Fact-finding Study on Japan's Energy Management Policies

– Proposals for Developing Countries –◆

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Summary

An anticipated worldwide increase in demand for energy has led to concerns on tightening and destabilization of oil supply over a medium to long term, as well as on concerns over changes in the global environment due to increased emissions of carbon dioxide. Under such circumstances, the promotion of energy conservation measures to be taken especially in developing countries where an accelerated increase in energy consumption is expected is a most effective means for resolving these problems.

On the other hand, Japan has constantly been making efforts for more than half a century in the field of energy conservation. In the Japanese industrial sectors, in particular, the energy management administration measures had been put into force as early as before World War II, followed by the introduction of the Heat Management Regulations (1948) and the Heat Management Act (1951). In addition, constant efforts have been made since then under the initiative of the energy management policies based on the Energy Conservation Act established on the basis of experiences of two oil crises in the 1970s. As a result, Japan has achieved world top class energy conservation technologies and has accumulated profound energy management know-how. It is thus expected that Japan's appropriate transfer of energy conservation know-how to other countries will contribute to suppressing worldwide energy demand to a certain extent.

Through identifying the actual status of Japan's energy management policies under such situations, this study aims at demonstrating the effectiveness of Japan's energy conservation policies and analyzing the know-how obtained through Japan's advanced systems so as to provide a reference guideline for planning energy conservation policies in developing countries faced with a significant increase in future energy demand.

Specifically, we conducted a questionnaire survey covering energy managers at Type 1 designated energy management factories in five categories of manufacturers that are subject to the designated energy management factory system and required to appoint energy managers. Through the survey, we extracted energy management measures' characteristics by corporate size, and

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specific effects and improvements of the energy management system. Finally, we attempted to work out policy proposals for developing countries based on our analysis.

1. Overview of Japan's Designated Energy Management Factory System and Purpose of This Study

1-1 Introduction

The Energy Conservation Act stipulates that energy business operators (hereinafter referred to as business operators) "shall make efforts for rationalizing the use of all types of energy (Article 4 of the Energy Conservation Act: efforts by energy users)." Under the Energy Conservation Act, a "Designated Energy Management Factory System" was established, requiring that any factory or business institution (hereinafter referred to as factories) consuming energy in excess of 3,000 kl (crude oil equivalent) or more annually be designated as a "Type 1 designated energy management factory" and that such a factory appoint (an) energy manager(s)[1], establish an energy management standard on the basis of its own criteria, set a nonbinding target of improving energy intensity by an average 1% or more over a medium to long term, and submit periodical reports and medium to long-term plans to secure the achievement of the target (see Figs. 1-1). Energy managers in the designated energy management factories shall be selected only from among those having a national certificate of qualified Energy Manager. The number of energy managers required in such a factory depends on annual energy consumption, ranging from one to four. Through this designated energy management factory system, these factories are required to perform various energy conservation measures. As a result, business operators maintain energy management organizations and perform voluntary and planned energy management activities appropriate for their own corporate and business characteristics to promote energy conservation measures.

The purpose of this study is to produce implications for developing countries by implementing a questionnaire survey according to the energy management activity model shown in Fig. 1-2, observing the effects of Japan's designated energy management factory system and considering desirable improvements to the system.

Specifically, we provide a detailed analysis by size of enterprise in Chapter 2, analyze the effects of the Japanese system in Chapter 3, and consider desirable improvements to the Japanese system in Chapter 4. In Chapter 5, we use these analyses for producing implications for developing countries.

[1] The Energy Conservation Act stipulates that energy managers "shall be responsible in the rationalized use of energy in the Type 1 designated energy management factories for the management of energy consuming equipment, for the improvement in and supervision of energy use and for performing other duties as defined by the ministerial orders of the Ministry of Economy, Trade and Industry".

Fig. 1-1 Relationship between Energy Conservation Act and Business Operators

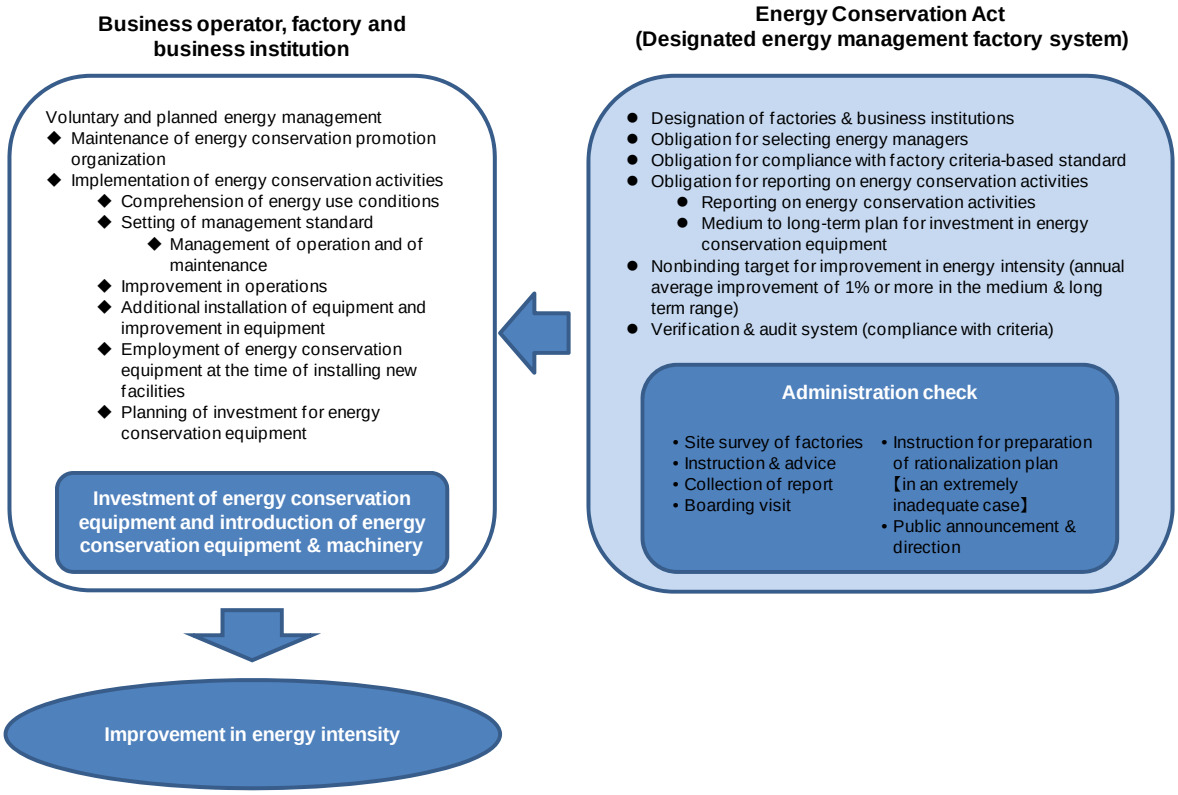
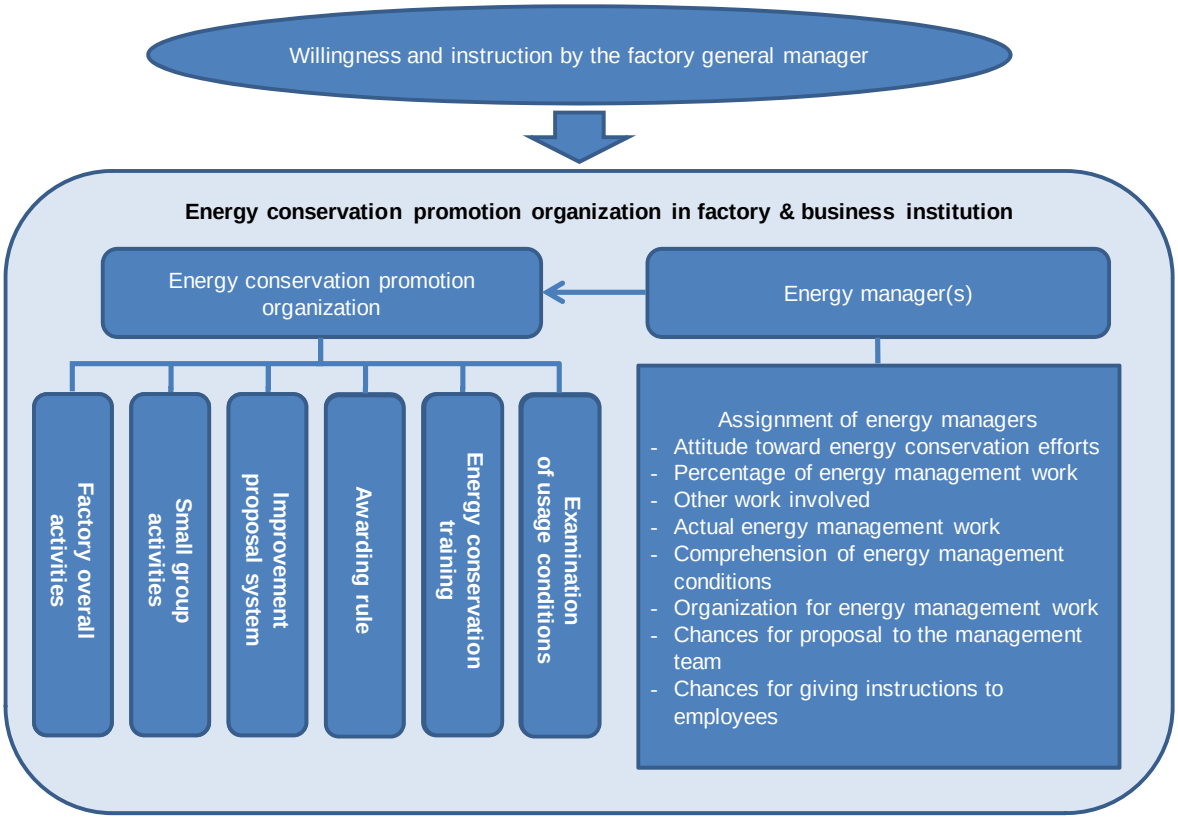
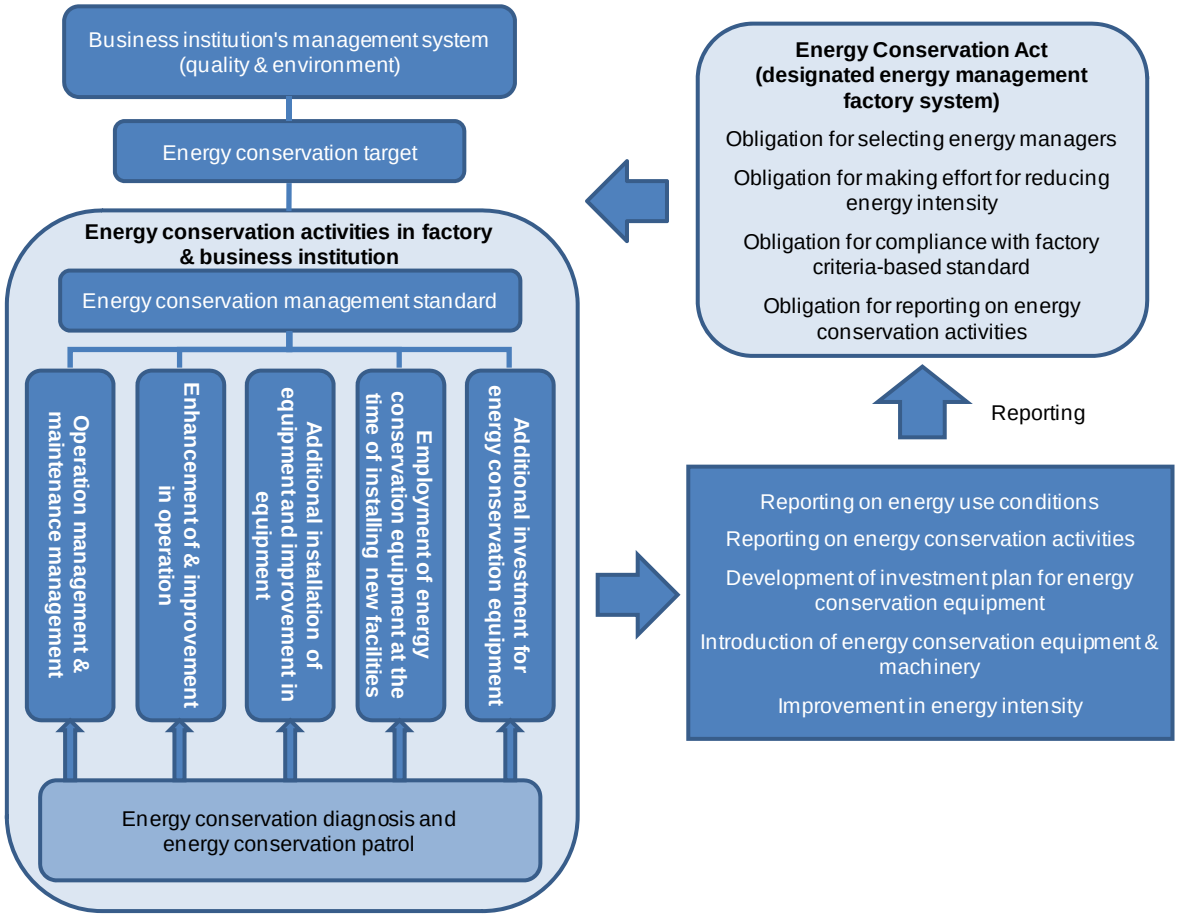


