Faculty of Electrical Engineering
Universiti Teknologi Malaysia

VOL. 9, NO. 2, 2007, 27-30

ELEKTRIKA
http://fke.utm.my/elektrika

Energy Savings Through Power Management in the Desktop Computer

Hasimah A. Rahman[*], **Md Shah Majid**, **Mohd Yusri Hassan** and **Tiw S. Lian**

Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia.

[*]Corresponding author: hasimah@fke.utm.my (Hasimah A. Rahman), Tel: 607-5535337, Fax: 607-5566272

Abstract: This paper presents a case study on the energy consumption of a desktop computer in the Energy Laboratory of Universiti Teknologi Malaysia, and shows the potential for energy savings through power management. The power consumption from the computer was measured using the energy analyzer, and recorded through observation. Two methods of power management were tested namely the Reminder Sticker and the software called Advanced Power Management System (APMS). The analysis shows that the first method managed to reduce 29.52% of the mean energy consumption over a week whereas, the second method which had been designed in the market to switch off the computer and peripherals after a user-specified period of inactivity produced reductions in the mean energy consumption of 16.97%.

Keywords: Desktop computer, Energy savings, Power management.

1. INTRODUCTION

Office equipment is the fastest growing electrical load in the business sector. With the widespread use of desktop computers, printers and other devices, an office can have hundreds of units and the energy costs can add up. Energy use from office equipment has surpassed lighting in many buildings where office equipment and miscellaneous loads can account for up to 2.5 Watts per square foot of floor space while lighting only makes up 1.5 Watts. In a recent study by APS, office equipment and other miscellaneous uses accounted for over 40 percent of electricity consumption in large office buildings with most of that by office equipment. Since office equipment accounts for an increasingly large share of the electricity bill, it is important to consider energy use characteristics. Energy-efficient offices help to protect the environment as well [1].

The past decade has seen governments enacting stringent building energy codes, and electrical utilities encouraging energy conservation to avoid building new generating capacity. However, during the same period, the energy consumption by office equipment (computers, printers, photocopies, faxes) has more than doubled. In fact, energy consumed by office equipment is now considered to be the fastest growing end-use of electrical energy in the commercial sector.

According to the Environmental Protection Agency, office equipment currently accounts for more than 7 percent of total commercial sector electricity use. The electricity used to run office equipment costs consumers and businesses $2.5 billion every year. Office equipment represents one of the fastest growing sources of energy use in both homes and businesses. The growing use of the Internet is also expanding the number of hours many computers are in use. Therefore, energy usage is a key environmental impact of a computer [1].

Table 1. Typical Power Requirements and Energy Use of Office Equipment

Equipment	Typical Power	Annual Energy Cost	Annual Energy Cost
Typical Power	Requirements (Watts)	Off at Night	On 24 Hours/Day
Computer	55.00	$9	$39
Monitor (15”)	75.00	$12	$54
Laser Printer	60.00	$14	$44
Fax Machine	35.00	$9	$27
Copier (small)	115.00	$30	$83
Copier (large)	310.00	$80	$224

Source: Office Equipment Energy Savings Calculator, LBL.

Table 1 provides a summary of typical electrical power requirements and annual energy use for common office equipment. The table compares the annual energy cost of equipment that is turned off at night and over the weekends and equipment that is left on round the clock.

Because of their large numbers, computers are the largest energy consumers among office equipment especially in the database center [2]. Therefore, analysis showed that significant energy consumption and electrical demand savings could be achieved if the time when computer were turned on could be more tailored to the actual use.

Figure 1 shows a frequency and duration usage profile for the desktop computer being used for a typical day with the total time used is 450 minutes.

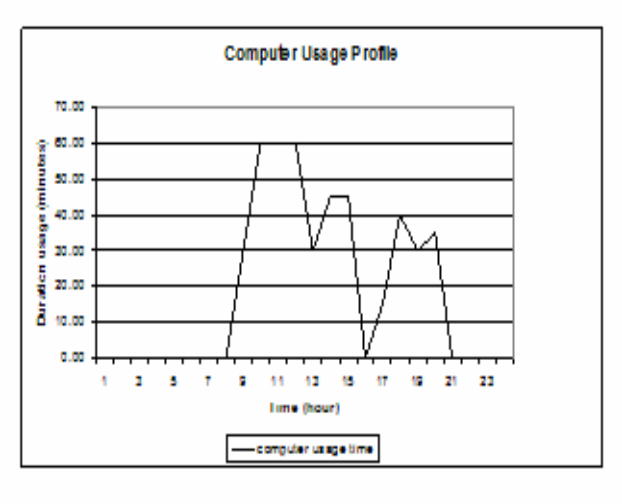

Figure 1. Computer usage profile for case study

2. POWER MANAGEMENT

The energy consumption by an individual computer can be expressed by the simple equation. In this case, the energy consumption, Q = Power consumed, P (kWh) x Time, T (hour).

