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## THE HISTORY OF JAPAN'S ELECTRIC POWER INDUSTRY BEFORE WORLD WAR II

TAKEO KIKKAWA \*

### I. *Introduction: Issues and Perspectives*

Tokyo Electric Lighting, Japan's first electric power company, was established in 1883. In the 129 years since then, Japan's electric power industry has contributed greatly to Japan's economic development in both the consumer and industrial sectors. In particular, in the period after the Russo-Japanese War (from the latter half of the 1900s to the early 1910s) and in the 1920s, the power industry played the role of Japan's leading industry, and then during the period from the mid-1950s through the early 1970s, formed the basis for Japan's high economic growth by providing a cheap and stable supply of electricity. Since the reorganization of the electric power businesses in 1951, Japan's electric power industry was carried forward under the system of nine (ten) privatized power companies<sup>1</sup>. However, the disaster of Tokyo Electric Power Company's (TEPCO's) Fukushima Daiichi Nuclear Power Plant of March 11, 2011 set off a process of thorough reform of the electric power business, and at present, a fundamental review of the nine (ten)-company structure is underway. The purpose of this paper is to present an overview of the pre-World War II development process of Japan's electric power industry and elucidate the history of the dynamic industrial development which affected that process from 1883 to the state control of 1939<sup>2</sup>.

The development of an industry is driven by the dynamism of the autonomous business management of that industry. This paper, therefore, focuses analysis on the autonomous aspects of electric power company management.

In this paper, autonomous electric power company management is simply defined as "electric power company management that satisfies the interests of private enterprise and the public." In other words, autonomous electric power company management means that privately owned and privately managed electric power companies achieve rationalization through corporate efforts and realize a cheap and stable supply of electricity.

The decline of autonomous electric power management would undermine the balance between the interests of private enterprise and public interest, giving rise to the problem of an alteration of corporate form and industrial organization. In fact, all epoch-making events in the history of Japan's electric power industry involved a restructuring of the industry's restructuring, including the "electric power war" in 1922-1931, the establishment of the Federation of Electric Power Companies in 1932, state control over electric power in 1939-1951, the reorganization of

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\* Professor, Graduate School of Commerce and Management, Hitotsubashi University

<sup>1</sup> The "nine-company structure" shifted to a "ten-company structure" with the privatization of Okinawa Electric Power Co. in October 1988.

<sup>2</sup> This paper summarizes the results of an analysis carried out by Kikkawa [2004a].

the electric power businesses in 1951, and the liberalization of the electric power market since 1995. When one considers the developmental process of Japan's electric power industry in accordance with the core issues of the industry, the focus of the analysis is inevitably narrowed down to the problems concerning the industry's organization.

By focusing on the changes in the industry's organization, the developmental process of Japan's electric power industry can be categorized into the following three eras:

- A. The era when the industry had a large number of privately owned and managed electric power companies, with some public-sector power suppliers owned and managed by local municipal entities (1883-March 1939).
- B. The era of state control when Japan Electric Power Generation and Transmission and the nine power distribution companies held a monopoly over power generation and transmission, and distribution businesses, respectively (April 1939-April 1951).
- C. The era of the nine (ten)-company structure, where the industry was dominated by nine (ten) privately owned and managed electric power companies with integrated power generation, transmission and distribution businesses and regional monopolies, supplemented by some public-sector electric power suppliers owned and managed by local municipal entities, Electric Power Development Co., a special corporation, and Japan Atomic Power Co., jointly owned by the government and the private sector (May 1951 onward).

Era A can be further divided into the following three periods, based on the existence or lack thereof of market competition among electric power companies:

- A-1. The period when electric light companies, mainly relying on small-scale thermal power generation, operated in each city with almost no competition (1883-1906).
- A-2. The period when regional electric power companies, mainly relying on hydraulic power generation and medium- and long-distance power transmission, were engaged in fierce market competition ("the electric power war") (1907-1931).
- A-3. The period when the "electric power war" nearly came to an end with the establishment of the Federation of Electric Power Companies, a cartel organization, and the enforcement of the revised Electric Utility Law that set out the principle of supply area monopolies (1932-March 1938).

Similarly, Era C can be subdivided into the following three periods depending on the existence or lack thereof of market competition and the degree of performance-based competition:

- C-1. The period when the regional monopolies by the privately managed nine electric power companies effectively eliminated market competition but when there still was performance-based competition (May 1951-1973).
- C-2. The period when there was no market competition due to the establishment of regional monopolies and waning of performance-based competition (1974-1994).
- C-3. The period when partial market competition began between the power wholesale and retail sectors with the start of the deregulation of the electric power market (1995 onward).

The developmental process of Japan's electric power industry, as outlined above, is

principally characterized by the fact that the industry has been basically managed by the private sector, except for Era B, when it was placed under state control. This stands in sharp contrast to Japan's telecommunications sector, also an electricity-related public utility service and, like the electric power industry, placed under the jurisdiction of the Ministry of Communications in the prewar period. It was consistently under direct management by the government or by a public corporation from the inception of the service through the 1985 privatization of Nippon Telegraph and Telephone Public Corporation.

