Approach to Energy Management for Companies

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Most companies in Japan are taking energy-saving actions in an effort to cope with environmental problems such as global warming. In addition, the increase in power rates in recent years due to the shutdown of many nuclear power plants after the Great East Japan Earthquake, increasing price of fossil fuels, and depreciation of the yen has affected the business management in many companies. Therefore, many companies including small and medium-sized building owners need a further approach to reducing their energy demand and cutting their energy costs, and they should continue with such approach. In this situation, effective energy management with information and communications technology (ICT) is essential and Fujitsu Enetune-BEMS (building energy management system) provides companies with useful functions for effective energy management as a cloud service. The energy management functions of Enetune-BEMS include energy consumption visualization, energy data analyses, and equipment control, and these help companies to reduce their energy demand and cut costs. This paper describes topics related to Enetune-BEMS such as the adopted technologies, cost-reduction effects relating to energy management and future plans for functional enhancement.

1. Introduction

Since the second half of the 1990s, most companies have been taking various measures such as energy-saving actions to cope with environmental problems including global warming. In addition, because of energy issues that emerged after the Great East Japan Earthquake, the increase in power rates and need to reduce the peak electricity demand amid a tight electricity supply and demand situation as a measure to deal with electricity shortages are having a significant impact on business management. Furthermore, regulations for consumers are expected to become stricter in future energy policies. For that reason, companies are required to take measures to further conserve energy and reduce energy costs and there is increasing demand for energy management that makes use of information and communications technology (ICT). For energy management, building energy management system (BEMS) has attracted attention and been adopted mainly by large companies. Recently, it has become possible for owners of small and medium-sized buildings and multiple stores to introduce BEMS functions easily and at low cost.

This paper presents functions relating to energy visualization and control provided by FUJITSU Intelligent Society Solution Enetune-BEMS, a cloud-based energy management service offered by Fujitsu, and describes examples of introducing the functions that contribute to energy conservation and energy cost reduction.

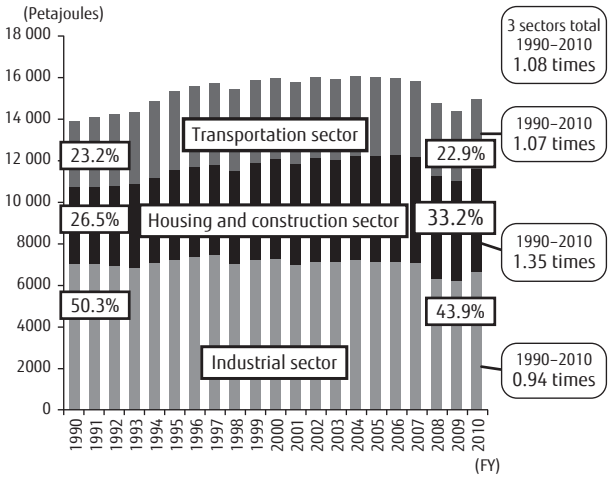
2. Environment surrounding energy

Our society consumes a large amount of energy. However, Japan lacks energy resources and is obliged to import most of the fossil fuels such as oil, coal and natural gas on which it depends. In addition, with the reality of global warming and other global environmental problems revealed, energy policies are being driven forward to reduce our dependency on fossil energy resources, such as by reviewing the electricity fuel mix in ways that include introducing nuclear power generation, saving energy in industry and reducing CO_2 emissions. Since the Great East Japan Earthquake,

however, the public has demanded safe nuclear power and attention is being placed on energy policies relating to the structure of energy resources such as principles for use of nuclear power and promotion of new energy.

In future, it is likely that companies, which are energy consumers, will need to take greater measures for energy conservation. Energy conservation has also been advocated up to now with activities promoted mainly in industrial circles, and there have been some positive results as shown in **Figure 1**.[1] Meanwhile, in the housing and construction sector including offices and stores, energy consumption is on the increase. For that reason, it is probable that regulations on companies and households, which are energy users, will become stricter in the future along with continued effort being made in the industrial circles.

