Application of Energy Efficiency Techniques While Using ICT Equipment

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Abstract

Information and Communication Technology (ICT) devices and services are becoming more and more widespread in all aspects of human life. Computers and home office equipment represent one of the fastest growing categories of home energy use. While ICT equipment has become more energy efficient in recent years, computers, peripherals, and data centers still use significant amounts of energy, especially if they are left on constantly. The information and technology ecosystem now represents around 10% of the world's electricity generation and it represents the largest area of potential energy savings, as well. Most of these devices now have power management features that allow them to enter standby or "sleep" mode during periods of inactivity but only a fraction of users, know about the potential energy savings features. The aim of this paper is to offer practical and actionable tips for saving energy with computers and home office equipment. I review and test the main opportunities, explain them in plain language, and provide practical tips for leading an initiative to increase ICT energy efficiency in order to cut energy consumption per unit in half – or more. This paper presents the survey conducted about ICT equipment energy use in four offices and in five residential buildings in Korça region, Albania. The users were advised to use some basic energy efficiency tips, and energy data were collected before and after the new practices. Experimental results show that the methods used for increasing efficiency were very effective and the electricity consumption was reduced to about 10% - 45% in offices and about 5% - 15% in residential buildings.

Keywords: Appliance efficiency, energy efficiency techniques, ICT equipment, standby power consumption, power management features.

Introduction

ICT and Energy

In general, ICT has a green image because it provides solutions to some environmental problems. Well-known solutions are electronic documents and electronic mail (no need to print and no transportation costs). As well, teleworking, a system where an employee can work from outside the workplace, is another possible application (P. Fernando and A. Okuda, 2009) which has many advantages such as an improved work-life balance, increased productivity, savings of CO2 emissions, space saving and financial benefits (S. Ruth, 2011). Even though ICT gives some solutions to environmental problems, it also induces some of them. One of these problems is energy consumption of ICT itself. It is predicted that 14% of the worldwide electrical energy in 2020 will be consumed by the ICT sector (M. Pickavet, 2008). Over the past decade, concern has been raised about the rapidly growing energy use by personal computers (PCs) and other electronic office appliances. The prominent publications by Mills (1999) and Huber and Mills (1999) suggested that as much as 8% of electricity demand in the United States was directly related to internet-linked computer use. With recent swiftly increasing market demands for new Communication Technology devices, the ICT sector continues to witness rapid growth and mass spread of ICT equipment and services at both the national and global levels. The electricity consumption associated with this expansion is also illustrated by the fact that the IEA estimates that, even with a continuation of all existing appliance policy measures, the electricity consumption for ICT and consumer electronics will grow by almost 800% from 1990 to 2030. Comprehensive data for electricity consumption by the ICT industry alone are not available, although, globally, electricity consumption by the ICT sector in 2012 was estimated to be roughly 900 million MWh, or 4. 6% of the world's overall electricity consumption (Heddeghem et al. 2014). This includes electricity consumption by end-use devices, data centers, and the telecommunications industry. Figure 1 shows the share of each. ICT has the potential to play a central role in addressing the climate and energy challenges we face today. The European Commission highlighted this opportunity

in its Recommendation COM (2009)7604 of October 2009 on mobilizing ICT to facilitate the transition to an energy-efficient, low-carbon economy.

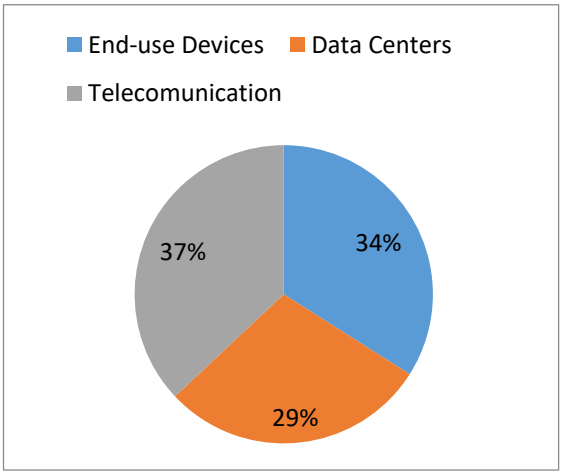

Figure 1. Electricity consumption by end-use devices, data centers, and the telecommunications industry.

