
UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT
Making digitalization work for sustainable development
IGE on E-commerce and the Digital Economy – 8th session
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Palais des Nations
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Rapid growth of the digital economy calls for more attention to its environmental impact

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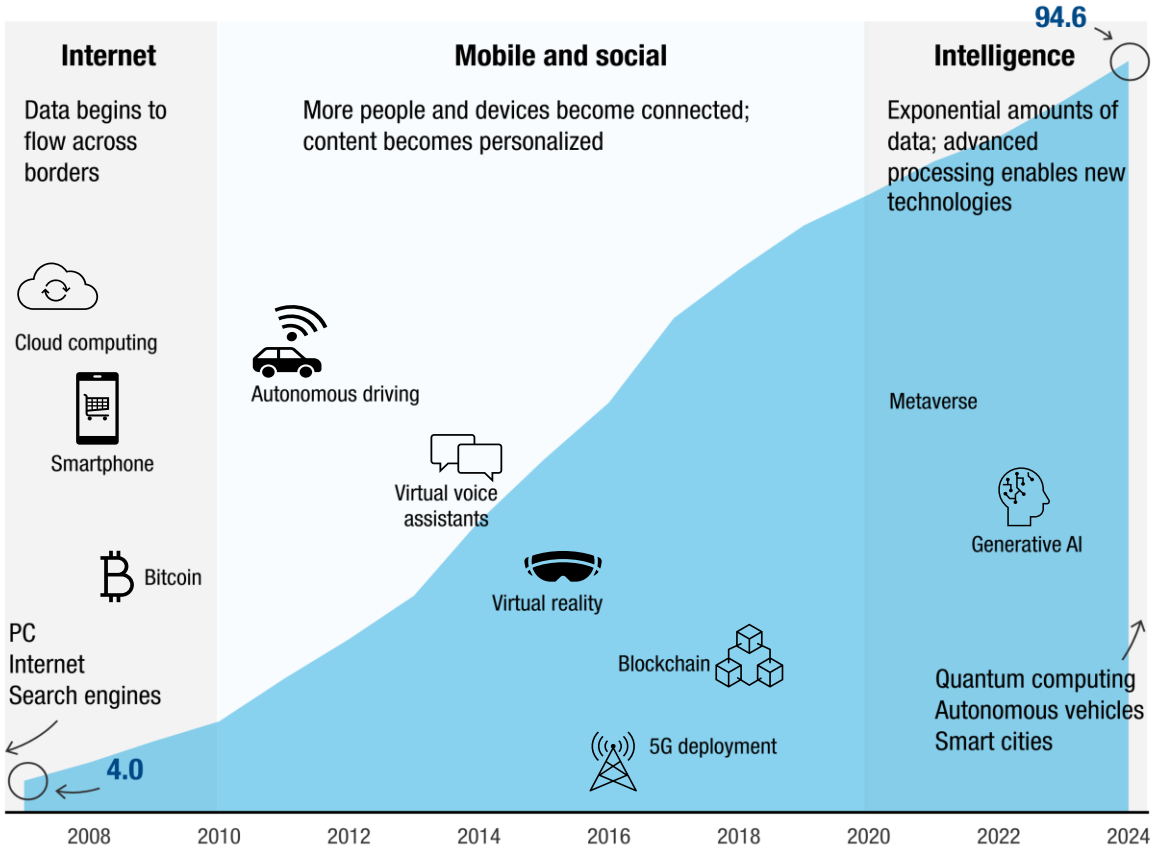
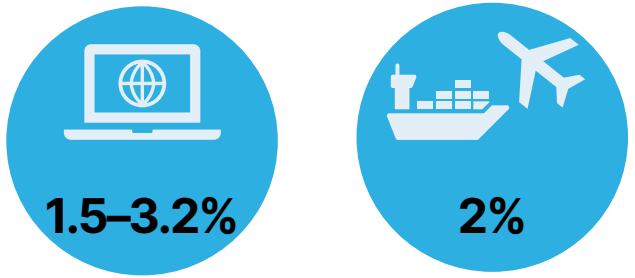
Age of ICT

Major inventions and active mobile-broadband subscriptions per 100 inhabitants



Source: UN Trade and Development, data from ITU (2024).

