gas and Electricity Companies),⁴ the firm which exploited this business until 1975.

1. For a general overview of the gas industry's evolution in Portugal, and a comparison with Spain, see Matos (2017). For a general overview of the gas industry's evolution in Spain see Fàbregas (2017).

2. On this subject see Paquier and Williot (2005).

3. At this time, the Belgian Gas Company had reached “son extension maximale” (Moreau [2010], p. 943).

4. On the merger process of the two companies see Matos et al (2005), pp. 96-101.

Given the advantages of a location near the Tagus River, the *Companhia Gás de Lisboa* chose as the site for the new gas plant the grounds that had been reclaimed from the river next to the Tower of Belém.

Since gas production was a polluting industry, listed under Class 2 of the table annexed to the decree of October 21st, 1863,⁵ the construction plan had to be analysed prior to the respective license being issued.⁶ To obtain this license, the plant had to satisfy several requirements:⁷ the plant, workshops and gasometer should be placed at least 30 metres away from the closest dwellings; the whole plant grounds should be encircled by a 5-metre-high wall; the various workshops must be built using non-combustible materials, with large and numerous openings in the walls and ceilings; the equipment for distillation, condensation and washing should be placed at the centre of the plant, to reduce the fire hazard; ammoniacal gas liquors and tar must be collected into perfectly sealed pits, to reduce the risk of contamination caused by the residues of gas production; tar could not be used as fuel. The concern to ensure good hygiene conditions in the city was also patent in the prohibition of releasing wastewater into the Tagus river or cleaning the scrubbers in the open air; it was also compulsory to build the purification boxes in a way that would completely prevent gas leaks.⁸

The project that the *Sociedade Gás de Lisboa* presented, of which it sent a plan to the Lisbon City Hall, followed the model of the gas plant built by Léon Somzée in Brussels.⁹ The actual construction took advantage of foreign technology: manufacture of the 20,000 cubic-metre gasometer was handed to the firm Bonnet Spazin, of Lyon; the five furnaces, each with eight retorts, were built by Leclaire, of Dijon; the system for condensing, washing and purifying the gas was entrusted to Walker's of London; the extraction system, the plant counter, and the pressure regulators and gauges were installed by the *Compagnie Générale pour la Fabrication des Appareils à Gaz*, of Paris.¹⁰ Some 250 kilometres of pipes were constructed, following the Somzée system

5. This decree ruled that no establishment classified as insalubrious, dangerous or inconvenient could be founded without previous license, and the *Portaria* of November 23rd, 1865, assigned to the administrative and sanitary authorities the obligation of imposing on these industries the conditions necessary to “*preserve public health and citizens' convenience, with no regard of the expenses such conditions might demand*”.

6. As Leslie Tomory mentioned, the concerns of the English government and municipalities were made clear early on, although the measures taken turned out to be, for the most part, ineffective. Tomory (2012).

7. On the various measures taken to lessen the negative consequences of constructing gas networks, see Cardoso de Matos (2016).

8. ANTT, Câmara Municipal de Belém, 4º Bairro Administrativo, book 600, pp. 41-43.

9. From 1867 on, Léon Somzée was the chief engineer of the Belgian Gas Company, which built plants in several European cities, such as Prague, Sienna and Rimini, among others. (Moreau [2010], p. 942).

10. Martins e Coelho, Adriano Pinto (1998), pp. 27-30.

—already in use in Germany, England, and Belgium— in which the connection between the different pipes was made using caoutchouc instead of lead.

The Belém Gas Plant, environmental issues, public opinion and protests

The plant was very close to the Tower of Belém, a monument celebrating the Portuguese Discoveries, so that from the day that work began the main newspapers and magazines were filled with criticism. In effect, since the gas industry was considered a polluting industry directly affecting the people in the vicinity, both for the active smell that could not go unnoticed, and for the smoke released into the air,¹¹ its location would have to be away from inhabited areas, as determined by law. Furthermore, in an attempt to diminish opposition to this industry, gas plants were often concealed behind building façades, as was the case with Lisbon's first gas plant, located at Av. 24 de Julho.¹²

The criticism levelled at the Belém plant was also related to an effort of embellishment of the waterfront. With the aim of highlighting the Tower of Belém, the surrounding plots containing a series of small houses and beach huts had been expropriated, and the old fair of Belém, in the Largo dos Jerónimos, had been suppressed.