All electric equipment commercialized in the European Union is required to comply with energy efficiency regulations. Energy standards are set up around the world through well-known eco labeling and energy efficiency programs, such as Energy Star for major appliances in North America, ASEAN in Asia, GreenTag in Australia, and Eco-Label in European Union that is set through the Regulation (EC) No 66/2010 of the European Parliament and of the Council.

Energy conservation through equipment efficiency is an essential component of international efforts to slow global warming and prevent the potentially catastrophic effects of climate change, caused primarily by increased atmospheric carbon dioxide levels that result from burning fossil fuels. Although ICT efficiency techniques alone will not save the planet, I believe that making home or office more energy efficient reduces domestic electricity consumption by at least a few percentage points, thereby helping our planet.

However, while industrial processes and public infrastructure still offer many opportunities for saving energy through conventional ICT-based automation and optimization, this is more difficult in a home environment. Conventional measures for reducing domestic energy consumption need to be taken – they essentially consist of using more energy-efficient appliances and reducing energy lost by appliances on standby mode.

A university is a specific example of an office environment, and the power consumption in four department offices has been considered for this study. In this paper I present the results of the survey about energy use by ICT equipment conducted in four offices in “Fan S. Noli” University and in five residential buildings in Korça city, Albania. Measurements were carried out for a period of two months. After the first measurements were performed, both office employees and residents were instructed to use a list of practical techniques to increase the efficiency of electricity consumption for the ICT equipment they used. Over the whole study period, continuous measurements were performed and the results were compared with previous measurements. It is observed that all experimental results show that the methods used for increasing efficiency were very effective and the electricity consumption was reduced significantly.

Measurement Methodology

In each site, consumed power was measured while the appliances were in normal routine use. A common measurement methodology and the same equipment were used in all measurements. The data were collected using the metering equipment EKM-OmniMeter I v. 3. The meter was connected to the central site power panel and to the computer (it can export data to computer in excel format through EKM Dash software). The data were collected for one month from each site. After that, the office employees and residents were instructed to use a list of practical techniques (explained in details in

Chapter III) to increase the efficiency of electricity consumption for the ICT equipment they used. Eventually data were collected again for another one-month period for each site.

The Main Saving Opportunities

Office employees and residents were provided with advice on managing ICT in order to minimize running costs. Also residents were provided with long term recommendations for purchasing efficient and environmentally preferable office equipment.

Out-of-office-hours use:

I have concluded that nearly half of my colleagues' PCs in my office are left powered on unnecessarily after office hours, greatly increasing the average monthly power consumption of these desktops to around 100 kilowatt-hours per Pc. Using an electricity cost of 10 cents/ KWh, the annual energy running cost of a single workstation left powered on unnecessarily after business hours, could be up to 365. 25*24-1800 (official working hours) = 6966 hours * 0. 12 KW/h * 10 cents/KW = $83. 6 per annum. The users were advised to switch-off or activate the power saving settings for computers or ICT devices when they are not in use. Spending a large portion of time in low-power mode not only saves energy but helps equipment run cooler and last longer.

Enable Power Management directly on all equipment:

Most computers, copiers, fax machines and printers now offer "power save" or "sleep" mode settings by which they go into an energy-saving mode after a certain number of idle minutes. The energy-saving mode typically uses at least 70 percent less energy than full-power mode. For example, a typical desktop PC consumes about 150W while powered on; roughly 80W by the PC and 70W by the LCD monitor, while only a fraction of this is consumed in standby or off-mode. It is a common misperception that screen savers reduce a monitor's energy use. Do not confuse screen savers with monitor and computer power management features. Screen savers can actually increase the energy used by both the display and the computer's processor. Screen savers were originally developed to prevent the permanent damage of patterns on older CRT monitors, but modern display screens do not suffer from this problem. Today, screen savers are purely for entertainment. Use automatic switching to sleep mode or simply turn it off. The users were advised to activate the power saving settings for computers and other ICT devices.

