# Energy Saving Measures Targeting Business PCs

UMETSU Masakazu, YANAGISAWA Tsunenori, SAITO Hiromi
SUZUKI Akitsugu, OOMACHI Satoshi, TAZUKE Ken

**Abstract**

A long time has now elapsed since environmental concerns became an important issue of the business domain. Power saving for the PCs that occupy a significant share among office IT equipment still remains one of the most important considerations.

In 2010, NEC set a target of halving its power consumption from the 2005 level. Since then, the corporation has been tackling power saving of PCs and the reduction of $CO_2$ emissions from various viewpoints, including those from a hardware perspective such as redesigning circuitry as well as from a software perspective such as for incorporation of the "ECO mode" with which the power setting can be changed by a one-touch operation.

This paper introduces the measures being applied by NEC in order to save the electrical energy consumed by PCs in the business environment.

**Keywords**

power saving, ECO button, ECO mode, not in use sensor
NeCycle, standby power

## 1. Introduction

NEC's business PCs feature not only compliance with environment-related laws such as the Japanese Act on the Rational Use of Energy (Energy-saving act) and various environmental regulations represented by the International Energy Star Program but also under the company slogan of the "Total Eco-Solution for Office". They are thus under pressure to meet more severe requirements than those based on laws and regulations.

Our endeavors deal specifically with the following three technologies.

- "Power-saving function" for reducing the power consumption of PCs by controlling their performances.
- "Power-saving design" for suppressing power loss by adopting more efficient circuitry designs.
- "Power-saving components" by adopting components with higher power efficiencies or ones designed to reduce the environmental load.

By positioning the above technologies as a means of power saving, we have been improving their performance with the aim of achieving a 50% reduction in power consumption by 2010 compared to that of 2005.

Below, we provide an outline of NEC business PCs together with a description of specific efforts being made for their power saving.

## 2. Outline of Business PCs

NEC boasts the top share in the Japanese PC market [*1] and offers a rich line of products in response to the broad range of requirements imposed by business needs.

### 2.1 Desktop PC "Mate"

Considering the limitation of available desktop space in the typical Japanese office environment, the Mate series is composed of a range that emphasizes space-saving properties.

The Mate series consists of six models, including the "Type ME" flagship packed with several environmental measures in a slender cabinet with a 9.9-liter volume and the "Type MG" that is an LCD-integrated model incorporating a not in use sensor that enables power saving.

[*1] NEC captured the top market share of shipments in the Japanese PC market in FY2009 (April 2009 to March 2010). (Source: ICD Japan, Japan Personal Computing Quarterly Model Analysis Q3, 2010.)

### 2.2 Notebook PC "VersaPro"

The VersaPro series includes the business notebook PCs mainly used in a networked environment and the mobile notebook PCs are designed in pursuit of size and weight reductions.

This series consists of six models including the "Type VD" higher-model business notebook incorporating an ECO button and "power visualization" feature and the "Type VB" mobile notebook capable of up to 10 hours of battery life.

## 3. Power–Saving Functions

At NEC, we provide the following three mechanisms for reducing PC power consumption by controlling behavior according to the usage circumstances of each user.

- ECO button/ECO mode function
- User detection sensor function
- Power consumption "visualization" function

### 3.1 ECO Button/ECO Mode Function

This function allows a single button (or a hotkey in the case of a desktop PC) to switch between the mode in which the PC can manifest the maximum performance and the mode in which the power consumption is saved.

The targets of the one-touch mode switching include not only OS settings such as the levels of power supplied to the device and CPU power-save operations but also cover items that cannot be directly set in the OS by the user such as the control of the desktop monitor brightness. As a function that enables ordinary users to contribute to eco-promotion, this function is incorporated in all of NEC's business PCs.

When used properly, this function can reduce the power consumption by about 20% (if the ECO mode is set as the default) compared to the standard mode.

**Fig. 1** shows the window for setting the ECO button and the ECO mode.

### 3.2 User Detection Sensor Function

In general business scenarios such as leaving the seat for a meeting or a break occur frequently. A better power-saving effect than the power management of the OS can be expected if the PC can detect the absence of the user and turn off the display and enter the sleep mode instantaneously. We adopted the IR-ray proximity sensor as the optimum method for detecting non-attendance of the user and also achieved a power saving of the sensor itself with minimal cost.

Considering the characteristics of the adopted IR-ray proximity sensor, we decided to monitor the operational status and reviewed data of the PC periodically as well as the physical distance between the user and the PC and judged the attendance and non-attendance status of the user by comparing the threshold value and sensor value for each condition. In addition, in order to determine the threshold value of each status, we investigated sensor values according to the usage status depending on the clothing and distance of the user and quantified the relationship of the IR-ray reflection amount between the attendance state (from a correct seating attitude to a relaxed attitude for which the user is relatively apart from the PC) as shown in **Fig. 2**[*2] .


Fig. 1 ECO button/ECO mode setting window.