Transferring the Belém plant: a long and complex process

The first attempts to transfer the plant

Early in 1910, after a contribution by the councilman Afonso Lemos, Lisbon City Hall —at the time headed by Anselmo Braancamp Freire— notified CRGE to transfer the plant to another location by the end of the first quarter of 1911, leaving the space near the Tower of Belém free to become a garden.¹³ This, however, had no practical results, despite City Hall having sued the company, for the lawsuit was in the end won by CRGE. The latter, however, was willing to move the plant to another location if it was given compensation, and a plot in another part of town was made available, filling the needs of a functioning gas plant.

The solution was slow to come and, in the years that followed —met with

11. On this subject see Tarr (2014).

12. Due to the concern of inserting the plant into the city's urban grid, at the time of its construction the plant had a pavilion whose façade, facing north, followed the typology of a vaulted pavilion, with three round arches. Santos (1996), vol. I, p. 379. In 1865, this building was demolished to widen the plant area, but the contract signed in 1870 imposed the construction, on the side facing Av. 24 de Julho, of a building façade. Following this dictate, in 1875/76 a Gothic façade by João Eduardo Ahrens was adapted to this plant.

13. This notification came in the wake of a City Hall decision.

protests in the press and from several associations such as the *Associação Comercial dos Lojistas de Lisboa* (Commercial Association of Lisbon Shopkeepers), the *Sociedade Propaganda de Portugal* (Society for the Promotion of Portugal), the *Sociedade de Belas Artes* (Society of Fine Arts), and the *Sociedade dos Arquitectos Portugueses* (Society of Portuguese Architects)—Lisbon City Hall sought an agreement with CRGE over the transfer of the plant.

In 1912, the magazine *Ilustração Portuguesa* published an article under the title “A City Issue: the Tower of Belém and the Gas Plant”. The idea that this was an “issue” of the City of Lisbon illustrates the protest of public opinion against the location of the gas plant so close to the Tower. The article mentioned that “this old issue, which has gone around the whole City Hall and was addressed in various places”, was finally going to be “put before the judges”.¹⁴

In 1923, negotiations were taken up again for transferring the plant from Belém to a different place, and on June 19th of that year António Centeno, a CRGE administrator, was appointed by the government to join the committee charged with studying the conditions under which the transfer could be made. Nevertheless, and although the board of CRGE did not openly oppose the transfer, the fact is that it was reluctant, for such a transfer could not be made without great expenditure and the need to overcome complex technical problems.

Meanwhile, in 1927, the engineer Jean Claude Forrestier again took up the idea of the waterfront boulevard, a project met with great acceptance by the various associations linked to tourism and by the city’s inhabitants themselves.¹⁵ Hence the contract signed in that same year between CRGE and Lisbon City Hall determined that the plant would be transferred to another part of Lisbon in three years’ time,¹⁶ under the condition that the plot of land for the new plant would be chosen by a mixed committee, composed of two engineers from the firm and another two from City Hall.

In the beginning, a plot on Bartolomeu Dias St., next to the Casa Pia was considered,¹⁷ but the idea was put aside because there was a government plan for the urbanization of that area.

The question was not settled within the prescribed time, in fact only in the next decade did the process see some progress. In 1934, it was finally decided

14. *Ilustração Portuguesa*, n. 316, March 11th, 1912, pp. 337-338.

15. In the 19th century, the idea of embellishing and improving the waterfront had been the object of proposals and plans by people such as the engineer Pezerat, from City Hall, the chemist Júlio Máximo de Oliveira Pimentel, who served as mayor, and Thomé de Gamond, among several others. In 1870, followers of Garmond’s ideas proposed “a great boulevard from Santos to Belém”. On this subject see Barata (2009).

