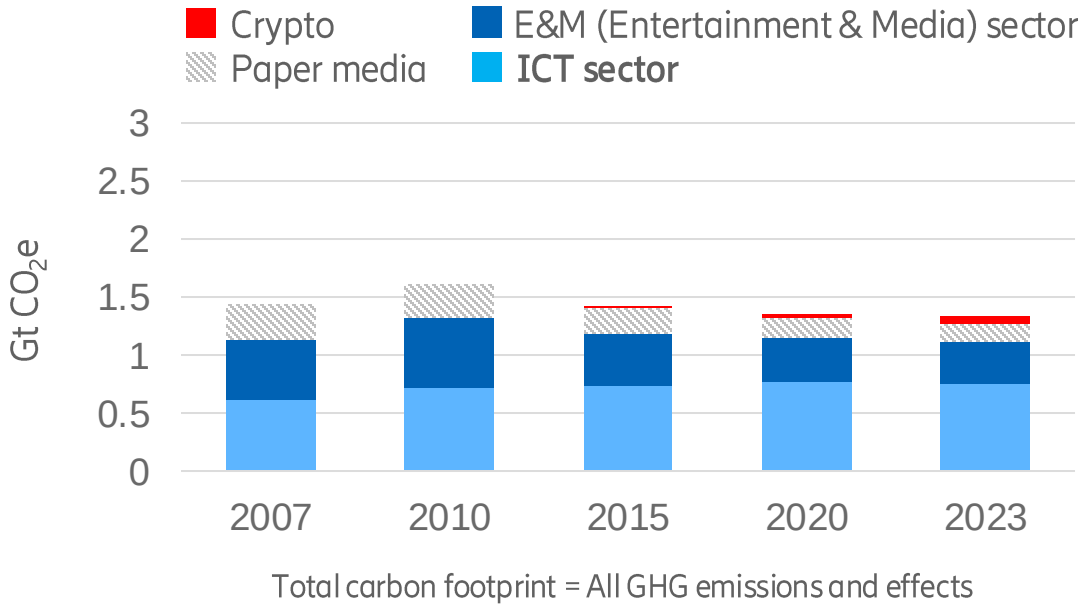
ICT and E&M Sector Energy and Carbon Footprint Globally – Latest Research and Forecasts

Jens Malmodin
Ericsson Research

ETSI and ITU Symposium on ICT Sustainability: Standards Driving Environmental Innovation
Session 6: The Power of Transparency: Reporting Environmental Impact for Climate Action in ICTs
Geneva, Switzerland, 11-12 December 2024

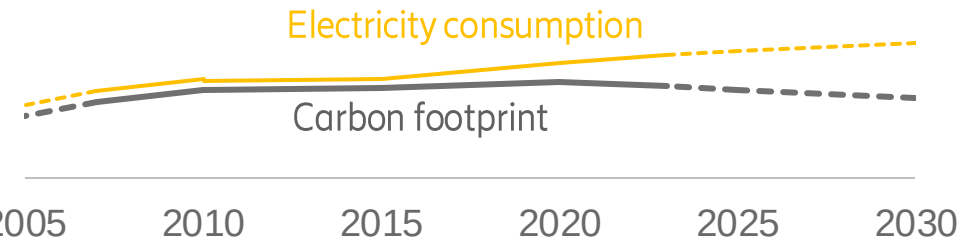
ICT / "Digital Tech" total carbon footprint

ICT = Information & Communication Technology



Total carbon footprint = All GHG emissions and effects

ICT sector history and forecast to 2030



Ericsson / Telia Research papers:

2010:
Greenhouse gas emissions and operational electricity use in the ICT and Entertainment & media sectors (2007)

2013:
The future carbon footprint of the ICT and E&M sectors (2010, forecast to 2020)

2018:
The Energy and Carbon Footprint of the Global ICT and E&M Sectors 2010-2015 (2015, forecast to 2020)

2023 (only Ericsson):
Assessing embodied carbon emissions of communication user devices by combining approaches (2020)

2023:
ICT sector electricity consumption and greenhouse gas emissions – 2020 outcome (2020)

2024 (only Ericsson):
ICT sector development 2007–2023 and forecast to 2030 (2030)
Published in Ericsson Mobility Report, November 2024 (no research paper)

Publication year (year studied and forecast to year)

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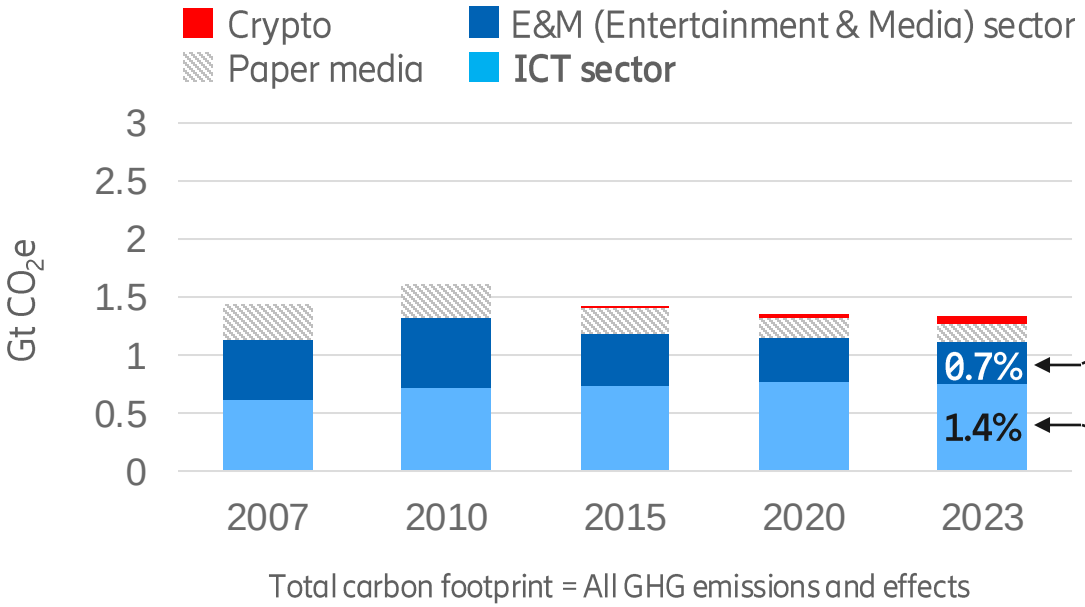

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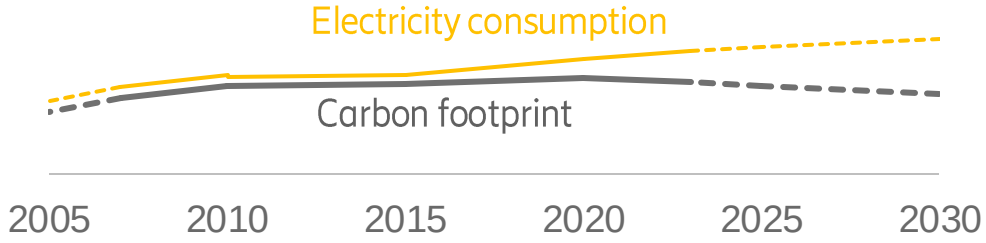
E&M sector (0.7% of global GHG)
~2.1 billion TVs used for many hours every day