Global greenhouse gas emissions per sector

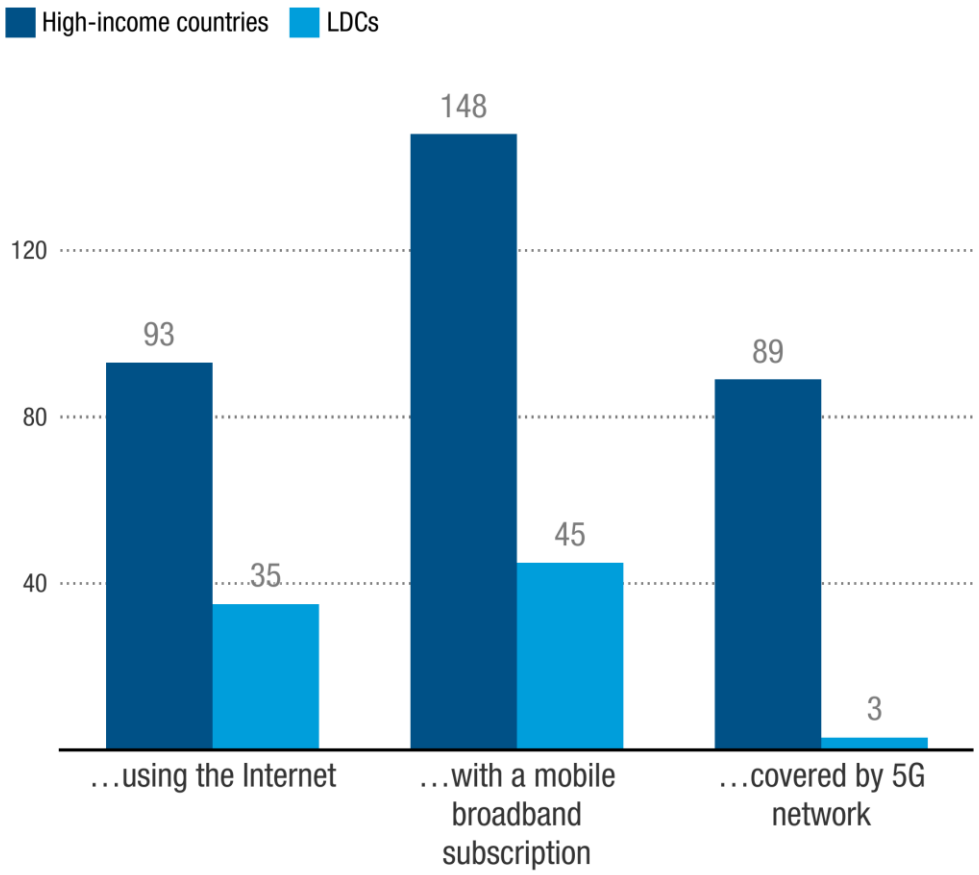


Sources: IPCC (2023), Ookla (2024).

Gaping digital and e-commerce divides...

Access and use of the Internet varies significantly between country groupings: Share of people...

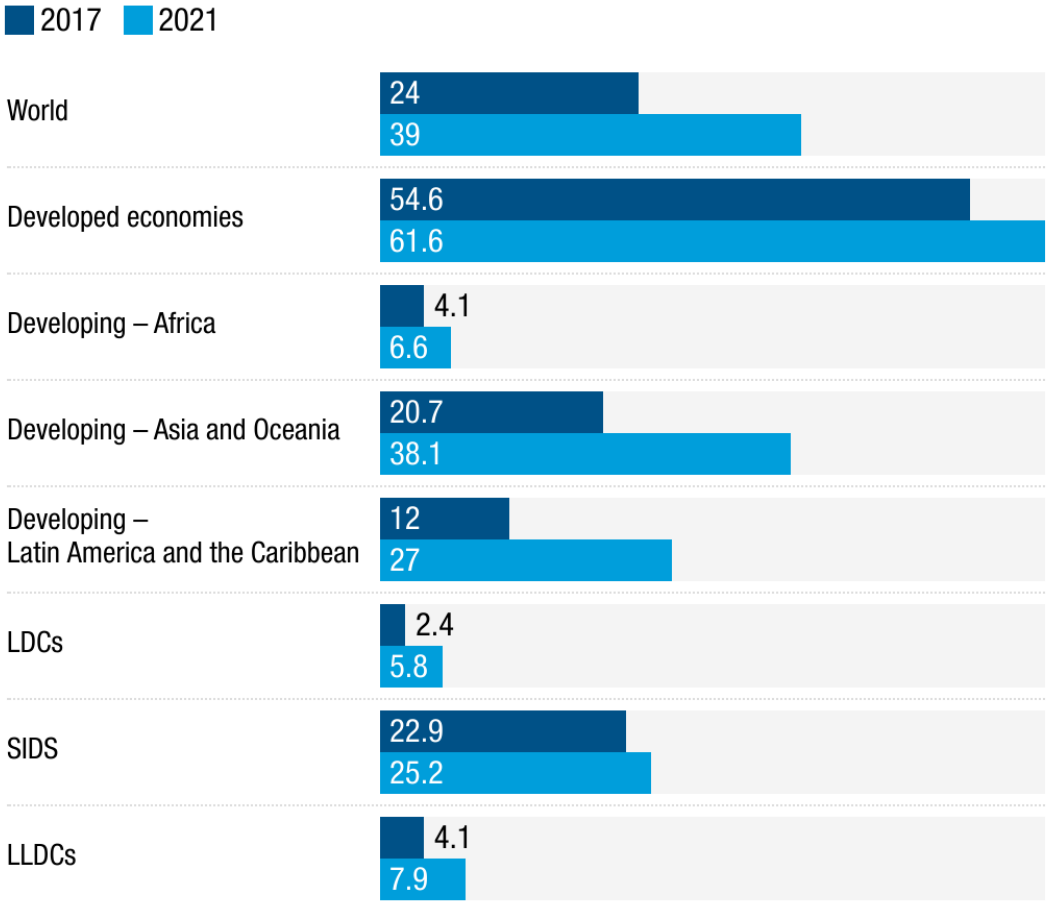
(in %)