Fig. 1-2 Energy Management Activity Model for Factory & Business Institution





・Explanation on specific terms

－ “Enhancement of & improvement in operation”: Activities as energy conservation measures for contributing to energy conservation mainly by means of software through the review of operation management values of equipment & machinery and improvement in the operation method.

－ “Additional installation of equipment and improvement in equipment”: Activities as energy conservation measures for contributing to energy conservation by means of hardware such as addition of automatic control devices to the equipment & machinery or replacement with efficiency-improved parts.

1-2 Method for Questionnaire Survey

Within the framework of this study, a questionnaire survey was performed with a view to gaining an understanding on the actual conditions of implementation of energy management policies in Japan. The target for the survey included all of the designated factories where “energy managers” as stipulated in the Energy Conservation Act are assigned. The method for the questionnaire survey is given below :

(1) Outline of questionnaire survey

Major questions in the questionnaire survey are about the following matters :

1. Overview of your business institution (factory)
2. Trend in energy intensity in your business institution (factory)
3. Energy conservation activities in your business institution (factory)
4. Assignment of energy managers in your business institution (factory)
5. Any room left for additional energy conservation as well as useful schemes and barriers for promoting energy conservation activities in your business institution
6. What kind of knowledge should be necessary for qualified energy managers
7. Impression and advice as to the energy management policies in Japan
8. Enquiry as to the questionnaire survey

(2) Target for questionnaire survey

The questionnaire survey covered 5,758 business institutions specified as Type 1 designated energy management factories in FY2007 and are obligated to appoint energy managers. These business institutions are the five categories of manufacturers which are mining, manufacturing and energy supply (electricity, gas and heat).

(3) Method for collecting responses to questionnaire

A letter of invitation with a printed URL was forwarded by mail to each business institution, requesting it to access the webpage for questionnaire survey response through the URL and to send a response.

(4) Forwarded documents

A letter of greeting and one sheet of invitation with a URL printed for e-mail-based response.

(5) Period for questionnaire survey

November 30 (Mon) 2009 to December 28 (Mon) 2009

(6) Implementation of follow-up

A follow-up postcard was sent (on December 14 (Mon) 2009)

(7) Number of collected responses/number of valid responses

A table is given below indicating the numbers of forwarded questionnaire survey sheets, collected responses and valid responses

No. of forwarded sheets	No. of collected responses	Collection rate	No. of valid responses (for collected responses)	Valid response rate
5,758	1,710	29.70%	1,708	29.66%

* Out of the 1,710 collected responses, two were excluded from the valid response group for the following reasons :
  - It was stated that the business institution is specified as a Type 2 designated energy management factory.

・ Part of the questionnaire (questions 1 to 3) was not answered.

The following analysis on the collected replies was made only for valid responses (1,708).

2. Analysis by Size of Enterprise

Regulations under Japan's Energy Conservation Act had initially covered relatively large factories and have been revised several times to widen the coverage to spread energy conservation efforts to smaller factories and commercial institutions. Generally, the promotion of energy conservation is viewed as more difficult for small and medium-sized enterprises than for large ones. Energy conservation at SMEs has thus become a major policy challenge in industrial countries. In Japan, SMEs account for 99.7% of all enterprises, representing 66.2% of regular employees.[2]

Through efforts to comprehend present energy conservation efforts at SMEs that account for a dominant share of enterprises and employees, we expect to get clues to the further promotion of energy conservation in Japan and implications for the expansion of energy conservation systems in developing countries[3] where relatively small enterprises are dominant. In Chapter 2, therefore, we focus on SMEs and conduct an analysis of energy conservation efforts by size of enterprise.

In this analysis, the small and medium-sized enterprises are defined as those that have less than 300 employees as reported in their response to the questionnaire and have one or no Type 1 designated energy management factory belonging to the specific business institution emitters[4] as stipulated in the Act on Promotion of Global Warming Countermeasures[5], while the rest are defined as large-sized enterprises. Fig. 2-1 shows a breakdown of factories and energy consumption by size of enterprise for this analysis.

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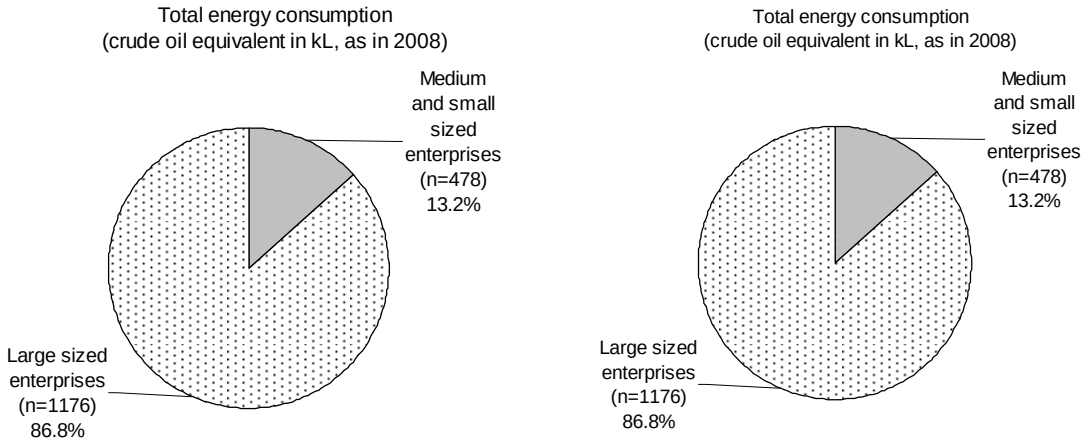
[2] "FY 2009 White Paper on Small and Medium-sized Enterprises" by the Ministry of Internal Affairs and Communications. The paper classifies small and medium-sized enterprises according to the following definition: (1)Number of enterprises＝number of companies + private business institutions (single business institutions, main offices/head offices/headquarters offices) (2) According to the definition in the revised edition of the Basic Act on Small and Medium-sized Enterprises, the SMEs are defined as those having 300 or less regular employees (100 or less for wholesale and services sectors, 50 or less for retail and restaurant sectors), or those having 300 million yen or less in capital stock (100 million yen or less for the wholesale sector, 50 million yen or less for retail, restaurant and services sectors).

[3] For example, Li Yizhong, minister of China's Ministry of Industry and Information Technology, stated that SMEs accounted for more than 60% of GDP, more than 99% of the total number of enterprises and about 80% of employees (as of March 10, 2009). China's notification on a tentative SME standard defines if company meets one of the following conditions, having 2000 or less employees, 300 million yuan or less in sales and 400 million yuan or less in gross assets, it will be classified as SMEs (Industry).

[4] Based on the revised Act on Promotion of Global Warming Countermeasures, since April 1, 2006, those emitting a large amount of greenhouse gas (specific business institution emitters) are obliged to calculate their own greenhouse gas emissions for reporting to the government, which compiles and publishes the information reported. The specific business institution emitters include all of the factories and business institutions specified as Type 1 designated energy management factories as stipulated in the Energy Conservation Act..

[5] Operators of all of the business institutions whose total energy consumption in terms of crude oil equivalent is 1,500 kl/year or more.

Fig. 2-1 Breakdown of Factories and Energy Consumption by Size of Enterprise



2-1 Characteristics of Small and Medium-Sized Enterprises

The results of the questionnaire survey have revealed that the distribution of energy consumption of the small and medium-sized enterprises is similar to that of the large-sized enterprises (see Fig. 2-2). It has also become apparent that SMEs have lagged behind large-sized enterprises in implementing energy conservation measures (see Fig. 2-3).