ICT sector (1.4% of global GHG)
~8.5 billion mobile subscriptions used for many hours every day
~2.5 billion PCs and tablets used for many hours every day
~1.4 billion fixed broadband lines

ICT sector history and forecast to 2030



Electricity consumption forecast: Slowly increasing

Carbon footprint forecast: Slowly decreasing due to more renewables

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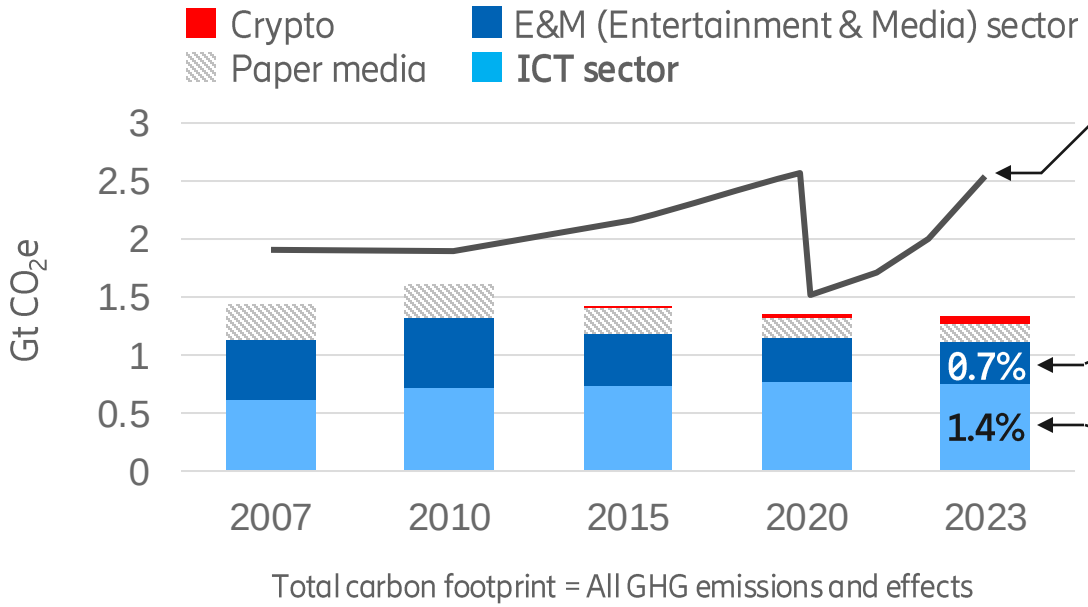

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Aviation sector (4.7% of global GHG)
~75% is air travel (3.5% of global GHG)
~1% of humans do ~12 trips per year
~10% of humans do ~1 trip per year
Most humans (nearly 90%) simply do not fly

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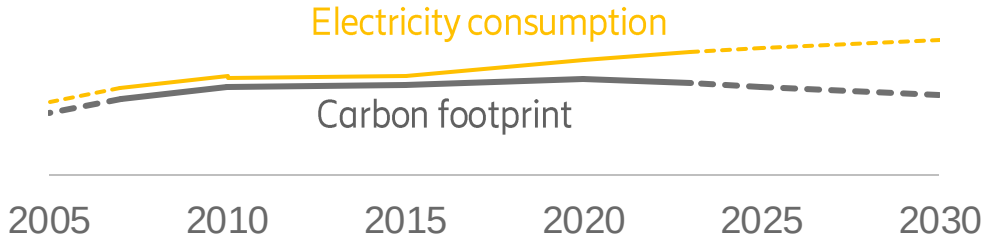

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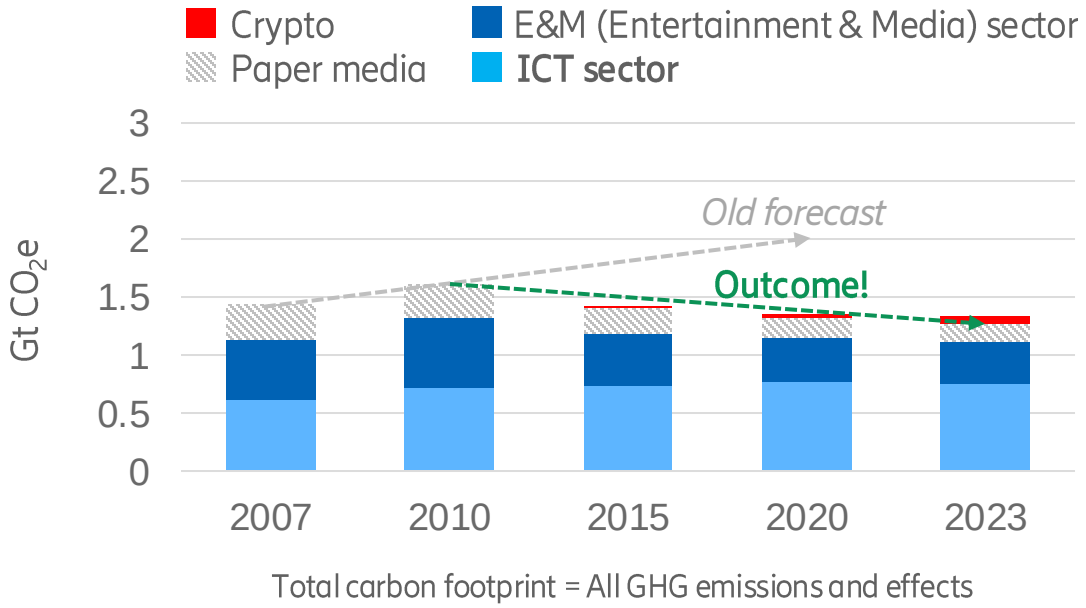

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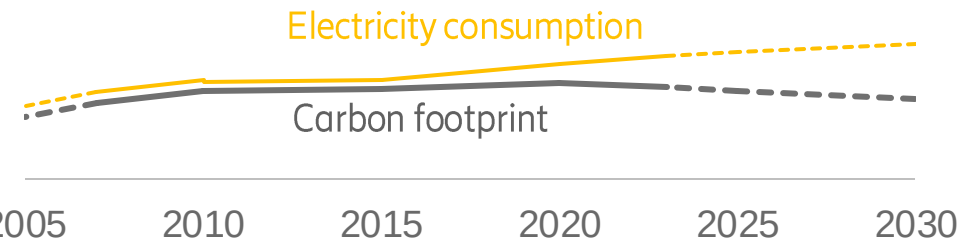