Source: UN Trade and Development (UNCTAD), based on ITU (2023).

Uneven increases in e-commerce adoption across regions

Share of population (aged 15+) shopping online, by regions and country groupings (in %)



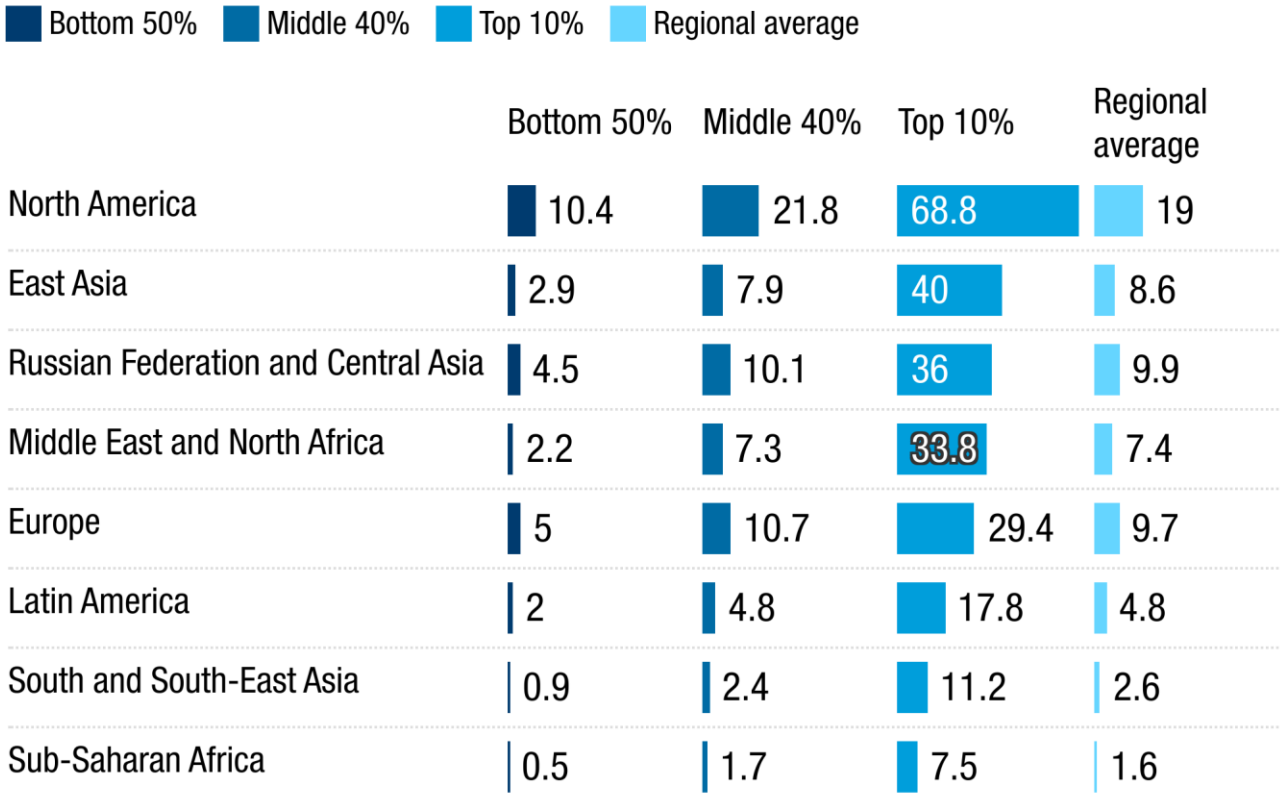
Source: UN Trade and Development (UNCTAD), based on World Bank Global Findex 2021.