16. Art. 11 of the contract.

17. The appointed committee actually produced a study detailing all the expenses to be incurred in the plant’s installation.

that the new plant would be located on a plot near Quinta da Matinha, which reached down to the river —from which some area would have to be reclaimed—. In 1935, the City Hall and CRGE struck an agreement that defined the stake of the gas company in the construction of the new plant and established that some of the work would be the government's responsibility. In the years that followed, the whole issue advanced considerably thanks to the intervention of the Minister of Public Works, the engineer Duarte Pacheco (1899-1943), who from 1938 to 1943 was simultaneously the mayor of Lisbon. Thus, in 1938, the 1935 agreement suffered alterations, to the effect that: the state assumed the obligation of building the landfill and the bridge pier; the City Hall would pay for installing the high-pressure unit that would connect the new plant to the existing distribution network, by means of pipes that would attain a length of 14 kilometres, and CFGE assumed the task of building the new plant.¹⁸

Many issues raised around the transferral of the gas plant from Belém to Matinha certainly had to do with the staging, in 1940, of the *Exposição do Mundo Português* (Exhibition of the Portuguese World), an event celebrating the years of 1140 and 1640, the first being the date of Portugal's acknowledgement as a new state and the second of the independence of Portugal from Spain.¹⁹ The site chosen for the Exhibition was on the waterfront area, and, to make sure that its urbanistic framing was adequate, a plan had been approved for the improvement of Lisbon. This measure provided a new impulse to the negotiations between the government, the City Hall and CRGE aimed at completing the plant's transfer to the grounds reclaimed from the Tagus in the Matinha area.²⁰ At the end of 1940, people were already saying that the Belém plant would soon be demolished, as soon as "the modern automatic plant now rising on the plot recently reclaimed from the Tejo, near Quinta da Matinha, in Poço do Bispo" was finished.²¹ But only in 1952 did that demolition actually take place.

18. These conditions were definitively established in a protocol from 1939. CRGE (1944), p. 6.

19. As there was not a direct successor to the throne of Portugal, in 1580 King Filipe II of Spain became King Filipe I of Portugal.

20. "A great industrial firm collaborating with the celebrations of the Double Centennial. The Companhias Reunidas de Gás e Electricidade would be built, on Quinta da Matinha, a plant unequalled in the Peninsula" (*Indústria Portuguesa* [1939], p. 11).

21. Supplement to *Diário da manhã*. (1940, n/p 78). The *Poço do Bispo* area is in the eastern part of Lisbon.

The Matinha Plant

Construction of the Matinha plant and of the distribution network

From 1913, the *Société Financière de Transportes et Entreprises Industrielles* (SOFINA) began to play a decisive role in the management of CRGE, and from 1914 onwards all studies pertaining to the construction of the new buildings, or the modification of those already in existence, were assigned to the technical staff of SOFINA.²²

Therefore, when the construction of a new plant in Matinha was decided on, all the studies, projects, and decisions on materials and building processes were in the hands of SOFINA and the *Sociedade de Estudos Técnicos*, an enterprise created on SOFINA's initiative.²³

The initial idea was to disassemble the Belém plant and reassemble it in Matinha.²⁴ This solution, however, implied several technical difficulties and was more expensive, in addition to causing the inconvenience of an interruption to the gas supply, so in 1934, as mentioned above, the definitive decision was made to build a new plant near the Quinta da Matinha —CRGE estimated that it would be completed by 1942 or 1943. This option made it possible to fit the plant with more modern machinery and enable a larger gas output.

The work of reclaiming the land from the river, done by the *Administração do Porto de Lisboa* (The Lisbon Port Authority), began after the 1938 agreement already mentioned, and after several soundings were carried out by the *Sociedade Portuguesa de Construções e Obras Marítimas* —EMPORT (Portuguese Society of Constructions and Maritime Works— EMPORT). Twenty-four hectares were reclaimed from the river, but only four hectares were actually occupied by the plant's premises.

