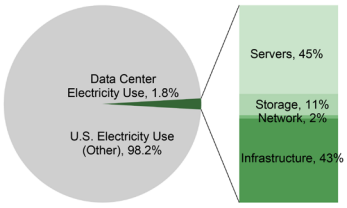
Green IT

Green Information Technologies (Green IT) reduce the environmental impacts associated with conventional Information Technologies (IT). Examples of Green IT include energy efficient hardware and data centers, server virtualization, and monitoring systems. Green IT focuses on mitigating the material and energy burdens associated with conventional IT while meeting our information and communication demands.[1]

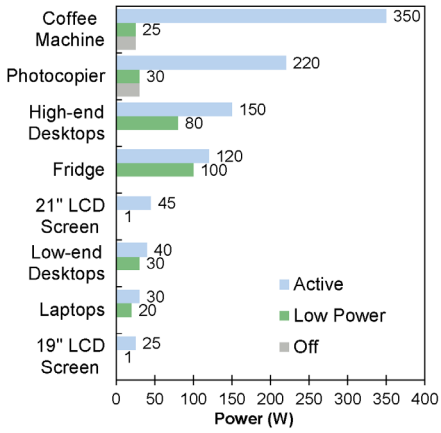
Patterns of Use

- In 2019, 2.16 billion mobile phones, tablets, and PCs were sold worldwide.[3]
- In 2010, 297 million smartphones were sold globally. Over 1.4 billion were sold in 2021.[4]
- Globally, more people have mobile phones than access to safe sanitation.[5,6]
- In 2018, 92% of households in the U.S. had a computer at home, compared to 8% in 1984. Of all households in 2018, 63% had a tablet, 78% had a desktop or laptop, 84% had a smartphone, and 85% had a broadband internet connection.[7]
- More than 14% of households used their primary computer for 10+ hours per day in 2009.[8]
- Computers and office equipment accounted for 13% of the total electricity consumption (227 billion kWh) of office buildings in 2018.[9]
- In 2014, U.S. data centers used 70 billion kWh of electricity—1.8% of total electricity consumption.[2]
- The peak power associated with servers and data centers in 2007 was 7 GW. Existing technologies and efficient design strategies can reduce server energy use by 25% or more, while best management practices and consolidating servers can reduce energy use by 20%.[10]
- Many countries have seen an increase in telecommuting in response to COVID.[11]
- Telecommuting during COVID in 2020 resulted in a 13% reduction in work-related energy consumption and a 14% reduction in GHG emissions.[12]
- The IT sector accounts for 4% of global GHG emissions and this could double by 2025.[11]

End Use Electricity Consumption of U.S. Data Centers[2]



Office Equipment Power Demand[13]



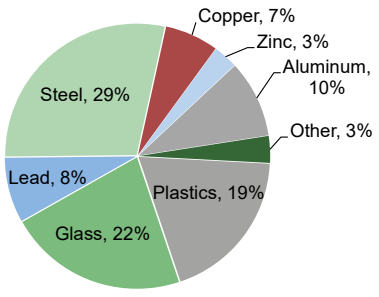
Energy and Environmental Impact

- Electricity used for U.S. servers and data centers emits 28.4 million metric tons (Mt) CO_2e annually.[2,14]
- Computer electricity consumption varies greatly with age, hardware, and user habits. An average desktop computer requires 66 W when idle and 1.9 W in sleep mode. Laptops require less power on average - 33 W when idle and 1.0 W in sleep mode.[15]
- A 17" light emitting diode (LED) LCD monitor uses about 13 W while on, 0.4 W in standby, and about 0.3 W when off.[16]
- Every kWh used by office equipment requires an additional 0.2-0.5 kWh for air conditioning.[17]
- The life cycle energy burden of a typical computer used for 3 years is 4,222 kWh. Only 34% of a computer's life cycle energy consumption occurs in the 3-year use phase. Production dominates life cycle energy due to the high energy costs of semiconductors and short use phase.[18]
- Manufacturing represents 60-85% of life cycle energy demand for a personal computer and 50-60% for mobile phones. Remanufacturing energy is a fraction of manufacturing energy: 5-30% for personal computers and 5% for mobile phones.[19]
- Some emerging technologies can reduce manufacturing burdens. Globally, 3D printing has the potential to reduce total primary energy use by 2.5-9.3 EJ and CO_2 emissions by 131-526 Mt by 2025.[20]