Two reasons can be pointed out for the dominant mode of private management for the electric power industry as compared with the public management of the telecommunications industry: (a) differences in initial conditions; and (b) differences in subsequent conditions. For (a), the governments in the Meiji era saw the telecommunications industry as critical for reasons of national security and public order. In terms of (b), the accumulation of organizational capabilities in electric power business management by private electric power companies basically forestalled repeated attempts at the nationalization of the electric power industry (except for the period of state control forced upon the industry amid the rise of nationalistic ideology) (Kikkawa [1992], Kikkawa [2001]).

The central feature of the developmental process of Japan's electric power industry — the predominance of private management — becomes even clearer in international comparison. For example, in Europe after World War II, there were many efforts to nationalize electric power companies (Myllyntaus [1991]), and Britain and France actually nationalized their electric power industries over the period of 1946-1948 (Caron [1979], Hannah [1979], Hannah [1982]). In Japan during the corresponding period, however, the opposite was observed (Kikkawa [1993]). It was the reorganization of electric power businesses in 1951 that created the present industrial structure of nine privately managed electric power companies, with the abolition of the state control introduced under the wartime controls. As a result of this reorganization, the structure of the electric power industry in postwar Japan came to be dominated by the nine large-scale private electric power companies, an internationally distinctive characteristic. Japan's industrial structure differs from major European countries in that it is predominantly privately owned and managed, and is also different from the United States in that private power companies all have large-scale business operations (Viotor [1986]).

The development of Japan's electric power industry, as outlined above, is characterized by the fact that the industry has been managed by the private sector, except for Era B, when it was placed under state control<sup>3</sup>. Placing importance on this fact, this paper elucidates the history of the electric power industry's development by focusing primarily on management trends in the private electric power companies.

This paper includes three chapters, which correspond to the aforementioned eras and periods: A-1 (1883-1906), A-2 (1907-1931), and A-3 (1932-March 1938). Furthermore, each

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<sup>3</sup> In opposition to the argument that the Japanese electric power industry has basically operated under private-sector management, some doubts may be expressed that perhaps the emphasis on the form of private management is insignificant, since even though private management was the dominant form of the industry's operation, the electric power industry as a public utility sector could not escape government intervention and as such the independence of electric power company management was limited. However, this ignores the potentiality of the power industry to exercise autonomous management even under circumstances where it was subjected to restrictions as the public utility sector. As discussed in detail in Chapters 2-4 and Chapters 6-7 in Kikkawa [1995] (and discussed to a certain extent in this paper), this potentiality became a reality in the 1930s as well as in the period from the 1950s to the early 1970s.

chapter has three sections that discuss, respectively, (1) an overview of the specific era or period and demand trends, (2) changes in the supply system, and (3) the dynamism of the industry's development.

## II. *Genesis of the Power Industry and the Era of the Electric Lighting Companies (1883-1906)*

### 1. Establishment of Electric Power Companies and the Creation of the Power Market

Tokyo Electric Lighting, Japan's first electric power company, was inaugurated when it received official permission for establishment in February 1883, and began actual business three years and five months later, in July 1886. This chapter covers the pioneering days of Japan's electric power industry up to the start-up of Tokyo Electric Lighting's Komahashi power plant in 1907, which significantly transformed the electric power supply and demand picture in Japan.

Tokyo Electric Lighting started building power plants immediately after the launch of its business. In November 1887, it completed its second electric light station<sup>4</sup> in Minami-Kayabacho in the City of Tokyo, Japan's first power generation plant for consumer use, and started actual supply on November 29, only five years and ten months after the world's first power plant for supplying electricity to consumer use began operating in the Holborn Viaduct area of London. Tokyo Electric Lighting installed a 25kW Edison direct-current generator at the second electric light station, a small coal thermal power plant, and supplied power using a low-voltage direct-current distribution system.

Tokyo Electric Lighting not only provided electricity in Tokyo but also undertook the installation of electric generators across the country, mostly for cotton spinning companies and newly established electric lighting companies. With regard to the electric lighting companies, Tokyo Electric Lighting by 1891 had installed generators for power for consumer use at Kobe Electric Lighting, Kyoto Electric Lighting, Nagoya Electric Lighting, Yokohama Kyodo Electric Lighting, Kumamoto Electric Lighting and Hokkaido Electric Lighting. Thus, in the first few years after its establishment, Tokyo Electric Lighting had served as an organizer of Japan's electric power industry as a whole.

The impact of the launch of business by Tokyo Electric Power gradually spread all over the country. Beginning with the creation of Nagoya Electric Lighting in September 1887 as Japan's second electric lighting firm, electric lighting firms were established one after another across Japan. And the start of business by Toyama Electric Lighting in the Hokuriku region in March 1899 marked the establishment of electric lighting companies in all of Japan's nine regions, except for Okinawa<sup>5</sup>.

At the time when electric power firms first began operating across Japan, electric lighting

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<sup>4</sup> The first electric light station of Tokyo Electric Lighting began operating in July 1888, later than the second electric light station.

