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Global Strategies and National Performance: Explaining the Singularities of the Spanish Electricity Supply Industry[1]

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In this article I compare the trajectories of two pioneers, contemporaries who were leaders of the electricity industry in their respective countries: Samuel Insull, who led the U.S. Chicago Edison Company, and Juan Urrutia, creator of Hidroeléctrica Ibérica in Spain. The Chicago Edison Company was the world leader in managerial strategy and design, in the application of new technology, internal management, commercial policy, and in the establishment of a framework for relationships among firms, financial systems, and administration. Hidroeléctrica Ibérica was created in 1901, shortly after major advances in long-distance electricity transportation, for the purpose of exploiting hydro-electricity resources. It immediately established itself as the leader of Spain's electricity sector, and remains a leader in the twenty-first century through the ambition of the initial project, the quality of the resources, and its strategies on various fronts. My purpose is to reflect on both the demand and the supply side of the complexities of the evolution of large technological systems, which are subject to a wide variety of influences. I explore the degrees of freedom that remain open to a follower who adapts strategies to special circumstances once a world leader has shown the way. I examine differences in context and their consequences for the economic logic Urrutia applied when making policy decisions that seem to differ from the best entrepreneurial practice of the period as defined by Insull.

The electricity supply industry, intensive in capital, technology, and management, appeared around the end of the nineteenth century. The

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circumstances surrounding its beginnings would make it plausible to expect a rather homogeneous development of the industry's timing and managerial strategies across countries. First, solutions were quickly found for several problems that had slowed down the diffusion of electricity, despite its apparent superiority in comparison to other carriers.[2] Second, an efficient cartel of electrical equipment manufacturers and of national and international holdings to promote the establishment of supply firms were created early on. These groups provided financial, managerial, and technical assistance to new firms, thus considerably reducing the typical uncertainties associated with the establishment of an emerging industry.[3] A third factor surrounding the industry's first steps was the ease of technological diffusion through fairs, conventions, periodical publications, and managers' organizations at both national and international levels. Finally, these same networking activities allowed the new industry to organize quite efficiently for the defense of its interests vis-à-vis the political authorities. In spite of these factors supporting homogeneous diffusion, distinct national and regional experiences arose. This was also the case with other technologies such as the telegraph and the telephone.

In this article, I compare the contemporary trajectories of two managers who were pioneers and leaders in their respective countries. One is Samuel Insull, who led the Chicago Edison Company in the United States, and the other is Juan Urrutia, head of Hidroeléctrica Ibérica in Spain. The Chicago Edison Company (Chicago Commonwealth Edison after 1907) was the world leader on many different fronts: managerial strategy, design, and application of new technology, internal management, commercial policy, and establishment of a framework for the relationships among firms, financial systems, and administration.[4] Hidroeléctrica

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[2] Systematic research on electricity started in the early nineteenth century, but defining its potential applications and finding operational means to use it took a long time. The most significant advances were made in chemistry, in telecommunications (since 1836), and in lighting (since 1858). Several innovations improved the competitive position of electricity with respect to other energy carriers and enlarged the types of uses. Some outstanding examples are: the introduction of alternating current by Westinghouse (1886), the development of Tesla's AC motor and the integration of the central station steam turbine and an AC generator (1900); see Warren D. Devine, "From Shafts to Wires: Historical Perspectives on Electrification," *Journal of Economic History* 43 (June 1983): 347-72.

[3] The origins of the international cartel of electrical equipment producers coincided with the creation of Edison General Electric (1889) and later on General Electric (1892); see Forrest McDonald, *Insull* (Chicago, 1962).

[4] According to Hirsh, Insull developed the principles of what would later be known as the "grow and build" strategy. By the 1920s that seemed to be the only possible and logical approach to running a utility company, and this approach was dominant in shaping the electricity industry from the 1930s until the 1960s.

Ibérica (later on Iberduero and now Iberdrola) was created in 1901, shortly after major advances in long-distance electricity transportation, for the purpose of exploiting hydroelectricity resources. It immediately established itself as the leader of the electricity sector in Spain, a position it has maintained into the twenty-first century as a result of the scope of the initial project, the quality of resources, and the strategies employed on various fronts.

My purpose is to reflect on the complexity of the evolution of large technological systems, which are subject to a wide variety of conditioning factors, on both the demand and the supply side. More specifically, I would like to understand what degrees of freedom remain open to a follower, who adapts strategies to special circumstances, once a world leader has shown the way. I look at the differences of context and their consequences for the economic logic applied by Juan Urrutia when making policy decisions that seem to differ from the best entrepreneurial practice of the period as defined by Insull.

I present some facts on the trajectories of these two managers, concentrating on the early years of their emblematic firms (both participated in many other concerns and their firms also kept evolving). I present these two stories in parallel, and then comment on similarities and differences. To begin, let me comment on the pertinence of this exercise in comparative history. There are obvious differences: Urrutia started his company nine years after Insull (although both had previous experience), and he could benefit from the impressive progress that was made during that time, because he was aware of the U.S. experience. He operated within a much more backward economy that offered less room for development.[5] However, there are also important similarities. Both Urrutia and Insull commanded a thorough understanding of the electricity business and anticipated the advantages of the central station. Both were able to raise the necessary financial support for their complex projects. They both went beyond the limits of their firms to promote and lead entrepreneurial organizations, to achieve agreements with their public administrations on matters of production and service standards, procedures, the limits between private and public interest, and the organization of the industry. They both operated in cities that emerged

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See Richard F. Hirsh, *Technology and Transformation in The American Electric Utility Industry* (New York, 1989).

