The Japanese Electric Power Policy Studied through the Business Structure of the Power Industry: A Long-term Analysis before and after "Deregulation"

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Authors' contributions

This work was carried out in collaboration between both authors. Author HA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author NK managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

ABSTRACT

The Federation of Electric Power Companies (FEPC) of Japan has long been releasing the detailed financial statements of their member corporations (on their website). We have analyzed the transition of Japan's electric power policy through the business structure of the electric power industry using the FEPC financial data over 53 years. Thus, we have clarified the problems and distortions built into the power industry by Japan's power policy as stated in the following: (1) During the regulation period, the dual-price mechanism for the industrial use and the home-use sectors had been effectuated, where (2) the former shared two thirds of the power demand but yielded only small profits or even losses; and the latter, sharing only one third of the demand, yielded nearly all of the industry's profits; however, (3) since the start of complete retail deregulation, this dual-price mechanism has come to suffer paralysis and the power majors began a cutthroat competition, which...
now seems to result in diminution of profitability in the home-use sector (the industry's former treasure box). This price-cutting war is considered very dangerous for the sustainability of this industry because this business is highly equipment-intensive and is severely vulnerable to any revenue instability. Meanwhile, declining demand due to the declining population is inevitable, and the power infrastructure will become excessively capacitive against demand. At the policy level of the government, recognition to this is overwhelmingly short. There is a possibility that the most powerful risk of both the electric power industries and social economy will be the way of the electric power policy that leads electricity demand from the expected growth rate and prepares the power supply configuration based on it.

Keywords: Electric power policy; electricity demand; dualistic pricing; power retail deregulation; population declining; overinvestment.

1. INTRODUCTION

Since April 2016, the electricity rate in Japan was exposed to the full retail deregulation: This implies a great transition in Japan's power policy. Meanwhile, Japan's power companies have long been enjoying the advantage of regional monopoly: they have been taking previously arranged profits on the so called "Rate-of-Return Regulation" mechanism, enabled to evade price cutting competitions in the market. But such a business regime and the national policy caused various questions and criticisms. Germany has also been enforced a dual pricing extremely advantageous for the industrial use; while Italy has been holding an equal-footing The fiscal year for the IUS (and some other large-scale users) was deregulated, the expenses in the IUS (sharing 2/3 of the power demand) have continuously been in the red, while those in the HUS have only been in the black and have been covered deficit in the IUS, affording the industry to remain in the black as a whole [1].

Japan's power industry has long been carrying out a double-layered rating system, where the rates on the home-use sector (HUS) had been regulated by the government until 2015, but since 1995, Independent Power Producers has been allowed to enter the wholesale power generation market, and the rates on the industrial use sector (IUS) underwent a partial deregulation in 2000. However, regulated prices apply to all small-capacity users below 50kW, including small shops and works, besides the home-use.

In the history of Japan's power policy, however, the IUS rates themselves had once been subject to the governmental regulation until 1999; and, in those years, the regulation system had fully been practicing the dual price mechanism for the HUS and the IUS. Japan's power industry, while enjoying the regional monopoly in the power service, had confirmed their business structures to this dual price mechanism; to which they had accommodated all their managerial resources such as power facilities, capital investments, and personnel organizations. This historically built-in structure seems to continue virtually intact even for the new round after the complete deregulation.

This study tries to clarify the fundamental (and historical) business structure of Japan's power industry has developed under the above stated rating mechanism; and, thus, to explicate the Japanese power policy in its historical transition. To forward this investigation on the structural analysis, we have eventually made up an entirely novel method of analysis that enables to compute the operating incomes, the overall gross costs for earning the incomes, and finally the operating profits of this industry by their respective demand sector. Such a view angle to cover a long-term over a half century seems to have been unique as far as we know.

2. MATERIALS AND METHODS

On a due course of this study, it has been necessary to adopt an entirely new approach that enables to elucidate the ‘actual prices’ (A) that the HUS and the IUS users (clients) have paid for; and then to compare (A) with the ‘actual gross costs’ (B) that the power companies have really paid for.

These analyses have been carried out as follows. Japan's Federation of Electric Power Companies (FEPC) has long been publishing the financial statements on its website [2] of FEPC's member corporations, including the balance sheet, the actual results of power generation and transmission, supply and demand of the electricity, the relevant revenues and expenditures, the status quo of power plants and facilities, etc. We have analyzed these FEPC data and have successfully elucidated the
various aspects of the electric power industry in Japan, where the most important matter is the analysis of power demands in the IUS and the HUS and of the relevant earnings and expenditures by demand sector.