<sup>5</sup> The nine regions are Hokkaido, Tohoku, Kanto, Chubu, Hokuriku, Kansai, Chugoku, Shikoku and Kyushu. This regional classification is based on the supply areas of the nine power distribution firms established in 1942 and the nine major electric power companies inaugurated in 1951.

constituted the majority of demand, with demand for power representing only a fraction of the total. The number of electricity users for lighting across Japan stood at 10,000 in 1894 and 50,000 in 1902, and topped 100,000 in 1906, reaching reach 141,058 by the end of 1906. The number of electric lights, which was 10,000 in 1889, rose to 100,000 in 1896 and topped 500,000 in 1906, reaching 678,511 by the end of 1906 (all numbers based on Japan Business History Institute [2004]<sup>6</sup> Table 3-1).

However, demand for electric lighting did not necessarily grow smoothly in the pioneering days of the nation's electric power industry. Power was not cheap, and besides, outside of urban areas, the power transmission and distribution networks were not well developed. Also, there was a technical problem: electric bulbs burned out easily because metal filaments were not yet used. Thus, in the period prior to 1906, oil lamps were widely used as sources of light in ordinary households, and gaslights were still prevalent as street lamps in urban areas. Electric lighting established its primacy in the competition among lighting sources only after 1907, when hydraulic power generation got into full swing thanks to the realization of long-distance power transmission, and when metal filaments came into widespread use in electric bulbs.

In the initial years of Japan's electric power industry, demand for electric power was very small in comparison to lighting. As of the end of 1906, a total of 2,335 electric motors were in operation across Japan, with the number of users being 2,166 and the converted electric force 8,391 kW (Japan Business History Institute [2004] Table 4). Prior to the Russo-Japanese War (1904-1905), industrial plants were powered mainly by steam power, with electric power playing only a limited role. Looking at the breakdown of factories by source of driving power across Japan as of the end of 1903, steam power accounted for 2,205, hydraulic power 1,004, oil 163, gas 123, electricity 86, the combination of steam and hydraulic power 107, the combination of steam power and gas 6, the combination of steam and electric power 19, the combination of electric power and power other than steam 11, and the combination of other driving power 17 (statistics compiled by the Administration and Documents Division, Secretariat of the Minister of Agriculture and Commerce [1905]).

## **2. Thermal Power-centered Supply System and Power Generation for In-house Consumption**

At the end of FY1906, the total power output of power generation facilities in Japan amounted to 91,296kW, with 66,101kW, or 72.4% of the total coming from thermal power and 25,195kW from hydraulic power (statistics compiled by the Electricity Bureau, Ministry of Communications [1909 edition]). Thus, the composition of power sources in Japan in the early years was dominated by thermal power generation.

Meanwhile, as of the end of FY1906, the length of electric lines was 3,801 km, with the total extension of electric lines 14,506 km (Japan Business History Institute [2004] Table 12). The power supply system in the early years of the nation's electric power industry consisted mainly of short-distance power transmission from thermal power plants.

However, it was also true that toward the end of the 19th century, pioneering efforts were made toward the development of large-scale hydraulic power and long-distance power

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<sup>6</sup> Japan Institute of Business History [2004] is a database on the history of Japan's electric power industry created through the cooperation of the Japan Institute of Business History and Takeo Kikkawa.

transmission. Such efforts included Hiroshima Hydraulic Electric's transmission of power at 11,000V over a distance of 9 km to Kure in May 1899 and over a distance of 26 km to Hiroshima in December of the same year, and Koriyama Silk Spinning's power transmission, also of 1,000V, over a distance of 23 km to Koriyama in June 1899.

Hiroshima Hydraulic Electric had rights to supply electric power to the City of Hiroshima and was engaged in retail electricity sales. At the same time, it sold wholesale power to Hiroshima Electric Lighting, which had rights to supply the City of Hiroshima with power for electric lighting. But the two companies had a dispute over wholesale power rates in August 1906. While the dispute itself was settled through a judgment by the Supreme Court, Hiroshima Hydraulic Electric and Hiroshima Electric Light can be considered to have been in potential rivalry at the time of 1906. The relationship between the two companies was a harbinger of the competition among electric power companies in the period after 1907, which will be taken up in the next chapter.

In the early years of Japan's electric power industry, the business areas of the power companies were quite limited due in part to the poor transmission and distribution networks, making it impossible for them to fully respond to the demand for electricity. Power generation for in-house consumption played a significant role in filling the gap. At the end of FY1906, the ratio of in-house power generation to the total output from the nation's power generation facilities was 44.7% for hydraulic power, 28.2% for thermal power, and 32.7% for hydraulic and thermal power combined (statistics compiled by the Electricity Bureau, Ministry of Communications [1909]).

### 3. Emergence of Dynamism

A total of 76 electric power firms were operating in Japan as of the end of 1903, immediately before the start of the Russo-Japanese War. The City of Kyoto had the only public-sector operator, with the remaining 75 firms being privately owned and managed electric power companies (Kikkawa [2004a] pp. 32-33).