Environmental impacts mirror development and digital divides

- **Unequal impacts of climate change**
  Hotter countries face reduced output, while wealthier, cooler ones benefit
- **Vulnerable populations hit harder**
  The bottom 40% and marginalized groups suffer greater losses from extreme weather
- **Biodiversity and natural resources**
  Low-income countries lose natural wealth; richer countries boost conservation

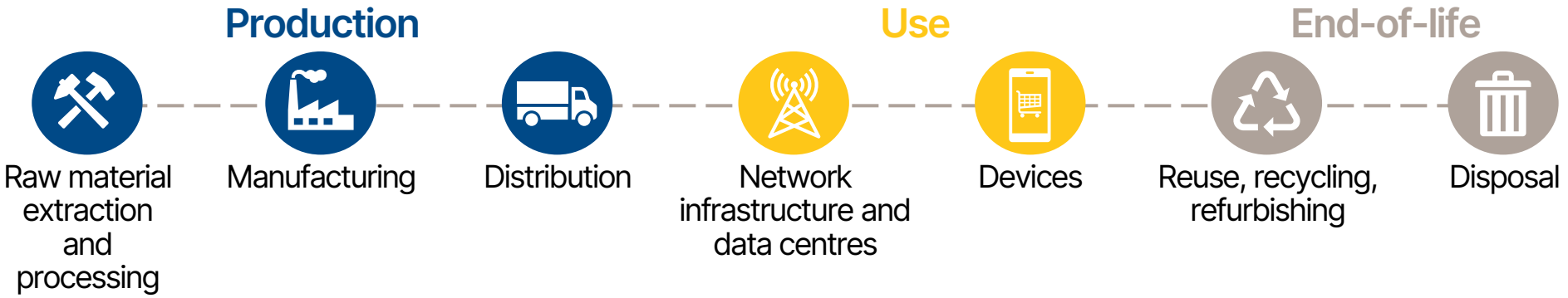
Environmental footprints between and within regions vary sizeably

Tons of CO2 equivalents per capita and year



Source: UN Trade and Development (UNCTAD), based on Chancel et al. (2023).
Note: Regions as defined by the source.

Environmental impacts are generated along the whole digitalization life cycle



Direct effects

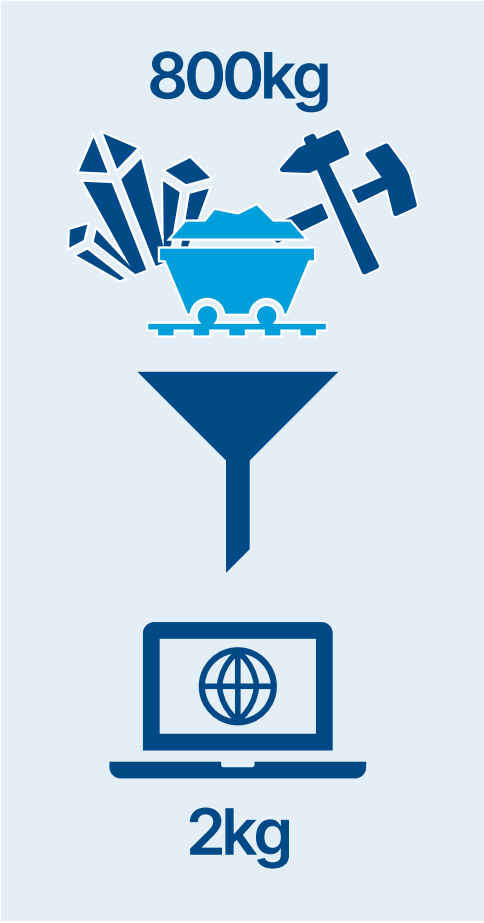
Natural resource depletion
Energy use
Water use
Greenhouse gas emissions
Pollution
...

Indirect effects

Optimization
Induced consumption
...