Fig. 2-2 Distribution of Energy Consumption in FY2008

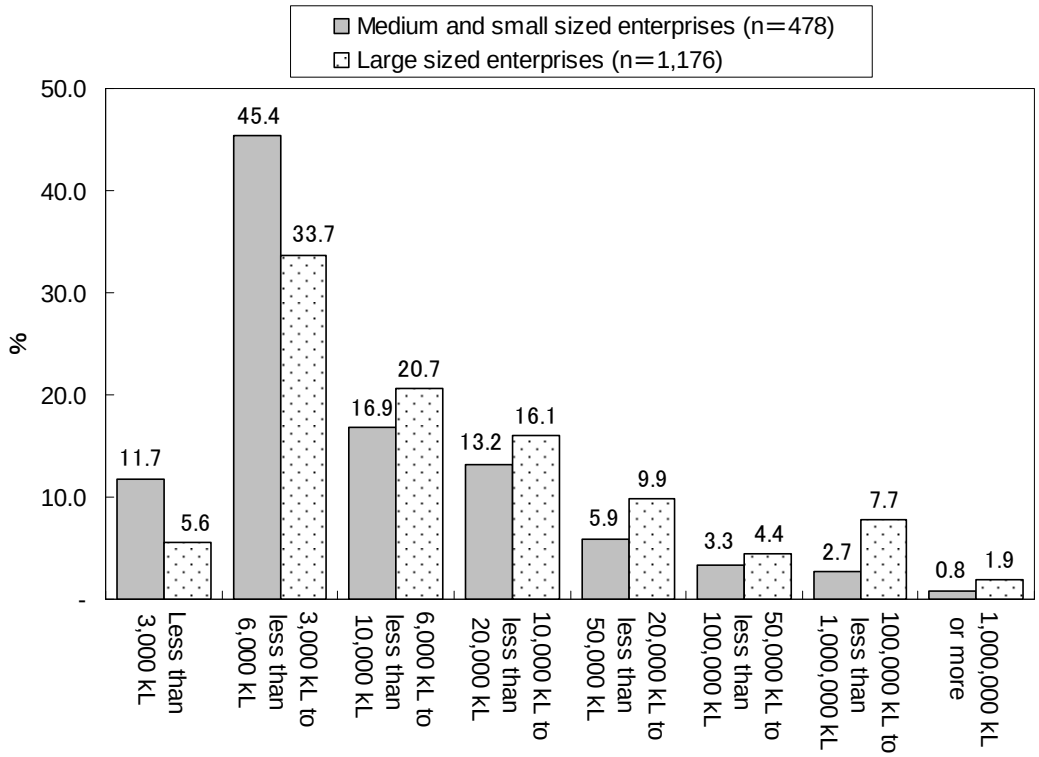
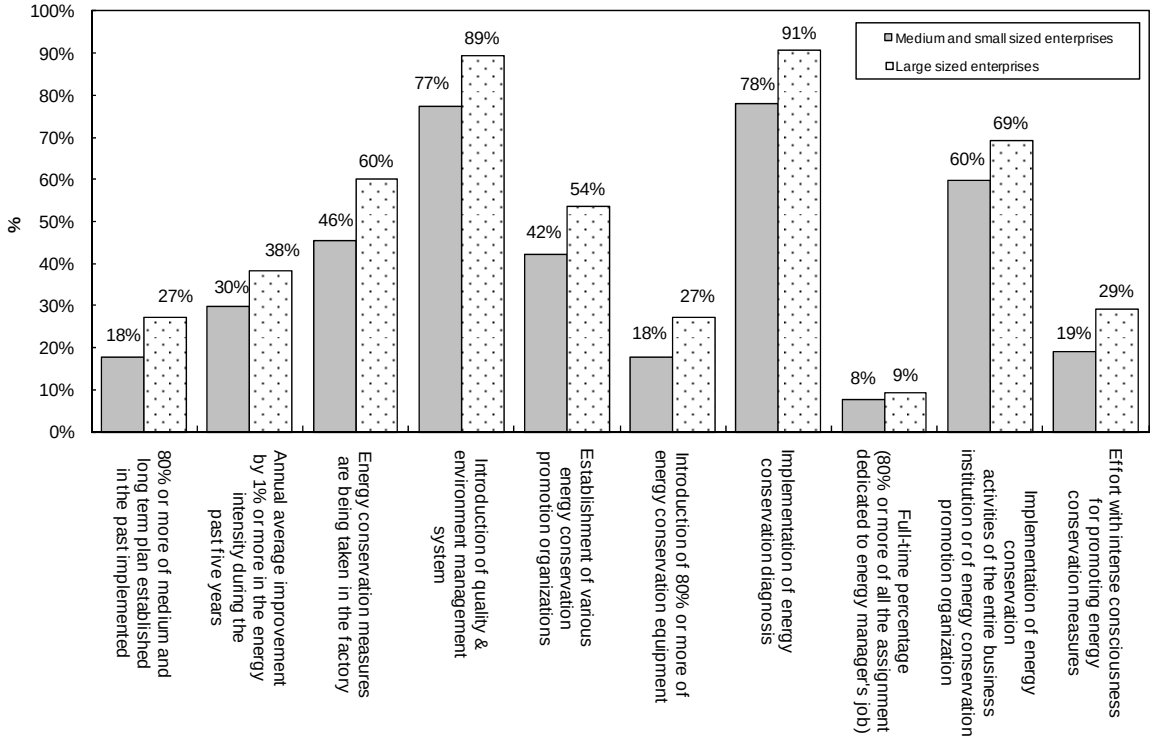


Fig. 2-3 Major Differences between Small & Medium-Sized and Large-Sized Enterprises



In consideration of the above points, this section discusses how to raise the level of implementation of energy conservation activities at SMEs. In the first place, in order to gain an understanding on the current situations, we made an analysis to identify barriers in promoting energy conservation measures at SMEs. The results of the analysis have revealed that major barriers for promoting energy conservation measures are “fund shortages,” and “the absence of time to spare for energy conservation amid manpower and other shortages,” which are common for both SMEs and large enterprise, but are more profound among SMEs. Hindrances such as “lack of information or knowledge on effective energy conservation means” and “disinterestedness of employees” are more significant among SMEs than among large enterprises. These results are in line with those of a survey by the Small and Medium Enterprise Agency (2009).

The highest priority in promoting energy conservation measures at large enterprises is given to “compliance with law” (cited by 53.2%) followed by “cost reduction” (31.3%). At SMEs, “compliance with law” (43.8%) and “cost reduction” (40.5%) are equally important.

The above indicates that SMEs show a tendency to be more sensitive to cost than large enterprises. This may be because of SMEs’ characteristics. It is thus necessary to comprehend the features of SMEs in order to ensure their effective promotion of energy conservation measures by SMEs, which often lag behind large enterprises in implementing energy conservation measures.

Minato et al. (1996) point out that SMEs have the following three characteristics, unlike large enterprises. First, SMEs usually have relatively smaller market shares than large enterprises and are exposed to continuous competition. Second, non-organizational decision making plays a more important role at SMEs, meaning that more emphasis is placed on personal factors than systematic

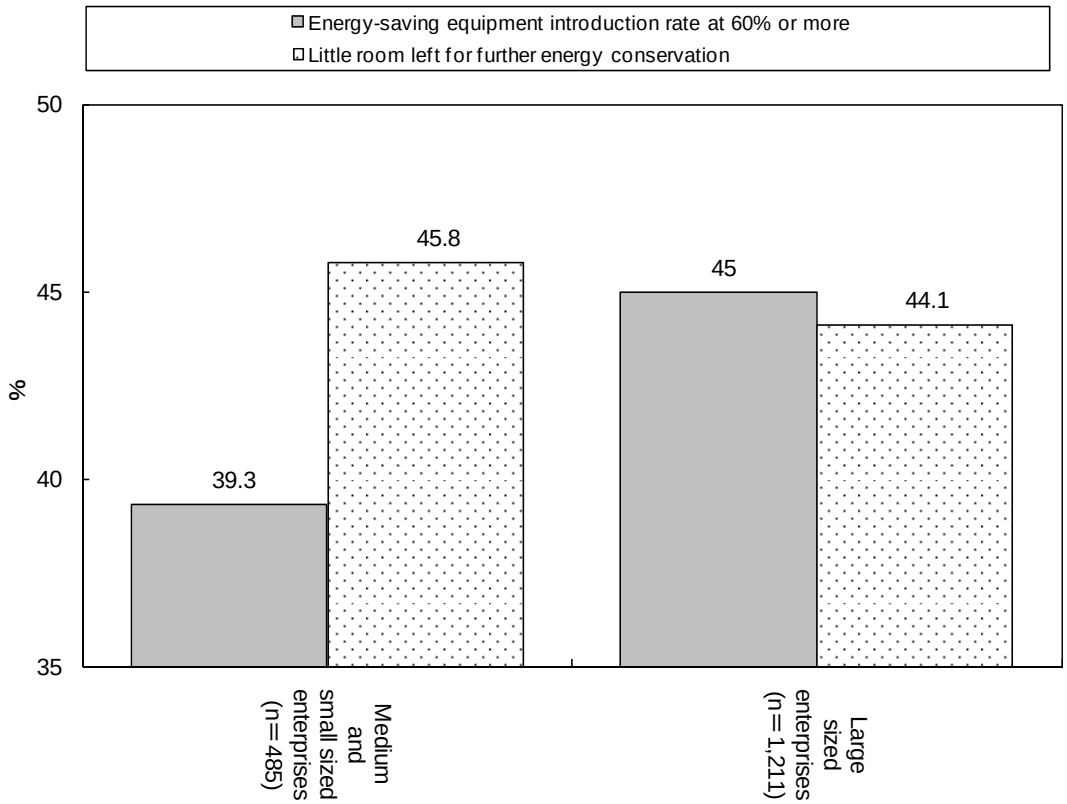
factors. Third, the quantity and scope of business resources (personnel, funds, goods and information) at SMEs are less than at large enterprises. The three points were cited as major characteristics of SMEs. In light of these points, the following section examines how to promote energy conservation measures at SMEs.

2-2 How to Promote Energy Conservation Measures at SMEs

As for the "severe competitive market environment" as the first feature for SMEs, energy conservation activities will by nature contribute to reducing their energy costs, resulting in positive effects on them in the competitive market. Actually, however, it is considered that energy conservation measures are not properly put into practice because of the third point of "limited business resources" meaning lack of human resources and information.

For example, Fig. 2-4 indicates responses of SMEs and large enterprises to questions about any room left for further energy conservation at factories and on the energy-saving equipment introduction rate. Of large enterprises, those giving the energy-saving equipment introduction rate at 60% or more accounted for 45.0% and those having little room for further emergency conservation captured a similar share at 44.1%. Of SMEs, those having little room left for further energy conservation accounted for 45.8%, against 39.3% for those giving the energy-saving equipment introduction rate at 60% or more. The latter percentage is smaller than indicated by the former (see Fig. 2-4).

Fig. 2-4 Gaps between Energy Conservation Consciousness and Actual Conservation Results



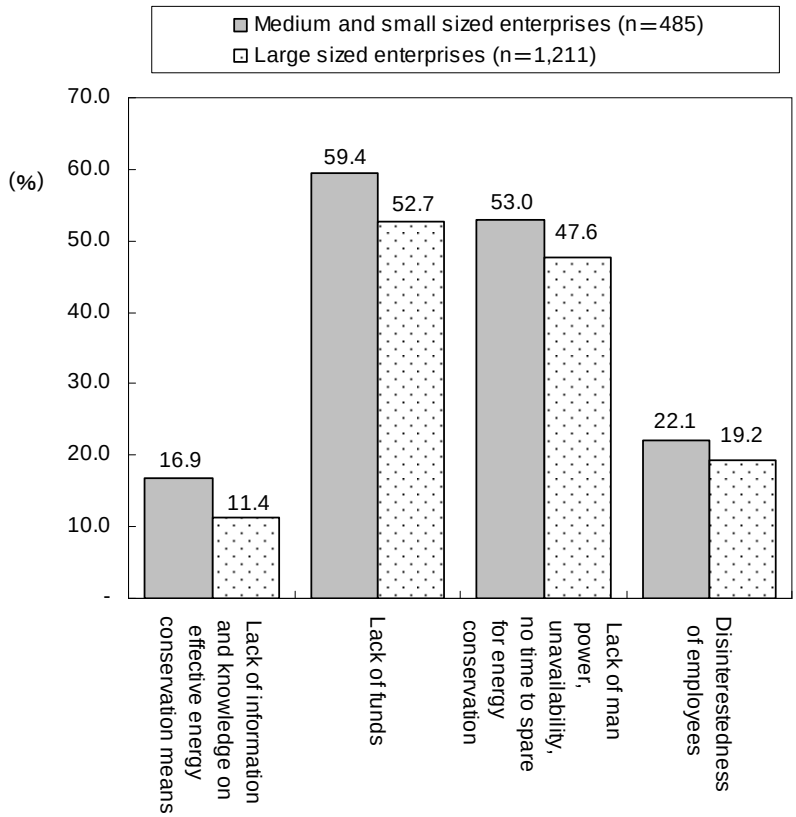
Despite their low energy-saving equipment introduction rate, they replied that they have little room for further energy conservation. There may be two reasons for such contradictory result.