Based on some statistics,[2] it seems that more and more enterprises are adopting building management systems and promoting energy management for large buildings. In many small and medium-sized buildings, however, systems that are capable of energy management have not been widely adopted. Meanwhile, the Ministry of Economy, Trade and Industry (METI) certified BEMS aggregators (energy usage information administrators) in 2012 for their efforts to accelerate the introduction of BEMS with the aim of reducing energy consumption in this sector. Fujitsu, which has established a consortium and been certified as a BEMS aggregator, is promoting its introduction.



Source: Agency for Natural Resources and Energy

Figure 1
Transition of final energy consumption.

Since the Great East Japan Earthquake, nuclear power plants offering a low unit cost of power generation have mostly been shut down and, instead, operation of thermal power plants, which have a high unit cost of power generation and cause more CO_2 emissions, has been increased to meet the demand for power. This has increased the power generation prime cost of power companies, which have in turn raised their power rates. In addition, fuel procurement costs are increasing due to a weakening of the yen as well as a major increase in crude oil prices overseas and this is systematically being passed on to power rates for consumers. Yet another point is that, in the total amount purchase system for renewable energy that started in July 2012, the electric power generated is purchased at a high price and the cost is again passed on to the power rates for consumers as a "levy to promote renewable energy generation." In this way, there is an ongoing situation in which power rates increase and thus they have a significant impact on the earnings of companies. This obliges companies to take action toward further energy conservation and energy cost reduction.

As the first step taken by companies to deal with this situation, an environment must be put in place in which the energy used by them is visualized in order to consider the action to be taken. By making energy information visible and analyzing data, measures can be formulated relating to operation and control for energy conservation and energy cost reduction without affecting the operating efficiency of the companies. Then, an environment for automatically realizing the operation and control must be built so as to optimize energy utilization.

3. Functions of Enetune-BEMS

Fujitsu's Enetune-BEMS is equipped with functions to collect energy information of consumer facilities, make the data visible and analyze them. In addition, functions are provided to make use of these analysis results to realize energy management for optimum operation by demand control, schedule control and remote control functions. In this way, Enetune-BEMS supports the construction of an environment for optimum use of energy by offering functions contributing to energy conservation and energy cost reduction of

companies.

As mentioned in the previous section, Enetune-BEMS is positioned as a product that has obtained BEMS aggregator certification from METI. That is, it assumes the responsibility for energy management of buildings in a field targeting small and medium-sized buildings with contract power of 50 to 500 kW (**Figure 2**).

Enetune-BEMS provides energy management functions as a cloud service, which has the following benefits.

1) By seeing multiple geographically distributed bases as virtual buildings, comprehensive energy management of a company distributed among multiple bases (offices) can be provided for the individual bases and entire organization.
2) Data collected in the cloud can be analyzed by experts, and this allows appropriate advice to be provided for energy conservation and energy cost reduction.

Table 1 shows the major functions of Enetune-BEMS.

Equipped with these functions, Enetune-BEMS not only provides building energy management functions as they are but also is capable of realizing comprehensive energy management for companies with multiple

