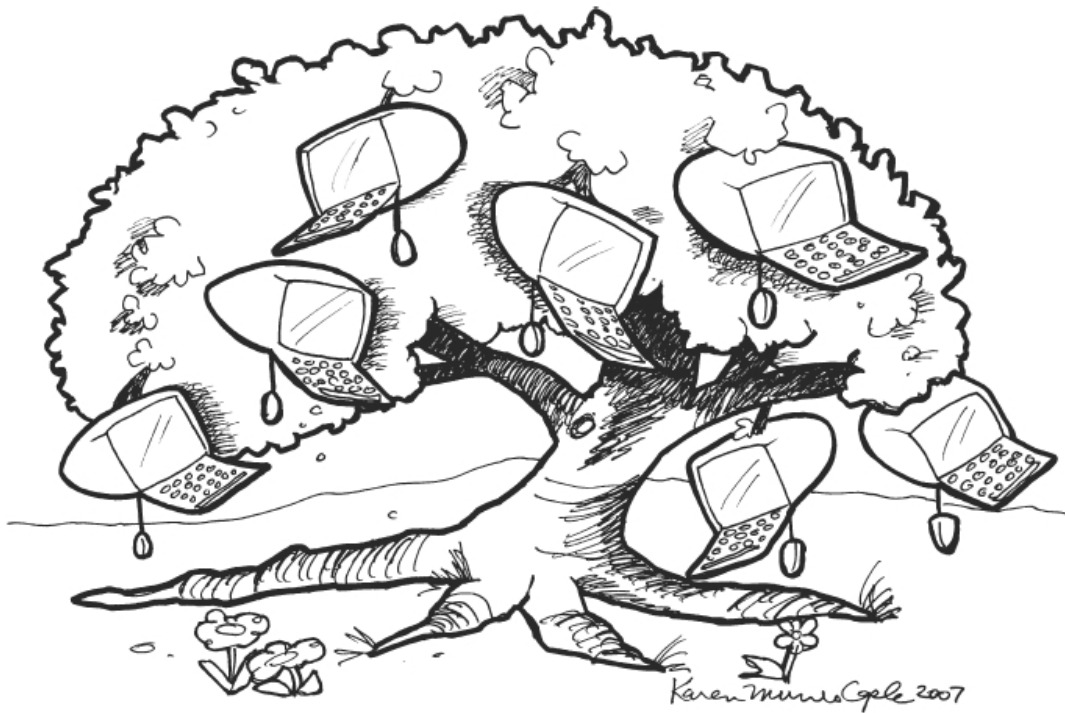


ENVIRONMENTAL COMPUTING GUIDE



**Suggested practices for having
a greener computing experience**

Robin Berry

Introduction

Computer equipment is one of the fastest growing electrical loads in the business world. Each year more and more computers are purchased and put to use in the work force, which implies a greater increase in our energy consumption. Not only do the numbers of computers that are being put to use add to the increasing energy burden, but also the way in which we use computers contributes towards this skyrocketing energy consumerism. Every time we leave computer equipment or lights on when not in use, we waste electricity. Electricity is produced mainly by the burning of fossil fuels or coal, and while energy is produced, so too are pollutants such as carbon dioxide (CO₂). Carbon dioxide is a greenhouse gas (a gas surrounding the earth that absorbs infrared radiation from the sun and traps the sun's heat in our atmosphere) that is a major contributor to climate change, smog and acid rain.

Studies have shown that most desktop computers are not being actively used and are being needlessly left turned on in an idling state the majority of the time they are running.

How much energy does your computer use?

The average computer (desktop and monitor) uses the following rates of electrical consumption (assuming no power saving features are in place):

0.145 kW (kilowatt) while in use
0.06 kW while idling (not in use)

For the average employee, a computer (and monitor) is left on for 7 hours a day, for 5 days. The amount of electricity used can then be calculated by:

EC (electrical consumption) = 35 hours x 0.145 kW (in use) = 5.08 kWh

For a computer (and monitor) that is left on for the rest of the time (on weekends and during non-working hours)

EC (electrical consumption) = 133 hours x 0.06 kW (idle) = 7.98 kWh

Total EC = 13.1 kWh**

The Office of Greening Government Operations of the Government of Canada uses a CO₂ emission figure of 0.5418 kg of CO₂ per kWh (meaning that 0.5418 kg of CO₂ is produced to create 1 kWh). Using this figure, 7.1 kg (or 15.6 lbs)** of CO₂ are produced a week to run one employee's computer.