The first is their lack of energy management analysis capability. They have little adequate capability to precisely identify and analyze energy use conditions of their factories and find energy conservation potentials, leading them to erroneously believe that further energy conservation is not practicable. This is attributable primarily to their lack of energy management know-how and information. For such factories, supply of adequate information and implementation of energy conservation diagnosis are considered effective.

The second reason is that factories exposed to "a severe competitive market environment," though being aware of how to promote energy conservation, have little room to employ additional human resources and invest funds for energy conservation measures. They thus replied that they had little room for further energy conservation, indicating the problem regarding the "feasibility" of these measures. For example, the percentage share for SMEs citing "deterioration of production facilities and their efficiency" as the reason for their failure to improve energy intensity by an average of more than 1% per year in the past five years was over 10 points more than for large enterprises doing so. In this respect, financial support to allow SMEs to perform energy conservation measures is believed to be effective. Given that half of the respondents to the questionnaire survey gave the payout time for energy conservation investment as less than three years, considering financial support for projects with a payout time at three years or longer is worthwhile.

As for SMEs' second feature of "non-systematic elements" meaning that the willingness of

Fig. 2-5 Barriers for Promoting Energy Conservation Measures



persons at SMEs can be reflected in decision making more directly than at large enterprises, Takahashi (2007) suggests that the smaller the size of an enterprise in terms of human resources, the more influential the decisions made by the top or upper staff member. Our questionnaire survey indicates that the "instructions by the management or the factory general manager" were cited by 64.4% of SMEs as a useful mechanism or system for promoting energy conservation at factories. The percentage was the highest. On the other hand, in response to a question about respondents' energy conservation attitude as energy managers, 29.3% of large enterprises answered that they "are strongly conscious" of energy conservation. The share for SMEs answering so was limited to 19.2%. Those answering that they "are engaged in promoting energy conservation as a job" accounted for 14.8% of large enterprises, against 21.4% of SMEs. The above results lead us to think that consciousness-raising of the management level, factory general managers and energy managers at SMEs is an effective measure.

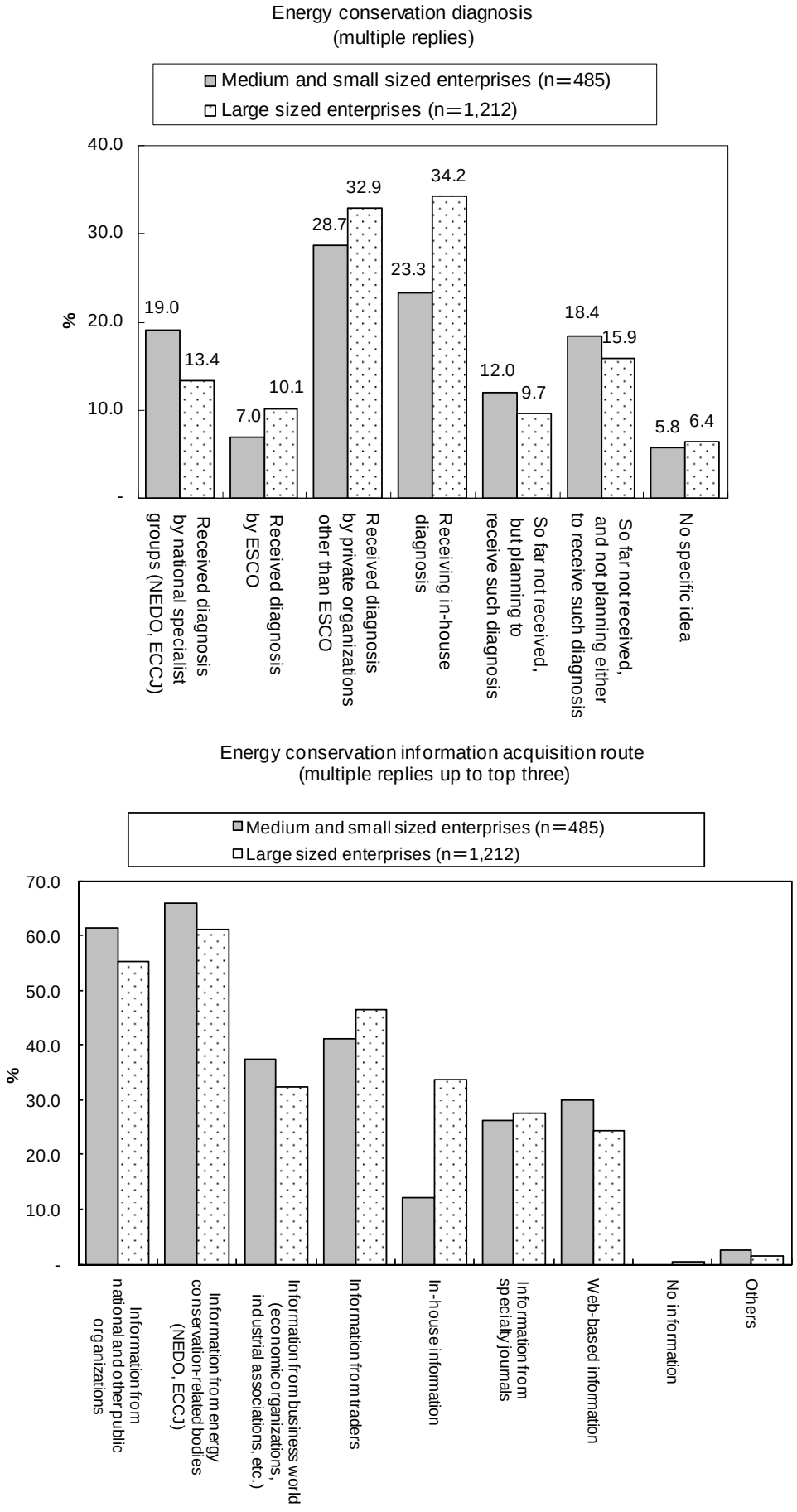
"Limited business resources" as the third characteristic of SMEs indicate that the share for SMEs failing to implement costly energy management measures (including those that can produce greater profit than their costs) is larger than for large enterprises doing so. Although past data lead us to estimate that ISO and other management systems and energy conservation diagnosis are effective for energy conservation, the share is low for SMEs that implement such costly measures. It is thus considered effective to offer financial assistance to SMEs for promoting the introduction of energy conservation diagnosis or energy management systems.

In connection with limited business resources, adequate investment of human resources is also worth considering over a medium to long term. It has become apparent through the questionnaire survey that factories replying "energy conservation promotion organizations have been established" or "energy conservation activities are performed throughout the factory" have attained higher levels of energy conservation than others. In comparison with large enterprises, SMEs feature a lower share for those that have established energy conservation organizations and a higher share for those replying "only energy managers or several persons at a relevant section are engaged in energy conservation activities." On a question about energy management operations' percentage share of all business operations by employees named energy managers, the share for SMEs giving the percentage at less than 10% was higher than for large enterprises doing so. This indicates that although only one or several energy managers are involved in energy management at SMEs, still only a small part of their overall operations is devoted to energy management work, with a greater part being other operations.

At large enterprises, on the other hand, it is occasionally indicated that energy management know-how has been accumulated in-house. For example, 23.3% of SMEs have done in-house energy conservation diagnosis, while 34.2% of large enterprises have done so. As for energy conservation information sources, 12.0% of SMEs have had in-house sources, while 33.6% of large enterprises have (Fig. 2-6).

As mentioned above, investment of human resources for energy management leads to in-house accumulation of information and know-how, allowing more effective energy conservation measures to be taken. This is an important challenge for medium to long-term measures.

Fig. 2-6 Disparity in Human Resources between SMEs and Large Enterprises



2-3 Conclusion

Concerning the current SME situation in Japan, Takahashi (2007) points out that "SME managers have deep-rooted feelings that efforts to tackle environmental problems only consume costs without leading to profit." Given SMEs' feature that top or senior managers' consciousness has a strong influence on business operations, changing the way of thinking about energy conservation among decision makers at SMEs may be the key to the promotion of energy conservation measures at SMEs. They should be led to believe that energy conservation measures bring about not extra burdens but energy cost cuts to improve productivity.

Seen from this sort of standpoint, the obligation to appoint "energy management control officers[6]" for specific business operators[7] as defined in the FY2008 revision of the Energy Conservation Act is expected to produce a certain effect. Also, as mentioned in Section 2-2, it is vital for upper staff members at SMEs to gain access to appropriate energy conservation information, so as to raise their energy conservation consciousness. In particular, it is essential for them to adequately comprehend the current situation of their energy management activities. In this sense, the government is expected to play a role in supporting education on energy management know-how, the establishment of information sharing platforms and energy conservation diagnosis.

Given SMEs' feature that they are always exposed to severe competition, financial assistance is considered necessary to some extent so as to make their energy conservation measures effective. Such assistance may include support for energy conservation diagnosis and subsidies for introducing energy conservation equipment. Finally, the existence of legal regulations should be kept in mind in the course of implementation of government support. As effective measures for the promotion of energy conservation at SMEs, "regulations to be observed under the Energy Conservation Act and other laws, ordinances and the like" were cited most frequently, by 72.2% of respondents in the questionnaire, followed by 45.2% for "higher energy prices (including steep rises in crude oil prices and the imposition of an environment tax)" and 24.9% for "customer's requests." For the promotion of energy conservation, it may also be effective to establish the situation where energy conservation measures are required to be taken. As a matter of course, prudent considerations may have to be given to the level of regulations to be applied to SMEs confronted with severe competition. Still, both the assistance and regulations are required for realizing effective energy conservation measures.

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[6] According to the FY2008 revision, a new rule system is established wherein business operator-based (enterprise-based) energy management is required in place of the conventional energy management for each factory or business institution. More specifically, when annual total energy consumption (crude oil equivalent) of a business entity as a whole (including the head office, factories, branches, sales offices, shops, etc.) is 1,500 kL or more, the business entity must report its annual energy consumption to the government and be designated as a specific business operator.

[7] The Energy Conservation Act requires that a specific business operator "appoint an energy management control officer." These energy management control officers are specified as "those who are in a position to supervise and control business activities." Therefore, they are supposed to have a voice in the board of directors and the like at joint stock companies. At any other enterprises, they might need to be entitled to make direct proposals to decision makers.

3. Effect of Japan's Designated Energy Management Factory System

This chapter verifies the actual effects of the designated energy management factory system in Japan. First, explanations are given as to the actual conditions of the designated energy management factory system, and then an analysis is made on the effects of this system.

3-1 Order of Priority in for Energy Conservation

In promoting energy conservation measures at factories, top priority is given to "compliance with law," followed by "cost reduction." To "compliance with law," energy managers give greater priority than factory management executives. Large enterprises place greater emphasis on "compliance with law" than SMEs. In the energy supply sector among industrial categories, more than 70% of factories give top priority to "compliance with law." Also about 70% of the factories responded that "regulations to be observed under the Energy Conservation Act and other laws, ordinances and the like" would be effective in promoting energy conservation measures at factories. It is observed from the results of the questionnaire survey that the existence of "legal regulations" pushes forward the promotion of energy conservation measures at factories.

3-2 Current Situations of Energy Management Activities at Factories

3-2-1 Impacts of Economic Crisis in FY2008

In the questionnaire survey, 69.1% of the factories replied that "the capacity utilization rate decreased" in FY2008, suggesting huge impacts of the global financial crisis that occurred in 2008 as a result of the collapse of U.S. housing bubbles. Out of the factories that replied that "the capacity utilization rate dropped," 28.8% said "energy conservation activities were activated," and 20.6% answered "energy conservation activities became sluggish." Again out of the factories that replied that "the capacity utilization rate dropped" and that "the factory's energy conservation activities were proceeding," 35.1% said "energy conservation activities were activated." On the contrary, out of the factories that replied "the factory's energy conservation activities were not proceeding," 38.0 said "energy conservation activities became sluggish." It is evident from the above that factories where energy conservation activities were proceeding continued their activities even under such an economic crisis.