For optimal savings and user experience, Energy Star recommends:

Set display to enter sleep mode after 5-20 minutes of inactivity.

Set computer to enter system standby/hibernate/sleep after 30-60 minutes.

On laptops, be sure to change the "AC" or "Plugged in" power profile; if you only make these changes to the "DC" or "Battery" power profile, you won't see any energy savings.

Imaging equipment:

Because printers, scanners, and copiers are commonly left on for 24 hours a day, energy-efficiency is an important purchasing consideration. Office equipment that has earned the energy efficiency certification helps save energy through special energy-efficient designs, which allow them to use the least possible energy to get a job done and to automatically enter a low-power mode when not in use. In addition to saving energy, energy efficiency certified copiers and printers also cut down on paper use by automatically printing on both sides of the paper. The users were advised to activate the imaging devices to automatically enter low-power sleep or standby modes when inactive, and to print on both sides of the paper.

Use smart power strips:

Most office equipment, consumer electronics and battery chargers continue to draw a trickle of electricity from the outlet even when turned off.

The users were advised to consider purchasing smart power strips with integrated master switch and attaching to them clusters of electronics that can be shut off at once, manually or automatically. Since it is not always practical to completely unplug these items whenever you leave your desk, smart power strips can effectively do that for you.

Switching to laptops and getting rid of desktops:

If your office is considering a computer upgrade, suggest switching to laptops instead of desktops. Laptops use roughly five times less electricity, consuming just 14–24 watts of power while on, compared to a desktop at around 100 W. When in sleep mode, most laptops use only 1–2 W, which means that businesses that trade in their desktops for laptops can see dramatic energy savings. The users were suggested that if they are considering a computer upgrade they should switch to laptops inside of desktops.

Make sure all lights are turned off in your office at the end of the day.

The users were suggested to create an office policy to ensure all the lights in office are turned off, including lights in bathrooms, kitchen areas, and meeting rooms. The employees were suggested also to switch off lights in a room if they are going to be out of there for longer than a few minutes at a time.

Energy efficiency qualified products:

The "Energy Star" or "Eco-Label" mark indicates the most efficient computers, printers, copiers, televisions, and other appliances and equipment.

It can provide remarkable energy savings, with as much as 90% savings for some products. Overall, energy efficiency qualified products use about half the electricity of standard equipment. The users were advised to always buy energy efficiency qualified products for their home or business.

Get the light right

For lights in the office, install LED or compact fluorescent light (CFL) bulbs that can use significantly less electricity than incandescent bulbs.

Unfortunately, not all of my colleagues expected with a sense of enthusiasm or urgency my computer power management initiative. I have identified three possible reasons for this:

The employees do not pay the utility bill. Office users rarely pay the electricity bills, so they don't directly benefit from energy efficiency measures.

Job priorities. An office employee's job, first and foremost, is to keep computer running to fulfil the tasks. Daily software upgrades ensure that this job is not jeopardized. Thus all initiatives to introduce energy efficiency modes take a distant back seat.

Lack of expertise. Energy efficiency is almost never a part of office-employee training. The time it takes to research energy-saving strategies, tools and techniques is often significant enough to serve as a barrier to action.

Estimate Implementation Costs

The costs associated with activating these settings are minimal, in contrast to energy savings.

Implementation costs may include:

IT staff time. Even for the largest companies, activating power settings rarely takes more than a few days of work.

Software solutions. There are lots of ways to activate sleep settings across entire networks of computers, and most of them are free. Although there are lots of commercially available software packages that offer more feature-rich solutions and may deliver more energy savings, they can involve fees of roughly $3-15 per PC.

Results

Office users find it easy to manually activate computer power management features, while it is a little bit more difficult for home users. After the users were instructed to use a list of practical techniques to increase the efficiency of electricity consumption, the energy consumption data were collected again for another one-month period for each site. Figure 2 and Figure 3 show the measurements before and after the electricity saving actions.