[5] Coal consumption in Spain was 250 kg/person/year in 1900. The equivalent figure for the United States was 3,453 kg/person/year; see Carles Sudrià, "Un factor determinante: la energía" in *La economía española en el siglo XX: Una perspectiva histórica*, ed. Jordi Nadal et al. (Barcelona, 1987). In 1933, the gross consumption of primary energy was 459 Kec in Spain and 4,897 in the United States; Joel Darmastadter et al., *Energy in the World Economy: A Statistical Review of Trends in Output, Trade and Consumption since 1925* (Baltimore, Md., 1971).

toward the end of the nineteenth century as industrial and communication centers, based on activities characteristic of the second industrial revolution. In addition, their firms continued as leaders well beyond the first steps I describe.

Insull and the Chicago Edison Company

Samuel Insull, a self-made man, entered the world of electricity in 1879, when he was appointed secretary for Edward Johnson, Thomas Edison's chief engineer, who had moved to London in order to promote the diffusion of Edison's telephone technology in Europe. In 1881, aged twenty-one, he went to New York at Johnson's recommendation to become Edison's personal secretary. Insull, who was born in London in 1859, had learned about managerial techniques, was acquainted with the main inventors, bankers, businessmen, and politicians in the London environment, and was familiar with the problems related to patents and to the financing of electricity companies in Europe.[6]

During his twelve-year stay in New York at Edison's side, Insull participated in the definition and first expansion of the central station system. His main role was to rationalize and ensure the efficient operation of a business that was based in a multiplicity of firms and activities. Given his talent and previous experience, he was initially assigned the responsibility to raise funds for Edison's new projects. In 1883, he was given the added responsibility of head of the Edison Construction Department in order to promote the creation of new companies that would build and manage central stations in large cities. Insull traveled all around the country for two years, checking the possibilities of different urban markets and devising strategies to face the competing gas suppliers and to deal with corrupt municipal governments. He kept track of all those companies, once created, and was appointed to the boards of many. In 1885, he created the Association of Edison Illuminating Companies (AEIC), whose aim was to promote information diffusion among these firms, and to develop new management strategies for central stations. Somewhat later, he created the National Electric Light Association (NELA) to lobby on behalf of the industry. These associations represented the interests of the private firms and led the industry until the Depression of the 1930s. In 1886, Insull became director of Edison Machine Works, whose main purpose was to rationalize the performance of the various equipment-manufacturing firms that had been established in preceding years. This effort resulted in the creation, in 1889, of Edison General

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[6] The description of Insull's managerial trajectory is drawn from Thomas P. Hughes, "The Electrification of America: The System Builders," *Technology and Culture* 20 (Jan. 1979): 124-61, and *Networks of Power: Electrification in Western Society, 1880-1930*, (Baltimore, Md., 1983); McDonald, *Insull*, and Harold L. Platt, *The Electric City: Energy and the Growth of the Chicago Area, 1880-1930* (Chicago, 1991).

Electric, the holding company for all the central stations created by Edison across the country. General Electric was born in 1892 from the merger of Edison General Electric and Thomson Huston. J. P. Morgan, the major financial supporter of this new $50-million corporation, assigned Insull the role of second vice-president. He declined, wanting his independence and in the belief that the future of the electricity business lay more in production and distribution than in equipment and appliance manufacturing. Instead, Insull accepted the presidency of Chicago Edison. He was convinced that the city would offer him a chance to prove that his approach to the electricity business and his defense of the central station were right.

Objectives and constraints on Insull's project. When he arrived in Chicago, Insull was convinced that electricity would supersede other forms of energy still in use, and that it was potentially applicable to a large spectrum of industrial and domestic tasks, beyond its major applications in the chemical industry, telecommunications, lighting, and traction.[7] His aim was to prove that the central station could supply energy to any type of urban consumer at very low prices. He created a unified system of light and power supply for Chicago.[8] His intuition was that central stations could benefit from economies of scale in production and distribution and produce at a much lower unit cost than the autonomous stations with much less capacity that were then used by the small and middle-sized consumers. But he had a long way to go.

Insull's project was not instantaneously implemented. The development of the industry in the preceding decades had produced a very different market structure than the one he had in mind. To begin with, only a few potential users had chosen electricity over alternative forms of energy. Chicago had nearly a million people in 1892, and there were only 5,000 users of electricity for lighting, supplied by small local central stations.[9] Those who used electricity for power and traction produced it directly, using their own generators. The bulk of demand for energy was covered by alternative sources, which remained competitive until after the end of the nineteenth century. Traction and power were obtained from

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[7] Around the middle of the century, different instruments and motors were developed. They were used for different purposes (fans, elevators, printing equipment, metal engraving), and by a variety of users who could not easily use steam energy. Household appliances (irons, stoves, heaters, coffee machines, and hotplates) were introduced at the 1892 Chicago World Fair.

[8] Insull's view of monopoly combined some elements from the English utilitarian tradition with others of German origin. From the English he emphasized the collective benefits under this form of organization; from the Germans he took for granted that the state would have a say in controlling the firm's objectives and management.