3-2-2 Current Situations of Energy Management Activities at Factories

This section analyzes the current situations of energy management activities from the viewpoints of the size of enterprises, energy consumption quantity and the time for designation. Specific aspects found in this analysis are given in the following.

(a) Establishment of energy conservation promotion arrangements and implementation of energy conservation activities

The questionnaire survey indicates that the percentage share for factories that have established energy conservation promotion arrangements and implemented energy conservation activities is

higher among large enterprises, greater energy consumers and those designated energy management factories earlier. An analysis of energy conservation activities by energy consumption size indicates that the share for factories implementing the "additional installation and improvement of equipment" is not low for those consuming less energy. This suggests that Energy Conservation Act revisions and the like (including the introduction of the medium to long-term plan) have contributed to raising the share for factories that have implemented the "additional installation and improvement of equipment." But the share for those implementing the "enhancement of management and improvement of operations" as cost-effective measures is lower than that for those implementing the "additional installation and improvement of equipment." This is an issue to be addressed from now on. As for energy conservation promotion arrangements, many factories replied that they had energy conservation promotion organizations. Fewer factories were using rewards-and-penalties regulations to assess energy conservation activities (see Fig. 3-2).

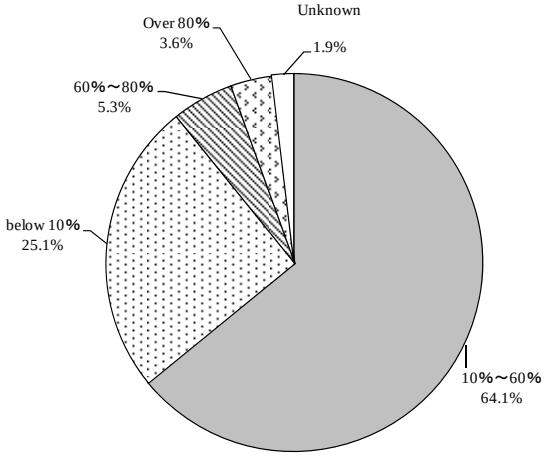
(b) Energy managers

The ratio of energy management operations to energy managers' overall business operations was cited as 10-60% most frequently, by 64.1% of respondents, in the survey, followed by 25.1% for less than 10%. This means that most of them are engaged in concurrent operations. The most popular type of concurrent operations is "equipment management other than energy management," followed by "production management." It is also noted that the ratio of "production management" to energy managers' overall operations is higher at factories with greater energy consumption sizes. According to the questionnaire survey, about 30% replied that energy management operations were performed "only by energy managers" or "by several persons of the section they belong to."

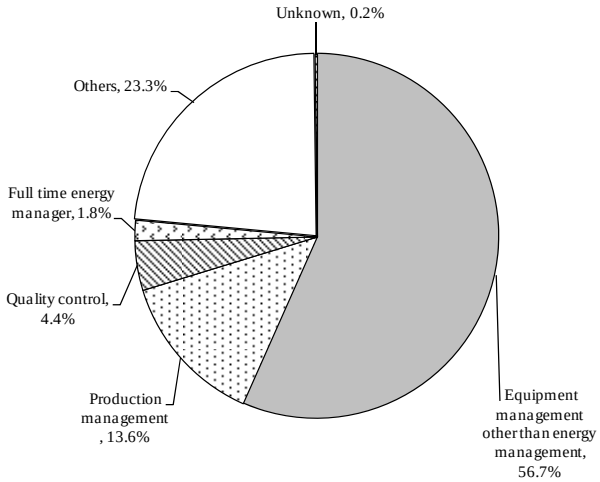
Of the factories that replied that "an energy conservation promotion organization has been established," about 40% failed to make factory-wide energy management efforts. About 20% said energy conservation was promoted only "by energy managers" or "by several persons of the section they belong to."

Fig. 3-1 Operations of Energy Managers

Ratio of energy management operations to energy managers' overall business operations



Energy managers' operations other than energy management



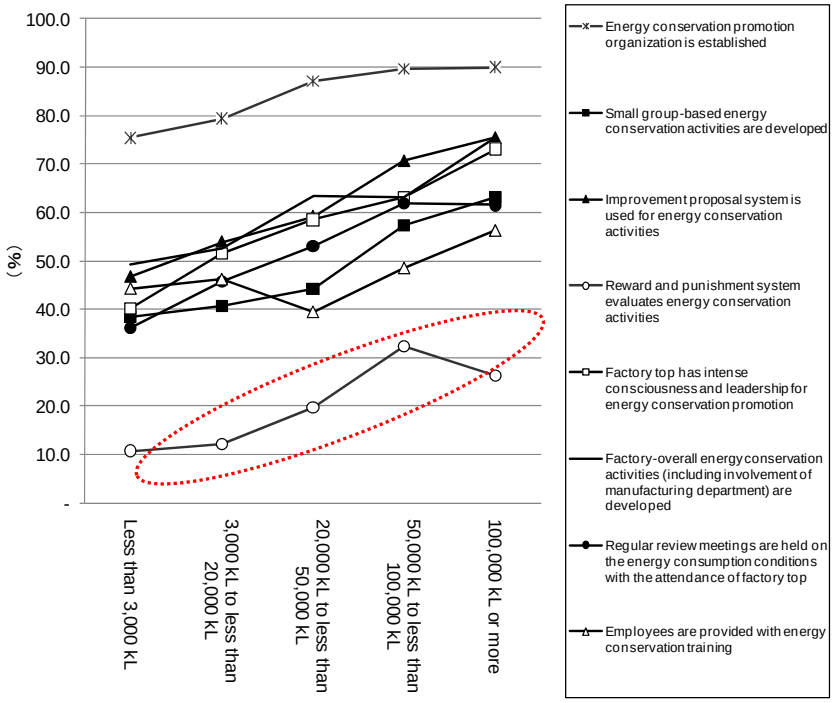
(c) Investment in energy conservation equipment

The energy conservation equipment introduction rate is higher at factories with greater energy consumption. As for times for energy management factory designation, the energy conservation equipment introduction rate is higher for large enterprises that received the energy management factory designation earlier. The share for SMEs scoring the energy conservation equipment introduction rate of 80% or more is higher for those that received the designation earlier.

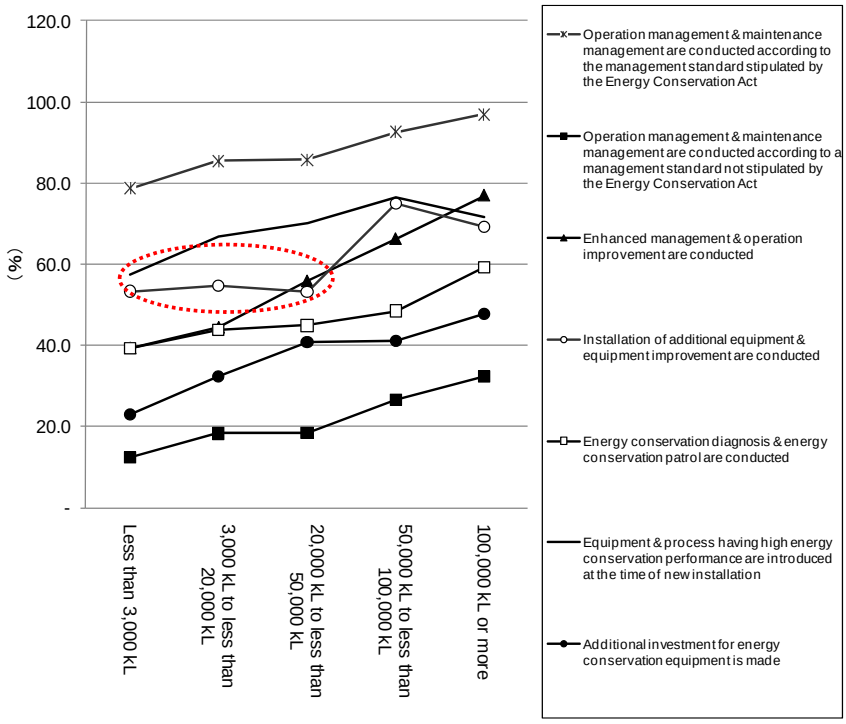
The medium to long-term plan implementation rate was "60% or more" at more than 80% of factories with energy consumption at 100,000 kL/year or more. The rate of "60% or more" covered about 60% of factories with energy consumption at 50,000 kL/year or more. The results mean that factories with greater energy consumption post higher medium to long-term plan implementation rates. Regarding times for designation, those with a medium to long-term plan implementation rate of "less than 30%" are fewer among factories that received the designation earlier.

Of large enterprises, 48.5% responded that "the payout time has been set" as a standard for investment in energy conservation equipment. Of SMEs, the largest group of 48.2% replied that "the payout time has not been set."

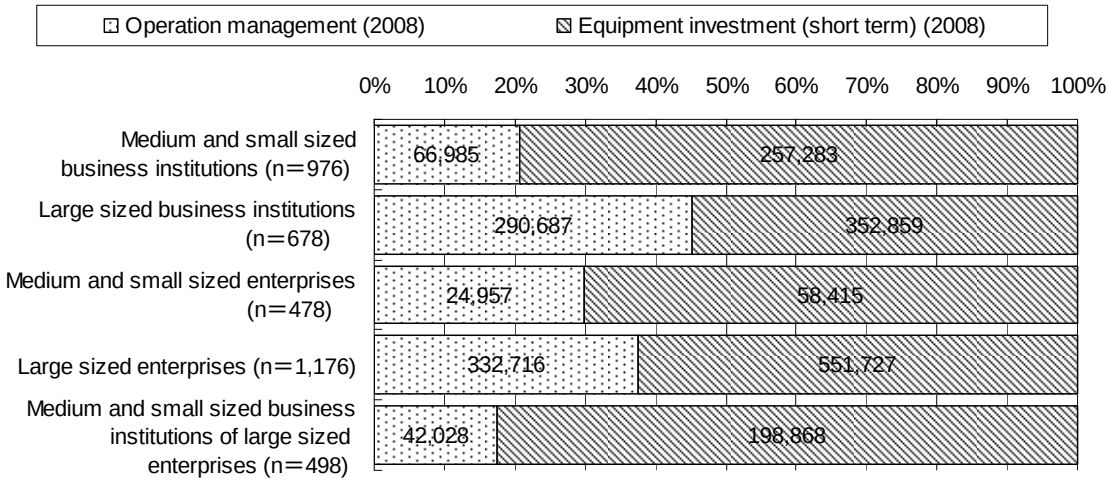
Fig. 3-2 Energy Conservation Promotion Arrangements and Energy Conservation Activities by Energy Consumption Size[8]



[8] In this analysis, business institutions with less than 300 employees that responded to the questionnaire are classified as small and medium-sized business institutions and others as large institutions. Business institutions with 300 or less employees that belong to large enterprises are defined as small and medium-sized business institutions of large enterprises.