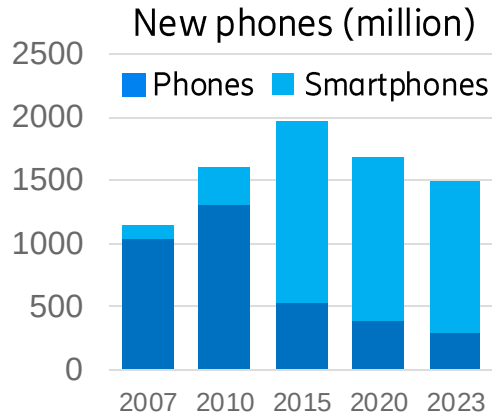

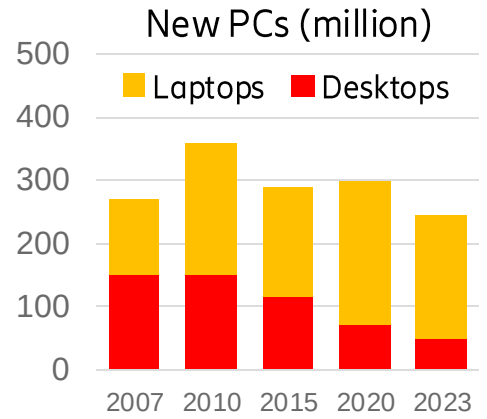

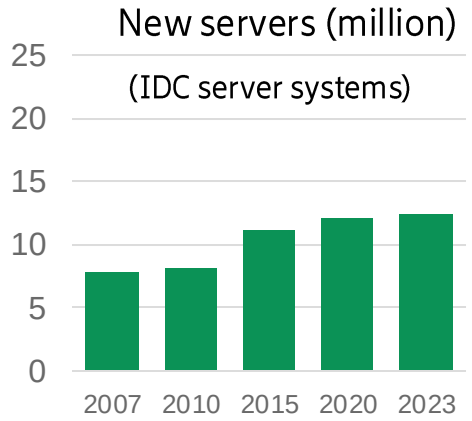

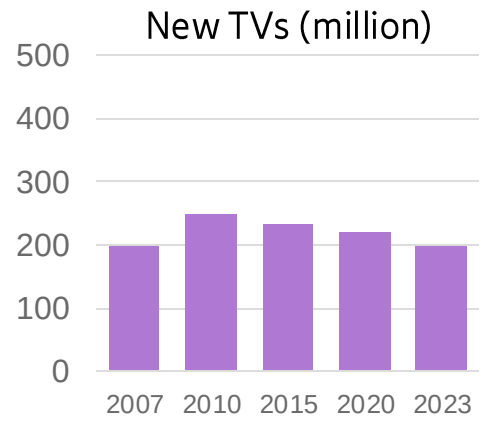

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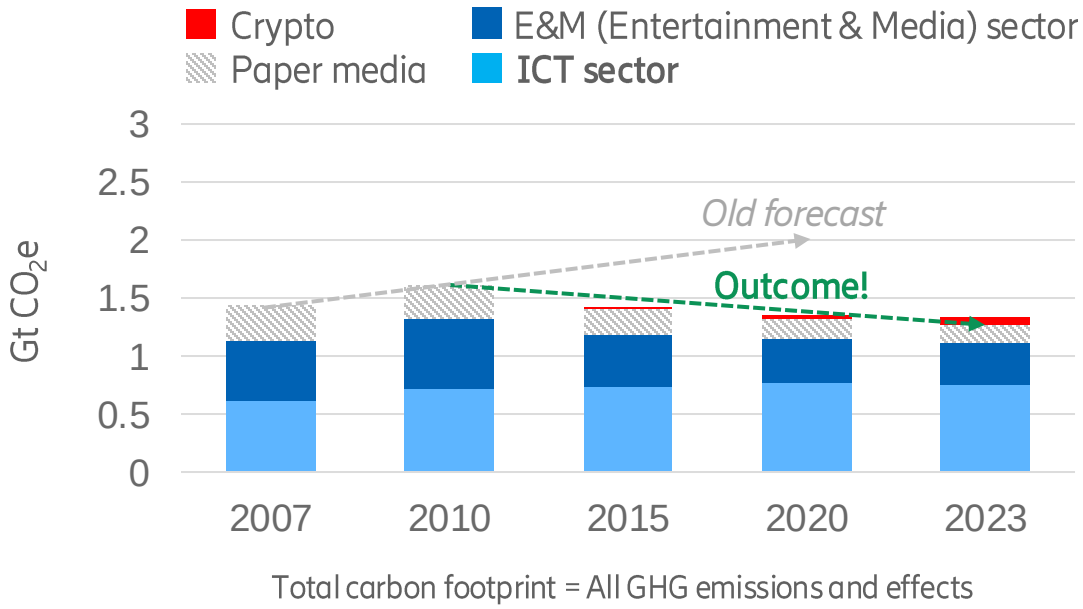

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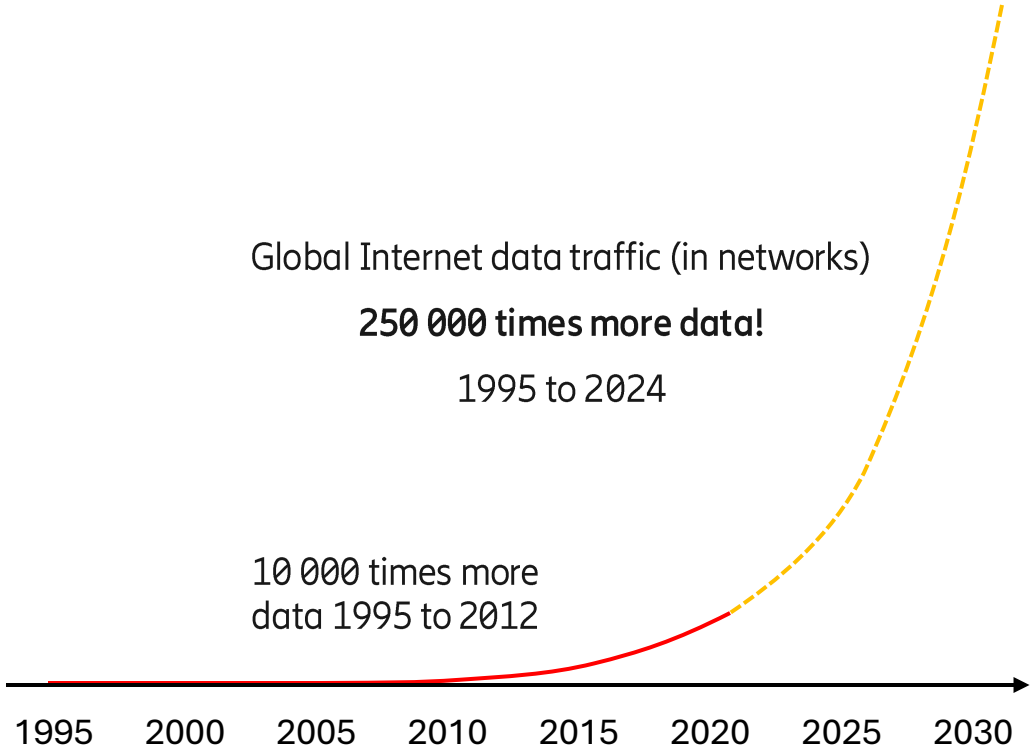

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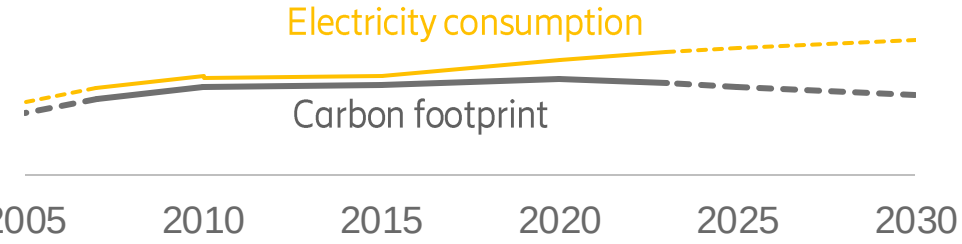