[9] McDonald, *Insull*, 63.

steam engines. Lighting often used gas, which produced very satisfactory results after the introduction of the Welsbach gas mantle. Hence, attracting potential users to the large central stations and away from their alternative sources was a real challenge. The alternatives had to be overridden in terms of price and quality, but that was not enough. Because the main advantage of electricity was to allow for increases in productivity through the use of new equipment, time had to pass until potential users decided to discard their existing equipment and to invest in the new and expensive electrical replacements.

At that time, the technology for production and distribution had not yet achieved the standards that later allowed electricity to displace its competitors. In 1892, there were 20 small central stations in Chicago and 489 medium-sized generators supplying electricity for the purposes of lighting, power, and traction. This fragmentation derived from the low productive capacity of the first prototypes for central stations, and also from the fact that Edison's infrastructure for distribution of direct current had very low returns.[10]

In addition to these technological difficulties, there also were open questions regarding management. The economic characteristics of the central station were not well understood. Factors affecting costs were not well known, making it hard to decide on optimal production levels and on pricing criteria. At first glance, the central station appeared to enjoy economies of scale. Yet, as long as all clients were using electricity for lighting, each new user would increase rather than reduce unit costs. This was the case with Edison's Pearl Street Station, a pioneer firm created to supply New York's financial district. It was created in 1882 but did not acquire its first client for mechanical uses until 1889.[11] In order to reduce costs effectively, the pioneers had to learn how to coordinate the supply and demand sides for a non-storable good and to extend the hours of use as prerequisites to distributing a high fixed cost among many different types of consumers.

Starting the business of electricity supply required significant financial resources, because it is a capital and technology-intensive

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[10] Vivid proof of the distance between the dreams of the first visionaries and their actual project achievements is given by the failed beginnings of the pioneering Pearl Street Station, which began operating in New York on 4 Sept. 1882. Each generator in that company had a capacity of 125 hp. In order to light 10,000 light bulbs, ten such generators were needed. However, they did not operate properly when connected in parallel. As the number of consumers increased, energy losses increased dramatically. Current escaped in subterranean wires and caused small fires at connection points. These losses reached 40%, and the 10,000 lights objective took two years to achieve at a high cost.

[11] Lacking a better guide, Edison used external criteria like the price of gas for lighting, and priced electricity slightly below that. His strategy was geared to entering the lighting market, rather than reflecting the cost characteristics of the electricity system and allowing electricity to compete on all applicable fronts.

activity. In addition to dealing with the speed of technological change, which required frequent equipment renewals, companies also had to devote capital to the takeover of previously established firms to avoid destructive competition in an industry where a natural monopoly seems to be the best arrangement. Therefore, both Edison and Insull had to use their charm and to put their reputations on the line in order to obtain money though non-standard channels. At the beginning of his activity with Chicago Edison, Insull obtained the support and sympathy of individuals who shared his views and who had been successful in business. Two important examples are Marshall Fields, who had pioneered in establishing large department stores, and John J. Mitchell, the president of the Illinois Trust & Savings Bank of Chicago.

Establishing the new industry required developing a specific institutional framework because of the good's characteristics as a public utility. Electricity supply required the use of public property, involved safety hazards, and clashed with the interests of other already-established services. Therefore, it strongly depended on agreements with local or state authorities regarding other vested interests. The company was interested in exclusive long-term franchises, at the lowest possible cost. The municipality oscillated between the defense of consumers' interests, maintaining its agreements with already established energy suppliers (gas and kerosene), and grabbing the profits from the new electricity industry. Municipalities saw these benefits accruing from different angles: the opportunity to obtain public services like street lighting, which was ultimately a municipal responsibility; obtaining new resources for the municipal budget; and, eventually, enriching individual administrators.

The pivotal period: 1892-1898. During his first six years as head of Chicago Edison, Insull considerably advanced his objective to secure the exclusive rights to supply electricity to the city. He obtained a long-term contract, achieved substantial cost reductions and production increases, and absorbed many of the previously established companies. Even before the beginning of his tenure he had secured his independence by becoming the main stockholder (thanks to a loan from Marshall Fields), and getting the commitment of the business community to make sufficient working capital would be available to him at all times.

His first actions were geared to eliminate restrictions on supply by increasing production capacity and lowering costs.[12] The company began building a new central station by the end of 1892. Two years later, it was the world's largest operating generating plant. After absorbing smaller companies, production capacity multiplied from 2,800 kilowatts (kw) in 1892 to 14,800 kw in 1898. As for cost reduction, Insull acted on several fronts. The most obvious was to benefit from the returns to scale of

[12] Chicago Edison's initial investment was roughly $1 million, and it initially planned a generating capacity of 2,800 kw.

central generating stations. In addition to the larger plants, he also secured an increase in demand by enlarging the number of consumers and increasing their individual consumption. In order to serve this larger set of clients efficiently, it was necessary to reduce the large losses associated with Edison's distribution circuits. The transmission of direct current imposed severe limitations on the size of the area that could be supplied and also on the number of clients and the quantity served. By adopting alternating current in 1896, Insull broke away from the orthodoxy of his old mentor and created a distribution system distinguished by its larger capacity and versatility. Also related to overall cost reduction was Insull's policy regarding shareholders. He tried to ensure that capital was rewarded with a good, stable dividend, thus creating a climate of confidence that allowed him to reduce the cost of capital and thus the company's financial charges.