A more detailed procedure for these estimations will be explained later in close combination with the actual results of the relevant estimations.

Japan’s power service has traditionally been dichotomized into the ‘Dento-ryo’ demand (charges on households) and the ‘Dennyoku-ryo’ demand (charges on the electricity for industry), of which the former is redefined, in this study, as the Home-Use Sector (HUS); and the latter, as the Industrial Use Sector (IUS).

By the summer of 2017, all the major power companies released their “securities reports” for 2016, which made it possible to analyze the business activities of major power companies after the full retail "deregulation" because. This research has compared the business behaviors of the said companies for the stages before and after the complete deregulation.

3. RESULTS

3.1 The Two Demand Sectors of Japan’s Power Industry and their Sales Revenues by Sector

The technical structure of the electric industry in Japan consists of (1) the generation and high-voltage power grid as a general foundation and (2) the low-voltage distribution systems, where the former (1) provides electricity to the IUS directly; and to the HUS, through the latter (2).

First, let us see the power demands and the corresponding revenues in the HUS and the IUS in fiscal 2015 (Fig. 1).

The electric energy consumed in Japan in fiscal 2015 was 797.1 Tera (trillion) Watt hours (TWh), where the home-use shared 266.9 TWh (33%) and the industrial use, 530.2 TWh (67%) of the total.

In contrast, however, the revenue from the home-use was 6.4601 trillion yen and that from the industrial-use, 9.3556 trillion yen, making the overall revenue of 15.8157 trillion yen, which implies that the HUS consumed 33% of the electricity but yielded as much as 41% of the revenue; meanwhile the IUS consumed 67% but yielded only 59%. These two sectors in contrast clearly show that Japan’s power rating system has consisted of a double-standard price mechanism.

3.2 Decision Making Method for the Power Rates in Japan: The ‘Rate Making’

In short, the pricing mechanism of Japan’s power industry comprises specific dual rates for the IUS and the HUS, where the latter has been bearing much heavier burden than the former.

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**Fig. 1. The power demands and the corresponding revenues in fiscal 2015**

*Source: FEPC data [2] adopted by the authors*
How to decide the regulated power rates for the HUS is prescribed by the Agency for Natural Resources and Energy as follows: [1,3]

(1) To integrate the overall operating expenses by summing up personnel expenses, fuel expenses, taxes and public dues, repair expenses, depreciation expenses, power purchases from other companies, and other miscellaneous expenses; and 'appropriate' operating profits, in addition to all the above-mentioned.

(2) To estimate thus integrated costs by subtracting power selling to other suppliers, transmission revenues, etc. (i.e. miscellaneous revenues other than revenues on ordinary power service) from the total revenues stated in (1).

(3) Firstly, to distribute (assign) the integrated gross costs abovementioned into nine divisions: the power production expenses in hydroelectric, thermal power, nuclear power, and renewable power etc.; transmission expenses; transformation expenses; the distribution expenses; selling expenses; and administrative expenses.

Secondly, to redistribute the above-mentioned costs into (A) the expenses for power production, transmission, and high-voltage distribution and (B) the other expenses concerning the low-voltage distribution alone.

Thirdly, to sum up the overall costs concerning the low-voltage distribution, to which the 'regulated' power rates are applied.

Fourthly, to redistribute the above-mentioned costs into two categories of (A) the transmission expenses and high-voltage distribution expenses and (B) the all expenses other than (A).

And fifthly/finally to sum up all the costs (C) concerning the low-voltage distribution contained in the categories (A) and (B), where the 'regulated' power rates are imposed on the (C)-related demands alone.

This is the essential procedure to determine the power rates for the regulated demand sector (HUS) under the administrative rate decision prescribed by the Electricity Enterprises Law. Such a policy for the rates decision is called as 'Fully Distributed Cost Method' (FDCM), of which the decision making specific for the regulated rates are officially termed as 'Rate Making' [3].