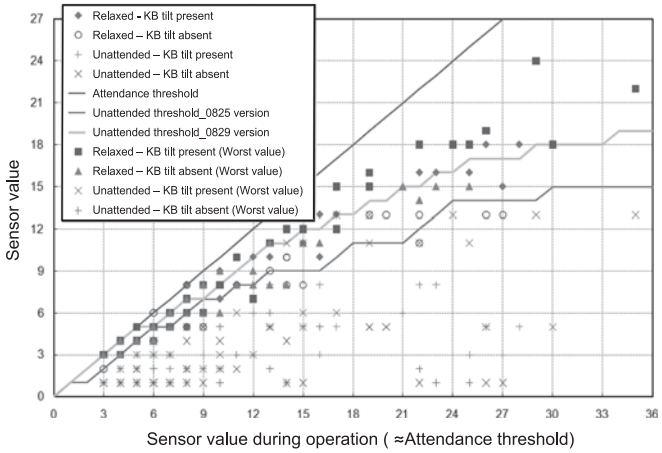



Fig. 2 Quantification of clothing and IR-ray reflection (Digital data).

[*2] We developed the judgment algorithm and threshold value table in collaboration with the NEC Service Platform Research Labs.

This procedure has enabled the PC to select the optimum settings automatically according to the usage status of the user, thereby improving the convenience significantly and reducing the power consumption by about 25% (when the ECO mode function is activated). The patent for this technology is currently pending.

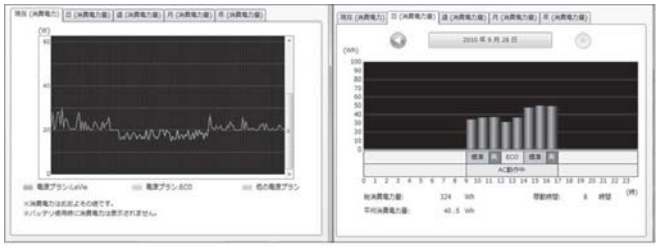
### 3.3 Power Consumption "Visualization" Function

Even if power-saving functions are incorporated in a PC, it is difficult to realize their desired effects unless the actual amount of reduction of power consumption can be identified. Therefore, to let users understand the actual power-saving effect, we incorporated hardware for consumed current detection in the power supply circuitry of the Type ME/MG/VD/VX/VA models in order to display the consumed power.

This hardware is capable of displaying the current power consumption in real time as well as to visualize power consumption graphs per month, week, day or hour based on the statistical data recording the past changes in power consumption.

The display can also show the approximate amount of power saved by the ECO mode at a glance. As it shows the power consumed on the primary side (power output from the AC outlet), it can also indicate the cost of the electricity and contribute to the planning of an optimum energy-saving operation according to the environment of each user (the accuracy of the power visualization function is about ±10%).

**Fig. 3** shows actual displays of the power visualization function.



Real-time display
Current power consumption is displayed.
Power consumption value updated every 5 sec.
Different modes are displayed in different colors.
(Example: Green curve for ECO mode, blue curve for standard mode)

Daily statistics display
Power consumption of each day is displayed.
Display per month, week or hour is also possible.

Fig. 3 Power consumption visualization displays.

## 4. Power–Saving Design

In the circuit design, we apply the following two kinds of measures in order to reduce the power consumption.

- Reduction of power consumption during CPU run.
- Reduction of power consumption during standby.

### 4.1 Reduction of Power Consumption During CPU Run

As the CPU consumes an important share of power among the PC components, it is effective to reduce the CPU power consumption to reduce the power consumption of the entire system.

One of the techniques known to be capable of reducing the CPU power consumption is to slow down the CPU clock using an external circuit, but this method has been regarded as being hard to implement due to the risk of unstable operation of the PC.

NEC found that the CPU performance could be restricted by utilizing the temperature protection function. When the CPU temperature rises above a specified level, this function enables the CPU to run with reduced power consumption by performing the throttle-ring control function to prevent thermal runaway.

We implemented an input/output (I/O) control circuit so that the above function is turned ON in the ECO mode. This circuit applies pseudo throttle-ring control function to the CPU in order to fake a temperature rise above the specified level and reduce the power consumption by lowering the CPU performance.

This design has made it possible to reduce the power consumption by about 10% when the function is enabled.

### 4.2 Reduction of Power Consumption During Standby

Even in the standby mode in which the power is set OFF, the PC supplies power to the motherboard circuitry such as the PCH (Platform Controller Hub) to prepare for startup, triggered by pressing the power button or from the network. Due to the presence of this circuitry, previous PC models used to consume a power of about 2 W even when the power was set to OFF.

We also monitored the power consumption during standby. With the Mate Type ME shipped in January 2010, we incorporated a function for supplying power only to the minimum required circuitry during standby (Deep Sleep func-

tion). This was a first time introduction for Japanese PCs and it achieved a standby power of 0.3 W, which corresponds to about 80% of the power used by previous models. This was equivalent to an annual reduction of $CO_2$ emission of about 3 kg (or an annual power charge of about 100 yen/unit [*3] ).