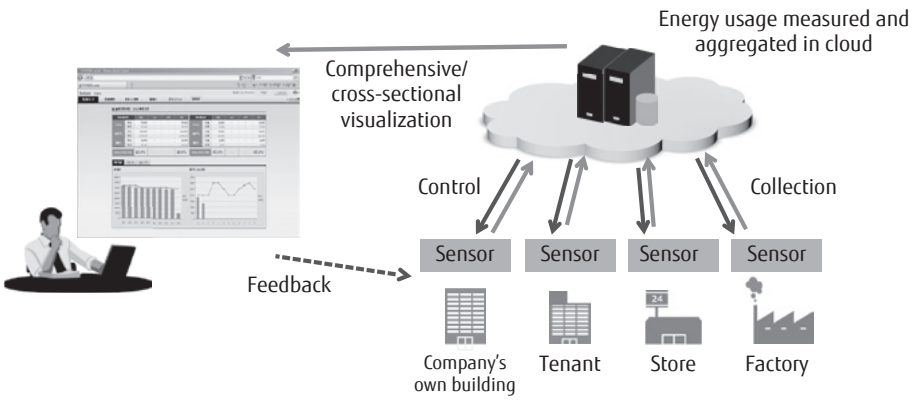


Figure 2
Overall image of Enetune-BEMS.

Table 1
Functions of Enetune-BEMS (excerpt).

Function		Description
Visualization	Base management	Aggregates and stores to cloud server the power data measured at individual bases Visualizes power usage state in the form of graphs and tables based on the stored data
	Comprehensive management	Aggregates and grasps power usage state of entire bases under management Allows the user to check on the progress of target achievement and compare/ evaluate power usage efficiency between bases
Analysis	Demand management	Gives warning from system to administrator by using periodic monitoring of the power consumed Suppresses excess of contract power by means such as remote control function
	Power demand forecast	Forecasts the day's power demand and provides administrator with information Allows the user to consider measures such as switching to energy-saving operation (storage battery/in-house generation)
Control	Remote control	Provides energy-saving control of air conditioning and lighting by remote operation
	Automatic control	Provides automatic energy-saving control of air conditioning and lighting

offices and stores.

However, several steps must be taken for energy conservation and energy cost reduction.

Figure 3 gives an overview and the following subsections describe the steps and functions realized.

3.1 Visualization

First, it is important to visualize the energy usage of each consumer. This indicates which equipment, floors and areas use how much energy. Such visualization has the users view the information and thereby raises their awareness of energy conservation relating to use of electric equipment. By constantly having such awareness, energy-saving operations are always implemented and energy conservation and energy cost reduction can be expected.

Enetune-BEMS allows comprehensive management of electric power usage of multiple bases. The target utilities are electricity, gas and water supply and usage of these time series can be graphically displayed. Data such as air temperature and humidity, if collected, can also be displayed. In addition to simply displaying the usage, Enetune-BEMS is capable of converting data to CO_2 emissions, which makes it possible to visualize CO_2 reductions.

Furthermore, customers who have adopted Futuric, Fujitsu's building management system, can link information with the building management system by incorporating the energy data collected by Futuric into Enetune-BEMS.

3.2 Analysis

Moreover, storing the data visualized in this way and analyzing them let a user understand the characteristics of energy use. If there is any area with high energy consumption, analysis can be performed to identify the cause.

The following gives a detailed explanation of the two characteristic analysis functions of Enetune-BEMS.

1) Demand forecast

For companies to curb peak demand, it is important for them to know the day's demand early on. Accordingly, demand forecast (**Figure 4**) is an important function for peak power demand control. The demand forecast offered by Enetune-BEMS takes advantage of research findings of Fujitsu Laboratories. It forecasts power demand by the hour of a day based on data on existing power usage and conditions including a rise in power usage at the time a company starts work and outdoor air temperature. Fujitsu also monitors power demand at individual offices, in which this demand forecast function is incorporated after being put