Before the year was out, the foundations were laid and the construction of the retorts, furnaces, the main building, and the gasometer had begun. In the following year the assembly of the equipment began and, in December of that year, the journal *Suplemento Diário da Manhã dedicado aos Centenários* (Supplement to the Morning Daily dedicated to Centenaries) wrote that, "In this plant no improvement was overlooked, either in terms of industrial output or of the quality and improvement of production".²⁵

The work of building the Matinha plant was assigned to several national and foreign companies: land reclamation from the river to *Sociedade Portuguesa de Construções e Obras Marinhas Emport*; the foundations to *Socie-*

22. On this subject see Matos e Silva (2008).

23. Jorge (1999/2000, p. 202, note 12).

24. On this subject see Matos (2009), pp. 67 and 70-71.

25. *Suplemento do Diário da manhã* (1940), pp. n/n (78). The same was said in the magazine *Indústria Portuguesa* in the same year (*Indústria Portuguesa*, 1940, p. 5).

dade Comercial Portuguesa de Estudos e Construções Monnoyer (The Portuguese Commercial Building and Surveying Society)²⁶ and the firm *Pieux Franki*; the distillation workshop to *Compagnie Générale pour la Fabrication de Fours*, the firm *Duarte Ferreira & Filhos*²⁷ and the *Companhia União Fabril* (Union Fabril Company)²⁸; the workshops for treating and purifying the gas to *Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz*; the gasometer was commissioned from *Société Anonyme Baume & Merpent*²⁹ and assembled by *L. Dargent Ld^a*; and the piping was commissioned from *Société Anonyme pour la Distribution du Gaz "Distrigaz"*.³⁰

Although the plant was finished in 1942, it was not possible to put it to work immediately because the war made it impossible to import the pipes required—which had been commissioned from the USA—to connect the plant to the existing piping networks.

The inauguration of the Matinha plant was thus postponed. It was only inaugurated on January 8th, 1944, by the Minister of Public Works and Communications, Professor Costa Leite (Lumbrals), who was met by CRGE administrators António Centeno, J. de Stoop, Augusto de Vasconcelos, and technical director José Cabral, engineer Maurice de Roo, the plant's chief engineer, Pompeu Nolasco da Silva, and other engineers.

In that year, when the assets of CRGE were evaluated for insurance purposes, the value assigned to the Matinha plant, including all its buildings and equipment, rose to a total of 29,575,000\$.³¹

The delay in starting production implied that the Belém plant had to keep up its own production,³² which continued even after the Matinha plant was inaugurated.

26. A photograph taken on January 8th, 1939 shows the load test of the plot, using the Monnoyer process. Photo album "Companhias Reunidas Gás e Electricidade - Fabrica de Gás da Matinha I. Construções 1938-39" kept in the Centro de Documentação da Fundação EDP, B1.2.10-2.

27. Located in Tramagal, *Metalomecânica de Duarte Ferreira & Filhos* was an important firm which, much later, became a museum. Recently, the Tramagal City Hall published a book on the life of Duarte Ferreira and his enterprise. Fonseca (2017).