The value of energy consumption is dependent on its mean plug load, which is the total power consumed by the desktop computer and the total computer usage time. Therefore to save the energy consumed, the plug load or the computer on time must be reduced. Reducing plug load requires new hardware; while new, low power hardware is still under development, there are millions of computers already in use [3]. In this paper, a measure to cope with energy savings named power management is recommended.

2.1 Evaluation of Power Management Strategies

Power management helps to manage the power supply to a desktop computer so that it minimizes the power consumption of the computer without affecting the quantity and quality of the work done. Power management is essential for every desktop computer because it helps to cut the electricity costs by reducing the amount of energy used by computers. Besides, it also allows the computer to meet the energy consumption regulations worldwide. There are three basic things that need to be determined about the power management in order to be evaluated: how much it reduces the power consumption of that component; what percentage of total power system is due to the component and how much it changes the power consumption of other components.

2.2 Strategies of Power Management

a) Reminder sticker

This is a public information campaign using a reminder sticker, placed on the monitor, urging users to switch off their computer manually when not in used. This sticker is approximately 90 mm x 75 mm, with lettering in distinctive red, and custom designed and printed for the project.

This strategy can help to reduce the computer usage time by switching the computer off manually. When this strategy is in used, there is no other power management system installed inside the computer, thus, the reminder sticker works as the only power management to save the energy consumed.

b) Advanced Power Management System (APMS)

APMS is the first major open industry standard developed to meet power management needs in personal computers. APMS is controlled from the computer's BIOS. The BIOS establishes a connection with an operating system driver and in this way provides power management instructions to the operating system.

APMS is provided on all Hewlett Packard computers, and has been successful in reducing the energy consumption of millions of computers worldwide. However, the computing world has changed radically in the few years since APMS was developed. Recent leaps in technology and new uses for desktop computer have rendered APMS ill equipped to deal with power management tasks [4].

These emerging APMS drawbacks include:

- Difficulty in meeting the increasingly strict power saving regulations.
- Diminished availability. Computers are increasingly being used for demanding tasks requiring 24-hour availability. A computer that goes into an APMS low power mode is unavailable for use and remains so until it has gone through the lengthy wakeup or startup procedure.

3. METHODOLOGY

The power consumption monitoring for the desktop computer was carried out for a period of one week for twelve hours a day from 9am to 9pm.

There were three conditions of data collected. The first is the power consumption before power management is applied. The second is after power management is applied with strategy 1, known as reminder sticker where the public was informed to switch off the computer if it is not in used. The third is also after power management is applied with strategy 2, known as APMS. Table 2 shows the brief schedule for the monitoring.

Table 2. Monitoring schedule for the desktop computer

Day 1	Computer usage pattern was observed
Day 2	Data collected before the power management
Day 3	Data collected before the power management
Day 4	Data collected after the power management using strategy reminder sticker
Day 5	Data collected after the power management using strategy reminder sticker
Day 6	Data collected after the power management using APMS
Day 7	Data collected after the power management using APMS

To measure the parameter of any element, the clamp meter should be clamped on the lifeline or the neutral line from the TNB source to the element. It works exactly the same as the current transformer. The function is to measure the current flow to the element. The voltage of the element is measured by setting the measurement knobs, one to the lifeline terminal and one to the neutral line terminal. Figure 2 shows the connection between the load and the energy analyzer through the clamp meter.

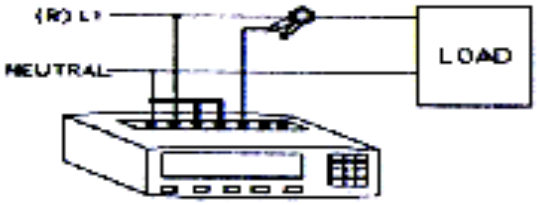

Figure 2. Connection between the load and the energy analyzer through a clamp meter

For the monitoring of the desktop computer, the total power flowing to the computer includes the CPU power and the monitor power. In order to get the total power consumed, the CPU supply socket and the monitor supply socket were plugged together into the same power extension. Then, the measurement was done on the wires connecting the power extension to the power supply from TNB.