Electronic Waste

- In 2019, approximately 54 Mt of e-waste were generated worldwide—only 17% was recycled properly.[22]
- U.S. federal regulations currently allow the export of e-waste, posing a global threat to human health.[23,24] An estimated 5-30% of the 40 million computers used in the U.S. were exported to developing countries in 2010.[25] In 2016, Basel Action Network found that 34% of the e-waste tracked by GPS trackers in the U.S. moved offshore, almost all to developing countries.[26]
- In 2018, the U.S. disposed of 2.7 million U.S. short tons of consumer electronics such as TVs, computer equipment, and telephones, 38.5% of which were recycled.[27]
- The main constituents of printed circuit boards used in mobile electronics are polymers and copper, with trace amounts of precious metals Ag, Au, and Pd, and toxic metals As, Be, Cr, and Pb.[28]
- One metric ton of printed circuit boards has a higher concentration of precious metals than one metric ton of mined ore.[29]

Composition of a Desktop Computer[21]



Paper Industry

- After slow growth from 2014 to 2017, paper production decreased by 2% globally in 2018, and decreased by 3% in North America.[30] Annual consumption of printing and writing paper is expected to rise from 109 to 274 Mt between 2006 and 2060.[31]
- The U.S. accounts for approximately 18% of global printing and writing paper consumption.[30]

- Depending on the process, producing one ton of paper consumes 12 to 24 trees.[32]
- In 2021, greenhouse gas emissions of the U.S. pulp and paper manufacturing industry were 35 Mt CO_2e, approximately equivalent to the annual carbon sequestered by 42 million acres of U.S. forests.[33,34]

Sustainable Alternatives

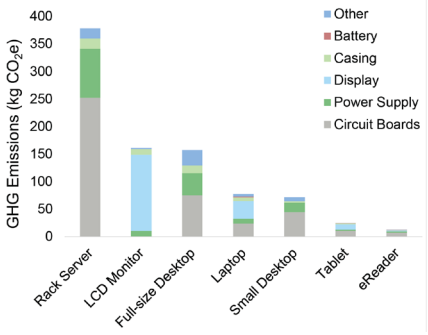
Technology

- Virtualization enables one physical server to run many independent programs and/or operating systems.[35] This technology reduces the number of physical servers needed and promotes greater utilization of each server. With virtualization, each machine can run at 80% capacity rather than 10%.[36] Virtualization reduces cost, material waste, electricity use, server sprawl, and cooling loads, saving money while reducing the environmental burdens of running a data center.[35]
- Data center energy efficiency can be improved by utilizing combined heat and power systems. Heat recovered from electricity generation in the form of steam or hot water can be used by an on-site chiller to cool the data center.[37]
- Telecommuting or working from home, in which employees work remotely, is becoming more common. Studies suggest energy savings as a result of decreased commuting transportation. When examining the broader energy system impacts, however, increased energy use at home for IT, lighting, and heating/cooling partially offsets the transportation energy savings.[38]

Reduce Energy Consumption

- Office equipment energy consumption could be reduced by 23% if all office equipment had and utilized low-power mode. If all desktop computers and printers were turned off for the night, energy consumption would be further reduced by 9%.[39]
- Energy Star certified computer servers are, on average, 30% more energy efficient than standard servers. If all servers in the U.S. met Energy Star standards, $1 billion in energy would be saved and 8.2 Mt of GHG emissions would be avoided per year.[41]
- Energy consumed by devices in standby mode accounts for 5-10% of residential energy use. Unplug electronic devices when not in use, or plug them into a power strip and turn that off.[42] Turning off a computer when it is not in use can save $50, 505 kWh, and 433 lbs of CO_2 per computer annually.[14, 43]
- When leaving computers on, EPA recommends setting computer monitors to go to sleep after 5-20 minutes of inactivity, and for desktop computers to enter standby after 30-60 minutes.[44]

Embodied Greenhouse Gas Emissions: Computing and Electronics Products[40]



Take Action

- Make informed purchases. Energy Star's Excel-based calculators estimate energy and cost savings for office equipment, appliances, electronics, and lighting.[45] The Green Electronics Council's Electronic Product Environmental Assessment Tool (EPEAT) rates and verifies the environmental impacts of computer products across multiple criteria, including energy efficiency, GHG emissions reduction, and recyclability.[46]
- Purchase Energy Star certified products, consolidate multiple devices into all-in-one equipment, and turn off devices when not in use.[47]
- The average American generates 410 pounds of paper waste each year, and 45% of printed paper in offices is discarded by the end of the day. Save resources by not printing or, when a paper version is necessary, by printing double-sided on recycled paper.[48,49,50]
- Extend the life of personal computers to delay the energy and materials burdens associated with making new equipment.[18]
- Maximize the life of batteries with these practices: minimize exposure to extreme hot and cold temperatures and time spent at both 0% and 100% charge; avoid fast charging, discharging faster than required, use in high moisture environments, and mechanical damage; and follow manufacturer calibration instructions.[51]
- Recycle your unused electronics. Responsible Recycling (R2) and e-Stewards offer third-party certification for electronics recyclers to ensure the proper disposal of used electronics.[52]

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