** The figures computed are for educational or representative purposes only, and are in no way a detailed scientific estimate of the likely emissions associated with the use of your computer equipment.

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Energy efficient computing

Turn your computer off whenever possible

It is commonly thought that a computer's life is shortened by turning it on and off. This belief has led some people to leave their computers (and other peripheral devices) on all the time. Others are reluctant to switch their computers on and off a couple times during their work day, even though they are only using this equipment for a fraction of that time.

Most experts agree that turning PC equipment off at night or on and off a few times during the day will not appreciably affect its useful life which may only be a few years in any event because of technological obsolescence^{1 2}. Electronic equipment life is based on operating hours and heat. Both these factors are reduced when equipment is switched off.

As well, it is believed that a computer doesn't consume the same amount of energy if it is on but not in use. Under heavy usage, a computer will draw only slightly more power than when it is not being used.

Therefore, you CAN turn off your computer (and screen, printer, scanner etc.) The inconvenience of waiting a minute or two for a computer to reboot or peripheral to come back on line may be small compared to the visible energy savings which can be achieved by keeping computer equipment off when not in use.

Some specific suggestions

- Turn off your computer and/or peripherals when they are not being actively used. A modest amount of turning on and off will not harm the equipment.
- Plug items like the computer, computer speakers, monitor, printer/scanner and desk lamps into one power bar, and turn off the whole power bar when items are not in use (evenings, weekends or when you are away from your desk for more than a few minutes – eliminating any idle time or standby time power waste). Turning off equipment using a power bar eliminates the possibility of phantom power draw – phantom power draw is

¹ "The belief that frequent shutdowns are harmful persists from the days when hard disks did not automatically park their heads when shut off; frequent on-off cycling could damage such hard disks. Conventional wisdom, however, has not kept pace with the rapid technological change in the computer industry. Modern hard disks are not significantly affected by frequent shutdowns." (Source: "User Guide to Power Management for PCs and Monitors", Bruce Nordman, Lawrence Berkeley National Laboratory, January, 1997, LBNL-39466)

² "Modern computers are designed to handle 40,000 on-off cycles before failure, and you're not likely to approach that number during the average computer's five- to seven-year life span. In fact, IBM and Hewlett Packard encourage their own employees to turn off idle computers, and some studies indicate it would require on-off cycling every five minutes to harm a hard drive ..." (Source: Rocky Mountain Institute Home Energy Brief #7 Computers and Peripherals.)

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the consumption of electrical power that a device uses even though the device has been turned off.

- Look for ways to reduce the amount of time your computer is on without adversely affecting your productivity. If possible, informally group your computer activities and try to do them during one or two parts of the day, leaving the computer and peripherals off at other times.
- Do you really require immediate access to your E-mail or to the internet when you enter the office? Could you survive using just a PDA (Palm Pilot, Blackberry etc.) for a portion of the day?
- If you use a local printer (a printer that is directly connected to your computer), don't turn your printer on until you are ready to print.
- When you leave the office for an extended period of time (for a meeting, lunch, to run an errand), turn off your entire computer system (CPU, monitor and printer) or at least your monitor and local printer.
- For network servers, which must be on to serve network functions during the day, consider the possibility of turning servers off at night. Are monitors required at all for you to access the local server – is remote computing a possibility? If a server monitor is needed during the day, consider turning it off at night and on weekends.
- Put common devices such as printers, photocopiers and multifunction devices on a power timer so they are automatically shut off from 6 PM to 8 AM.
- If your mouse or keyboard or other computer related equipment requires batteries, use re-chargeable batteries instead of the usual alkaline batteries.

While the energy saving suggestions listed above are appropriate for many employees in any work situation, some of the suggestions may be inappropriate for certain computer applications or certain work situations. When in doubt, discuss possible energy conservation measures with your colleagues, supervisor or computer network administrator to determine which steps can be taken without harming your equipment or your productivity.

