“EnePal Office” to Support Office Energy Saving

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Abstract

Ever since the Great Tohoku Earthquake, energy saving on the part of businesses has become an urgent task in Japan. And increasingly more attention is being focused on the office, where energy-saving measures have taken longer to adopt. This paper introduces the SaaS type service “EnePal Office” which supports energy-saving at offices that are lagging behind, by not only applying “Visualization” to office energy consumption but also by providing a Navigation System to help save energy.

Keywords

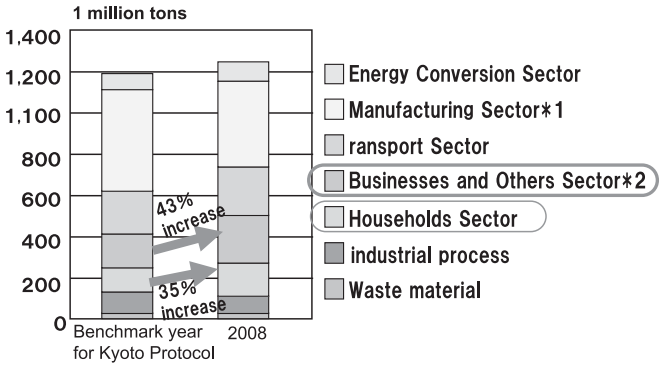
rentable floor area ratio, energy consumption, visualization, baseline electricity

1. Introduction

NEC Fielding, Ltd. supports the reduction of power consumption and CO_2 emissions in businesses, so that we may contribute to further reducing business costs through corporate-wide energy saving.

When we look at the breakdown of CO_2 emissions in Japan for fiscal year 2008, the amount at factories and other manufacturing facilities has been reduced by 13% compared to fiscal 1990. By contrast, the amount at places of business including stores and offices has increased by 43% (**Fig. 1**).

But more recently, due to a marked drop in the electrical power supply in the Kanto Region of Japan since the Great Tohoku Earthquake last year, as well as the subsequent stopping of all nuclear power plants in the nation, the threat of serious electricity shortages became real and energy conservation at the office became a focal point.



*1: Factories, etc. *2: Stores, Services, Offices, Public organizations

ource: National Institute for Environmental Studies (NIES), created based on data from Greenhouse Gas Inventory Office (GIO)

Fig. 1 CO_2 emissions in Japan by sector.

This paper discusses the mechanics of energy usage “Visualization” (visual representation) in the “EnePal Office”, as well as the system of navigating to effective points of energy saving.

2. Characteristics of Office Buildings and Reasons for Increased Energy Usage

Offices characteristically increase their energy consumption as their gross floor area increases. Typically, as the number of office users increases, so does floor space, as well as the requirements for ventilation and air circulation, and the number of lighting fixtures. One factor in indicating the configuration of an office building is the “rentable floor area ratio,” which is attained by dividing the “floor area rentable as office space” by the “total floor area.” Tenant buildings that are used mainly as offices usually have a rentable floor area ratio of about 70% to 80% or more, but for the purposes of this paper we have graphed the energy consumption ratios for tenant buildings with rentable floor area ratios of 60% and over in **Fig. 2** .

For energy management, it is essential to have a firm grasp on how much energy is being consumed and where it is being consumed. Purely office space is designated as “Office-specific,” and “Office-shared” refers to common areas such as elevator halls and restrooms. The energy consumption per category shows the percentage of primary energy (fuel, heat and electricity) consumed for air circulation, ventilation, lighting, and wall outlets. The chart on the right of Fig. 2 shows a break-

down of the Office-specific category into air circulation, lighting, and wall outlet ratios.

One PC per person being the norm for offices these days, office equipment such as PCs are also major contributors to the increase in energy consumption.

Concrete, day-to-day countermeasures are needed to reduce energy consumption and improve present conditions. Right now it seems that relatively easy countermeasures, such as turning off unnecessary lights, are being taken. However, many issues remain, and detailed, effective countermeasures have yet to be implemented due to a variety of reasons. These reasons may include not being able to understand the energy consumption for each category, not having a person-in-charge for regulating energy usage and promoting energy conservation, and not having a cohesive enforcement policy or clear-cut rationale to encourage support within the organization. So obstacles to proactively adopting countermeasures exist in terms of current status understanding, the positioning of administrators, and for the system to take root in the organization.