4. RESULTS AND DISCUSSIONS

4.1 Effect of strategy using reminder sticker

The average power consumption per hour when the power management is applied using the reminder sticker is as shown in Figure 3. The top curve shows the power drawn from a computer will be more tailored to the actual use.

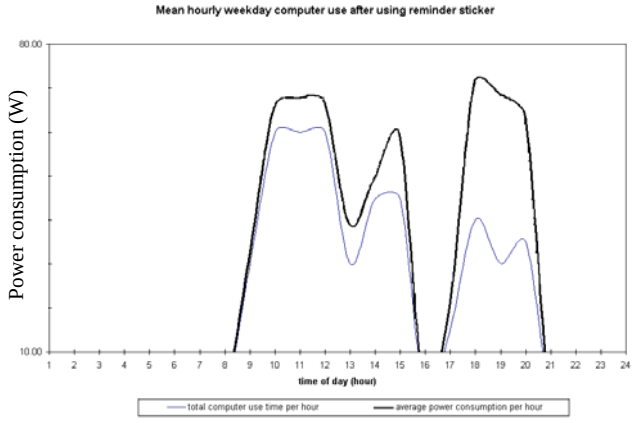

Figure 3. Mean hourly weekday computer use after using reminder sticker.

4.2 Effect of strategy using APMS

Figure 4 shows the pattern of average power consumption per hour when the power management is applied using APMS. The top curve gives the effect that is similarly to the previous graph. The power consumption of the computer during this period is significantly lower than before the power management is applied.

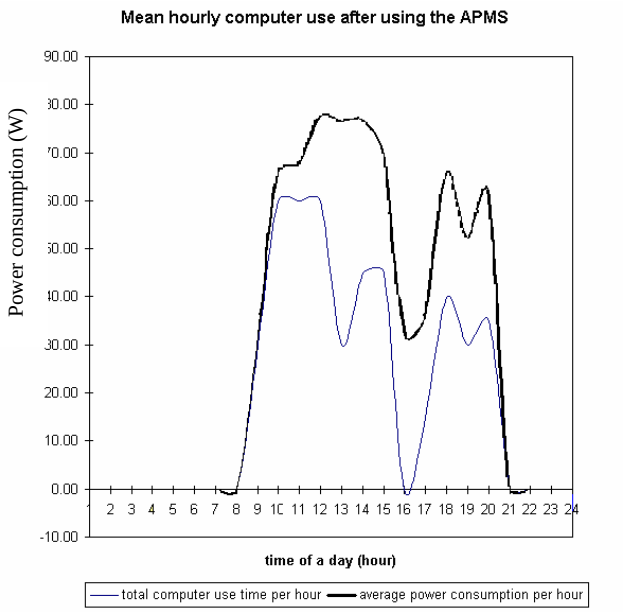

Figure 4. Mean hourly weekday computer use after using APMS

4.3 Power Consumption

The graphs of the power consumption for the desktop computer in the three different conditions, before and after the application of power management of the computer are as shown in Figure 5.

(a) Before Power Management

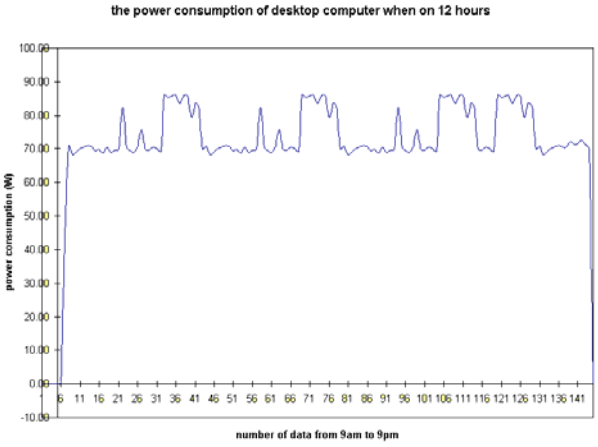

Figure 5. Graph of the power consumption before power management

Figure 5 indicates the power draw to the desktop computer is normally constant when it is switched on continuously 12 hours per day. There is only a slight change in the power drawn with task. However, since the computer is not in use every minute for 12 hours, then a lot of energy is wasted when it is left running for the whole period.

