



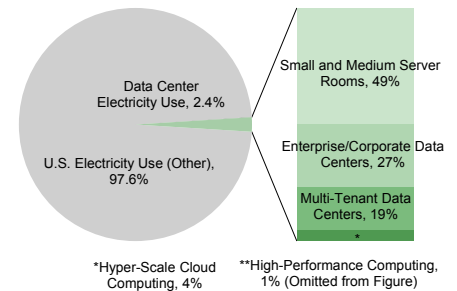
Green IT

Information Technology (IT) offers many benefits including increased productivity, access to information, and convenience. However, the production, use, and disposal of computers require large amounts of energy and resources. Green IT enhances the sustainability of computing through manufacturing lower impact materials and products, reduced energy consumption of data centers and computers, and better recycling and end of life management.

Patterns of Use

- Data centers in the U.S. consumed 91 billion kWh of electricity in 2013—2.4% of total electricity consumption—at a cost of \$13 billion.^{1,2}
- The peak load on power plants associated with servers and data centers was about 7 gigawatts (GW) in 2007. Updated technologies can reduce server energy use by 25% or more, while using best management practices with existing equipment can reduce energy use by around 20%.³
- Computers and office equipment accounted for 2.4% of the total electricity consumption (253 billion kWh) of office buildings in 2012.⁴
- In 2011, 76% of households in the U.S. had a computer or a tablet, compared to 51% in 2000.⁵ Globally, 1.4 billion smartphones, which have capabilities similar to a computer, were sold globally in 2015, up from 174 million in 2009.^{6,7}
- From 2005 to 2009, the proportion of primary household computers that were laptops rose from 31% to 44%.^{8,9} More than 14% of primary household computers were used 10 hours or more a day in 2009.⁹

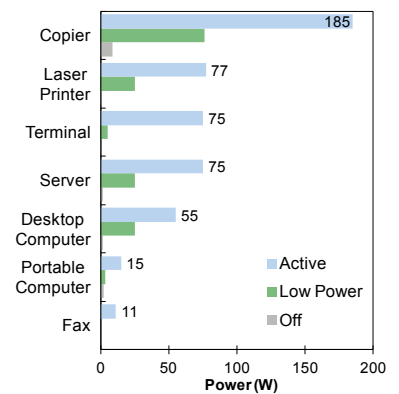
Electricity Use by U.S. Data Centers, by End Use^{1,2}



Energy and Environmental Impact

- Approximately 103.9 billion lbs CO₂e are released annually due to electricity used by U.S. servers & data centers.^{1,11}
- Electricity consumption of computers varies greatly with age, hardware, and other factors. An average multimedia desktop computer uses 48W when idle and 2.3W in sleep mode (285kWh annually). Laptops use significantly less energy - about 15W when idle and 1.2W in sleep mode (89kWh annually).¹²
- A 17" liquid crystal display cold cathode fluorescent lamp (LCD-CCFL) monitor uses 16W while on, 1W in standby, and 1W when off. A 17" light emitting diode (LED) LCD monitor uses about 13W while on, 0.4W in standby, and about 0.3W when off.¹³
- For every kilowatt hour used by office equipment, an additional 0.2-0.5 kWh load is placed on the air conditioning unit.¹⁴
- The annual life cycle burden of a computer is 5,600 MJ. Only 34% of life cycle energy consumption occurs in the use phase; extending the lifetime could mitigate the energy burden of the production and disposal phases.¹⁵

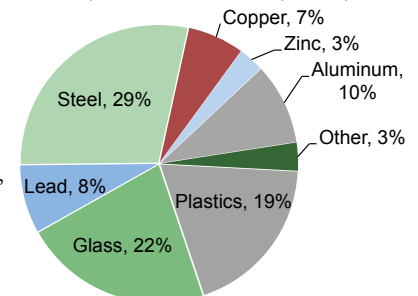
Power Used by Office Equipment¹⁰



Electronic Waste

- In 2014, approximately 41.8 million metric tons of e-waste was generated worldwide.¹⁷
- U.S. federal hazardous waste regulations do not deter exporting potentially hazardous e-waste, which is often handled and disposed of unsafely, threatening humans and the environment.¹⁸ One study estimated that 5-30% of e-waste collected for recycling in the U.S. is exported to developing countries, although a study by the U.S. International Trade Commission found that 17% of used electronic products were exported in 2011.^{19,20}
- In 2010, the U.S. disposed of 51.9 million computers and 152 million mobile devices (phones, PDAs, pagers). About 40% of computers and 11% of mobile devices are recycled.²¹