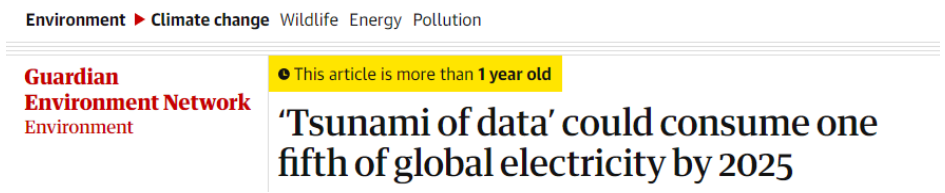
Environment ▸ Climate change Wildlife Energy Pollution

Guardian Environment Network
Environment

This article is more than 1 year old

'Tsunami of data' could consume one fifth of global electricity by 2025

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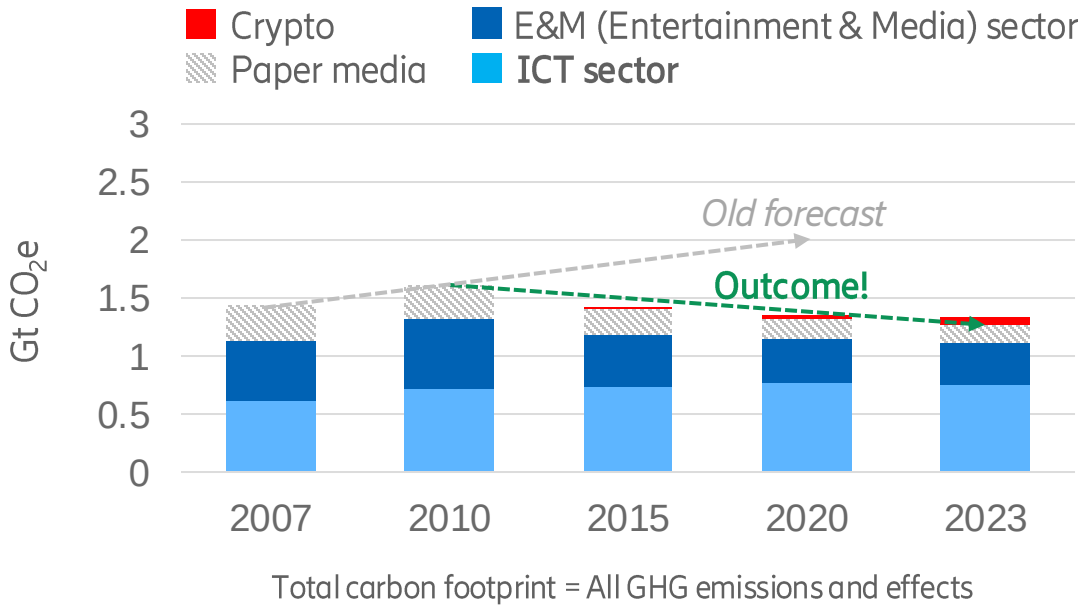

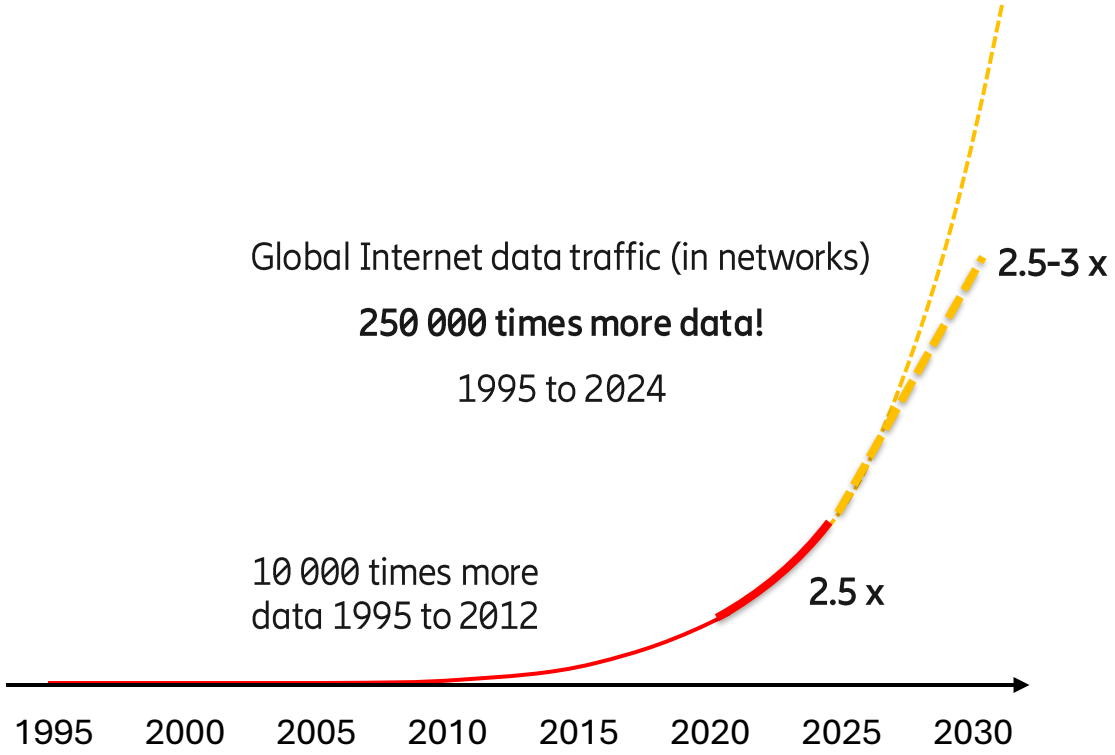

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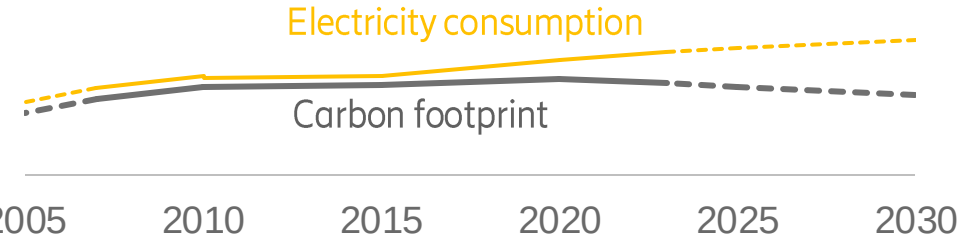