Meanwhile, regulatory rules for the electric power business — the first unified law provision related to the electric power industry — were promulgated in May 1896, giving concrete shape for the first time to Japan's power industry administration. However, the principal objective of the regulatory rules for electric power business was to ensure safety. The government's involvement in the industry was quite passive, leaving the course of the industry to the initiatives of the private sector from the beginning.

Japan's electric power industry established itself almost as early as its counterparts in Western industrial countries, as evidenced by the fact that Japan's first power plant for electricity for consumer use went into operation only five years and ten months after the launch of the world's first such plant. It was quite unusual for a so-called "transplanted industry" to establish itself in Japan, a latecomer, almost simultaneously with its peers in Western industrialized countries and to achieve smooth development thereafter. This was made possible by the special circumstance that there was no international competition in the electric power industry. But what should not be overlooked here is that the lack of international competition may be a necessary condition, but not a sufficient condition, for the early development of an electric power industry in a latecomer country. In other words, the early development of an electric power industry in a less developed country is difficult unless certain economic

conditions are in place. Given that the electric power industry is capital intensive, one of its main economic preconditions is funding. Japan's electric power companies were not necessarily successful in mobilizing capital through the issuance of shares in the period prior to the Russo-Japanese War. The major force behind the industry's surmounting of the difficulty of funding constraints was electrical engineers who acted as organizers of the power industry.

In the early days of Japan's electric power industry, the number of shareholders of electric power companies was quite limited, with the amount of capital put up by each shareholder reaching exorbitant levels. The people who played a crucial role in making such large capital contributions by shareholders possible were engineers such as Ichisuke Fujioka of Tokyo Electric Lighting, Kunihiko Iwatare of Osaka Electric Lighting, and Sakuro Tanabe of Kyoto City's municipal electricity service. These electrical engineers powerfully explained the convenience and safety of electricity and the future prospects of the electric power industry in an effort to persuade influential people in their respective areas, who were initially reluctant to make big investments in an industry they did not know much about. Without the devoted commitment of these engineers, the mechanism for the successive establishment of urban electric light companies would not have worked so smoothly.

As seen above, a certain dynamism was at work even in the period immediately after the birth of the electric power industry, but that dynamism was driven not by publicly owned electric power suppliers but by privately owned and managed companies. Thus, Japan's electric power industry, from its inception, was strongly called upon to exercise autonomous management to ensure compatibility between the interests of private enterprise and public interest.

However, Japan's electric power industry in its pioneering days failed to fully carry through autonomous management. This is clearly demonstrated by the fact that the industry could not fulfill the public-interest task of providing cheap electricity due to the sharp rises in coal prices, as it relied heavily on thermal power generation. The supply of cheap electric power was only achieved with the advent of a new era after 1907, characterized by the development of hydraulic power and market competition.

### III. *The Era of Hydraulic Power Development and Competition (1907-1931)*

#### **1. Start of Competition and the Rapid Growth of the Power Market**

In the period around the Russo-Japanese War (1904-1905), two situational changes emerged that significantly affected Japan's electric power industry. One was the realization of long-distance power transmission at high voltages of over 50,000V in the United States. Another was the sharp rise in the price of coal, a fuel used for thermal power generation, caused by the outbreak of the Russo-Japanese War in 1904.

In the wake of these changes, Tokyo Electric Light built the Komahashi power plant with an output of 15,000 kW in Yamanashi Prefecture and in December 1907 launched power transmission at 55,000V to Tokyo, over a distance of 76 km.

The start of operations at Tokyo Electric Lighting's Komahashi power plant, with the introduction of long-distance high-voltage transmission technology, marked a turning point for the composition of Japan's power sources, from one dominated by thermal power and



supplemented by hydraulic power to one dominated by hydraulic power and supplemented by thermal power. Hydraulic power development for medium- and long-distance and high-voltage transmission was launched across Japan, and by 1912 the combined output of hydraulic power plants exceeded that of thermal power plants (Japan Business History Institute [2004] Table 7). For Japan's power industry, the "era of hydraulic power-first, thermal power-second" had arrived, and remained in place until the early 1960s.

The shift in the composition of power sources to one dominated by hydraulic power and supplemented by thermal power significantly altered the shape of the power industry<sup>7</sup>.

First, the reduction in power generation costs made it possible to lower electricity rates, which led to dramatically increased demand for electricity. In urban areas, as a result of lower lighting charges, householders began to replace oil lamps with electric lights. Reflecting the decline in the price of electricity relative to coal, the electrification of industrial plants also made progress. In the period immediately after the Russo-Japanese War, however, the diffusion of electric motors still lagged behind that of steam engines at the national level. It was only after the period of World War I (1914-1918) that the networks of power distribution improved and factory electrification really took off.