The dualism in the power rating, i.e. the discrimination of the HUS rates and the IUS rates, can be, in principle, of economic rationality because the two sectors, HUS and IUS, have distinctly different cost structures, which will reasonably lead to the dual pricing: in fact the IUS receives the power direct from the high-voltage grid; while the HUS receives the power necessarily through the low-voltage distribution networks extended from the high-voltage grid. This surplus cost for the low-voltage distribution should naturally be imposed on the HUS rates, which are to become somewhat higher than the IUS rates. This dual pricing can meet "the beneficiary pays principle" as far as the surplus cost be calculated appropriately and accurately.

There is, however, no guaranty that this cost calculation and its transfer to the HUS rates should be of sufficient rationality and fairness from the economic and technical viewpoint; in fact, the actual "Rate Making" process has continually been suffering distortive or officious stresses and, considerably, has failed to form a fair and rational rate assignment.

Here, we refer to a historical transition of the power rates released by the government in Fig. 2 [1].

Fig. 2 shows that Japan’s electric energy policy has been carried out on this dual price system steadily since the end of the World War Two (nearly all through the latter half of the twentieth century). Thus, the double-layered mechanism of the HUS & IUS prices has firmly been built in the very core of the business structure of this industry.

Then, to realize the industry's incomes-and-expenses structure and its historical behavior, it is indispensable to acquire not only "Price-Aspect Information" as shown in Fig. 2 but also "Cost-Aspect Information" as follows.

To begin with, we have investigated the overall costs concerning power generation, transformation, transmission, and distribution to the final users; and thus, have elucidated the triad relation among the unit gross cost (a), the unit HUS price (b), and the unit IUS price (c), as shown in Fig. 2. The results are interpreted in the following section.
Fig. 2. The retail power rates (unit prices) for the HUS, the IUS, and the HUS & IUS in all for Fiscal 1951-2010
Source: ANRE (2011) [1] compiled by the authors

Fig. 3. The HUS unit price, the IUS unit price, and the gross unit cost averaged for all companies
Source: FEPC data [2] with additional estimation by the authors

3.3 Estimation of the Unit Price on “Home-Use Sector” or the “Industrial Use Sector” and of the Gross Unit Cost

These analyses in the present paper are fundamentally based on the said FEPC database, from which we extract the Profits-and-Losses Accounts and the demands by the HUS and the IUS (N.B. Here ‘unit’ denotes ‘per kWh’). By referring to the Profits-and-Losses Accounts for the power companies, we can calculate (1) the HUS unit price by dividing the revenue from the HUS by the demand from the HUS; and (2) the IUS unit price through dividing the revenue...
from the IUS (and the specific large-scale users) by the demand from the IUS etc. These calculations are enforced in the same method as that adopted by the ANRE to compose the Fig. 2, where the starting year is fiscal 1963 as is the case for the FEPC Database [2]. And (3) the gross unit cost can be obtained through dividing the operating costs (given in the Profits-and-Losses Accounts of the power companies) by the total electricity demand (consumption) comprising all the HUS, IUS, and other large-scale users.

However, it should be remarked that the operating incomes in the Profits-and-Losses Accounts include some miscellaneous incomes, other than the power charges, such as the sales to other companies, commission fees, equipment rental charges etc.; and, therefore, these incomes must be subtracted from the corresponding expenses like purchase from other companies, transmission expenses, equipment expenses, etc.

In addition, the subsidies from the grant by the Act on Purchase of Renewable Energy Sourced Electricity are not direct business returns and the levies for the said Act are not the actual costs concerned with power generation or transmission. Therefore, we have subtracted the grant subsidies from the total revenues, and the levies from the gross costs.

As mentioned in the previous section, the cost structure differs between the "Industrial use" and the "Home-use". Therefore, the business analysis will require accumulating the expenses claimed to each division, comparing them with the incomes collected by each division, and analyzing the profit structure in each division.

However, such an analysis is indeed significant but is not the ultimate purpose. The true aim of this study is a historical elucidation of the basic structure of the power industry management built up under the current tariff system. To achieve this aim, it is necessary; to grasp the level of sales prices for "Industrial use" and "Home-use", and the level of costs required to the power industry in their business operation; and to assess their change over time. This is the true purpose of the present research.

Anyway, on these arrangements added, we can finally estimate the HUS sales unit price, the IUS sales unit price, and the gross unit cost (each averaged for all the power companies) as shown in Fig. 3. The most important points shown in Fig. 3 are; (a) that the IUS unit price had been nearly the same as, or only slightly greater than, the gross unit cost during the 20th century; (b) that the IUS unit price has finally come to fall below the gross unit cost since the beginning of the 21st century; and (c) that the loss in the IUS seems to have suffered a grave tendency to grow larger certainly and unilaterally.