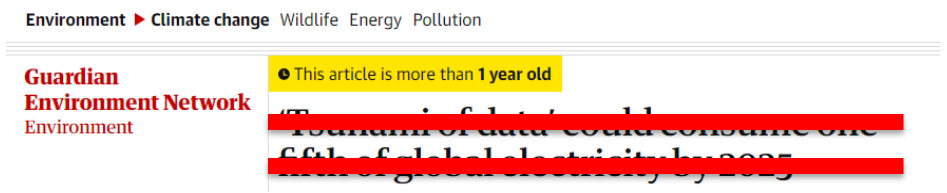

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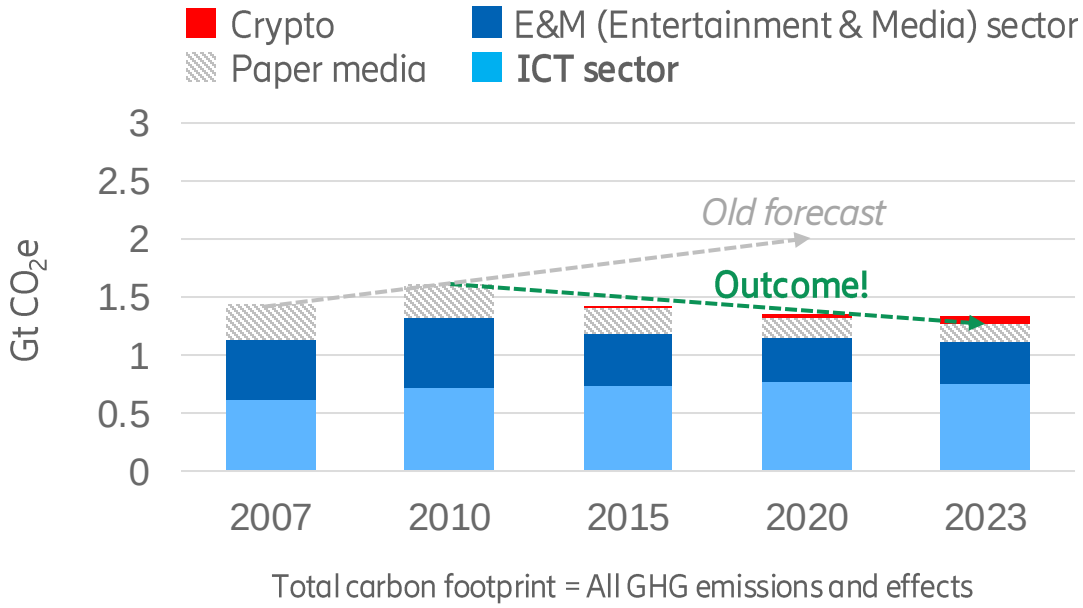

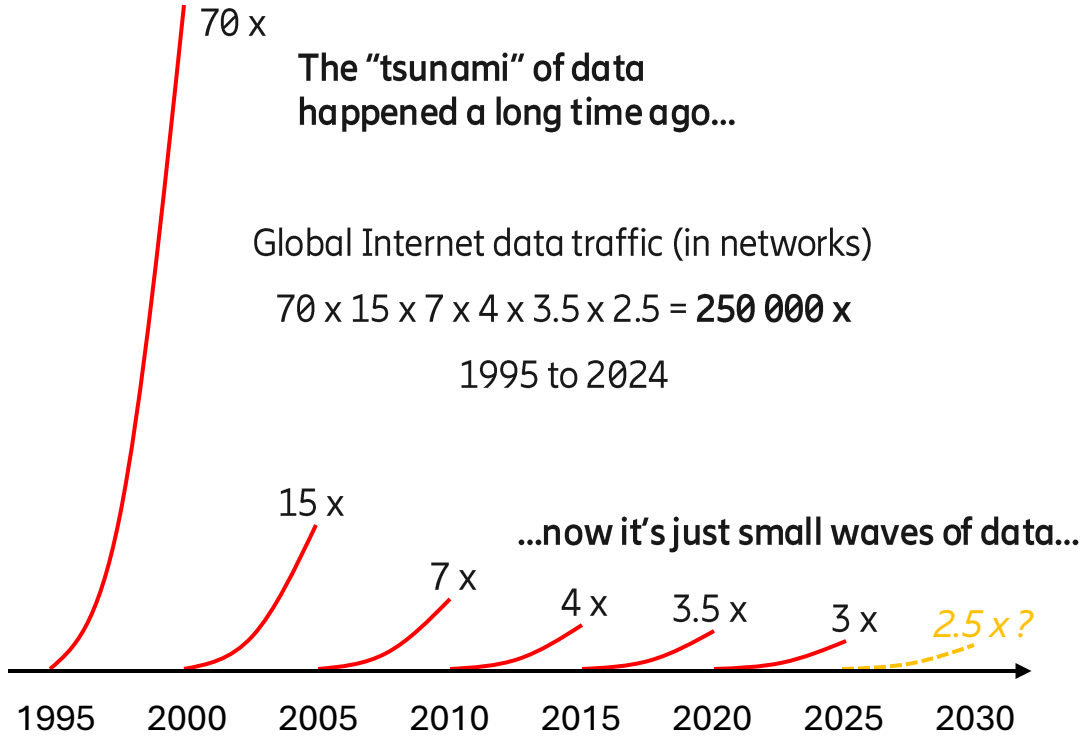

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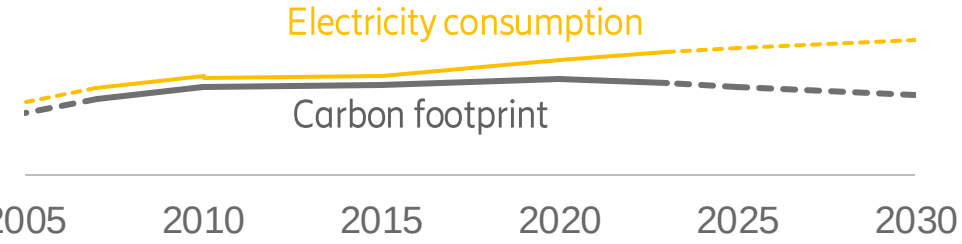