Another important front was the improvement of management efficiency. When he arrived at Chicago Edison, Insull was already an experienced businessman; he had a vast knowledge of his industry, as well as excellent intuition regarding future developments. He created large departments for statistical and accounting control of the firm, as well as a marketing department that allowed the firm to exploit the advantages of the central station. By the early 1890s, the standard rate of utilization of equipment in the industry was 15 percent. Insull's strategy was to increase this rate dramatically. This tactic is necessary in all industries with high fixed costs, but it is especially challenging with electricity because current is not storable and requires production, distribution, and consumption to occur simultaneously. In principle, generating equipment allows for continuous, round-the-clock production, but consumer demand tends to concentrate at specific times of day. It is important to be able to apply a pricing system inducing consumers to spread their demands throughout the day. The precondition for such a policy is the firm's ability to measure consumption. The demand meter developed by Arthur Wright allowed the determination not only of total consumption, but also of its distribution over time and the maximum amount of instantaneous consumption of each consumer in the distribution network. With these data, Insull's company was able to use two-part tariffs (introduced in 1898) to stimulate consumer demand at off-peak hours, allowing the firm to charge according to actual costs.

In the absence of data about the time distribution of demand, firms tended to overproduce. The norm they followed in order to guarantee a reliable service was to set capacity at the level of the sum of demand peaks, even if they did not occur simultaneously. The availability of readings for consumption by type and their distribution throughout the day allowed lowering the capacity requirement. In the case of Chicago, the difference between the sum of peak demands (without adjusting for the lack of simultaneity) and the maximum demand at any given moment in time was on the order of 92 to 29 kw. By carefully monitoring the hourly distribu-

tion of demand, the firm could adjust production to their actual peak loads.

Accurate measurement of consumption also facilitated understanding the breakdown of the fixed and variable costs of serving different types of consumers. In addition to two-part tariffs, incentives to consume in off-peak hours were provided to smooth out the hourly distribution of demands, and new clients were added. In order to support expansion by publicizing the possibilities of electrical equipment and the firm's prices, the sales department was increased to twenty-five people in 1895. These efforts to smooth demand and to approximate supply to actual demand resulted in substantial unit cost reductions, on the order of 32 percent, allowing a considerable cut in prices by 1897. In 1900, a new section of the company was created, to provide potential clients with the design of energy systems for lighting and power. These designs could incorporate already available motors and models or new ones, according to the needs of the client.

Backed by these technical and commercial achievements, Insull became the sole supplier of Chicago's electricity. Between 1893 and 1897, a period of low expectations, Edison absorbed the twenty-two other firms that had been operating in town and some of those in the suburbs. With that Insull not only enlarged and diversified the customer portfolio, but also obtained the exclusive rights that some of these companies held for different types of equipment, resulting in technological superiority. All these efforts allowed him to pre-empt potential new suppliers.

Agreements with the city administration were essential to provide continuity and to consolidate the firm model defined by Insull in these early times. Concessions for electricity supply to Chicago were relatively easy to get, but they lasted for only ten years, subject to renegotiation. At the turn of the century, due to the extraordinary growth of the city and to the deficiencies and abuses of several companies, there was a heated debate regarding the management and regulation of public utilities. It was within that context that Insull managed to obtain a long-term concession. This success derived from the solidity of his firm, from Insull's negotiating skills, and from other political circumstances. In 1897, he managed to buy the Commonwealth Electric Company, created by some local politicians in an attempt to secure a fifty-year concession to supply the whole metropolitan area.[13] Insull was aware of the public aspects of the electricity industry, and he sought continuity for his model by reaching agreements with the politicians. He avoided the partisan interests and corruption that tended to play too much of a role in the process. At the

[13] The constitution of this society was not a real threat to Insull, because he had already secured exclusive buying rights for the Chicago area from the main equipment suppliers. Faced with their inability to get the project going, politicians ended up accepting an offer of $5,000, much below the $1 million they had expected; see Platt, *The Electric City*.

1898 NELA convention, he made a procedural proposal (for the creation of state utility regulatory commissions) that included negotiation (the rights and duties of private utilities) to consolidate a model of regulated monopoly. The companies accepted this proposal, which defined the framework within which negotiations between the utilities and the states took place during the first two decades of the twentieth century.

By 1898, after six years of managing Chicago Edison, Insull had established his project. The central station was competitive with isolated autonomous plants, his firm was ten times larger than in 1892, and he had the concession to supply Chicago for fifty years. Along the way, he had also given shape to the most radical aspect of his strategy, which was called at the time the "gospel of consumption." Because of his success as a manager and his attractive and popular ideas, he was elected president of the NELA in 1899.