Until March 2000, the IUS rates had also been regulated by the government and the 'regulated' unit price had probably been about the same as the actual gross unit cost. Taking this situation into consideration, the IUS price unit seems to have been 'regulated' in tune to (or slightly above) the gross unit cost all through the period of the full regulation, to avoid any loss-making in the IUS demand.

Another important fact is seen in Fig. 3 is that the HUS unit price has continuously been far above the gross unit cost; and that the difference between the two price systems has been nearly constant almost permanently. This fact implies that it has been from the HUS demand that Japan's power industry has gained the greater part of its profit under the legal system of the power rate regulation.

In effect, the long-term business behaviors show that Japan's electric industry has continued to hold the IUS unit price as low as possible: on the level barely to cover the unit gross cost; and, instead, to gain a high rate profit exclusively from the HUS demands. This profit-and-loss structure is just what this industry established in the early 1960s and has retained firmly since then. Japan's electricity policy had induced the electricity industry to live on this mechanism. This problem shall be discussed in more detail in the following sections.

3.4 Estimation of the Profits in the Home-use Sector and the Industrial Use Sector

Here we try to evaluate the profits in the HUS and the IUS respectively. A provisional method for this evaluation is to multiply the amount (in kWh) of the demand in each sector by the unit profit therein, i.e. the difference of (income per kWh minus cost per kWh) for each sector (cf. §3-1). Then summing up both the results gives the overall profits. This method, however, has a certain ambiguity because the profits by sector are the results of complicated estimation while
the demands by sector are the effectively measured amounts.

It is possible, however, to remove the said ambiguity and to obtain a more precise evaluation of each sector's profits and/or losses through the following analysis. First, we assign the gross total costs per fiscal year to the cost payment by the HUS and that by the IUS in proportion to each sector's demand (amount of consumption): the results are the cost paid by sector. Then each sector's cost payments are subtracted from each sector's annual revenues: the results are the very profits by sector calculated from measured amounts alone, which are of the best possible accuracy. Thus, obtained profits by sector are shown in Fig. 4.

![Fig. 4. The operating profits by demand sector of the power industry](image4)

Source: FEPC data [2] with the additional calculation by the authors

![Fig. 5. Profits by the HUS and the IUS on the accounting base averaged for all the companies](image5)

This figure (Fig. 4) shows that Japan's power industry has permanently gained large operating profits from the HUS demand; in contrast, however, the profits from the IUS have shown no small change with the times. In 1980's they had been rather considerable, but then they became gradually thinner, and finally, they have fallen into the red since the onset of 21st century.

In short, the power sales to the HUS (ca. 1/3 of the total) had once been just one of the routes to boost up the industry’s general profits but has now become the only route to gain profits and narrowly to keep the whole company in the black in compensation of the losses compelled in the IUS demand (ca. 2/3 of the total).

3.5 Profits and Losses by Demand Based on the Financial Accounts

In the previous section, we estimated the operating profits by demand sector by assigning the gross cost to the HUS and the IUS in proportion to each sector's demand; and subtracting the assigned costs from the sales amount in each sector. In this section, however, we take an ordinary financial-account approach to estimate the operating profits-and- losses, where the gross total costs are assigned to the HUS in a far higher ratio and to the IUS in a lower ratio.

These intentionally discriminated cost assignments are concerned with the low-voltage power distribution cost imposed on the HUS prices alone, exempting the IUS from sharing this cost. Because of this cost transfer from the IUS to the HUS, the HUS demand is compelled to bear far the greater part of the gross cost than the IUS. Therefore, the operating profits by demand sector rise in the IUS and lower in the HUS due to this systemic transfer of the cost assignment.

And the profits-and-losses calculations based on such a rule for treating costs must have been ordinary routines for the power companies, which, however, have never been disclosed openly. Recently, however, the Agency for Natural Resources and Energy (ANRE) noticed the results of these calculations on their website because the open notification was obliged by the "General electric utility sector balance calculation rules" [4].

However, the ANRE data covers no more than the newest fiscal years, 2011-2015. So, we have derived the additional evaluation for fiscal 2006-2010 (about the ANRE’s paper sent to the Cabinet Office Consumer Commission [5]: Fig. 5. shows the resulting data covering the ten serial fiscal years.