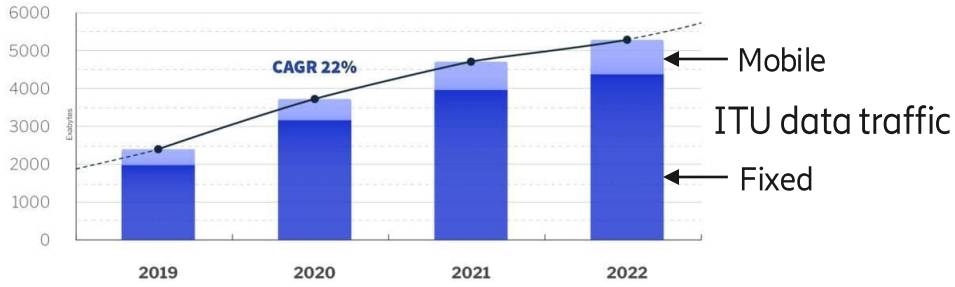

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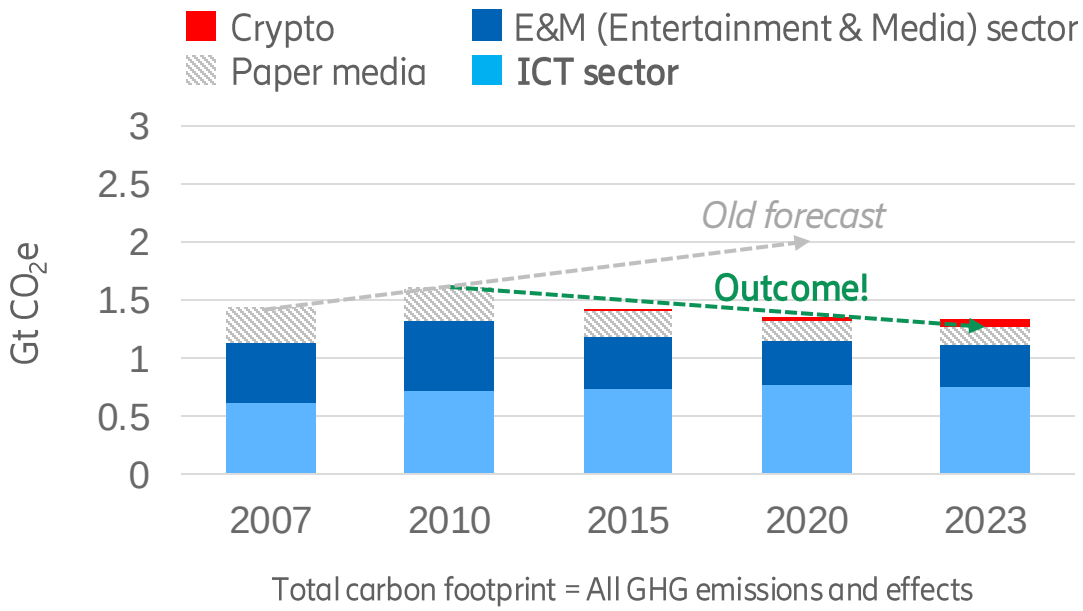

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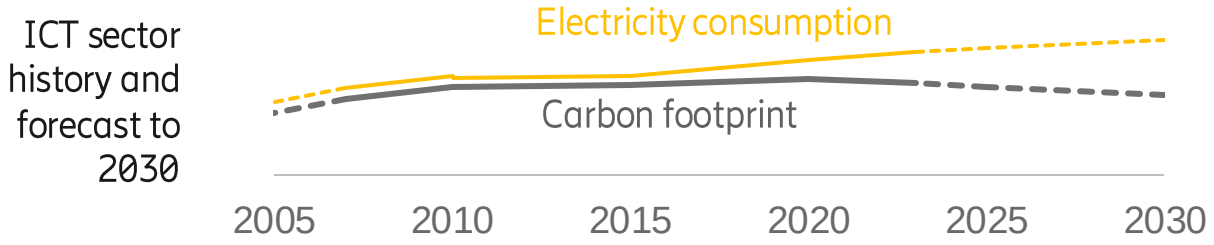
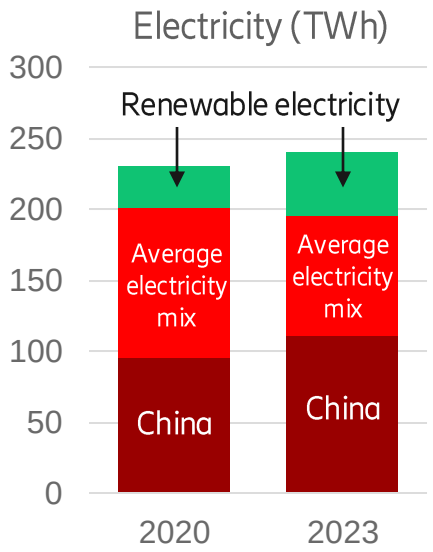


Real company data is key

Network operators

63 network operators
~75% of mobile/fixed subs

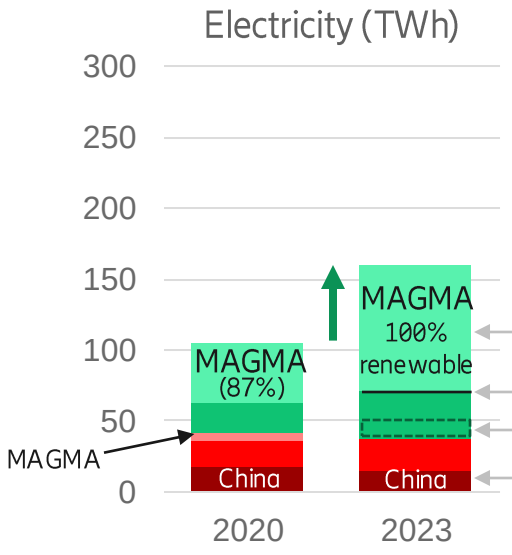
China Mobile:	61.1 TWh
China Telecom:	27.2 TWh
China Unicom:	22.5 TWh
AT&T*:	13.2 TWh
DT/T-Mobile*:	11.3 TWh
Verizon*:	10.2 TWh



Data center companies

36 data center companies
>90% of Internet data

Amazon (AWS est.):	~25.5 TWh
Google:	25.3 TWh
Microsoft:	23.6 TWh
Meta:	15.3 TWh
Digital Realty:	11.0 TWh
Equinix:	8.2 TWh



* 2022 or 2022/2023 report, 2023 report not published yet

MAGMA = Microsoft, Amazon, Google, Meta, Apple

- About 35% of total data center electricity
- About 50% of total Internet data traffic
- About 30% of all new servers 2018 – 2020
- About 40% of all new servers in H1 2021
- About 80% of all new AI GPUs in 2023
- AI GPUs in 2024 is "~6%" (~16 TWh) MS/Google estimate

Netflix (incl. use of AWS) and Akamai

- About 0.5% of total data center electricity
- About 30% of total Internet data traffic

China data centers

- Alibaba, Tencent, GDS, Chindata, and 6 other large DC companies in China report 28 TWh in 2022/2023
- Chinese operators have also large DCs (~10 TWh)

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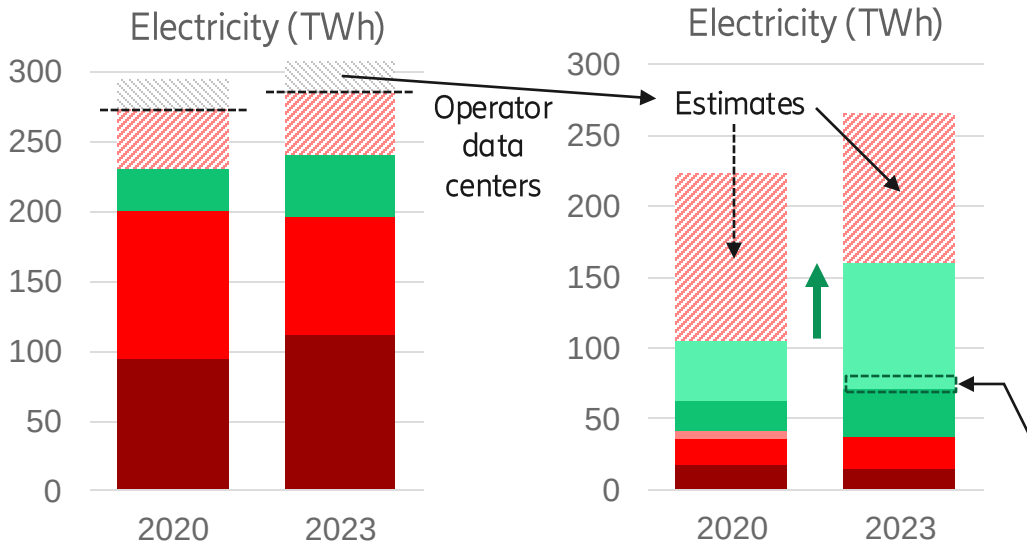