Energy conservation measures: as per the size of enterprises



(Note) In the figure, business institutions with less than 300 employees that responded to the questionnaire are classified as small and medium-sized business institutions and others as large institutions. Factories with less than 300 employees that belong to enterprises having one or no Type 1 designated energy management factory amounting to a specific business institution emitter as stipulated in the Act on Promotion of Global Warming Countermeasures are defined as small and medium-sized enterprises and others as large enterprises. Business institutions with 300 or less employees that belong to large enterprises are defined as small and medium-sized business institutions of large enterprises.

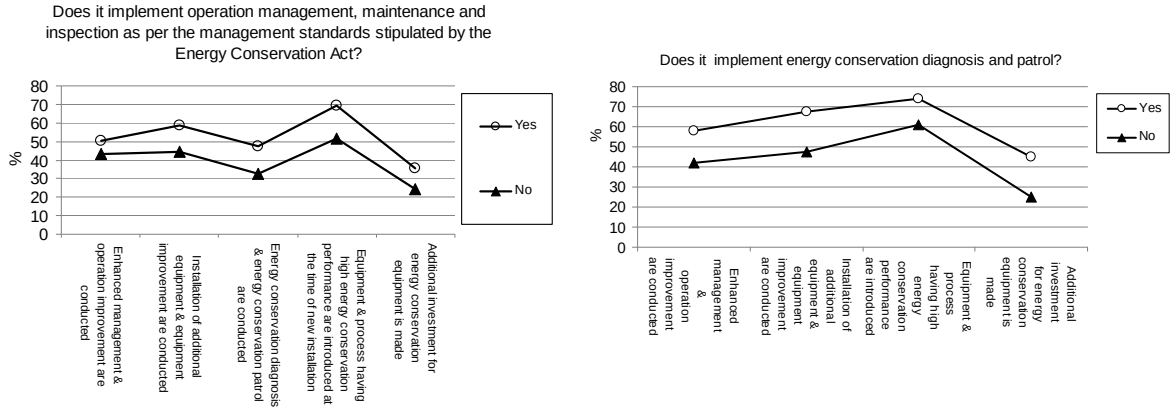
(d) Barriers in promoting energy conservation

About half of respondents to the questionnaire cited “the absence of time to spare for energy conservation amid manpower and other shortages” as a barrier in promoting energy conservation. This barrier was cited more frequently by SMEs and by enterprises with less energy consumption.

3-2-3 Management Standards and Energy Conservation Diagnosis

A cross analysis has revealed that the "implementation of operation management, maintenance and inspection as per the management standards stipulated by the Energy Conservation Act" and the "implementation of energy conservation diagnosis and patrol" are related to the implementation of other energy management activities. For example, when compared to factories that "do not implement operation management, maintenance and inspection as per the management standards stipulated by the Energy Conservation Act," those that do so have a higher rate of implementing energy conservation activities. In comparison with factories that do not implement "energy conservation diagnosis & patrol," those that do so post a higher rate of implementing other energy conservation activities[9] (Fig.3-3).

Fig. 3-3 Management Standards and Energy Conservation Diagnosis



3-2-4 Gap between Energy Conservation Consciousness and Energy Management Level

The questionnaire survey included questions about factories' subjectivity-based assessment of progress in their energy conservation promotion. Factories seeing progress feature a higher rate of implementing energy conservation arrangements and activities. These factories also show a higher rate of introducing energy conservation equipment and implementing medium to long-term plans. The above results indicate that the energy management level of a company is consistent with energy managers' consciousness about progress in energy conservation. However, responses to questions about the room for further energy conservation efforts indicate a gap between energy managers' assessment and actual situations of energy conservation measures at factories where the introduction of energy conservation equipment has made little progress (with the energy conservation equipment introduction rate at less than 30%). Of factories with the energy conservation equipment introduction rate at less than 30%, more than 40% replied that not much room was left for further energy conservation in terms of "enhancement of management and improvement of operations" and "investment in equipment." Particularly, they tended to see little

[9] The relationship between energy conservation diagnosis and "other energy conservation measures" is discussed in "3-2-4 Gap between energy conservation consciousness and energy management level" and "4-2 Energy conservation diagnosis."

room for the “enhancement of management and improvement of operations” (Fig. 3-4). One reason for this tendency may be that measures having a function of “energy conservation diagnosis” to check energy management conditions at factories are not sufficiently put into practice. As a consequence, factories might have failed to identify any due room for energy conservation through the “enhancement of management and improvement of operations” (Fig. 3-5).

Fig. 3-4 Energy Conservation Equipment Introduction Rate and Room for Energy Conservation

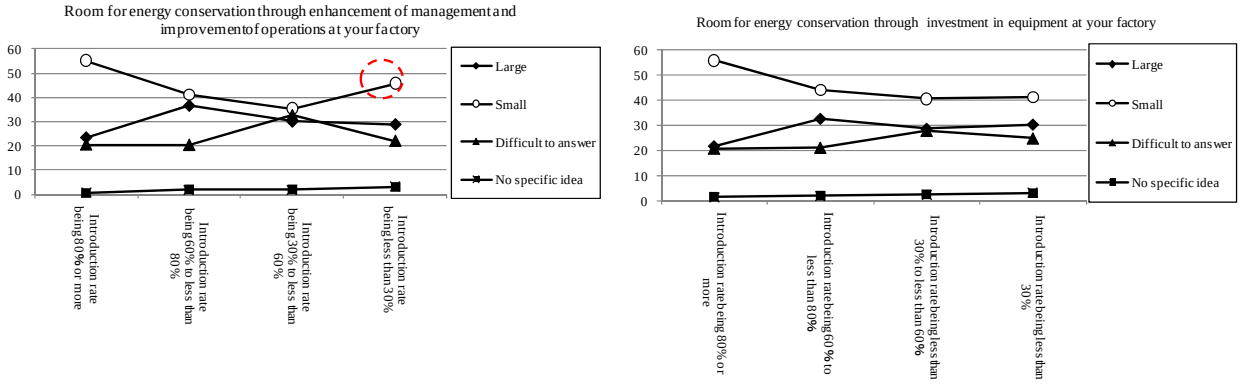
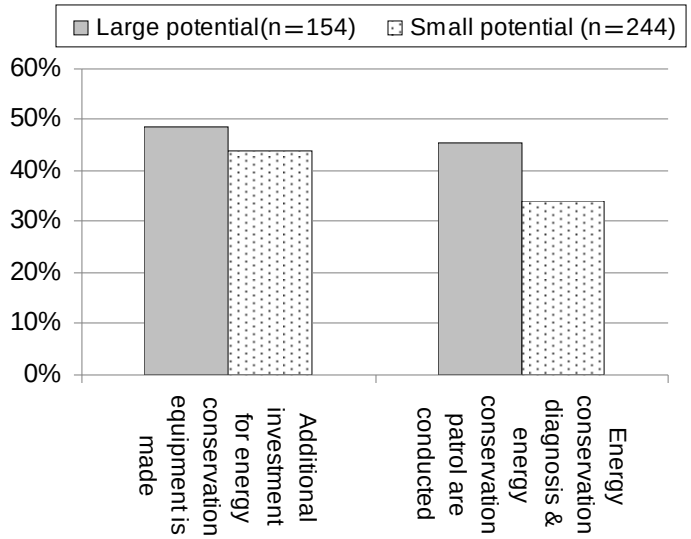


Fig. 3-5 Room for Energy Conservation through Enhanced Management and Operation Improvement at Factories with the Energy Conservation Equipment Introduction Rate of less than 30%

(Gap between actual energy conservation measures and consciousness)



3-3 Effects of Designated Energy Management Factory System

3-3-1 Maintenance Development of Infrastructures for Promotion of Energy Conservation Activities

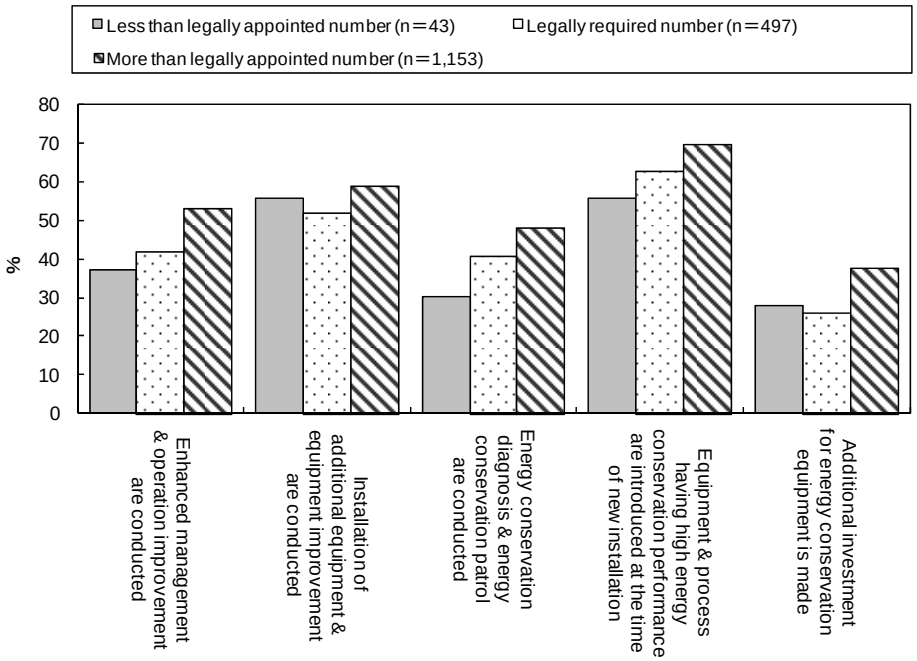
Type 1 designated energy management factories have attained an overall implementation rate of 80% or more for the "development of energy conservation promotion organization," "establishment of energy conservation targets," and "operation management, maintenance and inspection as per the management standards stipulated by the Energy Conservation Act," on which energy management activities are based. The results of the questionnaire survey indicate that energy managers have achieved high rates of performing their duties: 80.9% for the "analysis of energy consumption conditions and preparation of documents" and 69.1% for the "development of energy conservation plans." The survey has thus confirmed that the Energy Conservation Act is well complied with.

Qualitatively, regulatory measures based on the Energy Conservation Act and the like are recognized as effective for the promotion of energy conservation at factories. Also factories put high priority on compliance with law. Therefore, regulations on factories under the Energy Conservation Act have been effective for the promotion of energy conservation activities. The background for the above situation includes the long existence of a network of legal regulations including the Heat Management Act, the intensification of regulations under a step-by-step approach and checking functions by means of regular reporting and factory inspection, which are considered to have accelerated the voluntary and scheduled energy management activities at factories.

3-3-2 Utilization of Qualified Energy Manager Qualification System

In Japan, about 6,000 Type 1 designated energy management factories in the factory sector have more than 50,000 qualified energy managers. At factories with active energy conservation efforts,

Fig. 3-6 Number of Energy Managers and Energy Conservation Activities



there are more qualified energy managers than required by law, suggesting that qualified energy managers have been fully utilized for the promotion of energy conservation activities (Fig. 3-6).

4. Points for Improvement for the Current Designated Energy Management Factory System in Japan

4-1 Periodic Report Publication System and Development of Energy Conservation Activity Indicators

At small and medium-sized enterprises, the rate of implementing the "enhancement of management and improvement of operations" tended to be lower. The questionnaire survey indicates that although energy managers at SMEs vaguely understand their energy conservation promotion situation, they might have failed to comprehend the exact room left for in-house energy conservation (Fig. 3-5).

In our questionnaire survey, we set out an open-response question about points for improvement for the designated energy management factory system. As a result, there were some responses, such as the "creation of databases and browsing systems for periodic reports," "information exchanges among designated factories," and the "recognition of energy conservation levels through the publication of energy intensity data at rival enterprises." Accordingly, it is assumed that enterprises need relative information to compare their energy management levels with those of others.