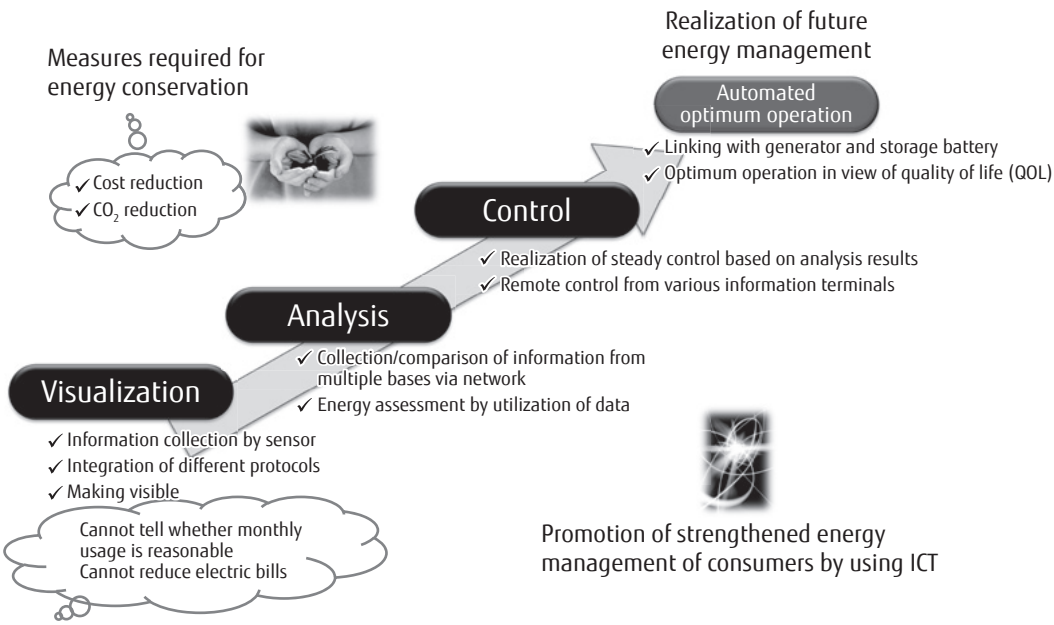


Figure 3
Steps to realization of energy management.

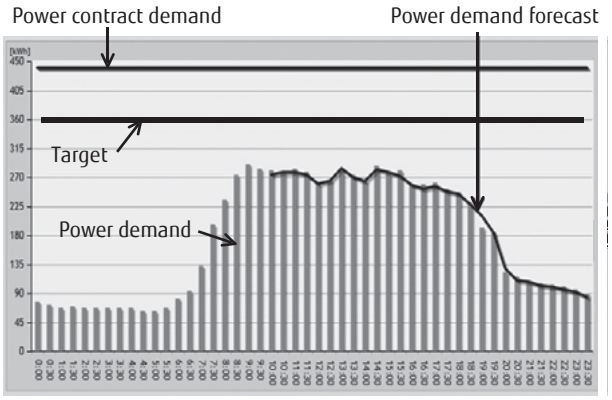


Figure 4
Screen display of demand forecast function.

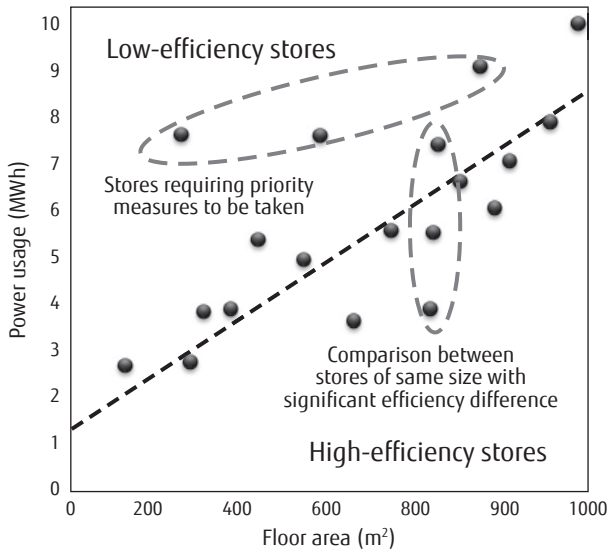


Figure 5
Energy basic unit comparison.

to practical use for more than one year and provides highly accurate demand forecasts.