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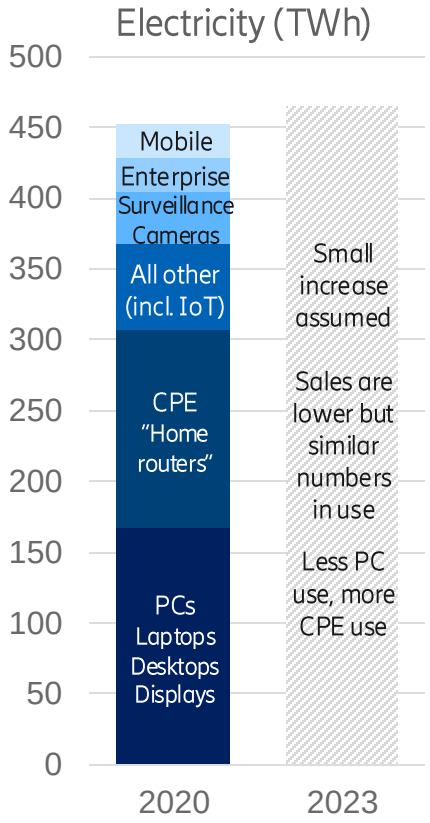
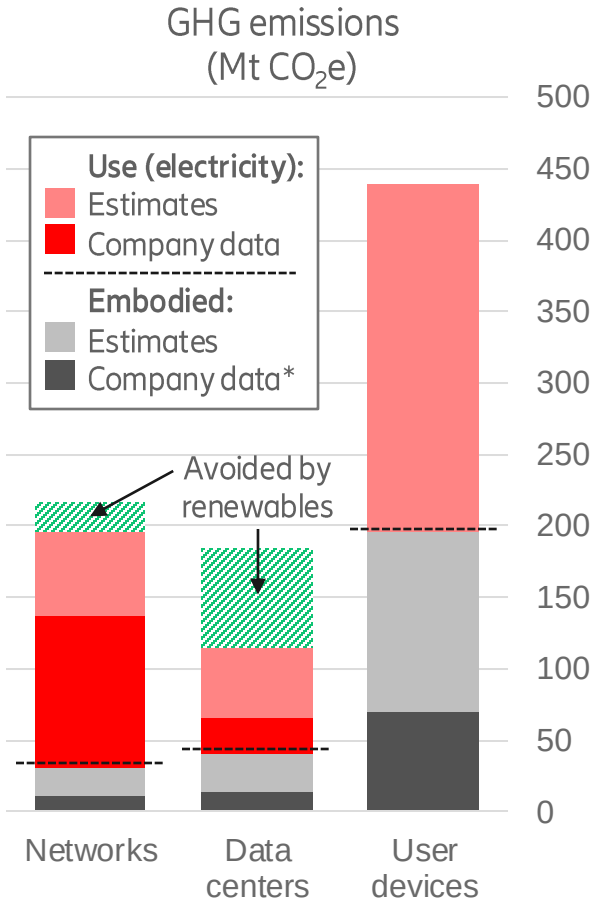
User devices modelled/estimated



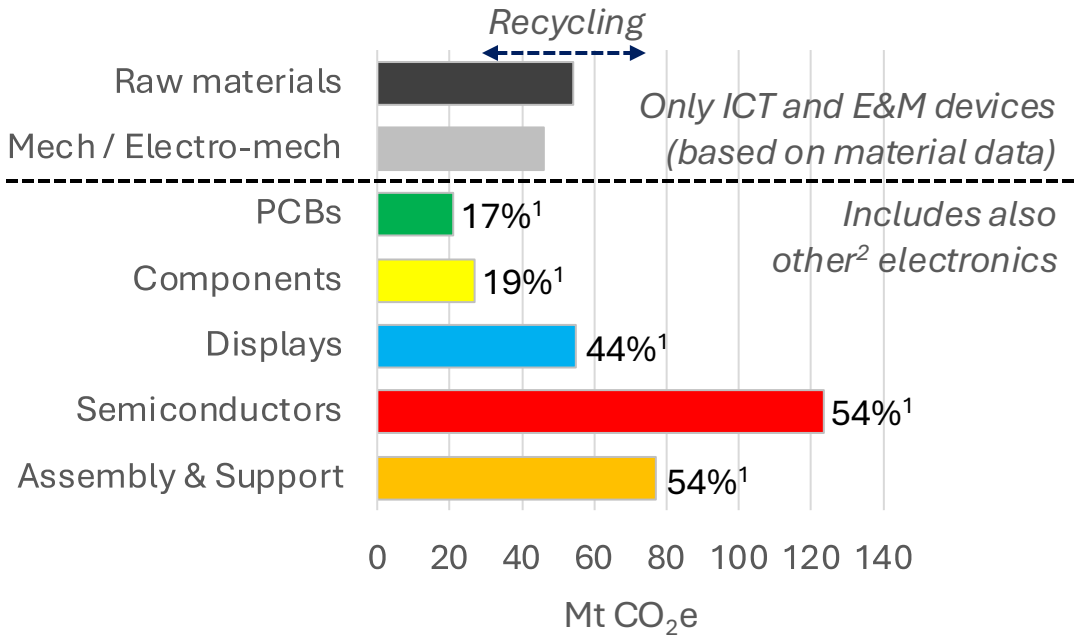
Specific AI HW about 4% in 2023
(6% 2024, 8% 2025, 15% 2026?)

ICT sector Total carbon footprint



Embodied Carbon Footprint of (ICT) Electronics

(Lövehagen et al. 2023)



The <u>supply chain approach</u>
Electronics production carbon footprint <u>2020</u>
[1] Measured / reported data from about 60 companies covering about 36% of total estimated carbon footprint
(More companies have been used as references)

[2] Not 100% of other electronics (but likely major part). It is the share that "got" included in the ICT and E&M manufacturers total data (as components and assembly/support are for all electronics).

Other ICT and E&M devices: Fixed phones, STBs, Audio devices, Public and commercial displays, Smart meters, Smart home devices, Payment terminals, Surveillance cameras, Others

Other electronics: Appliances / tools, Automotive / aviation, Medical (health care), Industry (production), Government / military

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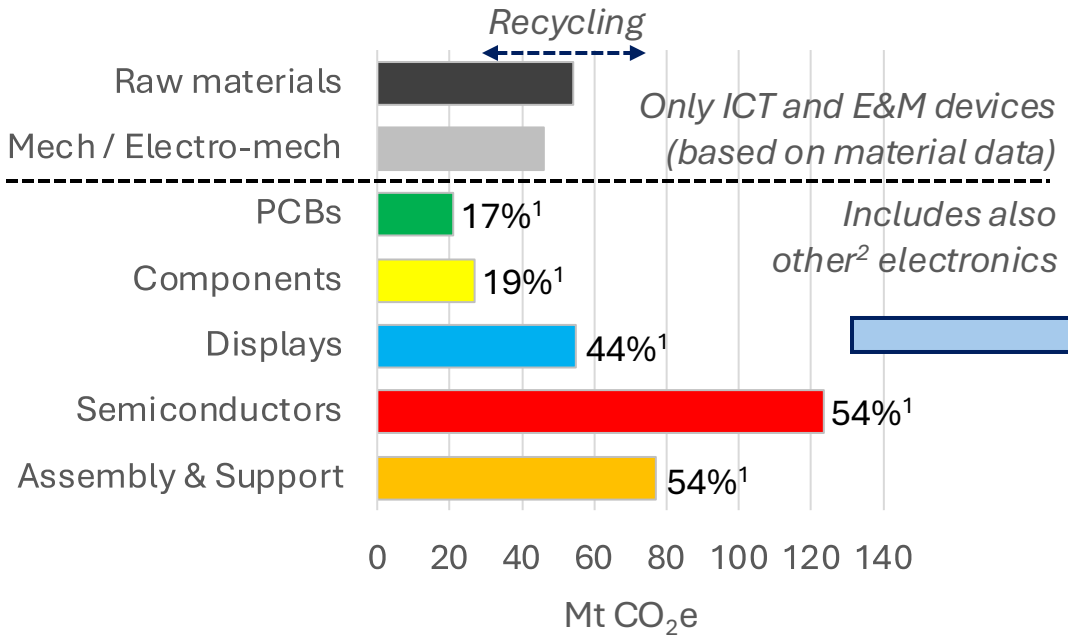

