“EnePal PC Pack” Service Contributing to a Reduction in Office CO 2 Emissions

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Abstract

The NEC Group has marketed the office energy-saving service “EnePal PC Pack” in an effort to promote “Green by IT,” energy saving by making use of ICT (Information Communications Technology) for the PC as the typical office information communication device.

This paper introduces its features by focusing on the functions with which the PC performs autonomous control by learning the behavior pattern of a user. It goes on to verify the effects of the introduction of the service, and discusses future deployment perspectives.

Keywords

Tokyo Metropolitan Ordinance on Environmental Preservation, cloud computing services visualization, autonomous control

1. Introduction

Of the energy consumption in a typical office building, about 40% is consumed by illumination and power outlets that can be controlled by the tenants [1)] . Although PCs take up an important share of the electrical power consumption in the office their energy-saving measures are for the present considered to be unsatisfactory.

In an effort to improve energy saving by making use of ICT (Green by IT) and based on the belief that a resourceful use of ICT would make it possible to develop CO 2 emission reduction technologies appropriate for ICT equipment, the NEC Group proceeded in 2004 to promote energy-saving in the PC, which is the most typical ICT device used in the office. This policy represented an extension of efforts designed to enable the previously attempted program of energy saving for office equipment in general (Green by IT). Since then, thanks to various support initiatives including that of the “Program for development of technologies to prevent global warming” of the Japanese Ministry of the Environment, we eventually succeeded in 2010 in developing the energy-saving office service “EnePal PC Pack” (hereinafter referred to as “EnePal PC”).

This paper describes features of the service, the role it plays in office CO 2 reduction and its future deployment perspectives.

2. Issues Related to PC Energy Saving

(1) Reduction of Power Monitoring Costs

This does not apply only to the PC, but continual reduction of CO 2 emissions requires identification and monitoring of all of the sources of the current CO 2 emissions (or of the power consumption in the case of PC energy saving). This strategy may be pursued by installing an electrical energy meter on each piece of equipment, including the PC, but this method is considered to be difficult due to restrictions imposed by the high cost of the meters. Consequently, the development and implementation of a low-cost power monitoring method is a priority consideration.

To assist the CO 2 emission reduction efforts of an organization, a mechanism is required by which the administrator can identify the setting levels of the CO 2 emissions in the organization. This can be achieved by creating a system to enable the centralized collection/storage/management of data from electrical energy meters, etc., but this method also necessitates high costs. In addition, when such a system is introduced in an existing office, the installation work would be essentially extensive and expensive. There would also be other problems such as the necessity of performing temporary job shutdowns in order to perform the installation work.

(2) Visualization of Savable Electrical Energy

Another issue that is equally as important as monitoring is

the identification of "reducible electrical energy." The power consumption quantity alone is not sufficient for knowing what proportion of the total energy requirement can be reduced. It is also required to identify the "electrical energy consumption that is essential" and the "electrical energy that can be reduced as its continued use would be wasteful."
Ordinary electrical energy meters measure only the power consumption, so they are incapable by themselves of make a distinction between the "electrical energy consumption that is essential" and the "electrical energy that is reducible."

(3) The Power OFF While Not in Use Issue

Much of the "electrical energy that can be reduced" is consumed when the power of a PC is left ON while it is not in use. One possible solution to this issue is a forced energy-saving measure such as turning off all PCs simultaneously from the server at a certain time of day. However, such a measure does not consider the circumstances of each user and may therefore spoil the effectiveness of the PCs of certain users.

3. Configuration, Features and Effects of the Introduction of EnePal PC

The EnePal PC has been developed and is marketed in order to solve the issues outlined above. The EnePal PC software cuts off wasteful power consumption by monitoring the power consumption of each PC without using an electrical energy meter or similar equipment, "visualizing" the "electrical energy that can be saved" as well as the CO_2 emissions and controlling power autonomously based on knowledge of user behavior patterns ("autonomous control"). Furthermore, the software can also collect/total up the power consumption of all PCs being monitored and thereby permits control by an administrator ("centralized management").

3.1 Configuration

EnePal PC is composed of the Agent Software (hereinafter the "Agent") and the Management Application Software (hereinafter "Management Application").

The Agent is installed in each individual PC for monitoring its power consumption, "visualizing" the "CO_2 emissions" and the "electrical energy that can be reduced" and performing "autonomous control." The Management Application collects/totals the power consumption of all of the managed PCs and enables control by the administrator. An example of the system configuration is shown in **Fig. 1** .

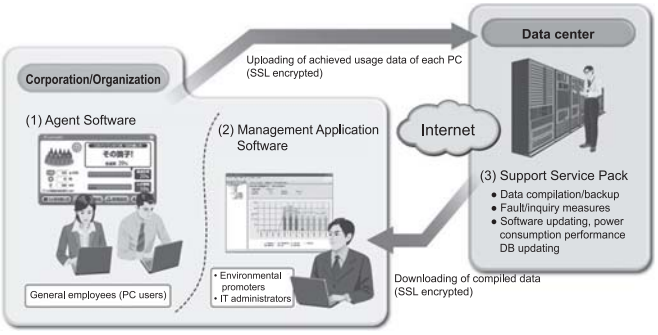

Fig. 1 Example of EnePal PC configuration.