The consolidation years. In the years to follow, Insull continued to make inroads on the fronts he had opened with his managerial strategies. He achieved important cost reductions by incorporating new technologies (like the steam turbine, introduced from Europe in 1900), by increasing the size of plants, by reducing factor costs, and especially by improving the load factor.[14] The director of the commercial department had remarked that there was more money in an intelligent sale of the product than in improving production and distribution efficiency. Accordingly, the main management innovations were geared to improve the adjustment between demand and production flows. During the first decade, the company reached twenty-three different types of consumers. These different types could be charged prices connected with the actual costs of serving them, thanks to the work of the departments of statistics and accounting, and the load dispatch department (created in 1903).[15] Prices for lighting evolved from 20 cents/kw hour (kwh) in 1892, to 10 cents in 1897, 5 cents in 1906, and 2.5 cents in 1909.[16] "Insull took satisfaction in pointing out that despite its dependence on thermal plants, Chicago compared favorably with Niagara and San Francisco, which utilized hydroelectric power. In 1914, Insull's company received an average of 2.05 cents per kwh. Boston

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[14] In 1902, Insull took charge of the coal mines that were supplying his firm. He improved their management and designed new labor contracts that reduced uncertainty and stimulated the increased productivity of labor.

[15] In 1901, in cooperation with several equipment producers, he created the Design of Energy Systems for Lighting and Power Department, which proposed prototypes fitted to the needs of prospective clients. In 1901, the Publicity Department was created. Its main initiatives were the launching of a periodical publication, *The Electric City*, which announced the major discoveries in the use of electricity, and the establishment of demonstration points where the new applications of electricity could be observed "in situ."

[16] McDonald, *Insull*, 104.

utilities received 5.37 cents per kwh, while New York companies received 4.45 cents per kwh. Among large cities, only San Francisco could provide cheaper electricity, due to the use of hydroelectric sources, at 1.97 cents per kwh."[17]

By 1910, Commonwealth Edison Company had capital of over $30 million. With a capacity of 219,000 kw, it was the largest integrated lighting and power company in the world, serving the area with largest consumption density at the lowest per capita prices within the United States. In the following years, it continued to expand and to diversify. Its activities in rural electrification led to the creation of the Public Service Company of Illinois, an integrated system for the provision of gas, electricity, and public transportation that served 195 communities spanning 6.000 square miles by 1923. Its efforts in organizing holdings, which started in 1905 with the creation of *the* Electric Board and Share Company, in cooperation with the First National Bank, reached a peak in 1917, when the Middle Western Company was constituted. This company had subsidiaries in nineteen states and supplied 8 percent of the commercial electricity in the United States by 1928.

Urrutia and Hidroeléctrica Ibérica

Juan Urrutia was born in Amurrio in the Basque country of Spain in 1866. He was educated as an engineer in one of the technical schools that had been created by the mid-nineteenth century. These schools provided one of the élites in Spain, as many of its graduates entered the state administration, while others served in large companies, often starting their careers in firms of foreign origin, within sectors like the railways and the water, gas, and electric utilities. A favorite student of Professor Jose Maria de Madariaga, Urrutia was immediately fascinated by electricity, though he was tempted to emigrate to Mexico and work for the oil industry. He did not, however, and as a young man he participated in the construction of electricity plants in the Basque country. His son describes him as a man of action, very intuitive, who was able to attract a wide team of collaborators from the technical, business, and political world who followed him with great fidelity.

When the Vizcaya business community approached him to create Hidroeléctrica Ibérica, Urrutia was already an accomplished professional. He was the director of an electricity supply company, the Compañía Eléctrica de San Sebastián, which exploited several hydroelectrical plants that he had built on the Oria River. Like Insull, although through different means, he accepted the new challenge only after having secured enough future control of the firm and promises of financial backing for his objectives and strategy.

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[17] Hughes, *Networks of Power*.

The Ibérica was created in 1901 with a capital of 20 million pesetas, with the purpose of supplying the major Spanish markets for energy through the exploitation of hydroelectricity. This was an ambitious project. The hydroelectrical plants that Urrutia planned for the first stages of the new firm represented 60 percent of the total installed capacity in all of Spain for the previous twenty-five years, since the origins of electricity in 1875 (128,000 HP, produced through 861 stations). Because the project was ambitious, it was carried out in stages, and an individual firm was created for the supply of nearly every major market area in Spain. Urrutia died in 1925, and by then he had created, directed, or been a member of the board of all the firms in the group: five in the generating and six in the distribution business, which represented 50 percent of all the electricity consumed in Spain at that time. Because my main purpose is to describe Urrutia's strategy and to compare it with Insull's, I will concentrate on Urrutia's plans for the first and most important of these firms, Hidroeléctrica Ibérica, which served the Basque market.

The original plan. The Ibérica was created to enter the emerging electricity industry with a very optimistic view. Its foundation project is described as follows in the 1901 *Annual Report:* "The immediate objective of this society is to build large water falls of over 1,000 HP, use their power, convert it into electrical energy and transport it to large towns where it can be easily used, either for lighting or to produce mechanical energy to be used in the existing industries, or in others to created in the future." The basic purpose of the business was to supply energy at a low price, a strategy that "should report excellent returns to the capital that gives support to our industry."[18]

Fixing objectives and strategies is harder for leaders than for followers. In the eight years between the creation of Insull's and Urrutia's firms, many technological limitations had been overcome.[19] In addition, partly thanks to Insull's entrepreneurial experience, the earlier uncertainty regarding the central station system had been resolved. This allowed Ibérica's foundation project to be very confident and coherent. When addressing the first assembly of shareholders, on September 29, 1901, Urrutia remarked, "The nature of our business is such that there are no

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[18] Hidroeléctrica Ibérica, *Annual Report 1901*.