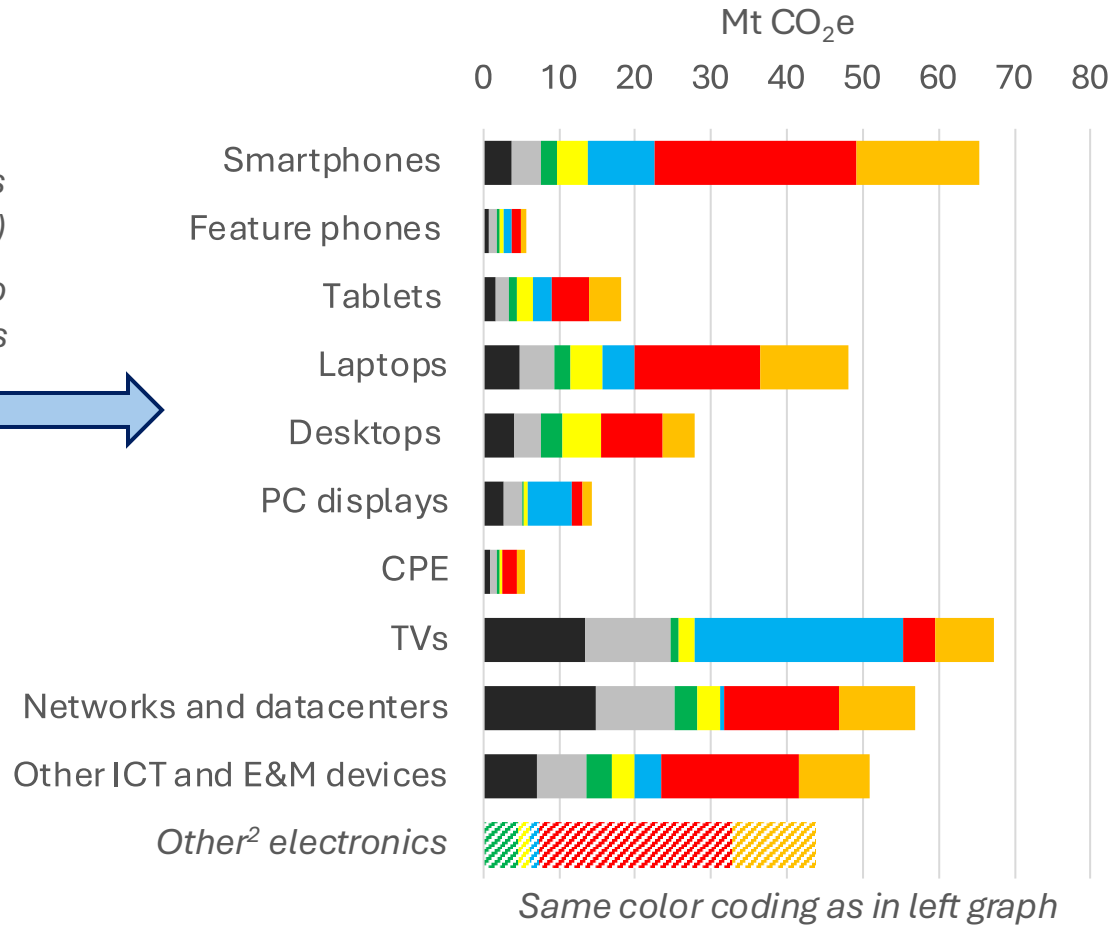

Same color coding as in left graph

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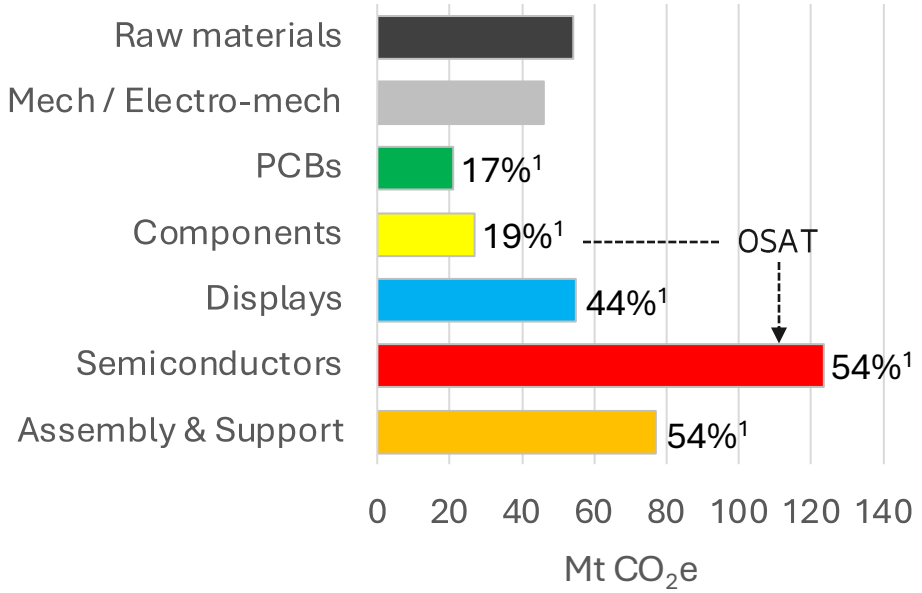
Supply chain approach for semiconductors (ICs)

(Lövehagen et al. 2023)



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Year 2020

TSMC	16.1 TWh
Samsung IC	13.6 TWh
SK Hynix	9.7 TWh
Intel	8.8 TWh
Micron	6.8 TWh
GlobalFoundries	3.0 TWh
UMC	2.6 TWh
Texas instruments	2.5 TWh
ST	2.4 TWh
Infineon	2.0 TWh
SMIC	1.6 TWh
NXP	1.5 TWh
Qualcomm, Nvidia, Broadcom, AMD	1.2 TWh

Total: **72 TWh**
(13.7 TWh renewables)
Scope 2: **29 Mt CO_2e** (market)

Scope 1: 19 Mt CO_2e

Scope 3: 17 Mt CO_2e

Total reported: **66 Mt CO_2e**

Extrapolations, estimates, and LCA as a "gap filler": **+55 Mt CO_2e**

Final total: **121 Mt CO_2e**

+OSAT: +7 = **128 Mt CO_2e**

OSAT = Outsourced Semiconductor Assembly & Test

2020 [Lövehagen et al. 2023]: https://www.sciencedirect.com/science/article/pii/S1364032123002794

Thank you!

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