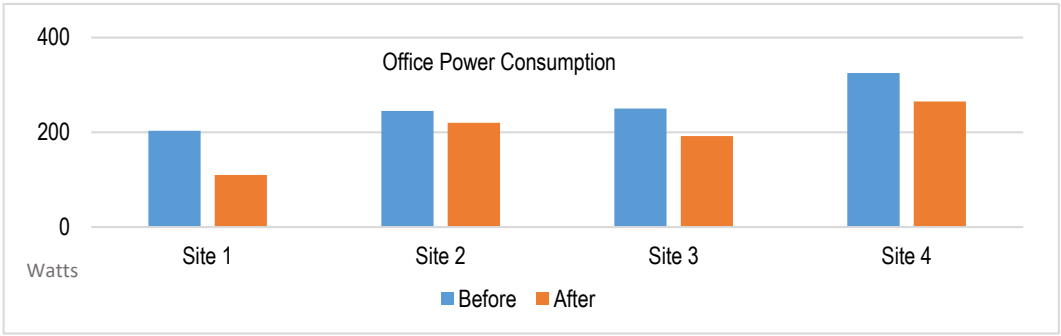

Figure 2. Office power consumption before and after recommended energy efficiency tips.

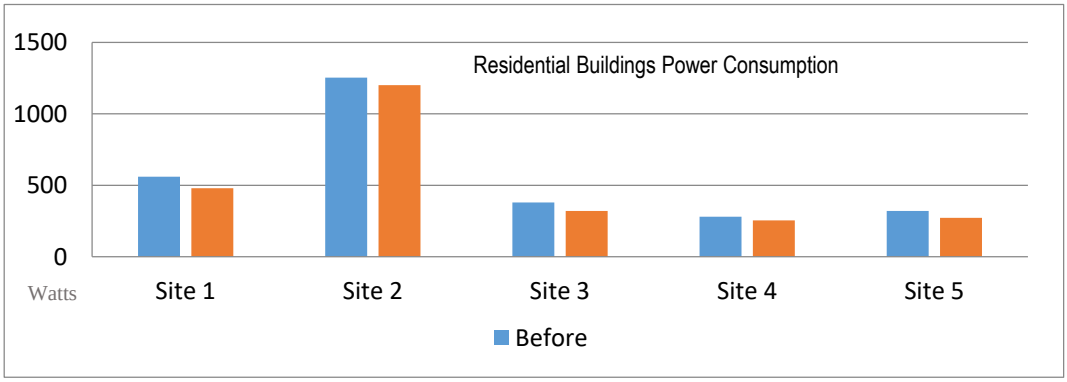

Figure 3. Residential buildings power consumption before and after recommended energy efficiency tips.

As seen in Figure 2 and Figure 3, the data shows the potential of energy savings from basic energy efficiency techniques. The average energy saved by all ICT for one average office is around 60 KWh per month, whereas for residential buildings it is slightly less, around 53 KWh per home. The results showed that the energy savings in offices were higher than in residential environments. This may be due to the fact that:

In the office, almost all the electricity consumed comes from ICT equipment type, while in residential buildings only a small portion is consumed by the ICT equipment.

Even before efficiency recommendation tips, the home users were more careful than office users not letting ICT appliances on all time, thus the difference of consumption before and after measures was smaller for home users.

Office users may find it easier to activate equipment's power management features than home users may.

Conclusion

ICT can make a significant contribution to saving energy, both through autonomous optimization and by inducing changes in user behavior. Obviously, the potential energy savings of energy efficient office equipment will only be achieved if the user acts accordingly. People often underestimate the little things they do at work, so promoting awareness and consciousness about energy issues is very important, not only for decreasing the amounts billed each month, but also for promoting a healthy environment within our workplace. Considering the crucial list of practical techniques mentioned above will enable us to see immediate changes in the energy bill in the subsequent month. In order to be effective, energy efficient suggested techniques should therefore be accompanied by organizational and educational measures to ensure that the potential efficiency gains are actually realized. Also, when it comes to influencing consumer behavior about efficiency,

further research is required not only to develop user interfaces that present consumption data in a suitable way, but also to identify and better understand concepts of behavioral science.

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