## 5. Power–Saving Components

A positive use of components with which power-saving effects have already been confirmed is one means of achieving an efficient promotion of power saving.

For example, the LCD panel is the PC key component that has the highest power consumption.

Since 2008, we have been adopting LCD panels that use an LED backlight featuring an advanced power-saving effect and all of the LCD panels used with the notebook PC models launched in FY2010 employ LED backlights. Compared to the previous models incorporating LCD panels with cold-cathode tube backlights, the power consumption of a typical A4-size notebook has been reduced by about 25% (which corresponds to the difference in the backlight).

Furthermore, we adopted a PSU (Power Supply Unit) with a high AC-DC conversion efficiency and selected high-efficiency components (DrMOS/Driver MOSFET) in the circuitry for generating dedicated power for the CPU and memory (VRM/Voltage Regulator Module), and succeeded in achieving a total power reduction of as high as about 10 to 15 W.

The pursuit of power saving is not the sole approach of our "Total Eco-Solution for Office," campaign. We were also the first to adopt "NeCycle," a bioplastic developed independently by NEC that provides safety at the world's highest level and an advanced flame retardant that is indispensable for use in electronic equipment. It is used in 90% of the plastic parts of the cabinet of the desktop PC Mate Type ME ( **Photo** ).

The NeCycle is the first bioplastic offering both high safety and flame retardant properties by adding a mineral based flame-retardant (aluminum hydroxide) to polylactide resin. It features a very high bio-mass component ratio of organic constituents of more than 75%.

The base constituent of this bio-plastic, the polylactide resin has insufficient characteristics, such as lower strength and toughness than traditional petroleum-derived resins and a longer time was required for molding due to the needs


Photo Mate type ME using "NeCycle".

of the crystallization process. As a result, in applying this bioplastic to the cabinet, we had to clear the NEC's cabinet quality standards while overcoming the above mentioned issues.

NEC solved the issues in collaboration with the NEC Green Innovation Research Laboratories that had developed this material, the NEC Production Engineering Development Division, which is in charge of supervising R&D of the production technologies of the NEC Group and the NEC Personal Products, Ltd., as PC manufacturer. Improvements of the composition were repeated for hundreds of times and developed a material that offers the best balance as flame retardant, optimum characteristics and reduced crystallization time while maintaining its high plant derivative ratio. Furthermore, new plastic injection molds were developed by incorporating mold flow design for ensuring the moldability and shapes for improving the de-molding function as well as introducing various reinforcements of the cabinet shape.

The use of the new material contributes to a retardation of the depletion of fuel resources by greatly reducing the amount of petroleum use and it can also significantly reduce $CO_2$ emissions throughout its lifecycle from manufacturing to disposal, thanks to its use of mineral constituents. We use such eco-materials extensively in order to contribute effectively to environmental controls.

## 6. Conclusion

In the above, we introduced some of the efforts made at NEC in support of the environment. These efforts have made it possible to achieve our target of halving the power consumption by 2010 from that of 2005. In the future, we intend to commercialize more products by aiming at even greater power

[*3] Calculated assuming that the annual total of operating days is 247 days, the working hours are 8 hours/day and that the periods other than the working hours are the standby periods. The $CO_2$ emission coefficient was assumed to be 0.41 kg/kWh and the power charge as 13.66 yen/kWh.

saving.

It is expected that requests for corporations to take environmental measures will continue in the future without decreasing. As a result of this trend, business PCs will increase in importance more than ever as a prominent part of the hardware platforms of all corporate activities.

At NEC, we will continue to apply positive environmental considerations deserving of the leading PC share company so that we can fulfill the aims of our slogan for the "all-inclusive eco-friendly office." [*4]



## Authors' Profiles

**UMETSU Masakazu**
Assistant Manager
Technology Strategy Dept.
Product Planning and Development Division
NEC Personal Products, Ltd.

**YANAGISAWA Tsunenori**
Assistant Manager
Technology Strategy Dept.
Product Planning and Development Division
NEC Personal Products, Ltd.

**SAITO Hiromi**
Assistant Manager
Design Technology Dept.
Product Planning and Development Division
NEC Personal Products, Ltd.

**SUZUKI Akitsugu**
Assistant Manager
Component Technology Dept.
Product Planning and Development Division
NEC Personal Products, Ltd.

**OOMACHI Satoshi**
Manager
Product Planning Dept.
Product Planning and Development Division
NEC Personal Products, Ltd.

**TAZUKE Ken**
Assistant Manager
Commercial PC Planning Dept.
Product Planning and Development Division
NEC Personal Products, Ltd.

[*4] NEC does not at present market PCs in overseas countries. However, details of our current and future PC business projects that are targeting overseas markets may be viewed on our web site at http://www.nec.com/. This paper introduces the PC technologies developed for the Japanese market.