(b) After Power Management Using Reminder Sticker

Figure 6 shows the power consumption with power management using reminder sticker. The result indicates a significant drop in power consumption when the desktop computer is switched off manually. This strategy contributes much in reducing the power consumption because the power reading is dropped to zero during the off mode.

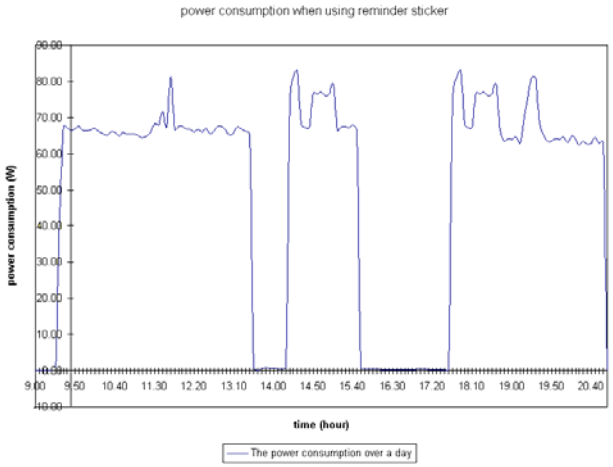

Figure 6. Graph of the power consumption with power management using reminder sticker

(c) After Power Management Using APMS

Figure 7 shows the power consumption with power management using APMS. The result shows a significant reduction in power consumption when the APMS is applied in the desktop computer for power management. The inactivity threshold had been fixed to set the idle time before going to the turned-off-monitor mode and the turned-off-hard disk mode. From the graph, when the computer had been idling for 10 minutes, the monitor will be turned off automatically. As a result, the power consumed will be drops to ± 42W and this indicates the monitor consumed ± 44W of the total power drawn. After an inactivity time of 15 minutes, the hard disk will be turned off automatically. Then, the power consumption again drops to ± 26W. This is the lowest power mode in the APMS where the power can drop to the lowest rating of ± 26W. However, this strategy still contributes greatly to power reduction.

5. CONCLUSIONS

Power management is essential for every computer because it helps to manage the power supply to a desktop computer so that it can minimize the power consumption of the computer without affecting the quantity and quality of the work done. Two strategies that were suggested in the monitoring period had definitely helped to reduce the energy consumed and also its electricity costs. The used of the reminder sticker strategy had reduced about 29.43% where Ares the used of Advanced Power Management System (APMS) strategy can saved the electrical energy about 16.86% of the total energy used.

From the analysis, it is obvious that the strategy of using a reminder sticker shows better result than the strategy of using APMS. However, it is necessary to consider the disk access time for turning on the computer again.

Therefore, the monetary value of savings from power management will be site specific, and depend on plug load, electricity rate structure and the computer use profiles.

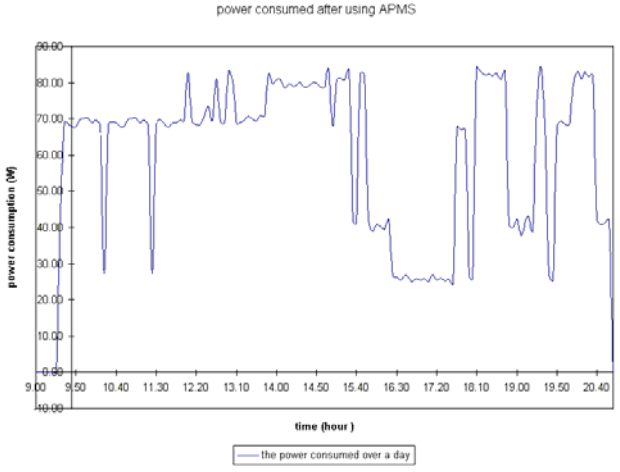

Figure 7. Graph of the power consumption with power management using APMS.

REFERENCES

[1] M. E. Herniter, *Personal Computer Fundamental For Technology Students – Hardware, DOS and Windows*, Prentice Hall, 1998.

[2] H. L. Capron, *Computers – Tools for an information Age*, Sixth Edition, Prentice Hall, 2000.

[3] W. Stallings, *Computer Organization And Architecture-Designing For Performance*, Prentice Hall, 1996.

[4] W. M. Fuori, L. V. Gioia, *Computers And Information Processing*, Prentice Hall, 1991.