3.2 Features

(1) Monitoring

The Agent installed in each PC measures the power consumption data and operation rate of the PC and its equipment at 3 second intervals and estimates the power consumption of the PC using estimation parameters and refers them to the power consumption performance database (hereinafter the "power consumption DB") provided in the Agent. The power consumption DB holds data per manufacturer, per model and per unit (CPU, memory, HDD, etc.), which are distributed periodically from an NEC data center and updated automatically in daily communications.
This software achieves monitoring of power consumption and other data without the need of adding hardware such as electrical energy meters.

(2) Visualization

The ongoing state of electrical energy consumption is "visualized" based on the power consumption value and related data of the PC collected and estimated by the Agent. The targets of "visualization" include the following three kinds of information.

1) Previous Day Usage

When a PC is booted, the Agent displays the usage (power consumption, CO_2 emission, power charge, reduction target/achievement and wastage percentage) of the PC of the previous day (**Fig. 2**).
If the reduction target is not reached, a screen icon and image are displayed to inform the user.

2) Monthly Usage

Since the job situations vary on a daily basis, a function for reviewing the usage of each PC over the past month is

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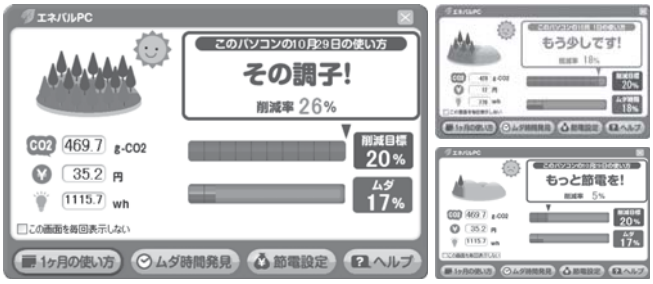

Fig. 2 Previous day usage.

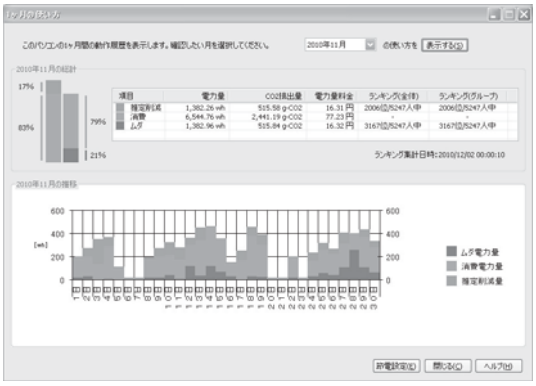

Fig. 3 Monthly usage.

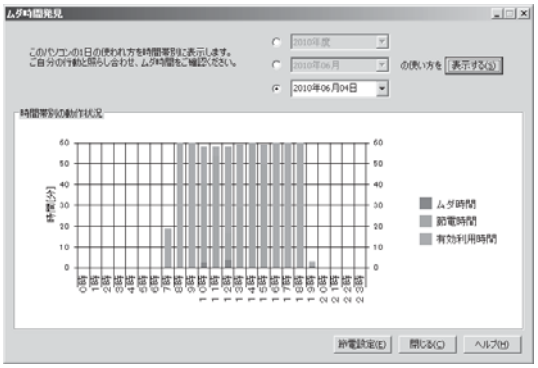

Fig. 4 Waste time discovery.

also provided.

The “Monthly Usage” window makes it possible to confirm the PC usage compiled per month and the positioning (ranking) of the PC among those of the entire organization or group (**Fig. 3**).

3) Wastage Time Detection

First of all, it is necessary to define what the “wastage” is. Let us define that the power consumed over the period in which the PC is used for business purposes is “effective” and that consumed during other periods is “wasted.” The EnePal PC identifies that the power consumed when none of the following conditions are met is “wasted.”

- Period in which the operation rate of the CPU or HDD is 10% or more.
- Period in which the keyboard or mouse is operated.
- Period in which the display is changing.
- Period in which the IT administrator is using a set application.

The EnePal PC judges if certain power consumed was “effective” or “wasted” by checking if the four conditions above are met in a certain time frame, based on the power consumption data of the PC and its equipment as acquired by the Agent.

It then displays the Waste Time Discovery window according to the judgment results.

This window divides every day into time zones and discovers the usage and wastage for each of them (**Fig. 4**).

As described above, the “visualization” function of the EnePal PC quantifies the “electrical energy that can be reduced,” which is an important factor in CO_2 emission reduction, in addition to the electrical energy consumption. This is an important feature of the EnePal PC that is not found in other competing products.

(3) Autonomous Control

The EnePal PC has a function that reduces electrical power consumption by predicting future power consumption from the stored past consumption patterns of PC users and optimizes the power supply control according to the prediction results (autonomous control). This function enables power-saving operations at a more rapid rate than the power supply setting function of Windows and without hindering the convenience of users. It also controls the PC power status in order to optimize the balance between the user convenience and the energy-saving effect based on learning, which is another important feature of the EnePal PC compared to the competing products (**Fig. 5**).