2) Basic unit comparison

Enetune-BEMS provides functions in a cloud-based manner and they can be introduced to companies with multiple distributed bases such as offices and stores to realize energy management of all the bases. One characteristic management function is basic unit comparison, which is used to select a base where priority energy-saving measures should be taken. This calculates power usage per basic unit such as the floor area and number of employees of a base to make comparison between bases.

Figure 5 shows a graph that plots the floor area and power usage on the horizontal and vertical axes respectively for each base. With the average power usage per floor area shown by a first-order linear curve, bases plotted above the line may be using too much power and those under the line may be using power efficiently. In this way, studying a basic unit comparison graph provides efficient management/analysis information to promote energy conservation including selection of priority bases for energy conservation.

3.3 Control

Visualization of energy use conditions and data analysis suggest there are issues with energy use. Going through this process, the type of control that is necessary can be discussed and control settings configured to realize effective control in terms of energy use. In addition, monitoring the conditions after the control allows users to rediscover hidden issues, and they can then be improved in the plan-do-check-act (PDCA) cycle of energy management. In this way, policy improvement can be implemented for energy conservation and energy cost reduction.

Enetune-BEMS offers functions including demand control, schedule control and remote control according to the purpose. The following describes how these functions can be used.

1) Demand control

Demand control is effective in controlling peak power. To curb peak electricity demand, it is useful to have control such as notification and reduction of lighting or air conditioning output near the peak of power demand. With Enetune-BEMS, a threshold can be set in advance and an event can be specified to occur when the power demand within a certain period exceeds the threshold. For example, the system can be set up to notify the administrator by e-mail, turn the lights off in a certain area and change the temperature setting of air conditioning when the demand exceeds a certain threshold, as shown in **Figure 6**. In this way, making use of demand control allows peak power demand to be reduced.

2) Schedule control

Schedule control provides control including turning equipment on or off at a given time. This allows automatic control such as automatically turning the

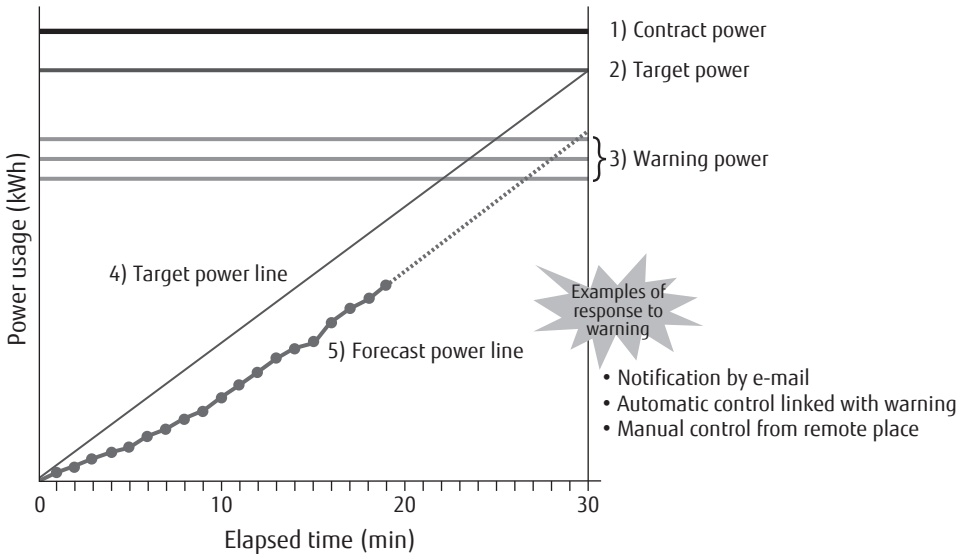


Figure 6
Conceptual image of demand control.

lights off at lunchtime and setting the strength of air conditioning according to the hour.

3) Remote control

Remote control is a function for turning equipment on or off from a remote place. This is convenient when centralized management at one place is provided for buildings including small and medium-sized ones without an administrator and for multiple bases. Equipment can be remotely controlled, and this makes it possible to reduce the management cost.