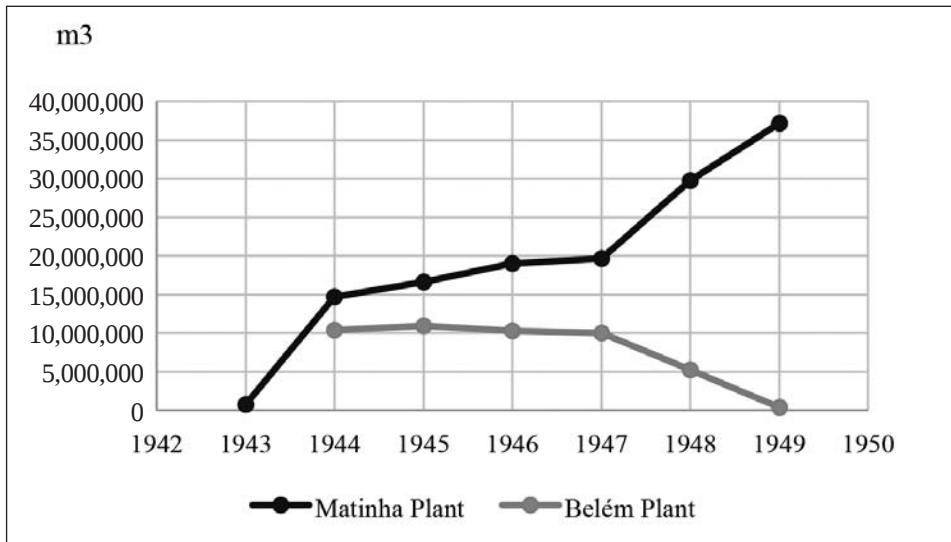
28. *Companhia União Fabril*—CUF was one of the big Portuguese enterprises and belonged to Alfredo da Silva, one of the greatest Portuguese industrialists. On this subject see Silva et al. (2002) and Rollo (2008). Despite its importance at the national level, at the time of the First World War CUF "had a much smaller dimension than its North-American, British and German counterparts", p. 180.

29. Created in 1853 by Clemente Delbèque in Baume, Belgium, this firm worked with metallic structures for stations, bridges, markets, gasometers, etc., having expanded to several countries in Europe and even to other continents, where it built several metallic structures from the end of the 19th century onwards.

30. *Fábrica de Gás da Matinha* (1944), p. 18.

31. *Relação e estimação dos bens* (1944), p.s/n (3).

32. Some improvements, in fact, had to be made to the Belém plant. See, on this subject, Matos et al. (2005).

CHART 1 • Gas Output, 1944-1949

Source: CRGE (1930-1957), years 1942-1950.

In 1944, the outputs from both plants were still significant. In the years that followed, the output from the Belém plant decreased, until it ended in 1949, allowing for the plant's demolition to begin on June 7th, 1950.

The various buildings and the process of gas production

The whole plant was closed off by a wall running along the river, while a pier bridge was built to allow access to the plant. In this way, all the coal acquired for gas production, after it was unloaded on the pier, was mechanically transported to the distillation silos, being ground down along the way.

The 20 chambers, or vertical retorts, installed in a building 34 metres long by 22 metres wide, were heated from the sides by the syngas produced by a set of rotating gas generators. In these the coal was distilled, leaving as residue the coke, which went out through the chambers' lower parts. This was the first step in the production of gas, which could be divided into five steps: continuous distillation carried out in those chambers; purification; benzol extraction; storage; and transportation. First, the gas went through a group of three vertical, water-cooled condensers, where it lost around 70% of its light and heavy tars; then it went through another two condensers, losing around 25% of its tars, and finally through two filter-condensers, where it became free of its last remaining tar. The gas was then washed in a "methodical washer" and a rotating washer, so as to leave its ammoniacal salts in the water. Next, the

gas went through four large boxes installed in a building measuring 25 by 25 metres. The iron oxide contained in those boxes chemically purified the gas, through the absorption of sulphides, hydrogen, sulphates, etc. After leaving the chemical purification chamber, the gas was measured by “total counters” and underwent one final operation —the partial extraction of benzol. After that, it was stored in the large gasometer, with a capacity of 30,000 cubic metres.³³

Outside the gasometer there was a pressure reduction station. This sent the gas into the pipes feeding the distribution networks by means of posts that lowered the pressure, to ensure normal and stable pressure throughout the Lisbon network.³⁴

There was, in addition, continuous distillation of coal, which produced tar for roads, light oils, benzol, phenolic oils, heavy oils, pitch, naphthalene, and other products.

In 1939, the piping network was already 7,340 km long, and the construction of the Matinha plant made it necessary to make a series of new pipes to link it to the existing network. The increase in gas consumption seen in the 1940s gave rise to the network’s expansion, and also to the installation of pipes parallel to those already in existence, in those areas where consumption was higher. In 1946, new gas pipes were installed in the boroughs that had been built in the meantime —Encosta da Ajuda, Campolide, and Madre de Deus. Two years later, the piping was extended to the borough of Alvalade, already home to 1500 consumers.