To sum up the foregoing investigation, even in Financial Accounting-based analysis, IUS has not made much profit as compared with HUS (except in 2015). The IUS has become a serious loss-producing division even in the financial-account-based analysis from 2011 (when the Great East-Japan Earthquake occurred) to 2013. An essential cause for such a situation is that, as already stated, the IUS unit price has fallen short of the gross unit cost.

3.6 Business Structure after Complete Retail ‘Deregulation’

What kind of change occurred in the power industry since April 1, 2016, i.e. the enforcement of the full deregulation? To clarify this problem, let's compare the basic business data of 2015 and 2016.

(note) The data for the fiscal year 2016 corresponds to the average on 9 companies excluding Tokyo Electric Power Company (TEPCO). TEPCO became “spin-off” companies in 2016; since then TEPCO ceased to announce the business data of the group companies except for the very financial statements of TEPCO Holdings were announced, and the data of the whole was not disclosed.

The unit price for "home-use" became 21.1 yen / kWh from the former 24.2 yen / kWh, which means a significant fall of 3.1 yen / kWh. In contrast, the unit price for "industrial use" fell to 16.0 yen / kWh from 17.6 yen / kWh: only 1.6 yen / kWh fall. The weighted-average price became 17.8 yen / kWh from the former 19.8 yen / kWh. The overall price decrease was 2.2 yen / kWh.

On the other hand, what has become of the "gross unit cost"? This has also decreased from 18.3 yen / kWh to 16.7 yen / kWh, resulting in the fall of 1.6 yen per kWh. Noticeably this fall is accurately coincident with that in the "industrial use" price.

As a result, the extent electric power industry has lost part of large operating profits formerly earned from the HUS until the deregulation. Yet the electric power industry is somehow able to secure a necessary profit, by abruptly reducing...
the total cost. The full deregulation gave such a serious impact on the sales structure of the industry and that immediately.

However, what is the reason for such a rapid cost-down? Take Kansai Electric Power Co., Ltd. for instance, the main factor of the cost reduction turns out to be a timely (coincident) lowering of the fuel price for thermal power generation: from 6.8 yen / kWh to 5.5 yen / kWh. This decrease is considered due to the then temporary slump in the energy resource prices of natural gas, coal, and crude oil.

![Fig. 6. The HUS unit price, the IUS unit price, the average unit price and the gross unit cost averaged for all companies in 2016 and 2015](image)

*Source: FEPC data [2] and the annual report of each company with additional estimation by the authors*

![Fig. 7. The breakdown of the 'gloss unit cost' by cost factor for Kansai-Denryoku 2015 vs 2016](image)

*Source: FEPC data [2] and the annual report of the company with the additional calculation by the authors*
Furthermore, a significant price down in the "home-use" did not necessarily benefit "households". According to the Ministry of Economy, Trade and Industry, as of March 31, 2017, one year after the deregulation, 5.53 million contracts switched. This corresponds to 8.8% of 62.53 million "home-use" contracts which the main power companies held at the end of March 2016. <Switching from the major companies to new power companies> was about 2.95 million (2.7%), and <switching of contracts within the major companies> (the regulation mode → the deregulation mode) was about 2.58 million (4.1%) [6].

Among these contract changes, <changes within the contracts held by the major companies> (fit for regulation → fit for deregulation) caused a significant cut in the selling prices. The so called "home-use" factually includes "industrial use" of low voltage demands smaller than 50 kW (see footnote 2). Tokyo Electric Power Company (TEPCO) and Kansai Electric Power Company (KEPCO) played a spectacular "discount battle" over the procurement of large-scale (yet low-voltage) customers (such as "Japan Post" and major convenience store chains). In the competitive bidding around "Japan Post", the final bid showed an astonishing cut of ca. 30% to the price of the previous year (before the deregulation) [7]. There was such a serious circumstance around the fall of the price for the "home-use".

4. DISCUSSION

4.1 Policy Response to Demand Decline

According to the latest estimate by the National Institute of Population and Social Security Research (IPSS) (estimated in 2017), the total population of Japan will decrease to 119.125 million in 2030. It will be a decrease of 8.959 million from a peak of 128.084 million in 2008. This reduction is roughly comparable to the population of Osaka Prefecture in 2015, 8,839 thousand people. Further, Japan’s population is estimated to decline down to 101.923 million in 2050 [8].

