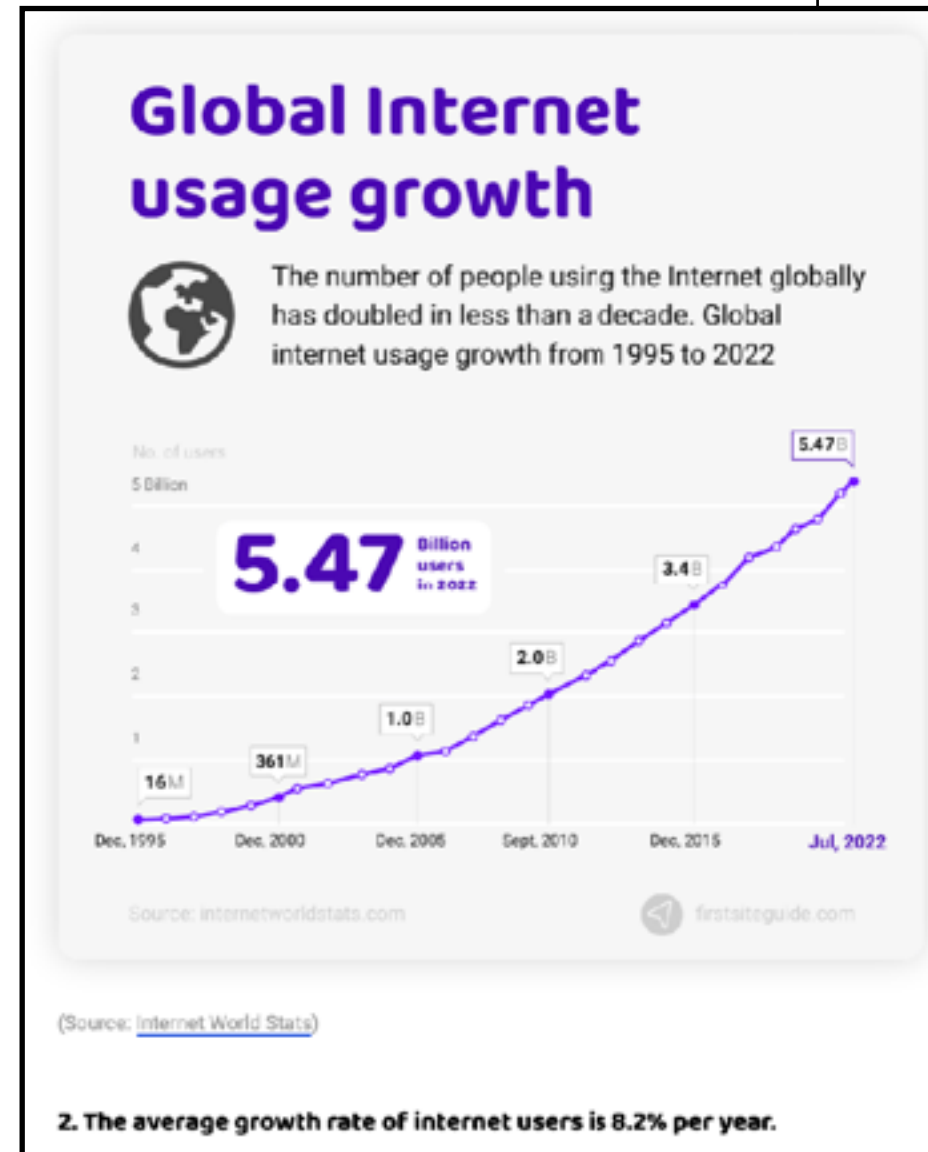


Best Current Practices for Reducing Environmental Impact of Internet Infrastructure