Second, demand for electric power surpassed that for lighting, in part due to the fact that electricity rates for daytime and power use were set at levels lower than electricity rates for nighttime lighting. These rate schedules were introduced partly because the power companies urgently needed to boost daytime demand for electricity as hydraulic power plants running around the clock came to command a large share of the composition of power sources. According to an estimate by Ryoshin Minami, electricity consumption for power exceeded that for lighting at end-users of electric power companies for the first time in 1919 (Minami [1965] pp. 198-199). Following that time, with the full-fledged electrification of industrial plants in the wake of the improvements to the distribution networks, the gap between electricity consumption for power and electricity consumption for lighting continued to widen.

Third, the combination of high-output hydraulic power development and long-distance high-voltage power transmission created wider opportunities for new entrants in the power industry, increasing the possibility of new entrants undermining the market monopolies of existing electric lighting companies in major urban areas. The hydraulic power development boom, set off by the completion of Tokyo Electric Light's Komahashi power plant, reached a crescendo during the postwar boom period from the end of World War I through the early 1920s. Through this process, powerful electric power wholesale companies that combined high-output hydraulic power development and long-distance high-voltage power transmission came to the forefront, including Daido Electric Power and Nippon Electric Power. These new wholesale power firms later came to be engaged in fierce market competition, in what became known as the "electric power war," with established retail power companies. Thus, the hydraulic power development boom was indeed a fanfare that ushered in an era of competition in Japan's electric power industry.

This chapter examines the development process of Japan's electric power industry during the period of 1907-1931, which can be characterized by hydraulic power development and

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<sup>7</sup> With regard to the changes in Japan's electric power supply system brought about by the start of operation of the Komahashi power plant of Tokyo Electric Lighting, Naofumi Nakamura conducted a detailed analysis of the changes in the Kanto region following the approach of Hughes [1983] (Nakamura [2010]).

market competition as seen above. This era of competition drew to a close in 1932, when the Federation of Electric Power Companies was established and the revised Electric Utility Law was enforced.

Between the end of 1907 and the end of 1931, the number of electricity users for lighting jumped from 210,000 to 11.45 million, the number of electric lights from 860,000 to 37.41 million, and the amount of electric power used for lighting from 30,000kW to 960,000kW (Japan Business History Institute [2004] Table 3-2). Also, between the end of 1908 and the end of 1931, the number of installed devices consuming electric power soared from 3,978 to 519,765 and the converted electric power from 12,752kW to 3,792,163kW (Japan Business History Institute [2004] Table 4). In short, the market for electricity expanded dramatically. The period from the end of the Russo-Japanese War through the 1920s, with World War I in between, can be described as the “first rapid growth period of Japan’s electricity market.”

In the first rapid growth period of Japan’s electric power market, a shift took place in the composition of demand from lighting to power. A calculation of the contribution to the increase in electricity consumption by lighting and power using the estimates by Minami [1965] pp. 198-199 produces a ratio of 53:47 (lighting versus power, same hereinafter) for the post-Russo-Japanese War period (1908-1913), 33:67 for the World War I period (1914-1918), 38:62 for the post-World War I period (1919-1923), and 11:89 for the period of 1924-1931. These figures show that the rapid growth of the market for electricity in 1907-1931 was led by increased demand for electric lighting in the post-Russo-Japanese War period<sup>8</sup> but by the expansion of the demand for electric power in the World War I period and thereafter. Roughly speaking, Japan’s electricity market, with World War I as a major turning point, shifted from one centered on demand for lighting to one dominated by demand for power.

## 2. Large-scale Hydraulic Power Development and Long-distance Power Transmission

In response to the rapid growth of the electricity market, the total output of electric power generation facilities expanded sharply from 114,913kW to 4,656,524kW between the end of 1907 and the end of 1931. The breakdown of total output by power source at the end of 1931 shows that 3,056,936kW, or 65.6% of the total, came from hydraulic power and the remaining 1,599,588kW from thermal power (Japan Business History Institute [2004] Table 7). As the composition of power sources was dominated by thermal power as of the end of 1906, the above figures indicate that active electric power development in the period of 1907-1931 primarily focused on the development of hydraulic power.

In Japan, hydraulic power sources suitable for large-scale development are mostly found in locations far from big cities, such as in the Chubu mountain range. Thus, large-scale hydraulic power development is not feasible unless it is combined with long-distance high-voltage power transmission. Between the end of 1907 and the end of 1931, the length of electric lines was

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<sup>8</sup> The full-fledged spread of electric lighting in the post-Russo-Japanese War period was facilitated by such factors as: (1) the decline in power rates for lighting as a result of competition among electric power companies in the urban lighting market sparked by hydraulic power development and long-distance power transmission; and (2) the widespread use of electric bulbs using tungsten filaments with high durability and lower power consumption after Tokyo Electric Lighting started producing such bulbs in March 1909. The decline in lighting rates and the arrival of metal-filament electric bulbs helped to finally establish the primacy of electric lighting in the battle for the top spot among sources of light in the post-Russo-Japanese War period.

extended considerably from 4,756 km to 265,953 km, with the total extension of electric lines also growing from 18,193 km to 920,963 km (Japan Business History Institute [2004] Table 12). In this period, the power transmission and distribution networks grew at a rapid pace.