Other motives to turn off your computer

- **Security:** It is a best practice to turn off your computer for security reasons every evening. Many updates (such as virus and security patches) to your computer require a reboot or restart for the actual software to be updated.
- **Maintenance costs:** The fans that are located at the back of computer or printer are constantly circulating the air to keep the internal parts cool; so consequently, they are sucking in the dirt and dust in the air. This internal office air pollution slowly reduces and degrades the effectiveness of these fans, causing the computers and printers to run at a higher temperature, and possibly reduce their life span. Regular maintenance on computers and printers can reduce this strain, but shutting off the machines at the end of the day can extend the life of these parts.

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- **Air conditioning:** Computer equipment generates heat – whether the equipment is in use or just idling - and requires additional cooling which increases the overall energy demands. This heat source can affect the internal temperature of an office, forcing the air conditioning to work harder (both in summer and in winter) to maintain an acceptable temperature level. Shutting off the machines when not in use both throughout the day and in the evening can translate into savings for the environment and for the budget.

About screen savers

“Screen saver” programs only “save” your monitor by preventing a permanent image from being burned onto your screen; they provide no “savings” in terms of energy consumption. A screen saver which displays moving images causes your monitor to consume as much as electricity as it does when in active use. These screen saver programs also involve system interaction with your computer which results in additional energy consumption. A blank screen saver is slightly better but even that only reduces monitor energy consumption only by a little. The best screen saver is also the best energy saver, that being the habit of turning off your monitor when you are not using it. This step also eliminates concern about exposure to any possible electromagnetic radiation emanating from the monitor.

Other steps towards green computing

You can take a giant step towards being environmentally responsible or “green computing” by conserving energy with your computer, but green computing involves other important steps as well. These pertain to paper use and printing, toner cartridges and other computer consumables, disposal of old computer equipment and purchasing decisions when considering new computer equipment.

Reduce paper use

Computers were once thought to be the key to creating a paperless office; but paradoxically computer use has vastly increased the amount of both paper consumption and paper waste. Here are some suggestions for reducing this waste:

- Print as little as possible. Review and modify documents on the screen. Minimize the number of hard copies and paper drafts you make. Instead of printing, save information to disks, or use a monitor that allows you to turn a document to be the full length of a sheet of letter sized paper to allow for onscreen editing.
- Save E-mail to a central repository whenever possible and avoid needless printing of E-mail messages.
- When sending a fax using hard copies, save paper by using a “sticky” fax address note or a scrap piece of paper and not an entire cover sheet.

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- On larger documents, use smaller font sizes or adjust the margin sizes to save paper (allowing for the document to still be legible).
- Use the smallest paper size that is appropriate to your print or copy job.
- If your printer or copier prints a test page whenever it is turned on, disable this feature – it's not necessary.
- Recycle waste paper – use the same piece of paper to print twice, or before recycling paper which has print on only one side set it aside for use as scrap paper for notes or in printing drafts.
- Buy and use recycled paper in your printers and copiers. If skeptical, buy a small quantity first and check results – not all printers and copiers work well with all or any recycled paper, and not all recycled paper is of the same quality. From an environment point of view, the best recycled paper is 100 percent post consumer recycled content and has not been de-inked.
- When documents are printed or copied, use double-sided printing or copying.
- When general information-type documents must be shared within an office, try circulating them instead of making an individual copy for each person or tack the documents to a notice board, or best yet, save the electronic document to a central repository and send an E-mail with a link to the document.
- Set up an office paper recycling program in your office, where colleagues can use both “waste” paper and recycled paper depending on their needs.

Printing options

Whenever possible, install and print to a network printer rather than a local printer. A network printer can accommodate the print jobs of 8 to 12 employees, perhaps even more depending on the amount of printing that is sent to that machine. A networked printer saves the costs of 8 to 12 individual printers (and other equipment), saves on toner cartridges (buying toner for one printer rather than multiple printers), and saves on the maintenance costs that would be incurred for multiple local printers. Also, by using a network printer, the settings can be adjusted to automatically print double-sided for all employees who print to that printer. A networked multi-function unit which does printing, photocopying, faxing and scanning would actually be the choice option as it would replace the need for separate machines for all of these tasks, but may not be appropriate for all office settings.