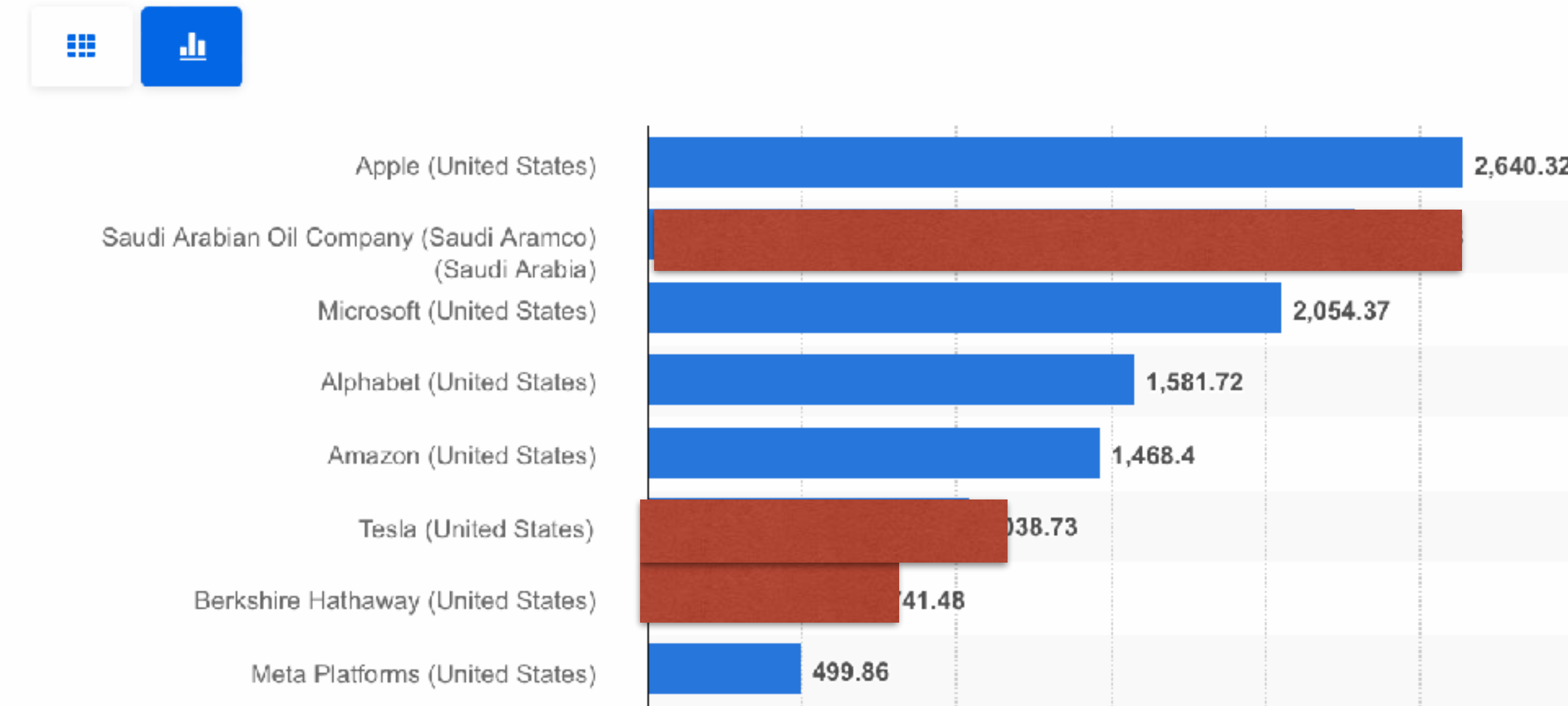
Draft, August 2023

ICT: Wealth, Growth, Emissions

Source: <https://www.statista.com/statistics/263264/top-companies-in-the-world-by-market-capitalization/>



The 100 largest companies in the world by market capitalization in 2022 (in billion U.S. dollars)



Global trends in digital and energy indicators, 2015-2021

	2015	2021	Change
Internet users	3 billion	4.9 billion	+60%
Internet traffic	0.6 ZB	3.4 ZB	+440%
Data centre workloads	180 million	650 million	+260%
Data centre energy use (excluding crypto)	200 TWh	220-320 TWh	+10-60%
Crypto mining energy use	4 TWh	100-140 TWh	+2 300-3 300%
Data transmission network energy use	220 TWh	260-340 TWh	+20-60%

Source: <https://www.iea.org/reports/data-centres-and-data-transmission-networks>



e-impact workshop

- **IAB Workshop: December 2022** : <https://www.iab.org/activities/workshops/e-impact/>
 - 30 papers 40 presentations and 50 knowledgeable & opinionated participants
 - Vesna's [report \(December 2002\)](#); Draft IAB [report](#): February 2023; IETF 116: March 2023 ([minutes](#))
- **Goals**
 - *“Full understanding of Internet's environmental impact*
 - *Continuous improvement of our technology.*
 - *Launching research relevant activities”*
- **Future: IETF 118 (Prague); RIPE87 (Rome)**
 - *Discussion list: <https://www.ietf.org/mailman/listinfo/e-impact>*

IETF Recommendations*

- For the corporations & communities:
- **reduce by 7.6% / year on all metrics** (emissions, materials, water, energy...)
- **Create NZE-WG**
- **“Net Zero Emissions” Working Group**
- **Add “Sustainability Considerations” section to every ietf-draft, RFC, BCP**

** personal opinion*

What should we not do?

- Use systems that are energy inefficient
 - Proof of work, old hardware, inefficient algorithms and protocols (computation a
- Use bad energy sources
 - Fossil fuels
 - Energy sources that are not green, renewable, clean....
 - Large greenhouse gas emissions and air pollution
- Luxury consumerism
- Systems that produce a lot of non-recyclable e-waste
- Systems with wasteful over-consumption of water, land, minerals
- Digital colonialism
 - Use of resources, export of e-waste for “recycling”
- Predatory systems that have a negative impact on society
 - Crypto-assets
- Use nonsense numbers that do not add up
- Send too many ACKs.
- Fly, use ICT systems instead

International Reduction Goals

- International Energy Agency: “align ICT with climate-based targets”
 - <https://www.iea.org/reports/data-centres-and-data-transmission-networks>
- **Setting the NZE targets!** <https://sciencebasedtargets.org/net-zero/>
- ITU in 2020: “reduce ICT GHG emissions by 45% by 2030”
 - <https://www.itu.int/en/mediacentre/Pages/PR04-2020-ICT-industry-to-reduce-greenhouse-gas-emissions-by-45-percent-by-2030.aspx>
 - <https://www.itu.int/rec/T-REC-L/en>