3. What is "Enepal Office"?

3.1 Service Outline

EnePal Office (**Fig. 3**) is an energy conservation support service for offices that "visualizes" and centrally manages energy consumption of office air circulation systems, lighting, and power outlets. This new service is positioned above EnePal PC, which was launched in 2009 to autonomously support energy saving in PCs. Since EnePal Office is a SaaS (Software as a Service) that is provided via our company's data center, clients are not required to possess their own servers, therefore minimizing the initial cost involved in

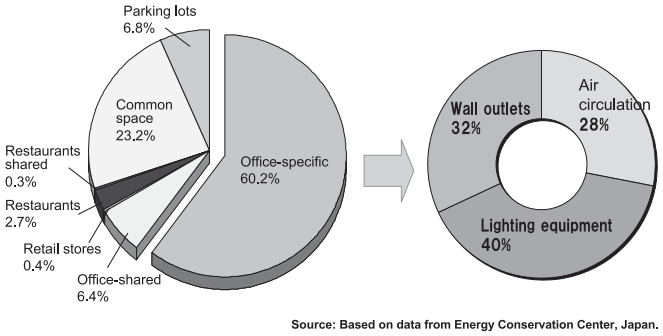


Fig. 2 Energy consumption ratio by category.

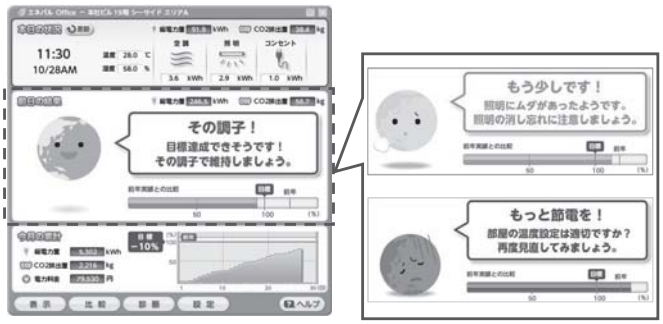


Fig. 3 EnePal Office main screen.

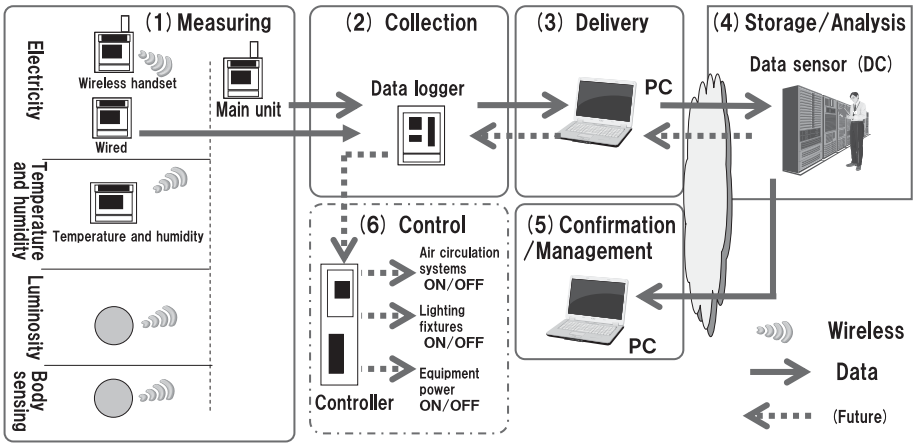


Fig. 4 Basic configuration diagram.

implementing the system.

EnePal Office is comprised of the following 6 phases (**Fig. 4**).

(1) Measuring Phase:
Measured data is transmitted via wireless or wired connection. Measured data includes temperature, humidity, electrical current, voltage, power consumption and power factor.

(2) Collection Phase:
Measured data is collected, then processed into equalized, differentiated and maximum values, and then stored.

(3) Delivery Phase:
Measured location information is added and transmitted to the data center at regular intervals.

(4) Storage/Analysis Phase:
Data stored in the multi-tenant database is batch processed at regular intervals, at which time the electricity rate of the applicable utility company, CO_2 (dependant on current coefficient), power consumption amount and other information is added and stored.

(5) Confirmation/Management Phase:
Current condition and analysis results can be checked via PC connected to the Internet.

(6) Control Phase (Scheduled for future)
Control information is transmitted to air circulation system and breakers to control the equipment.

3.2 Location Management

Although it is possible to install sensors directly onto a device or appliance, it is much more common to install them onto the circuit breaker of the power distribution unit. In this case, it is of utmost importance to survey beforehand what is downstream from the circuit breaker, such as power outlets, lighting fixtures, air circulation, etc., and exactly which office spaces they affect.