By using these control functions, peak power cutting in the respective bases and advanced energy management for energy conservation and energy cost reduction can be realized.

4. Effect of introduction

When considering an introduction of Enetune-BEMS, we conduct a field study on customers' facilities and propose the arrangement of measuring sensors, energy-saving measures and effect of introduction based on a calculation of cost-effectiveness. These activities are performed by Fujitsu Facilities, which is engaged in facilities management of Fujitsu's plants, and Fujitsu Semiconductor and proposals for customers' optimum energy use are offered based on Fujitsu's management know-how in facilities including semiconductor plants.

Figure 7 shows an example of calculating cost-effectiveness achieved by introducing Enetune-BEMS based on these activities. Generally, the initial investment cost can be recovered within three years. The figure is an example of a plan in which equipment for energy visualization is installed on each floor of an ordinary seven-story office building to recover the investment cost in about three years.

5. Future functional enhancement plan

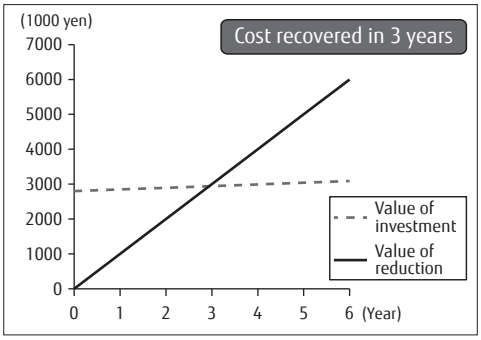
The present Enetune-BEMS provides basic functions of visualization, analysis and control as described above. In the future, we intend to make the system compatible with photovoltaic (PV) power generation, which is becoming increasingly widespread, and storage batteries, which are expected to become more widely adopted, and expand the types of equipment that can be connected to include various measuring devices and sensors. We also plan to provide support for demand response.

1) Linking with and control of PV power generation and storage batteries

In the microgrid system proving tests conducted at the Kawasaki Plant of Fujitsu, PV power generation and storage batteries have been introduced and good results achieved in peak power demand reduction.[3] We are now conducting a study on how to incorporate this

■ Conditions of estimation
- No. of power measurement points: 21
- Contract power: 300 kW
- Annual power usage: 972 000 kWh
- Annual power rates
  - Basic rate: 5 156 000 yen
  - + Meter rate: 10 750 000 yen

■ Investment
- Initial cost: 2 800 000 yen
- Monthly cost: 4000 yen/month



■ Effect
- Peak power cut of 4.8% by air conditioning control: cost reduction of 247 530 yen/year
- Power usage for air conditioning and lighting reduced by 10% each: cost reduction of 752 520 yen/year

Figure 7
Example of calculation of cost-effectiveness.

technology into Enetune-BEMS. We intend to provide an extension of the visualization functionality such as monitoring of PV power generation. And for PV power generation and peak power demand reduction that make use of storage batteries, we plan to formulate the optimum storage battery control plans and control functions and add a function to support effective utilization of these facilities.

2) Enhancement of measuring sensors

To realize energy management of companies, it is essential to collect various types of information at low cost. In the future, we intend to make it possible to connect at low cost various measuring devices and sensors with Enetune-BEMS to continuously meet the needs of companies.

3) Demand response function

As measures to deal with power shortages are called for, there is a growing interest in demand response. We are therefore conducting a study on how to equip Enetune-BEMS with a demand response function.

6. Conclusion

This paper has described an approach to energy management by making use of Enetune-BEMS for saving energy and cutting energy costs.

Since there is a need to promote energy policies to solve issues related to the environment and resources, the role played by companies is important and a further approach to energy management is required. Fujitsu, as a BEMS aggregator for the project led by METI to promote the introduction of an energy management system, has launched Enetune-BEMS and been engaged in activities for promoting energy management of companies. We will continue working to strengthen the energy management of companies by offering energy-related solutions.

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