[19] In 1886, George Westinghouse and William Stanley perfected the transformer, which allowed the transmission of electricity in a cheaper way and over longer distances, in the form of alternating current. This opened up the possibility of exploiting hydroelectric plants and of serving their electricity to distant consumption centers. In 1895, Nicoli Tesla's innovations led to the perfecting of motors driven by alternating current, which increased their efficiency, quality, size, and adaptability to a wide range of uses. These were important developments for Urrutia's project, which relied on the transportation of hydroelectricity to the mining and industrial firms in the Bilbao.

unknown factors in it, in contrast with other kinds of industrial activities. This allows us to progress with full confidence that we can know about our results a priori, with certainty." Although Urrutia's experience was not as rich as Insull's, he had all the necessary basic information. He had decided on the main features of the firm's strategy, and he had taken measures to ensure market control and long-run planning capacity, two key elements that allowed him to run efficiently an industry with local monopoly power.

Expectations of a strong demand were certainly very favorable for the Ibérica. Per capita energy consumption was lower in Spain than in the advanced industrialized countries, but the allocation of energy resources in Spain worked in favor of a quick substitution of hydroelectricity for steam and of rapid progress toward a more energy-intensive economy.[20] Electricity generated great expectations, because coal was expensive, and there were no lags in the introduction of electricity compared with the pace in more advanced countries.[21] Yet, these expectations could not be fulfilled until the end of the nineteenth century, because only then did advances in long-distance transportation allow the use of hydroelectric resources, with which Spain was well endowed but which were available only at a distance from production centers.

Ibérica eventually concentrated on the market in the Bilbao region, where several firms were already operating. (The same partners created other firms to cover different areas.) The Compañía Electra de Bilbao, which provided steam generators, was created in 1890. The first supply company, Eléctrica del Nervión, was founded in 1892. The first two hydroelectric plants were built in 1896. By 1901, an incomplete census counted twenty-five generators with a total capacity of 1,548 HP. Guipúzcoa, the other Basque province with significant industrial activity, had a larger number of hydroelectrical plants, mostly build by individual industrialists to serve their own firms. The third Basque province, Alava, started to produce hydroelectricity in 1896, and Suministro Eléctrico de Urumea was founded in 1898. At the turn of the century, when Ibérica was created, other small companies were created to serve specific areas and to exploit small hydroelectrical plants. Most ended up being absorbed by Ibérica, or distributing electricity bought from Ibérica.

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[20] The results from a study on consumption densities at the turn of the century were transcribed in the *Annual Report* of 1901. Guipúzcoa was ahead, with 27.61 kw per 1,000 people, followed by Madrid with 24.72, Vizcaya with 18.79, Navarra with 9.73 and Barcelona with 8.43.

[21] Annual electricity consumption in Spain was 10.2 kwh per capita in 1900. This was much lower than the 64.9 kwh per capita of the United States, but higher than France's 7.59 kwh per capita or the United Kingdom's 5.2 kwh per capita; see Bouda Etemad and Jean Luciani, *World Energy Production, 1800-1985* (Paris, 1991).

One of Urrutia's first activities, before constituting Ibérica, was to study the available natural resources and technological options to evaluate prospective profits. After evaluating the costs of infrastructure, service, and finance, he concluded that he could produce at a cost of 150 pesetas per HP/year. Comparing this figure with the cost of 250 pesetas for autonomous plants, he concluded that he might be able to reward investors with 20 percent per year.[22]

Urrutia's memoirs and reports to the various company boards during the first two years of his activity in Ibérica contain the major lines of his strategies on markets, production, prices, and profits. In order to benefit from the scale economies that the technologies of that period allowed, he sought to cover areas with a diversified set of demands and a high per capita level of consumption. These included the industrial areas in the Basque country, the Valencia region, Santander, and parts of Catalonia. He also took an interest in areas where the high cost of coal would allow for a wide benefit margin. This was the case of Madrid, where the costs of coal transportation doubled the price of steam-generated electricity relative to that in the Basque country. He proposed to produce, transport, and supply electricity to large consumers in these areas, including local distribution companies, which in most cases would be subsidiaries.

In order to reduce production costs, he planned to exploit the most productive sites for hydroelectricity production in each of the areas, developing them gradually to avoid overcapacity. He also foresaw an active policy of technological renewal. In order to avoid uncertainties regarding supply needs, Urrutia consistently negotiated contracts with new customers that required increases in capacity before putting that capacity in place. For example, the first annual report points out that the company had secured contracts for the full capacity of its first plants even before the works were started. Finally, he decided to guide his price negotiations in supply contracts by setting prices just slightly below those his clients would have to pay for other types of energy.[23]

Other aspects of the initial strategy were not made explicit but are clear from the actions taken well before they were carried out. These were a determination to control the market fully and to develop a long-term planning horizon. At the time of its establishment, Ibérica already had the rights to exploit hydroelectricity concessions far beyond those needed to

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[22] *Annual Report 1901*.