The construction of power plants and expansion of the power transmission and distribution networks required massive funds. The fund-raising process of Japan's electric power industry before World War II can be divided broadly into two periods: up to the 1910s when stock issuance was the central vehicle, and the 1920s and onward when the issuance of bonds came to play an important role<sup>9</sup>.

The progress of large-scale hydraulic electric power development and long-distance and high-voltage power transmission indicates the existence of economies of scale as well as the merits of vertical integration in Japan's electric power industry. Large-scale hydraulic power development and long-distance and high-voltage power transmission triggered competition among electric power businesses by attracting wholesale power firms into the market. However, there were problems in that this development emerged just as the economies of scale and the merits of vertical integration began to function. Generally speaking, if electric power companies engage in market competition at a time when economies of scale are at work, this can lead to self-destructive competition through never-ending additional investment and can cause socially wasteful overlapping investment and the destabilization of the supply of electricity resulting from the exhaustion of electric power suppliers<sup>10</sup>. Furthermore, large-scale market entry by wholesale electric power companies can be described as fundamentally contrary to the economic merits of vertical integration. These problems materialized in the course of competition in the market in the 1920s (the "electric power war" fought among the five major electric power firms), with serious consequences for the future shape of Japan's electric power industry.

### 3. Dynamic Development

With the emergence of Daido Electric Power and Nippon Electric Power, which had large-scale hydraulic power plants in the Chubu mountain range and undertook long-distance power transmission to big cities in the Kanto, Chubu and Kansai regions, the fierce battle for commercial-scale power users, which came to be known as the "electric power war," began in the central part of Honshu. The "war" was fought mainly among the five major electric power firms, which included three retail electric power firms (Tokyo Electric Light, Toho Electric Power and Ujigawa Electricity) and two wholesale electric power companies (Daido Electric Power and Nippon Electric Power)<sup>11</sup>.

In most instances, the "war" followed a pattern where the wholesale firms were on the offensive, with the retail power firms trying to defend their markets. In order to secure their existing commercial-scale users, the three retail electric power firms tried to terminate the fierce competition by purchasing a massive supply of power from the two wholesalers, on unfavorable

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<sup>9</sup> For details of the fund-raising process, see Kikkawa [1995] pp. 17-170.

<sup>10</sup> Given this, in a situation where economies of scale are at work, it may be argued that it is reasonable to allow natural monopolies in the electric power industry.

<sup>11</sup> In this paper, companies whose principal business was to sell electricity to end users are called retail electric power companies and those whose principal business was to sell electricity to other electric power companies are called wholesale electric power companies.

terms. As a result, from 1923 through 1928, the business performance of the two power wholesalers improved, but in stark contrast, the earnings of the three retail firms deteriorated. Amid the intensifying conflict among these five power firms, from around the mid-1920, active movements began toward the reorganization of the industry, or toward the regulation of electric power.

During the period of 1907-1931, which was characterized by large-scale hydraulic power development and fierce market competition, the dynamic development of Japan's electric power industry intensified further. The launch of Tokyo Electric Lighting's Komahashi power plant in 1907, which ushered in the era of hydraulic power development and competition, had a profound impact on the electric power industry, bringing down the cost of supplying electric power, contributing to a rapid expansion of the electricity market led by increased demand for power, and stimulating competition among electric power companies. The rapid expansion of the electricity market led to the rapid development of power sources and the expansion of power transmission and distribution networks. The necessary money was procured through the mobilization of social funds via issues of shares as well as the issuance of utility bonds, including foreign currency bonds.

In this entirely new situation, the electrical engineers who had dominated in the pioneering days of the power industry were replaced by electric power firm managers who were quite effective in developing business strategies and raising necessary funds, acting as the main drivers of the dynamic development of the nation's electric power industry. Momosuke Fukuzawa and Yasuzaemon Matsunaga were the two most influential power company executives in the period of 1907-1931.

Fukuzawa's scheme for controlling the electric power industry revolved around the prioritized development of hydraulic power and the separation of power generation and transmission from the distribution business. His idea was embodied in the management of Daido Electric Power and Nippon Electric Power, the two power wholesalers among the five major electric power companies. On the other hand, Matsunaga gave weight to the combination of hydraulic and thermal power and the integrated management of all three stages of power generation, transmission and distribution. His ideas were reflected in the management of Toho Electric Power, one of the three power retailers among the five major electric power firms. Fukuzawa's ideas were later adopted in the form of state control over the industry of 1939-1951, while Matsunaga's scheme was reflected in the reorganization of electric power businesses of 1951. These two opposing courses for the development of Japan's electric power industry had already been built in the market in the 1920s when the five major companies were the chief players<sup>12</sup>.

During the period of 1907-1931, Japan's electric power industry maintained its private sector-led management. Thus, during this period, the industry was required to exert autonomous management to ensure the compatibility of the interests of private enterprise and public interest. In terms of results, there was a certain degree of progress in the autonomous management of the industry; the industry realized public interest, through the supply of cheap electricity — that it had failed to achieve in the pioneering days — in terms of electricity rates for power, which came to account for the bulk of demand for electricity, in 1924 and onward, though with limited success with power rates for lighting.