Toner cartridges and other computer consumables

Do you really need to print a document in colour? A colour laser printer uses at least 3 times the number of toner cartridges that are used in a monochrome (black and white) printer. When you receive a colour document, consider what the end result will be, and choose the appropriate printer.

Consider the possibility of buying recycled cartridges for any laser or inkjet printers there might be in your office. Buying recycled cartridges not only keep

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used cartridges out of landfill sites, but buying recycled consumable products also reduces the need for new raw materials. Not all recycled cartridges work best with all printers though, and not all recycled cartridges are of the same quality, so always speak first to your network administrator or printer/cartridge vendor before making any changes to the printers in your office.

Reusing and recycling computing diskettes

Computer diskettes are very inexpensive, but recycling a diskette can offer savings both for your budget and for the environment. Diskettes with outdated information on them can be reformatted, reused and most of the time relabeled. New labels can be purchased from most office supply companies and are easy to use. If you must destroy a diskette – for security reasons or if it no longer functions properly – keep the aluminum tab or shutter out of the trash and recycle it. Rather than keeping many diskettes on hand or buying more diskettes as more information is saved, perhaps consider a portable hard drive or USB flash drive as an alternative to saving to multiple diskettes.

Recycling old computers and buying new

The industry standard for the lifespan of the average office computer/laptop is approximately 2-5 years, the general best practice being 4 years (barring any major issues with the computer). For a CRT monitor, the average life span is 5 years; for an LCD monitor, 10 years. Network servers, have a relatively short lifespan of about 3 years, while laser printers have a life span of 3-5 years.

Computers are replaced for a variety of reasons, but this does not mean the computer or computer equipment is now totally useless. Computers for Schools is a national, federal government-led program that refurbishes computers and related surplus equipment donated by government and private sector sources. Once the computers and other equipment have been “cleaned” and tested, this equipment is then distributed to schools, public libraries and not-for-profit learning organizations throughout Canada. If you are not currently donating computer equipment through this program, speak to your IT Administrator to see if this is a possibility for your office.

When it comes time to buy new computer equipment, it might be possible to extend your computer equipment’s life by buying a larger system than you need. By buying a machine or equipment with more memory or a larger storage capacity, barring any major failure of the system, you might be able to use the computer or other equipment for at least one year more than what might be the accepted standard, thereby keeping more computer equipment out of the landfills, reducing the need for raw materials and being frugal with the IT budget.

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Green computing guide

This guide was created to provide the DIAND Legal Services Unit with some possible green ideas and possible energy conserving guiding practices to reduce our carbon footprint when it comes to computer and energy use.

Please visit the links at the end of this document for more information and helpful tips on conserving energy, reducing energy consumerism, and to minimize material waste.

Special thanks to Department of Indian and Northern Affairs Environmental Management Officer Christopher Beninger, Environment Canada Green Team Coordinator, Analise Saely, and Environment Canada Project Officer Colin Dobson for their input, encouragement and suggestions.

Resources and Further Reading

“User Guide to Power Management for PCs and Monitors” -
<http://eetd.lbl.gov/EA/Reports/39466/>

“Rocky Mountain Institute Home Energy Brief #7, Computers & Peripherals” - <http://www.rmi.org/sitepages/pid171.php#LibHshldEnEff>

Computers for Schools - <http://cfs-ope.ic.gc.ca/>

Energy Star - <http://www.energystar.gov>

Green Seal - <http://www.greenseal.org>

Office of Greening Government Operations (OGGO) -
<http://www.pwgsc.gc.ca/greening/>