[23] Urrutia explained the criteria that he had adopted on pricing in the following terms. "The prices to charge by the society will be fixed in terms of an extreme value, which is the minimum price at which power is obtained in the industry, which limit is set by the best steam machines and stands at about 248.40 pesetas the CV/year. This is the price that is fixed for internal calculations, but the actual prices charged may be higher, especially for industries which now obtain power at very high prices, and in particular for lighting and traction uses."

supply the market in the short run. It also quickly absorbed a number of smaller established firms.[24]

The abundance of available capital resources and the characteristics of concessions for hydroelectricity production and distribution facilitated the firm's long-term planning ability. In those times, concessions in Spain were awarded for an indefinite period. The indifference of local and state authorities toward regulation, which persisted until the 1930s, resulted in a wide margin of discretion for concessionary firms, which could decide when and how to exert their rights. In summary, Urrutia managed to reserve the market for his firm against all possible competitors, thanks to Ibérica's financial strength, scale of operation, and strategic decisions within a favorable institutional setup.

The development of the project, 1904-1921. Once Ibérica was constituted, Urrutia limited his objectives to the Basque market for six years for "prudence." Then new firms were created under his direction, and a number of hydroelectric plants and dams were built to serve other regions. Here I consider only Ibérica and the Basque market, which are sufficient to characterize Urrutia's strategies.

Construction of the first three hydroelectric plants to serve the Basque country began in 1901, a few weeks after the establishment of the society, for a theoretical total capacity of 19,200 HP. The supply to Bilbao began in 1904, with a capacity of 300 kw. The three plants were gradually put into operation and were completely functional in 1911, along with a thermic station in Burceña. By then the total capacity was 19,000 kw. From then on it grew slowly, up to 24,000 kw in 1921. Only in 1924, after the exploitation of new falls in the Pyrenees, bought in 1916, was capacity boosted again. In order to minimize infrastructure costs, Urrutia decided to build falls without a dam, to use the most advanced generation and transportation techniques, and he kept improving them as new discoveries were made. Thanks to the special connection between Ibérica and the Bank of Vizcaya, and to the fact that the operation was profitable by the second year of exploitation, financial costs stayed very low.

Urrutia's results were excellent. After two years of supplying electricity, the firm's rate of utilization was already 23 percent, and it went up to 42 percent in 1910, four years later. This is close to the best recorded rates for the whole period, which were approximately 43 percent. Ibérica's technology and the limitation of the flows within the basin for several months in the year made such figures very unlikely. They must be credited to Urrutia's energetic management, the flexibility of his pricing system, and the prudence of his expansion policies.

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[24] The *Annual Report* of 1902 states that, "since we are the owners of the only falls that can be used to serve certain communities, we are also free of potential competitors that might appear, like those that arose in Bilbao and destroyed our calculations."

The crucial aspect in his policy regarding growth was the decision not to expand capacity until guaranteed demand exceeded the projected level of production. Urrutia could implement that policy because neither legislation nor his concession contracts forced him to supply adequately the demand within his exclusive area. From a technical point of view, this policy was implemented by delaying both the construction of new hydroelectric plants and the enlargement of existing ones. Added flexibility was introduced through the addition of thermic generation plants, or by renting additional capacity from producers close but outside its markets. As a result of this strategy, from 1904 to 1912 production expanded rapidly to 68 million kwh, at an annual rate of 55 percent, coinciding with the execution of the works planned in 1901, for which demand was essentially guaranteed from the start. The following period, 1913-1922, was one of relative stagnation, with a growth rate of only 1.4 percent, to reach 79 million kwh. This stagnation was partly the result of a weaker demand during World War I, but more of the absence of new investments in generating installations.[25] Ibérica acted very prudently under uncertainty. Even if it had all of its capacity in use essentially from 1909 on, it postponed the creation of new facilities, other than those already planned in 1901, until the Pyrenees hydroelectric plants started producing in 1923. During those intermediate years, the coefficients of utilization were extremely high, and Ibérica even had to ration its own clients in 1918 and 1919.

As a complement to the supply policy, market control and price policies greatly favored the task of selecting those clients who could be turned away from alternative energy options. In the absence of other central station operators and of any effective regulation, Ibérica could choose those clients that were more adequate to its interests of smoothing demand and more willing to pay. From its early stages, it combined the industry supply with that for public lighting, and thus had large clients and a stable demand for long years ahead. In addition, it used the pricing system to induce these clients to smooth their consumption levels along the day. Its prices went steadily upward and were strongly correlated with the price of coal, which provided the best indicator of the cost of alternative energy types.[26]

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[25] The Basque economy, that around the Ria de Bilbao in particular, was affected by strikes, a decrease in iron ore exports, and the high price of coal.

[26] The costs of electricity for lighting in Bilbao evolved as follows. In 1913, the cost of using five light bulbs was 2.5 pesetas a month. This price had changed to 3.15 pesetas in 1921. In 1926, the meter system was introduced. In that year, the price for a kwh was 0.62 pesetas, and by 1944 the price of a kwh was 0.92 pesetas. (*Boletín Oficial de Estadística del Ayuntamiento de Bilbao*) Considering all types of consumers, the average price paid for electricity supplied by Ibérica increased by 76 percent form 1913 to 1929. To establish some comparative terms, in a previous article I have shown that in the 1913-1929 period electricity became

By 1921, which corresponds to the full exploitation of the hydroelectric plants planned when the firm was set up, Ibérica was producing 33 percent of the capacity of the Basque country.[27] It had achieved a coefficient of utilization of 37 percent, well above the Spanish average of 24 percent, a high net return of 3.5 pesetas per kwh, and this allowed it to pay an average dividend of 7 percent to shareholders, much larger than that of any other electricity company in Spain.[28]

On the Similarities and Differences between Insull's and Urrutia's Strategies

I want the reader to see these two firms and their managers in parallel, although here is no need to stretch comparisons to the limit. In this section, I consider some substantial differences between the two histories. The many similarities speak for themselves and require no further explanations. Among these similarities, one could mention the use of the most advanced technology (of its own creation in one case, imported in the other), a clear choice in favor of the central station, and the availability of abundant financial resources.