This office space is designated as the “Location.” For instance, if the measuring point and the office can be clearly linked, this simplifies management since Location = Office (**Fig. 5** , Example 1). However, actually, the relationship between Location and Office is not that simple. Electricity may be supplied from the power distribution unit to more than one office, and some equipment such as air circulation systems affect the entire building (Fig. 5, Examples 2, 3). With EnePal Office, the office can be managed by each separate location, thereby enabling complicated energy management by each tier separately.

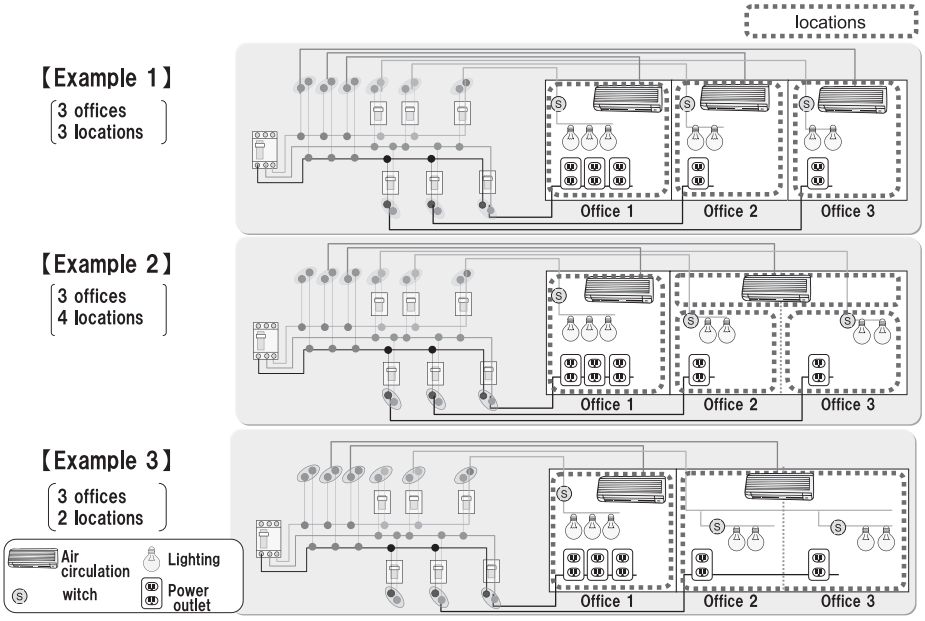


Fig. 5 Measurement points and locations.

3.3 Energy Consumption Management by Time Period

Typically the energy consumption in offices differs drastically by time period (**Fig. 6**).

(1) Time period when business is stopped
(2) Time period before business hours when employees arrive
(3) Time period when business is fully running
(4) Time period when power consumption is reduced such as during lunch hour
(5) Time period after normal business hours with employees working overtime

EnePal Office compares the actually measured power consumption per location against the predicted figure for each time period, and when there is a disparity between the expected trend and actual measurement it determines that there must be waste and sends a diagnostic message to the administrator's control screen (**Fig. 7**).

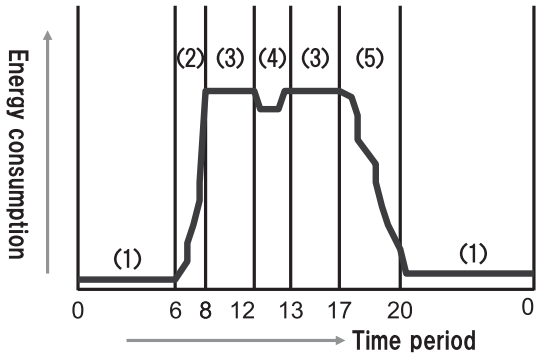


Fig. 6 Office energy usage characteristics.

3.4 Comprehensive Diagnosis Based on Multiple Sensors

The system collects temperature and humidity distribution data from temperature/humidity sensors installed throughout the office. By analyzing the data collected from the temperature/humidity sensors and the energy used by the air circulation system, it can tell whether the air circulation system is working efficiently or not. Since it allows settings such as "Cool Biz" and "Warm Biz" per building, fine temperature control is possible.