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<sup>12</sup> For details on this point, see Kikkawa [2004b] pp. 94-105.

The point that should not be overlooked here is that the decline in electricity rates in 1924 onward stemmed from intense competition among the major electric power companies, as exemplified by the “electric power war.” This competition, encouraged by the dynamic development of the electric power industry in the period of 1907-1931, brought about the merit of lower electric power rates, but at the same time had the demerit of destabilizing the supply system of the electric power industry by hurting the retail electric power companies. The fact that the issue of electric power controls came to the fore in the course of the “electric power war” signaled the emergence of moves to overcome this demerit.

#### IV. *The Era of Self-Imposed Controls (1932-March 1939)*

##### 1. **The End of Competition and the Transformation of the Market**

The market competition among electric power companies, as exemplified by the “electric power war” among the five major electric power firms, came to an end in 1932, as marked by the establishment of the Federation of Electric Power Companies in April and the enforcement of the revised Electric Utility Law<sup>13</sup> in December. The federation was a cartel formed by the five major electric power companies, while the revised Electric Utility Law established the principle of service area monopolies.

This chapter looks at the development process of Japan’s electric power industry in the period from 1932, when the market competition ended, through 1938, the year before the imposition of state controls over the power industry. Japan’s electricity market was transformed in two ways in the period of 1932-1938. One was the aforementioned end of competition, and the other was the slowing of market growth.

Between the end of 1933 and the end of 1938, the number of lighting users rose from 11.38 million to 12.56 million, and the number of lights increased from 38.38 million to 48.63 million (Japan Business History Institute [2004] Table 3-3). Electricity consumption for lighting also expanded from 2.61 billion kWh in FY1933 to 3.0 billion kWh in FY1938 (compiled by the Utility Bureau, Ministry of International Trade and Industry [1963]). These figures show that demand for lighting grew steadily in 1933-1938. However, the rate of growth apparently began to plateau. In Japan, the spread of electric lighting ran its course in the 1930s, and the number of lights per population of 100 and the ratio of the number of lighting users to the total number of homes both grew at a sluggish pace (Kikkawa [2004a] p. 61).

Meanwhile, between the end of 1933 and the end of 1938, the contracted kW for electric power equipment (including electric heaters) increased from 3.26 million kW to 5.83 million kW (Japan Business History Institute [2004] Table 4, compiled by the Electricity Bureau, Ministry of Communications [1940]). Electricity consumption for power also expanded from 12.67 billion kW in FY1933 to 23.623 billion kW in FY1938 (compiled by the Utility Bureau, Ministry of International Trade and Industry [1963]).

In the period of 1932-1938, which is the focus of this chapter, the demand for electric power also grew faster than that for electric lighting. As a result, the ratio between electric lighting and electric power in electricity consumption changed from 22:78 in 1931 to 11:89 in

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<sup>13</sup> The Electricity Utility Law (the old law) was promulgated in March 1911.

1938 (compiled by the Utility Bureau, Ministry of International Trade and Industry [1963]), making the primacy of electric power in the demand composition more evident.

However, the growth of demand for electric power in the period of 1932-1938 slowed from that seen in the period of 1907-1931. In the 1930s, the electrification of industrial plants seemed to have run its course, though not as conspicuously as the diffusion of electric lighting. Consequently, the growth of the electricity market in the period of 1932-1938 slowed from the previous period.

## **2. Concomitant Use of Hydraulic-thermal Power and Development of the Regional Supply System**

Between the end of 1931 and the end of 1938, the total output of electric power facilities in Japan expanded from 4,657,000 kW to 7,560,000 kW. As for the output of electric power facilities by power source at the end of 1938, hydraulic power accounted for 4,245,000 kW, or 56.2% of the total, and thermal power for the remaining 3,315,000 kW (Japan Business History Institute [2004] Table 4, compiled by the Utility Bureau, Ministry of International Trade and Industry [1963]). The generated output also increased from 16,027 million kWh in 1931 to 32,424 million kWh in 1938. Of the generated output in 1938, hydraulic power accounted for 23,728 million kWh, or 73.2% of the total, and thermal power for the remaining 8,696 million kWh (compiled by the Utility Bureau, Ministry of International Trade and Industry [1953]). As seen from these figures, the development of electric power resources moved ahead steadily in line with the sound increase in demand for electricity in the period of 1932-1938. During this time, the hydraulic-first and thermal-second composition of power sources was basically maintained.

However, the ratio of hydraulic power to thermal power dwindled by 9.4 points for the output of electric power facilities and by 13.5 points for the generated output between 1931 and 1938. In other words, in the period of 1932-1938, while the hydraulic-first and thermal-second composition of power sources continued, the relative weight of thermal power increased in terms of both the development and operation of electric power resources. This indicates that in the 1930s, the development and operation of electric power resources were geared toward the concomitant use of hydraulic and thermal electric power.