Composition of a Desktop Computer¹⁶



Paper Industry

- Global paper use increased 4% from 2000-2014 but has decreased 6% since 2011.^{22,23} Annual consumption of printing and writing paper is projected to increase from 109 million metric tons in 2006 to 274 million metric tons in 2060.²⁴ The U.S. accounts for approximately 18% of printing and writing paper consumption.²²
- Depending on the production process, one ton of paper can take between 12 and 24 trees to produce.²⁵
- The average annual greenhouse gas emissions of the U.S. pulp and paper manufacturing industry are 176 million metric tons CO₂e, approximately equivalent to the annual emissions of 51 coal-fired power plants.^{26,27}
- One study comparing paper and digital journal articles found that life cycle energy consumption varied greatly depending on the number of times an article was read, the reader's driving distance, and whether copies were printed. Generally, the study found that the digital option saves energy when an article is read only a few times, and paper saves energy when an article is read many times.²⁸

Sustainable Alternatives

Technology

- Virtualization enables many independent data servers to run software and/or operating systems on one physical server.³⁰ This technology allows companies to greatly reduce the number of physical computer servers needed and better utilize each server; with virtualization, each machine can run at 80% rather than 10% capacity.³¹ Virtualization reduces material waste, electricity use, space, costs, and heat generation, benefiting both the environment and a business's budget.³⁰
- Data center energy efficiency can be increased by utilizing combined heat and power systems to recycle excess heat.³²
- Multi-function office equipment can reduce energy consumption and waste. For example, Xerox claims its ColorQube multifunction printer can reduce costs by 62%, waste supplies by 90%, GHGs by 10%, and energy use by 9% over its lifetime.³³
- Video teleconferences can greatly reduce business travel impacts. One study found that a video conference requires 500 times less energy than a business trip including a 1,000 km (663 miles) flight.³⁴ Telecommuting, in which employees work from remote locations, is increasing in frequency. One study found full-time telecommuting could prevent 3,700 lbs of CO₂ emissions per employee per year.³⁵

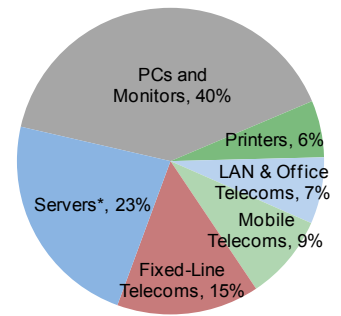
Life Cycle Impact of One Ton Uncoated Freesheet Paper²⁹

% Recycled Content	0%	50%	100%
Wood Use (tons)	4	2	0
Net Energy (million Btu)	33	27	22
Greenhouse Gases (lbs CO ₂ e)	5,601	4,567	3,533
Solid Waste (lbs)	1,922	1,546	1,171
Wastewater (gallons)	22,853	17,244	11,635

Reduce Energy Consumption

- If offices used proper power management and completely shut down at night, office equipment energy use could be reduced by 23% and 9%, respectively.¹⁰ If every PC in the world were shut down for one night, the energy saved could light up the inside and outside of the Empire State Building for over 30 years.³⁷
- Energy Star certified computer servers are, on average, 30% more energy efficient than standard servers. If certified servers replaced all new servers sold, annual energy savings of \$800 million and greenhouse gas (GHG) emissions reductions equivalent to those of over 1 million vehicles could be realized.³⁸
- The average computer wastes 50% of its power.³⁹ To improve efficiency, the EPA recommends setting monitors to go to sleep after 5-20 minutes of inactivity, and the system to enter standby after 15-60 minutes.⁴⁰
- Standby power accounts for 5-10% of residential energy use, adding up to \$100 per year for the average American household. Unplug electronic devices when not in use, or plug them into a power strip and turn the power strip off.⁴¹ Turning off a computer when it is not in use can save \$50, 505 kWh, and 662 lbs of CO₂ per computer annually.^{11,42}

Distribution of Global CO₂ Emissions from IT Devices³⁶



*Including cooling

Take Action

- Recycle your unused electronics. Responsible Recycling Practices (R2) and e-Stewards offer third-party certification for electronics recyclers to ensure the proper disposal of used electronics.⁴³
- Be an informed shopper. The EPA's Electronic Product Environmental Assessment Tool (EPEAT) rates the environmental impacts of various computer products across 23 required criteria and 28 optional criteria, including energy efficiency, material toxicity, and recyclability.⁴⁴
- The average American uses 434 pounds of paper each year, and 45% of printed paper in offices is discarded by the end of the day. Save resources by printing double-sided on recycled paper, or by simply not printing.^{45,46,47}
- Printers, copiers, and fax machines can use significant amounts of electricity, even in standby mode. Reduce office energy consumption by purchasing Energy Star certified products, consolidating multiple devices into all-in-one equipment, and turning off devices when not in use.⁴⁸

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