Furthermore, a logic program is embedded in the software to accommodate information collected from Body Sensors and Luminosity Sensors. By incorporating new sensors that are scheduled for release in the future, it will be able to sense when there are places that are brightly lit even though no one is there, and can bring this to the attention of the administrator by displaying a diagnostic message. We intend to enhance this functionality in the future (**Fig. 8**).

Since it is difficult for the Body Sensor to recognize when people are always in a large room, we are in the process of developing this feature by coupling it with software.

3.5 Comparison with Other Offices

EnePal Office uses the power consumption trend per time period together with past power consumption values to calculate the average figure for the same month in the previous year, which is considered the baseline electricity. By comparing the actual power consumption now with the baseline electricity, it can recognize if there is wasteful electricity usage or whether energy saving activities are effective. What's more, comparative analysis of the baseline electricity with other similar

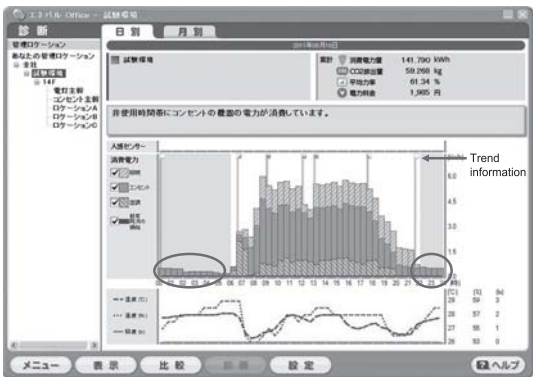


Fig. 7 Diagnostic screen (1).

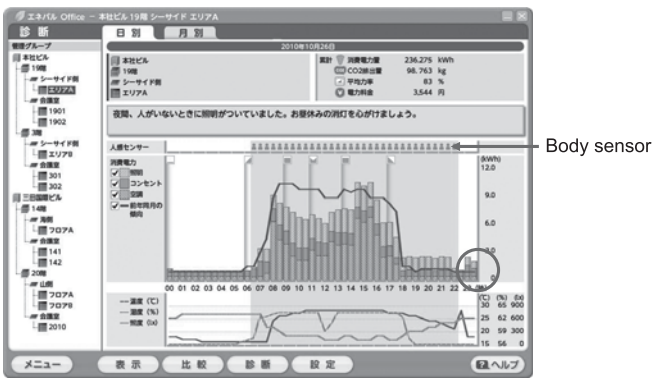


Fig. 8 Diagnostic screen (2).

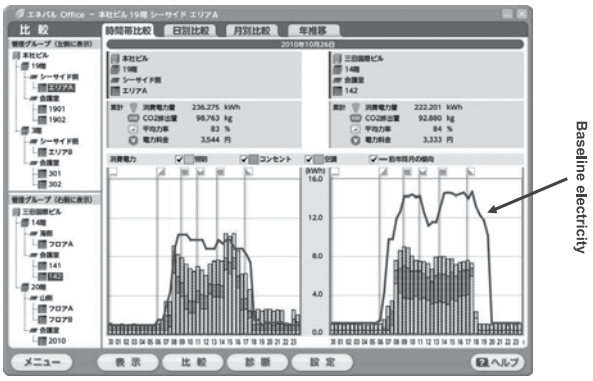


Fig. 9 Inter-office comparison screen example.

offices will enable confirmation of wasteful or non-wasteful energy usage.

Furthermore, applying a multitude of analysis including shifting energy consumption by time period, by day, by month and by year, will make it possible to achieve more effective energy saving results (**Fig. 9**).

4. Conclusion

EnePal Office makes it easy to save energy not only at the individual office level but also on a corporate-wide level, to enable further cost reductions.

In order to provide a most user-friendly interface, NEC adopted universal design for the first time in this newly developed screen. Plans are underway to connect a PLC (Programmable Logic Controller) to enable autonomous control of energy saving operations such as lighting and air circulation in the future. Moreover, we intend to expand our target to beyond the office to enable more widespread energy consumption reductions.

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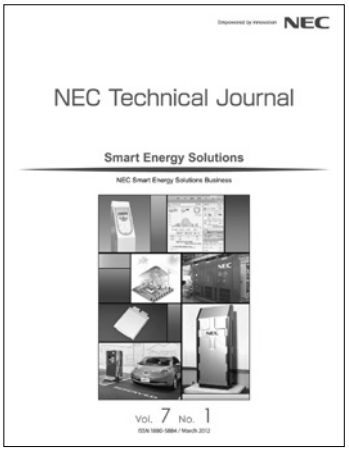

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