A MORE CLIMATE-FRIENDLY WORKPLACE

Reduce Costs & Help the Climate at the Same Time

Action	Annual Energy Cost Savings (\$)		Annual GHG savings (tonnes)	
	Range	Average	Range	Average
Turn off equipment at the end of the business day				
• Your computer	\$13 - \$50	\$32	0.09 to 0.23	0.16
• Your monitor	\$0.25 - \$7.5	\$3.9	0.002 to 0.05	0.03
• Your desk lamp	\$10 - \$33	\$21	0.07 to 0.23	0.15
• A laser printer	\$ 0 - \$28	\$15	0 to 0.19	0.10
• A photocopier	\$10 - \$74	\$42	0.07 to 0.50	0.29
• A water cooler	\$25 - \$61	\$43	0.17 to 0.42	0.29
Use electrical equipment wisely				
• Turn a baseboard heater down in winter 10-20%	\$23-\$105	\$64	0.16 to 0.48	0.32
Buy EnergyStar®				
• A computer & monitor		\$14		0.08
• A high-speed copier		\$14		0.08
• A laser printer		\$18		0.10
• A fax machine		\$17		0.09
Buy different technologies				
• A flat-screen monitor (& not a TV-type)	\$7 - \$75	\$41	0.05 to 0.34	0.19
Get to work (NB: the costs or savings for parking, insurance, maintenance, repair and tickets are not included)				
• Telework, walk, bike, run, rollerblade (10%)	\$10 - \$46	\$29	0.04 to 0.16	0.10
(20%)	\$22 - \$92	\$57	0.08 to 0.32	0.20
(100%)	\$110 - \$460	\$285	0.38 to 1.62	1.00
• Carpool (10%)	\$10 - \$46	\$29	0.04 to 0.16	0.10
(20%)	\$22 - \$92	\$57	0.08 to 0.32	0.20
(100%)	\$110 - \$460	\$285	0.38 to 1.62	1.00
• Compress your work week	\$10 - \$46	\$29	0.04 to 0.16	0.10
• Take the bus (10%)	\$10 - \$46	\$29	0 to 0.16	0.08
(20%)	\$22 - \$92	\$57	0 to 0.32	0.16
(100%)	\$110 - \$460	\$285	0 to 1.62	0.81
• Buy the most efficient vehicle in its class for your next personal vehicle	\$0 - \$170	\$43	0 to 0.60	0.15
Travel for Business				
• Take the train instead of the plane under 500km				0.034 / one-way trip per passenger
• Walk, bike or conference call instead of taxi to your next meeting		\$2 / km		0.00027 / km
• Choose hotel location so to eliminate taxis to meeting or conference		\$2 / km		0.00027 / km
• Stay at "Green Leaf" hotels		0		0.002 / night
• Rent the most fuel efficient vehicle you can (hybrids are now often available but typically more expensive at this point)			0 to 0.0003 / km	0.00015 / km
Reduce Consumption				
• Fine paper		\$35 / 5000 sheets		7.55 / tonne 0.0018 / sheet
• Newsprint				2.66 / tonne
• Cardboard				5.18 / tonne

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• Mixed paper				5.49 / tonne
• Pop Cans				2.45 / tonne 0.0032 / can
• Plastic				1.2 / tonne 0.005 / bottle
• Organics				0.53 / tonne
• Glass				0.29 / tonne 0.0032 / bottle
Recycle				
• Fine paper				5.77 / tonne 0.0004 / sheet
• Newsprint				1.75 / tonne
• Cardboard				3.81 / tonne
• Mixed paper				3.93 / tonne
• Pop Cans				4.38 / tonne 0.0014 / can
• Plastic				1 / tonne 0.001 / bottle
• Glass				0.1 / tonne

- Information about the source data used in the preparation of this table is noted on the following page.

Notes:

All figures should be taken as estimated averages. Low and high scenarios were taken and averaged. Price ranges are based on typical Canadian figures in 2004. Emission figures are based on Canadian national averages. For electricity, this assumes that the first fuel saved by the grid network is natural gas burning. While electricity in some provinces (namely Quebec and Manitoba) produces very little GHG emissions, saving electricity in these regions is still desirable ecologically as these provinces export surplus electricity to the US where it primarily displaces electricity produced by burning coal. Waste emission figures are based on the 2001 levels of landfill gas capturing across Canada. Commuting figures are based on a study done for Environment Canada on commuting by federal public servants across Canada in 2004. It is important to note that the money saved and emissions saved figures for commuting are for commuting only and for fuel cost savings only. Approximately 1/5th of a typical Canadian driving year is spent commuting to and from work.