For this purpose, it is desirable to develop energy conservation activity indicators to allow each factory to compare its energy conservation level with those of others. In addition, periodical reports may be statistically processed to publish sector-by-sector energy management performance data, allowing each enterprise to find its position and prompting the principle of competition to work for the further promotion of energy conservation[10].

As for questions on energy conservation promotion arrangements, only 15.2% of factories were using rewards-and-penalties regulations to assess energy conservation activities. In response to questions on "the advantages of energy manager qualification acquisitions," only 7.7% of respondents cited "pay hikes," 9.0% "greater authority," and 5.2% "the obtainment of respect from others." But an overwhelming 70.8% replied "there is no particular advantage." It can be said that construction of a system where the promotion of energy conservation leads to higher assessment scores is a challenge left for the future. In this regard, it may be worthwhile considering developing a system for assessing energy conservation activities through visualization of the energy conservation promotion situation of a factory in the form of an energy conservation label.

[10] Benchmark indicators introduced under the May 2008 revision to the Energy Conservation Act represent a good example. But they have not necessarily been set for all sectors. We expect to see further consideration of such indicators.

4-2 Energy Conservation Diagnosis

Energy conservation is mainly promoted by the following measures: (1) Enhancement of management and improvement of operations, (2) Equipment addition and improvement, and (3) Adoption of energy conservation equipment and improvement of energy conservation processes upon equipment introduction or replacement. In the promotion of such energy conservation activities, the "management of operations based on management standards and standardization of maintenance management" and "energy conservation diagnosis" will serve as indispensable activities, as their energy conservation promotion effects were identified in Chapter 3. On the other hand, at present, factories that are not implementing energy conservation diagnosis or patrol represent 50% of large enterprises and about 70% of SMEs.

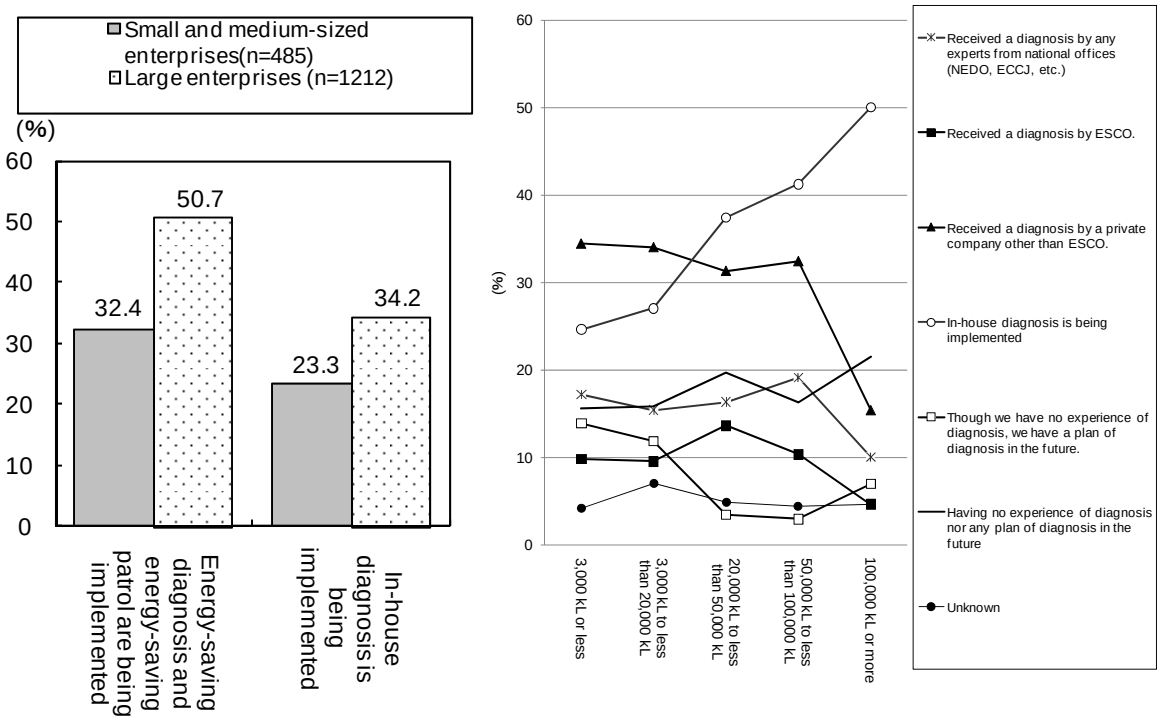
4-2-1 Factory-Level Energy Conservation Diagnosis Conditions

At SMEs or factories consuming less energy, it is considered that energy conservation activities in the form of "equipment addition and equipment improvement" have been promoted through the enhancement of regulations (including the introduction of the nonbinding target of improving energy intensity by 1% annually) under the Energy Conservation Act. On the other hand, the "enhancement of management and improvement of operations" known as cost-effective measures have failed to make progress[11]. Understanding about actual equipment conditions is indispensable for the "enhancement of management and improvement of operations." It is considered that one of the causes for the absence of progress exists in the situation where the "enhancement of management and improvement of operations" cannot be performed without the extraction of matters relating to energy conservation measures and the assessment of their feasibility through energy conservation diagnosis. In response to questions about mechanisms and systems for the promotion of energy conservation in the questionnaire survey, only 12.0% of all respondents stated that they implemented energy conservation diagnosis. Only 10.7% of SMEs answered so. Behind the low implementation rates for energy conservation diagnosis might have been the underestimation of effects of energy conservation diagnosis. Of the total respondents, 28.6% answered that they had never carried out energy conservation diagnosis. Of them, 16.7% answered "we have no experience of diagnosis nor do we have any plan of diagnosis in the future." The number of factories who answered that "though we have no experience of diagnosis, we have a plan of diagnosis in the future" was larger for factories consuming 20,000 kL/year or less of energy. But we cannot deny the possibility of these factories failing to implement diagnosis, given that Type 1 designated energy management factories are exempt from official energy conservation diagnosis, with the ESCO diagnosis coverage being as low as about 10%. On the other hand, the percentage share of factories answering "we are implementing in-house energy conservation diagnosis" is higher for factories consuming more energy. Those answering so accounted for nearly

[11] At factories, production equipment is subject to the "enhancement of management and improvement of operations." These measures are difficult to implement without the manufacturing division's cooperation and understanding. Another factor behind the absence of progress in the "enhancement of management and improvement of operations" may be that energy managers might have believed that they had nothing to do after implementing "the equipment addition and improvement."

50% of factories consuming more than 100,000 kL/year or more (Fig. 4-1).

Fig. 4-1 Energy Conservation Diagnosis

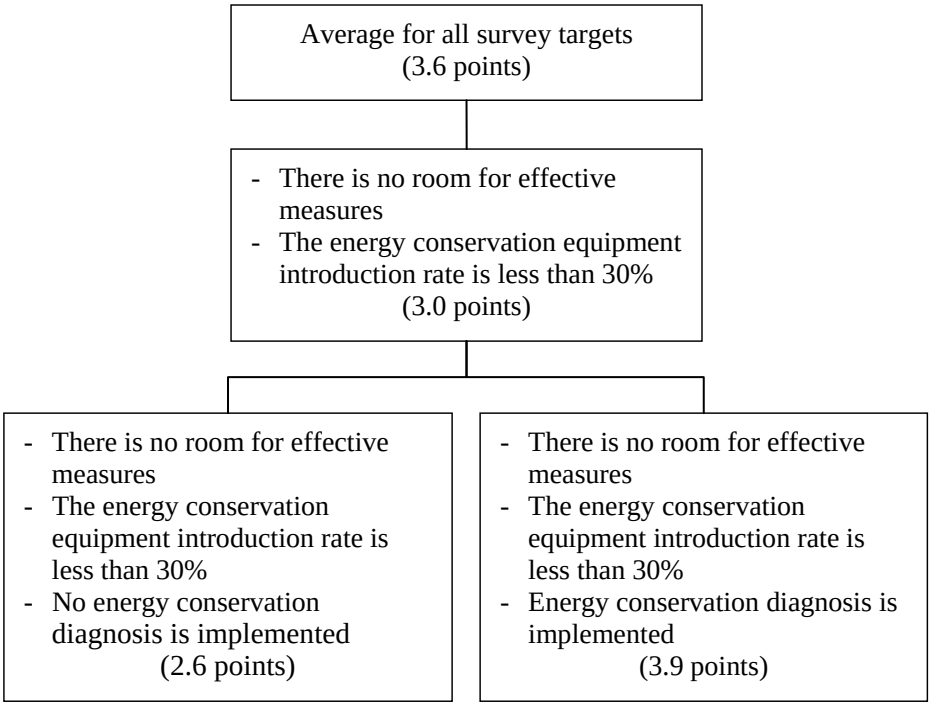


4-2-2 Energy Conservation Measures' Recognition and Energy Conservation Diagnosis

Among factories that answered "there is no room for effective measures" in relation to obstacles to the promotion of energy conservation, some (n= 128) answered that the energy conservation equipment introduction rate was less than 30%. In this group, the implementation rate for energy conservation diagnosis and patrol is as low as 32.8%, against 45.3% for the whole of respondents in the questionnaire survey. We divided the group into two subgroups – one for those implementing energy conservation diagnosis and another for those implementing no such diagnosis – for their comparison (Fig. 4-2)[12].

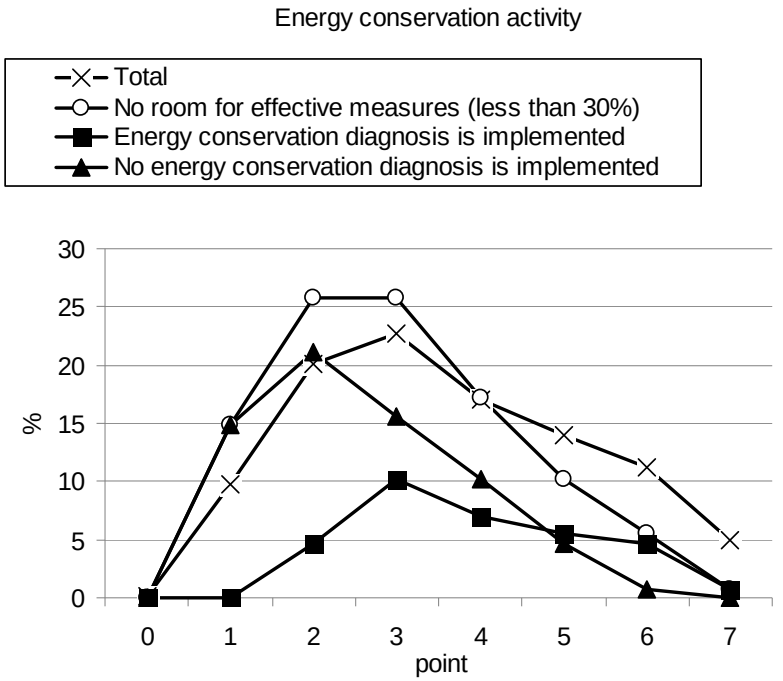
[12] For this comparison, one point is given for each of seven energy conservation measures ([1]implementation of operation and maintenance management based on management standards under the Energy Conservation Act, [2] implementation of operation and maintenance management based on others than management standards under the Energy Conservation Act, [3] implementation of the enhancement of management and improvement of operations, [4] implementation of equipment addition and improvement, [5]implementation of energy conservation diagnosis and patrol, [6] introduction of more-energy-saving equipment or processes upon installation of new equipment, and [7] implementation of additional investment in energy conservation equipment). The full score is seven points.