The ratio of the output of in-house electric power facilities to the output of all electric power facilities in Japan rose slightly in 1932-1938. But the increased weight of in-house power facilities only had a limited significance. The ratio of the output of in-house electric power facilities to the output of all electric power facilities in Japan demonstrated the following process: from a large weight in the 1900s, a decline in the first half of the 1910s, an inadequate recovery in the second half of the 1910s, a decline in the first half of the 1920s and an inadequate recovery in the latter half of the 1920s and onward (Kikkawa [2004a], p. 71, p. 139). In other words, the increased weight of in-house electric power facilities in the mid-1930s was merely one phase of the inadequate recovery in the latter half of the 1920s and onward.

The power transmission and distribution networks grew steadily in the mid 1930s. The length of 154,000-volt aerial electric lines exceeded 3,000 km in 1936 and reached 3,174 km by the end of 1938. At the end of 1938, the length of the lines totaled 300,273 km over the whole of Japan, including 39,097 km for transmission lines and 4,381 km of underground lines

(Japan Business History Institute [2004] Table 12).

The regional electric power supply system developed further in the 1930s, and the concomitant use of hydraulic and thermal power sources reflected the situation. Two other developments were important in this respect: (1) power transmission connections improved and expanded within each region of supply, and (2) joint thermal power companies were established one after another within each supply region.

### 3. Adjustment Phase

The electric power industry, which maintained the private sector-led management in the period of 1932-1938, pursued simultaneously, for the first time, the supply of cheap electricity and the stable supply of electricity, and achieved a measure of success in that pursuit. Autonomous electric power company management, defined as the fulfillment of both the interests of private enterprise and public interest, made further progress from the period of 1907-1931.

In the previous period, the development of the electric power industry became very dynamic, as exemplified by the “electric power war.” In the period of 1932-1938, the fierce competition among the electric power companies came to an end and the industry’s development entered an adjustment phase. Despite the end of market competition and the establishment of supply area monopolies, the electric power companies emphasized the supply of cheap electricity along with the stable supply of electricity reflecting new behaviors of managers in this period. Aware of the public nature of the electric power industry and accepting public regulations, they did not aim solely at the strengthening of private monopolization but acted to respond to the social demand for the supply of abundant and cheap electricity. The necessity for power company executives to adopt these behaviors, which may be termed “self-imposed controls,” was emphasized by Yasuzaemon Matsunaga of Toho Electric Power in his 1928 book, *A Personal View of Electric Power Controls*<sup>14</sup>. Matsunaga continued to serve as the industry’s opinion leader in the 1930s.

However, the self-imposed controls on the electric power industry in this period had limitations: the parallel existence of retail electric power firms and wholesale electric power companies was left intact. Focusing on this situation, the establishment of the Federation of Electric Power Companies in 1932, based on the idea of maintaining the status quo, helped entrench the parallel existence of retail and wholesale electric power firms, in effect undermining the self-imposed controls of the power industry.

## V. Concluding Remarks

A package of four bills for the state control of the electric power industry was enacted in March 1938. Following the enactment of these bills, the five major electric power companies, which had mounted a campaign against state control, disbanded the Federation of Electric Power Companies in October 1938. In April 1939, Japan Power Generation and Transmission

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<sup>14</sup> For details on *A Personal View on Electric Power Controls* by Yasuzaemon Matsunaga, see Kikkawa [2004b] pp. 100-102.

was born, with private electric power companies and other electric power operators contributing equipment and facilities to the new company, marking the official start of state control over the electric power industry. The equipment and facilities contributed by the electric power businesses to Japan Power Generation and Transmission included new hydraulic power facilities with an output of over 5,000 kW, thermal power facilities with an output of over 10,000 kW, and major power transmission facilities and transformation installations, but did not include the existing major hydraulic power facilities.

The establishment of Japan Power Generation and Transmission marked the first phase of the state's control over the power industry. Three years later, the second phase of the state control over the industry was implemented, including the contribution to the state-owned company of existing major hydraulic power facilities and the consolidation of power distribution companies. For this second phase, the enforcement order of the law for control of the electric power industry was revised in April 1941 by imperial decree, without parliamentary debate, and in August 1941, an order for power distribution controls was enforced. Under the revised enforcement order, private electric power companies and other electric power operators were to contribute existing hydraulic power generation facilities with an output of over 5,000 kW to Japan Power Generation and Transmission by April 1942. Further, under the order for power distribution controls, in April 1942, nine regional power distribution companies were inaugurated covering Hokkaido, Tohoku, Kanto, Chubu, Hokuriku, Kansai, Chugoku, Shikoku and Kyushu. In the meantime, private electric power companies and other electric power operators were forced into dissolution, with very few exceptions, after they lost the foundation for continued operations in the second phase of state control.

There is no doubt that the most important factor behind the state control of the power industry from 1939 was a non-economic factor, namely the rise of nationalistic and totalitarian ideology during the years when the country was put on a war footing. However, there is also no doubt that the electric power industry could have resisted state control more effectively if power firm managers had implemented vertical controls (the consolidation of retail and wholesale power firms under the principle of one company in one supply area) as proposed by Matsunaga in *A Personal View of Electric Power Controls* and realized the integrated management of power generation, transmission and distribution businesses.

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