Operational BCP

- Kubernetes Efficient Power Level Exporter (Kepler) <https://sustainable-computing.io/>
- Carbon-neutral self-hosting & software development: <https://codeberg.org/Codeberg/Community/issues/856>
- Environmental sustainability at GitHub <https://github.blog/2021-04-22-environmental-sustainability-github/>
- Orange: Deep Sleep Mode for WiFi : slashes gateway power consumption to under 1W: “Sustainability in Broadband” webinar: <https://app.livestorm.co/rethink-technology-research/faultline-webinar-series-2023-or-sustainability-in-broadband?type=detailed>

Networking BCP

- SubSea Cables Sustainability Map <https://suboptic.org/page/sustainability-map>
- Carbon-Intelligent Global Routing in Path-Aware Networks
 - https://netsec.ethz.ch/publications/papers/green_routing2023.pdf
- Green OSPF <https://www.sciencedirect.com/science/article/abs/pii/S1084804516300662>
- Optimizing Power Consumption in High-End Routers (Juniper)
 - <https://www.linkedin.com/pulse/optimizing-power-consumption-high-end-routers-sharada-yeluri/>
- High Bandwidth Router Power Consumption & Cisco 8800 Power Provisioning
 - <https://xrdocs.io/8000/blogs/cisco-8800-power-provisioning/>

Regulatory BCP

- Redirecting Technologies for the Deep Sustainability Transformation, TU Berlin
 - <https://doi.org/10.14279/depositonce-16187.2>
 - <https://digitalization-for-sustainability.com/digital-reset/>
- A Telco Sustainability Reality Check: December 2022
 - <https://go.abiresearch.com/lp-telco-sustainability-reality-check>
 - human-centered decision-making will continue to evaluate the challenges and opportunities of addressing the climate crisis, working together with technology to drive reductions of global carbon emissions, water use, and waste.

Measuring Telcos' Sustainability

- “Ranking of ten leading telecom operators for sustainability.” : Sustainability Index by ABI Research (Q1 2022)
 - <https://www.abiresearch.com/press/deutsche-telekom-telefonica-vodafone-and-kpn-are-leaders-in-abi-researchs-telco-operators-sustainability-index/>
- “How five of the world’s biggest telecom operators deal with their greenhouse gas emissions” (February 2023) * AT&T, Verizon, NTT, China Mobile and Deutsche Telekom.
 - <https://telecoms.com/opinion/how-five-of-the-worlds-biggest-operators-deal-with-their-greenhouse-gas-emissions/>
- Carbon reporting regulations are rising. Small businesses need to keep up.
 - <https://app.wedonthavetime.org/posts/5fa28ad9-11b7-47e9-9926-913ff1f915ab>

Measuring Networking Emissions

- Green Networking Metrics <https://datatracker.ietf.org/doc/html/draft-cx-green-metrics>
- Quantum Internet hackathon 2022: measuring sustainability <https://github.com/becha42/ClimateJustice/blob/main/ReportHackathon2022.md>
- “Big business climate pledges must be measured” (audited)
 - <https://genevasolutions.news/climate-environment/peter-bakker-big-business-climate-pledges-must-be-measured>

Reducing Use & Emissions of Devices

- "The Rare Metals War: The Dark Side of Clean Energy and Digital Technologies", Guillaume Pitron <https://www.nhbs.com/the-rare-metals-war-book>
- "An Ontology Of Electronic Waste" Maurits Fennis
 - <https://theanarchistlibrary.org/library/an-ontology-of-electronic-waste>
- Prefer: https://en.wikipedia.org/wiki/Low-power_electronics
- (reducing) Emissions From Computing Onboard Autonomous Vehicles <https://ieeexplore.ieee.org/document/9942310>

Political Demands for Digitalisation & DeGrowth

Three requirements must be met for digitalisation to work for sustainability:

- The social and environmental impacts of producing and operating **digital devices, infrastructures and data centres** must be reduced. To make a difference in the short term, this report presents a combined strategy for digital sufficiency, repairability, circularity, and efficiency.
- The growth-oriented **business models of Big Tech companies** must be controlled and eventually replaced by business models that are oriented towards the common good. This report points out three policy pathways that can initiate this transition.
- The governance of **data and artificial intelligence** needs to actively pursue an information-based circular economy. This report shows which new institutions are required, and which policies can put data and AI in the service of sustainability.

<https://digitalization-for-sustainability.com/digital-reset/>

Political Demands, Bits & Bäume 2022

1. Digitisation within the planetary boundaries
2. Global justice and regional self-determination
3. Redistribution of technological design power, democracy and participation
4. Fair digitisation, sustainable technology design and social issues
5. Protection of digital infrastructure and IT security

<https://bits-und-baeume.org/konferenz-2022/forderungen/#heading>

Conclusions

- We are in an environmental emergency!
- As networkers community, we must focus on immediate actions!
 - decreasing material & energy consumption
 - reduce GHG emissions
 - decelerate growth
- Let's build the Internet for the future: within planetary boundaries.