Comparing recent demographics and electric power demand, it is as follows.

Total population has entered a declining phase with peaks in 2008. Electricity demand peaked in 2007 and has decreased since then. Comparing both, the trends are almost "synchronized" (Fig. 8).

As far as the correlation between the population and electricity demand does not collapse, the demand for electricity will also decline synchronously with the declining population.

However, the latest version of “Energy Basic Plan” also seems to have failed to take this population decline into consideration despite their claim that the plan foresees the circumstance up to 2050 [9].

The power supply configuration indicated by this “Energy Basic Plan” is fossil fuel such as oil, coal and natural gas: 56%, nuclear power generation: 22 to 26%, renewable energy: 22 to 26%.

Regarding nuclear power generation, the plan says, "to reduce dependence as much as possible", but it is positioned as "an important baseload power source that contributes to the stability of the long-term energy supply and demand structure" and shows a policy to proceed with a restart. In the energy mix of 2030, it is a policy to set the ratio of nuclear power generation to 20 to 22%, but about 30 nuclear power plants need to operate. However, in the basic plan, no mention is made of the addition or replacement of nuclear power plants.

This "Energy Basic Plan" is based on the "Long-Term Energy Supply and Demand Outlook". [10] The logical composition of this demand forecast is following. Demand for FY 2030 will be 376 million kiloliters from 361 million kiloliters of crude oil equivalent in FY 2013 due to "economic growth" of 1.7% every year. However, this can be reduced to 326 million kiloliters by thoroughly implementing energy saving measures.

METI announced to adopt in addition to the population projection (middle projection) of National Institute of Population and Social Security Research and the active volume of the steel industry etc. However, the assumption that the "economic growth rate" of 1.7% will continue in the population decline logically implies that per capita GDP and energy consumption will increase by more than 1.7%.

The Japanese government is requesting the power industry to meet the supply based on such demand assumption. But, if the demand forecast is too large (thought to be too large), supply excess will be inevitable.
Although it is possible to reduce the installed capacity of the power generation equipment, it is not easy to reduce the transmission and distribution system according to the demand, and it is inevitable that the usage efficiency drops.

The average cost (power distribution cost per unit demand electricity) in the power distribution sector is lower as the demand (population) density is higher and is higher as the demand (population) density is lower. Power companies cannot control such variations in demand. If other conditions are constant, there is concern that general distribution costs will increase regardless of home-use or industrial use, due to the future population decrease or population density decrease (From Cabinet Office "Annual Report on the Japanese Economy and Public Finance 2013").

The transmission and distribution department will be facing a decline in the revenue from the consignment charge due to the shrinking demand. In this case, it will be hit harder by the major electric power companies in the region. Ultimately, I think that the electric power company will separate power distribution areas where profitability is extremely deteriorated.

Demographic dynamics predictions are extremely reliable. Demand forecasts based on this are far more accurate than demand forecasts based on market conditions. It is an inevitable business choice that electric power companies try to reduce the distribution area accordingly.

However, electric power companies must fulfil their supply obligations.
If they try to achieve these two at the same time, the introduction of Distributed Energy Resources (DER) is essential. In other words, it would be the only policy arrangement to reduce the distribution area systematically after establishing conditions by proactively introducing DER.

The adoption of such policy seems to have a high possibility of stabilizing the electric power company in terms of management.

5. CONCLUSION

This research has clarified that Japan's power industry has historically constituted a concrete business structure: the double-layered pricing mechanism for the Home-Use Sector and the Industrial Use Sector. The power service makes up the essential core of the social infrastructure and underpins every social capital such as communications, transportations, railway transports, plumbing, medical service, etc. This research clarified the historical transition and structural features of the electric power industries in Japan. The electric power industries only must take over this trend and characteristics completely and develop themselves in the future. Meanwhile, declining demand due to the declining population is inevitable, and the power infrastructure will become excessively capacitive against demand. Some of the power stakeholders are beginning to look for countermeasures in preparation for this situation [13]. At the policy level of the government, recognition to this is overwhelmingly short. There is a possibility that the most powerful risk of both the electric power industries and social economy will be the way of the electronic power policy that leads electricity demand from the expected growth rate and prepares the power supply configuration based on it.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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