In order to prove that the electricity supplied by central stations could displace other forms of energy and enlarge the types of energy use to achieve mass consumption, Insull developed a multifaceted program. He integrated backward, becoming a self-sufficient owner of coal resources and a developer of generating equipment, and forward, by developing equipment and appliances for industrial and domestic use. Insull's profit opportunities lay in taking advantage of the large economies of scale and scope provided by the central station system, and he also benefited from the substantial improvements in the techniques of thermic generation that came after 1900. Because of that, his efforts were directed toward increasing consumption by progressive and continued price decreases. This in turn justified the building of larger, more efficient plants, demanding more clients and allowing for further cost and price reductions: the so-called grow and build strategy.

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six times cheaper than coal in the United States; see Arthur G. Woolf, "Electricity, Productivity, and Labor Saving: American Manufacturing, 1900-1929," *Explorations in Economic History* 2 (April 1984): 176-91. In Spain the ratio stayed at 1.7 and at only 1.1 for the Basque country. See Francesca Antolín, "Electricidad y crecimiento económico. Los inicios de la electricidad en España," *Revista de Historia Económica* 3 (1988).

[27] This share is lower than that achieved by other central stations operating in more competitive systems as in Catalonia (79%) or in the United States (70%). It did not surpass the capacity of independent power producers until after 1926. See Francesca Antolin, "Hidroeléctrica Ibérica y la electrificación del País Vasco," in *La empresa en la historia de España,* ed. Francisco Comin and Pablo Martín Aceña (Madrid, 1996).

[28] See Francisco Sintes Olives and Francisco Vidal Burdils, *La industria eléctrica en España* (Barcelona, 1933).

In contrast, between 1901 and 1921, Urrutia developed his original, simple plan. He exploited the water power that the firm acquired when it was constituted, limiting the firm's function to that of a wholesaler, with the aim of maximizing the return on investment. The different primary resources used by the two firms may largely explain the different approaches to business, and their different production and pricing strategies. The key to Urrutia's plan was to benefit from the rents of a scarce natural resource in a context where alternative sources of energy, like coal, were very expensive. His prudent growth strategy was optimal: he avoided excess capacity by increasing capacity only when enough additional demand was already contracted. And his pricing policy was consistent with that approach: he charged his clients a price close to that client's outside option, generally the use of coal. This caused electricity prices to remain higher than under a "grow and build" strategy, which may explain the slower progress of electrification in Spain.

In addition to the differences in type of energy source, Insull and Urrutia also had widely different personalities, although both were the kind of leader that their diverse circumstances demanded.

Insull fitted the dynamic country in which he lived. He faced the challenge of proving that Edison's not quite successful pitch for the central station in New York was well conceived, though many problems remained to be solved. He solved those problems with the Chicago Edison Company, where he had broad powers as both president and major shareholder. His personality was that of an inventor-entrepreneur whose talent was to anticipate the potential of an industry yet to be developed and to put the puzzle together. The challenges to the inventor were important in his motivation: he had a passion to meet technological, managerial, and institutional challenges, pride in his achievements, and a strong interest in public recognition. He pushed forward, well beyond the initial purposes set for his firm, and contributed decisively to the objective of making electricity a widespread and affordable good. In this entire quest, he benefited from the openness of the American public toward technological innovation. He was both helped and checked by a state and federal public administration that produced effective incentives for improved quality of service and better managerial practice.

Urrutia, in turn, was suited to his more limited environment. In 1901 he still played the role of an innovator, because he had to adapt the new business to the special characteristics of his socioeconomic environment. However, he did not face many of the uncertainties others had dealt with, because his predecessors in the business had resolved them. He was not a major shareholder, but rather the person elected by the Basque business community to direct an important project. This does not mean that Urrutia was not able or ambitious. Hidroeléctrica Ibérica aimed at all major markets in the Iberian Peninsula, including Portugal. Although the notion of having a unique firm was quickly abandoned, a series of different firms associated with Ibérica eventually achieved much of this objective, with Urrutia in the lead. However, the project had no

pretense of originality, nor was it an attempt to educate new consumers. It was oriented toward obtaining a good return to capital, and this should be the measuring rod applied in evaluating Urrutia's performance as a manager. As we have seen, there were several reasons why there was little point for him to adopt a strategy based on unconditional growth and low prices. The Spanish market lacked depth, and growth was slower than in the United States. Public authorities did not interfere much with the activities of public utilities, due to the weakness of the state. Hence, price discrimination could be used very effectively, and there was little pressure to respond quickly to new demand. An efficient, highly qualified administrator like Urrutia did not have to do more than he did to be successful within this more conservative environment, which demanded from him only a substantial return on investment.