In 1950, the continuing expansion of the network was accompanied by the replacement of old pipes in the city’s old quarter. By 1951, the gas distribution network measured 509,524 linear metres, comprising 23,257 in the high-pressure network and 486,267 in the low-pressure network.³⁵

As early as 1943, it was considered that the project for the Matinha plant would not enable the production of enough gas to supply the city of Lisbon. From the start, therefore, the installation of two extra furnaces (in addition to the five original ones) had been contemplated, and their construction started at the end of 1945. That same year saw some improvements to the plant —including the installation of a new gas generator for heating the furnaces, and an increase in the gasometer’s capacity. These improvements gave this gas production facility an output capacity of 100,000 m³ of gas per day, at 4,200 kcal/m³. The following year saw a new installation of carbur-

33. On the evolution of gas production techniques in Spanish plants, see the article by Alayo Manubens and Francesc Xavier Barca Salom. Manubens and Salom (2017).

34. A description of the gas production process was included in the journal *Diário de Lisboa* (1944), p. 5.

35. That same year saw the start of construction of the new gasometer on Av. Infante Santo, concluded in 1953 with its connection to the network.

ized water gas, comprising two *Humphreys & Glasgow* production units, each with a capacity of 30,000 m³ of gas per day at 4,200 kcal/m³, thus enabling the plant to produce 160,000 m³ per day. This installation was completed in the year 1948.³⁶

Despite all this it became necessary, in order to respond to the constant rise in gas consumption, to increase the plant's output. But its operations—extremely polluting—had already reached the limit of carbon oxide emissions per cubic metre, so that a new installation of carburized water gas was out of the question. Therefore, the chosen alternative was to install “vertical chamber, batch distillation furnaces which, from the same coal, produce a much denser, harder, and less breakable coke than that resulting from continuous distillation, being apt for many industrial uses. These same furnaces can treat special coal, the so-called coal for coke, and produce metallurgical coke (...), being suitable for most of the country's foundries”.³⁷

The installation comprised six batch-distillation furnaces made by *Fours Lecocq*, each having five vertical chambers, with a joint output capacity of 100,000 m³ and, for heating the furnaces, three rotating-grid gas generators; this installation was concluded in 1954. From 1955 on, the plant began to receive the residual gases coming from the refinery of SACOR —*Sociedade Anónima de Combustíveis e Óleos Refinados* (Refined Fuels and Oils, Ltd.)—through two conduits that connected the two plants.

In 1957, when CRGE merged with SACOR to form *Sociedade Portuguesa da Petroquímica* (SPP), the production of gas started to depend on petroleum, by using the by-products of the Cabo Ruivo refinery.³⁸ Thus, the year 1958 saw the termination of gas production from coal. The same change had taken place in Spain two years earlier, when gas production from petroleum began in Barcelona.³⁹ Just like in Portugal, those plants in Galicia which survived the aftermath of the Second World War radically transformed their processes of gas production. Many among them replaced their gas production machinery with modern cracking lines.⁴⁰

36. For more details see Cardoso de Matos et al. (2005).

37. Nolasco da Silva was at the time the head of the Matinha gas plant.

38. Santos (2004), pp. 324-325.

39. As mentioned by Mercedes Fernández-Paradas and Carles Sudrià Triay in this issue of the *Revista de Historia Industrial*, “since 1957 it had been extracted from petroleum gas liquors, with the permission to found BUTANO, S.A., whose partners were, in equal shares, CAMPSA (Compañía Arrendataria del Monopolio de Petróleos Sociedad Anónima) and REPESA (Refinería de Petróleos de Escombreras, S. A.), controlled by the Instituto Nacional de Industria”. Fernández-Paradas and Sudrià Triay (2018).

40. On this subject see Martínez, Mirás Araujo, Tato Lindoso (2009, pp. 342-34).