# Information Technology

Information and communication technology (ICT) includes personal and business computers, smartphones, data centers, connectivity networks, and emerging technologies such as artificial intelligence (AI) and cryptocurrency. See AI Factsheet. As the sector expands, its growing energy and water use poses challenges to meeting global climate goals.[1]

## Patterns of Use

- In 2023, 5.4B people (67% of the world's population) were online, a 45% increase since 2018.[2]

- In 2021, 90% of U.S. households had a smartphone, 81% owned a desktop or laptop, 64% had a tablet, and 90% subscribed to broadband internet.[7] Globally, more people have mobile phones than access to safe sanitation.[5]

- Global smartphone sales peaked at 1.6B units in 2018 and decreased to 1.3B units by 2023.[4]

- In 2022, global sales of mobile phones, tablets, and PCs totaled 1.8B units, a 12% decline from 2021.[3] AI PC shipments, however, are projected to total 114M, up 166% from 2024, and reach 43% of total PC market share in 2025.[10]

- 33% of global data centers are located in the U.S., 16% in Europe, and 10% in China.[8] Virginia, Texas, and California accounted for 43% of 2023 U.S. data center load.[9] Electricity demand increased by 14 TWh in Virginia and 13 TWh in Texas, across the other 40 states it fell by 28 TWh.[11]

- From 2021 to 2024, data centers and telecom networks accounted for 13% of electricity demand growth in the buildings sector and 4% of global electricity demand. Data centers alone made up 3%[11] and are expected to drive an increase in summer peak electricity load from 151 GW to 178 GW by 2034.[8]

- Data center electricity demand is 40% from computing, 40% from cooling, and 20% from other IT equipment.[8] Power Usage Effectiveness (PUE) quantifies data center energy efficiency by dividing total facility energy use by the energy used solely for IT equipment. The U.S. average annual PUE declined from 2.5 in 2007 to 1.6 in 2023.[9]

## Energy and Environmental Impact

- Computer electricity use varies by age, hardware, and user habits. Desktops use 65–250 W per hour active and 1–6 W in sleep mode. Laptops use 20–50 W when active.[13] An LCD monitor uses 20-40 W per hour on, and 2 W in standby.[11]

- Each ChatGPT request uses 2.9 Wh of electricity, while a standard Google search uses 0.3 Wh.[12]

- Over a 3-year lifespan, a typical computer uses 4,222 kWh of energy, with 34% from the use phase.[15]

Estimated Electricity Use Per Request (Wh/request)[12]
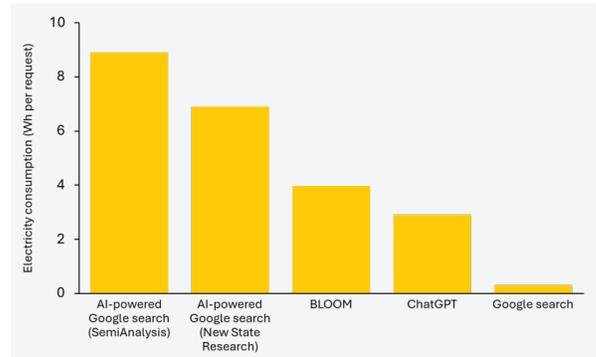


- A desktop system has a carbon footprint of 679 kg $CO_2$e while a laptop's is 286 kg $CO_2$e, with over 75% from production. End-of-life disposal contributes less than 1% of total GHG emissions for both.[26]

- In 2022, the ICT sector used 1,183 TWh of electricity, up 8.2% from 2020, driven by data centers.[1] Data centers used 240-340 TWh of electricity, 1.3% of the global total,[17] while cryptocurrency mining used 67-240 TWh.[18]

- The ICT sector's global carbon emissions were 567 Mt $CO_2$e in 2022, 1.7% of the world total.[1] Cryptocurrency mining emitted 90 Mt $CO_2$e in 2024.[19] Electricity used for AI, cryptocurrency, and data centers could exceed 1000 TWh by 2026.[8]

- In 2023, U.S. data centers used 150 TWh of electricity, equivalent to the annual use of 14M households.[9] This results in 57 Mt $CO_2$e emissions annually, 0.9% of the U.S. total.[9, 20, 21]

- Data centers used 26% of Virginia's electricity in 2023, the highest among U.S. states.[9]

- Data centers are among the top-ten commercial/industrial U.S. water users. Their operational water footprint in 2018 was 136B gal/yr, with 75% from electricity and 25% from onsite use. One-fifth of onsite use occurs in water stressed regions, nearly half of data centers use electricity from these regions.[25]

- Between 2019 and 2023, Google's carbon emissions rose nearly 50%,[23] while Microsoft's grew 25% since 2020[24] — largely due to data center expansion.[22]

- Electricity use by telecom operators rose 7% from 2020 to 2022, reaching 258 TWh. Due to cleaner energy grids, this increase did not result in a proportional rise in emissions.[1]