Fig. 4-2 Implementation Rates for Energy Conservation Diagnosis and Energy Conservation Activities



Given that the full score of seven points is given to factories carrying out all seven measures, the average for all questionnaire survey respondents came to 3.6 points. The average stood at 3.0 points for those answering “there is no room for effective measures with the energy conservation equipment introduction rate at less than 30%,” at 3.9 points for those answering “there is no room

Fig. 4-3 Comparison of Groups Having No Room for Effective Measures



for effective measures with the energy conservation equipment introduction rate at less than 30% and with energy conservation diagnosis implemented," and at 2.6 points for those answering "there is no room for effective measures with the energy conservation equipment introduction rate at less than 30% with no energy conservation diagnosis implemented." Energy conservation arrangements of this group (having no room for effective measures with the energy conservation equipment introduction rate at less than 30%) are similar to those of the entire questionnaire target. But those implementing no energy conservation diagnosis feature a lower implementation rate for energy conservation activities (Fig. 4-3).

Those having no room for energy conservation measures with the energy conservation equipment introduction rate at less than 30 include a group implementing energy conservation diagnosis and another implementing no such diagnosis.

4-2-3 Conclusion

Although it is suggested that energy conservation diagnosis is among the indispensable energy conservation activities in the promotion of energy conservation, the questionnaire survey indicates that the dissemination of energy conservation diagnosis does not make progress on an autonomous basis. In order to further promote energy conservation at factories in Japan, it is necessary to consider measures to increase the energy conservation diagnosis implementation rate.

4-3 Suitable Factory-Level Measures

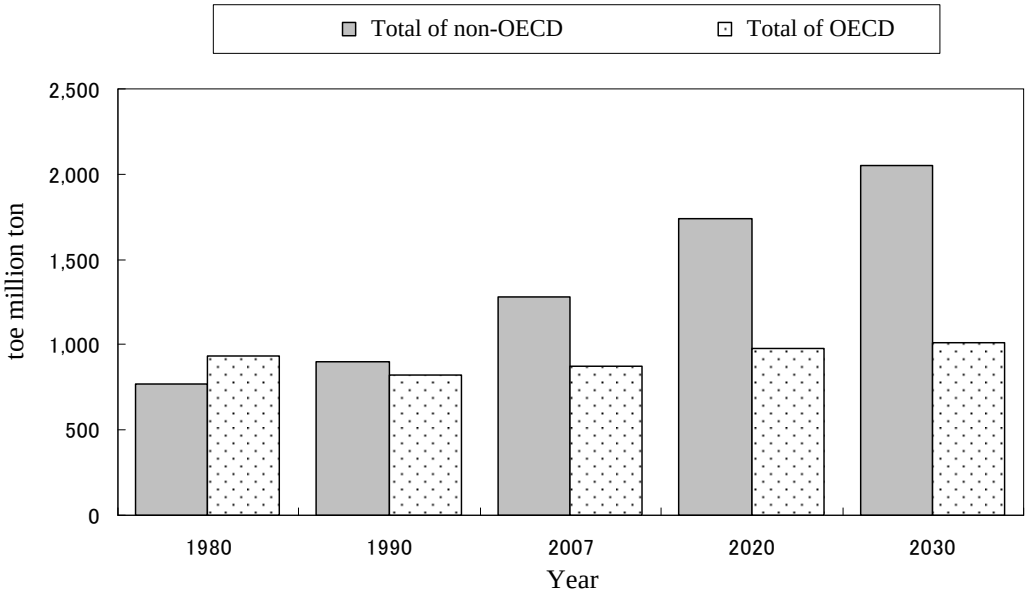
As pointed out in Chapter 2, large enterprises, where human resources are not so limited, are expected to achieve further progress in energy conservation activities by making energy conservation diagnosis obligatory. On the other hand, SMEs have human resources constraints (including labor shortages and low ratios of energy managers' energy management operations to their overall business operations) and have fallen short of spreading energy conservation promotion arrangements throughout their factories. It may be needless to say that time constraints exist on exploration of the room for energy conservation and the implementation of conservation measures at an SME factory where one to several energy managers might have undertaken energy management operations while being required to perform other business operations. Our questionnaire survey indicates that the implementation rate for the "enhancement of management and improvement of operations" for energy conservation is lower than for the "equipment addition and improvement." Traditional public energy conservation diagnoses have so far been dominated by sporadic one-day inspections and diagnoses for "equipment addition and improvement" purposes. At SME factories where energy conservation activities have lagged behind for the abovementioned reasons, however, support for the development of "energy conservation promotion arrangements" may be required along with continuous energy conservation instructions including those for the "enhancement of management and improvement of operations." Support menus meeting their business characteristics should be considered.

5. Implications for Developing Countries

5-1 Introduction

When looking at the tightening supply/demand relationship for fossil fuel resources and growing concerns on the global warming issue in recent days, we find that energy conservation efforts are indispensable not only in Japan but also in the entire world. On the other hand, it is predicted that final energy consumption in the world will increase 1.4 times from 2007 by 2030 (as estimated by the Institute of Energy Economics, Japan). Industrial sector energy consumption in the world has the same tendency (Fig. 5-1). The present world is characterized by small growth in industrial sector energy consumption in OECD (Organization for Economic Cooperation and Development) countries and by rapid growth in energy demand in developing countries. Industrial sector energy consumption in non-OECD countries is projected to expand 1.6 times from the present level by 2030.

Fig. 5-1 Prediction of Final Energy Demand (in OECD and non-OECD countries)



(Source) Estimation by Energy Data and Modelling Center, Institute of Energy Economics, Japan (2009)

When we work on global energy conservation measures, it is clearly important to consider energy demand conservation measures in developing countries. Consequently, in this chapter, we attempt to extract some useful points for developing countries' future development of energy conservation institutions based on experiences with Japan's energy management policies that have been found effective for promoting energy conservation measures through our survey.

5-2 Implications Gained from Experiences with Japan's System

Japan has performed energy conservation promotion efforts for more than over a half century. As shown by this study, it is clear that the designated energy management factory system of Japan has achieved certain effects in promoting energy conservation activities (see Chapter 3 for specific effects).

As a result of such efforts over a long period of time, Japan has developed high-level energy conservation technologies and energy operation management know-how. Japan is now expected to contribute to global energy demand conservation measures by transferring its energy conservation know-how to other countries appropriately.

Given rapid growth in energy demand in developing countries, however, it is indispensable to promote energy conservation over a shorter period of time. Therefore, developing countries can be expected to efficiently design institutional arrangements by taking advantage of Japan's experiences, instead of independently groping for institutional building from scratch.

A detailed analysis of the Japanese system has been described in Chapters 2 to 4. Particularly, the following points are important for promoting energy conservation in developing countries :

5-2-1 Institutional Infrastructure

It can be said that the development of the basic institutional infrastructure for energy conservation promotion, such as recording of energy use conditions and the establishment of management standards, is indispensable in all countries.

At factories in Japan, it has been recognized that regulatory measures based on the Energy Conservation Act and the like have been effective for promoting energy conservation. High priority has been given to compliance with law at factories. Therefore, factory regulations under the Energy Conservation Act have apparently been effective. Factors behind the effects may include the long presence of laws and regulations including the Heat Management Act to regulate factories, the enhancement of regulations based on a step-by-step approach, and checking functions of periodical reports and factory inspections. These factors might have contributed to voluntary and systematic energy management activities at factories.

However, we cannot deny that there are limits on the approach to the promotion of energy conservation from the viewpoint of voluntary efforts or cost cuts. If high priority is given to economic growth, funds tend to be invested in the production expansion instead of energy conservation equipment, as noted by an earlier study (Ogawa, Noda and Yamashita, 2010).

It can be said that the development of institutional infrastructure for energy management in the stage of economic growth is an indispensable element to the promotion of energy conservation.

5-2-2 Human Resources

In Japan's institutional experiences, great significance can be found in the "energy manager system" that has required "energy managers" as energy management experts to be involved in energy conservation measures at factories. The introduction of energy conservation equipment alone is not effective for energy conservation. But appropriate operation, maintenance and

inspection of energy conservation equipment can bring about great effects. From such a viewpoint, it is no exaggeration to say that the accumulation of human resources and energy management know-how peculiar to each factory is indispensable for the promotion of energy conservation at the factory.

On the other hand, we would like to point out that an increase in the number of qualified energy managers alone cannot necessarily solve all problems easily. As noted in Chapters 2 and 3, it is essential for energy managers to promote energy conservation organizationally by arranging for the organic factory-wide implementation of their knowledge and technologies, instead of independently conducting energy conservation promotion activities. It can be said that any organization can promote energy conservation efficiently only by implementing cross-organizational activities and employing human resources to spread energy managers' know-how throughout each factory.

5-2-3 Viewpoint by Size of Enterprise

It is expected that the share for small and medium-sized enterprises in developing countries is equal to or more than that in Japan. Therefore, in working on energy conservation measures in developing countries, we should not forget the viewpoint by size of enterprise.

For example, given SMEs' feature that top or senior managers' consciousness is easily reflected in business operations, changing the way of thinking about energy conservation among decision makers at SMEs may be the key to the promotion of energy conservation measures at SMEs. As seen in Japan, a system for the appointment of an energy management control officer in the management team may be effective particularly for SMEs. Although Japan introduced an obligation to appoint the energy management control officer under the FY2008 revision to the Energy Conservation Act about 30 years after the establishment of the law, the early introduction of the "energy management control officer system" in developing countries may deserve consideration.

Moreover, it is also indispensable for enterprises to appropriately comprehend their energy management conditions. For that purpose, the government is expected to play roles in supporting education on energy management know-how, developing information-sharing platforms and backing up energy conservation diagnosis.

Finally, given SMEs' feature that they are always exposed to severe competition, financial assistance is considered necessary to some extent so as to make their energy conservation measures effective. Such assistance may include support for energy conservation diagnosis and subsidies for introducing energy conservation equipment. Then, the existence of legal regulations should be kept in mind in the course of implementation of government support. For the promotion of energy conservation, it may also be effective to establish the situation where energy conservation measures are required to be taken. As a matter of course, prudent considerations may have to be given to the level of regulations to be applied to SMEs confronted with severe competition. Still, both assistance and regulations are required for realizing effective energy conservation measures.

5-3 Conclusion

First of all, efforts of eveloping countries are the most important for the promotion of energy conservation in these countries. What kind of institutional development is inefficient or can effectively promote energy conservation? In this respect, developing countries may be able to efficiently develop their energy conservation promotion systems by referring to the history of policy changes in Japan. Of course, developing countries have various social, economic and political situations and various energy supply/demand characteristics. Japanese systems can not necessarily be transferred to all developing countries without modification. From the viewpoint of "the advantage of backwardness," however, it may be useful for future energy conservation policies to create systems meeting specific national conditions based on Japan's experiences.

Second of all, Japan may be able to take advantage of developing countries' voluntary efforts and its own energy conservation promotion experiences as the world's top runner to support the development of realistic energy conservation systems and accelerate the promotion of energy conservation in developing countries.

As discussed above, developing countries' self-supporting efforts, coupled with their institutional development taking advantage of the experiences of Japan and other countries with advanced energy conservation know-how to back up such efforts, will be very effective for promoting energy conservation promptly and efficiently.

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