As described above, the Agent judges “wastage” and “usage status” based on the power consumption data and operating rates of the PC and its ancillary equipment and stores the PC usage data thus obtained from the judgment results, for up to a year. The stored data is used to provide each user with optimum power control data by considering the balance between wastage reduction and convenience based on the “optimum power control algorithm.”

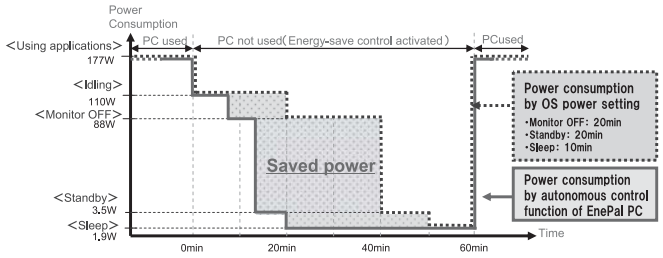

Fig. 5 Power Saving Before OS Power Setting.

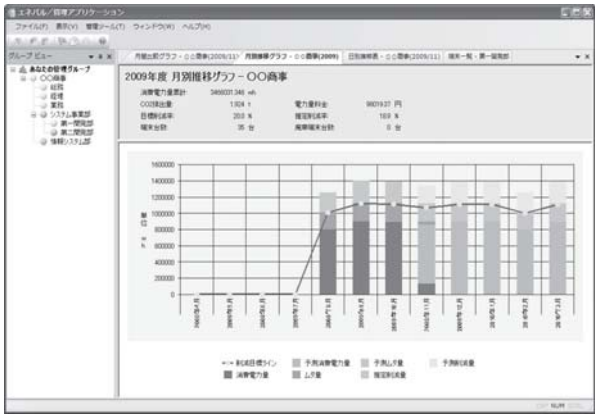

Fig. 6 Transition graph.

The effect of the autonomous control function can be adjusted in terms of numerical values. When the reduction target is set, a power control execution plan for achieving the target is developed and the power mode is switched according to the plan while discovering the time in no use (= wastage time). This function enables energy saving without importantly lessening the usefulness of the PC of each user.

(4) Centralized Management

When the Management Application is installed in the PC of the administrator, the PC can be used for centralized control of the information collected from the Agents.

- **Transition graph**

This displays the transition graphs per year, per month or per day together with outlines of the progression (**Fig. 6**).

- **Comparison graph**

This displays comparisons between groups in each year or month (**Fig. 7**).

The achievement data is stored in the data center via the Internet. The use of a cloud-type computing service does not require the user to prepare a server and therefore

Fig. 7 Inter-group comparison graph.

contributes to the CO_2 emission reduction.

3.3 Effects of the Introduction of the Service

This section reviews the effects of introduction from actual case histories.

(1) Japan Women's University

The campus of this university in the Bunkyo Ward, Tokyo, is one of the target sites of the Tokyo Metropolitan Ordinance on Environmental Conservation and it achieved a CO_2 emission reduction of about 6% in FY2009.

The campus introduced and started to use EnePal PC in September 2010 in order to improve the awareness of the staff with regard to energy saving issues. As a result of deployment in 250 PC units, it succeeded in reducing the PC power consumption by about 30%.

(2) NEC Fuchu Plant

This plant is also designated as one of the target sites of the Tokyo Metropolitan Ordinance on Environmental Conservation, and is executing various measures aimed at achieving the CO_2 emission reduction target of -6% (compared to 1990).

Since July 2010, the plant deployed the EnePal PC in 8,000 employees' PCs and has achieved an electrical energy wastage reduction effect of about 20%. This performance is estimated to have cut down the power consumption by 441 MWh and to have reduced the energy cost by about 5 million yen and CO_2 emissions by165 tons every year.

In both cases, thanks to the possibility of system introduction simply by installing the software and that of CO_2 emission reduction immediately after installation, the EnePal PC is

playing an important role in the reduction of CO 2 emission in offices where fast-acting CO 2 reduction measures have hitherto been unavailable.

4. Conclusion

As described above, the EnePal PC contributes significantly to the reduction of the power consumption of a PC. Nevertheless, from the viewpoint of the CO 2 emission reduction of an entire office, it is insufficient to apply measures only to the PCs. The targets need to be expanded to include the illumination, air conditioning and for ICT equipment other than PCs, because these devices consume the greater part of the electrical energy used in the office.

To follow the introduction of EnePal PC the NEC Group is planning and developing products that can "visualize" the electrical energy consumption of these other types of equipment. An "energy-saving navigation" function that identifies electrical energy wastage and displays messages allowing users to apply appropriate measures is also under development. These products and functions will further enhance the energy-saving effects in the office environment.

The NEC Group intends to contribute to the creation of next-generation offices by providing "energy management solutions" applying technologies cultivated via the EnePal PC.

In closing this paper, we would like to express our gratitude to all the persons concerned in the projects of the Japanese Ministry of the Environment for the "Program for development of technologies to prevent global warming" and the "Business incubator projects for global warming prevention". All of them supported us greatly during the development and marketing of the technology described above.

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