GHG Emissions for Electronic Products (Mt $CO_2$e)[56]
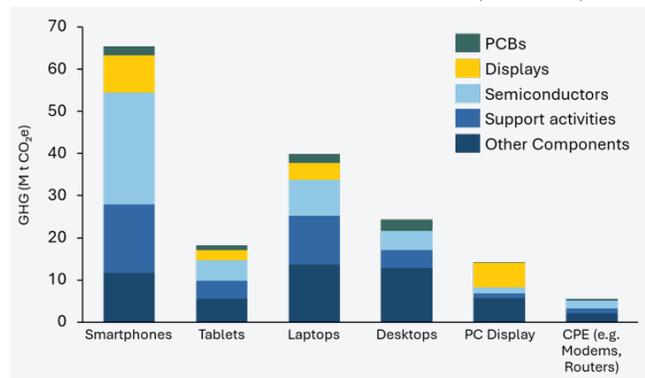
## ICT Sector GHG Emissions and Electricity Use[1]

| Industry | Emissions (million tCO$_2$e) | | | | Electricity (TWh) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2020 | 2021 | 2022 | 2020 - 2022 % Change | 2020 | 2021 | 2022 | 2020 - 2022 % Change |
| Telecommunications operators | 135 | 134 | 133 | -1% | 239 | 255 | 258 | 8% |
| Data Centers | 58 | 67 | 75 | 29% | 143 | 170 | 194 | 36% |
| ICT Equipment | 154 | 173 | 154 | 0.5% | 282 | 329 | 311 | 10.6% |
| Product use | 222 | 215 | 205 | -7.5% | 430 | 442 | 430 | -0.1% |
| Total | 568 | 589 | 567 | -0.2% | 1,094 | 1,196 | 1,183 | 8.2% |

*Data centers include Colocation, and Cloud & content data centers reported by companies.
*ICT Equipment refers to the manufacturing of PCs, smartphones and network equipments.
*Product use is the use phase of PCs and smartphones.

## Electronic Waste

- In 2022, 62 Mt of e-waste was generated globally, equivalent to 1.55M 40-t trucks. Only 22% was recycled. Global e-waste is projected to increase to 82 Mt by 2030.[28]

- In 2022, 800M kg of uncontrolled e-waste and used electronics were exported to developing countries. The Americas, primarily the U.S., were responsible for 388M kg of these exports.[28]

- The U.S. generated 7.2 Mt of e-waste in 2022, 56% was recycled.[28] Up to 29% of the 40M computers retired in the U.S. were exported in 2010.[29]

- Printed circuit boards used in mobile electronics are made of polymers and copper, with trace amounts of precious metals Ag, Au, and Pd, and toxic metals As, Be, Cr, and Pb.[32]

- 1 t of printed circuit boards has more precious metals than 1 t of mined ore.[33]

## Material Composition of a Desktop Computer[55]



Ferrous Metal, 59%
PCB, 14%
Plastic, 12%
Aluminum, 11%
Copper, 4%

## Paper Industry

- In 2023, global paper and paperboard production fell slightly from 413 Mt in 2022 to 400 Mt. China is the largest producer, accounting for 33% of the world total, followed by the U.S. with 15% of world total, or 61 Mt, a 19% decline from 2012.[34]

- Global paper use has grown by 400% over the past 40 years. Packaging accounts for the largest share.[27,30]

- China and the U.S. together accounted for nearly half of global paper and paperboard use in 2023.[35] The U.S. alone uses 30% of the global paper supply.[30]

- Producing 1 t of paper uses 12 to 24 trees.[37]

- In 2023, GHG emissions of the U.S. pulp and paper industry were 32 Mt CO$_2$e,[38] equivalent to the annual carbon sequestered by 32M acres of U.S. forests.[39]

# Sustainable Alternatives

## Technology

- AI supports sustainability through energy and resource optimization, grid management, disaster response, climate modeling, and ecological forecasting.[40] Optimization could cut the carbon footprint of AI training by up to 75%.[36]

- Virtualization enables one physical server to run multiple programs or operating systems,[41] reducing the number of servers needed and improving utilization,[42] cutting data center costs and environmental impact.[43]

- Data center efficiency can be improved using combined heat and power systems. Waste heat from electricity generation can be repurposed by on-site chillers to cool the facility.[44]

- 3D printing could cut global energy use by 5–27% by 2050.[45]

- Telecommuting (working from home) reduces transportation-related energy use, though some gains are offset by increased home energy demand.[46] This has resulted in a 13% reduction in work-related energy use and a 14% reduction in GHG emissions in response to COVID in 2020 across the U.S.[47]

## Take Action

- The ICT sector accounted for 60% of renewable power purchases in 2021.[1]

- Choose Energy Star certified devices and use The Electronic Product Environmental Assessment Tool ratings to assess environmental impacts. If all U.S. servers met Energy Star standards, $1B in energy costs and 8.2 Mt of GHG emissions would be avoided yearly.[48]

- Devices in standby mode account 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.[49] Turning off an idle desktop can save 675 kWh (an average of $90), and 520 lbs of CO$_2$e annually.[13,20, 50]

- Use power management features—sleep mode can save up to $30 a year, reduce heat, and extend device lifespan. The U.S. Department of Energy recommends enabling sleep mode after 20 minutes of inactivity and powering down after 2 hours of inactivity.[51]

- Avoid unnecessary printing and print double-sided on recycled paper if necessary.[52]

- Extend the life of personal computers to delay the energy and materials burdens associated with making new equipment.[15]

- To prolong battery life, avoid extreme temperatures, fast charging/discharging, and time spent at 0% or 100% charge.[53]

- 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.[54]