Environmental footprint of ICT

Production phase: Digitalization has a heavy material footprint



- Heavy reliance on **raw materials**, including minerals and metals, plastics, glass and ceramics
- **Complexity** of devices is increasing – more elements from the periodic table used
  - Phones: 10 elements used in 1960, 27 in 1990 and 63 in 2021
- **Challenge**: low-carbon and digital technologies largely compete for the same minerals
  - Material resource extraction could increase 60% between 2020–2060
  - Demand for cobalt, graphite and lithium is expected to increase by 500% until 2050

Sources: Justice et Paix (2019); Le Monde Diplomatique (2021); UNEP and IRP(2024); Hund et al./World Bank (2020).

Geopolitics may exacerbate digitalization's environmental footprint

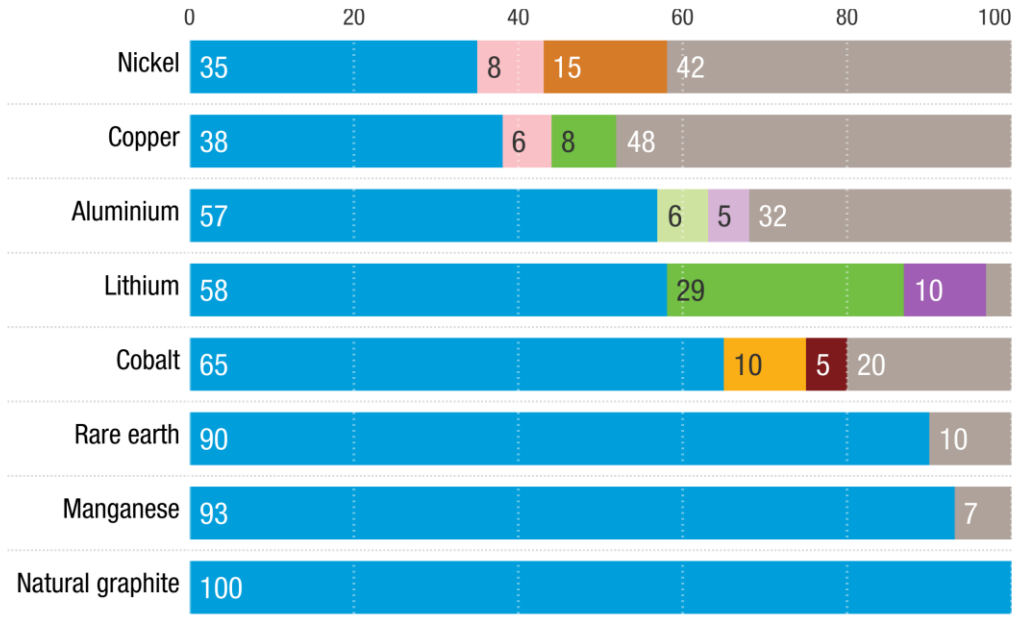
- High geographic concentration of raw material reserves, extraction and processing
- For example, extraction in 2023:
  - Cobalt: 74% in the Democratic Republic of the Congo
  - Nickel: 50% in Indonesia
  - Natural graphite and REEs: 77% and 69% in China
- Most raw materials are exported for processing

Strategic interest in transition minerals are spurring new industrial policies in many countries

Risk of an expanded environmental footprint through hoarding and overcapacity

China leads in critical mineral processing

Share of top mineral processing countries in world total for selected minerals



Source: UN Trade and Development (UNCTAD), based on OECD (2023a).

Sources: United States Geological Survey (2023).

Supply response pushes the mining frontier

Growing demand

- Both low-carbon and digital technologies require significant amounts of raw materials

New exploration

- Spurring **increased exploration** for new deposits
  - Global exploration budgets: +34% in 2021; +16% in 2022
  - But declining rates of discoveries of some critical minerals in recent years

Development of new mines

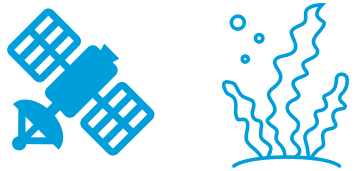
- Sharp increase in **mine development**
  - Investments: +20% in 2021; +30% in 2022

Production

- Increasing supply pressures and extraction difficulties as ore grades decline
  - Less efficient and time lag in availability

Need to rethink modes of consumption and production in view of potential limits to minerals supply on a finite planet and intergenerational equity

New mining frontiers?



Sources: S&P Global Market Intelligence (2023); IEA (2023a)

High growth in ICT demand and Internet use pushes the environmental footprint

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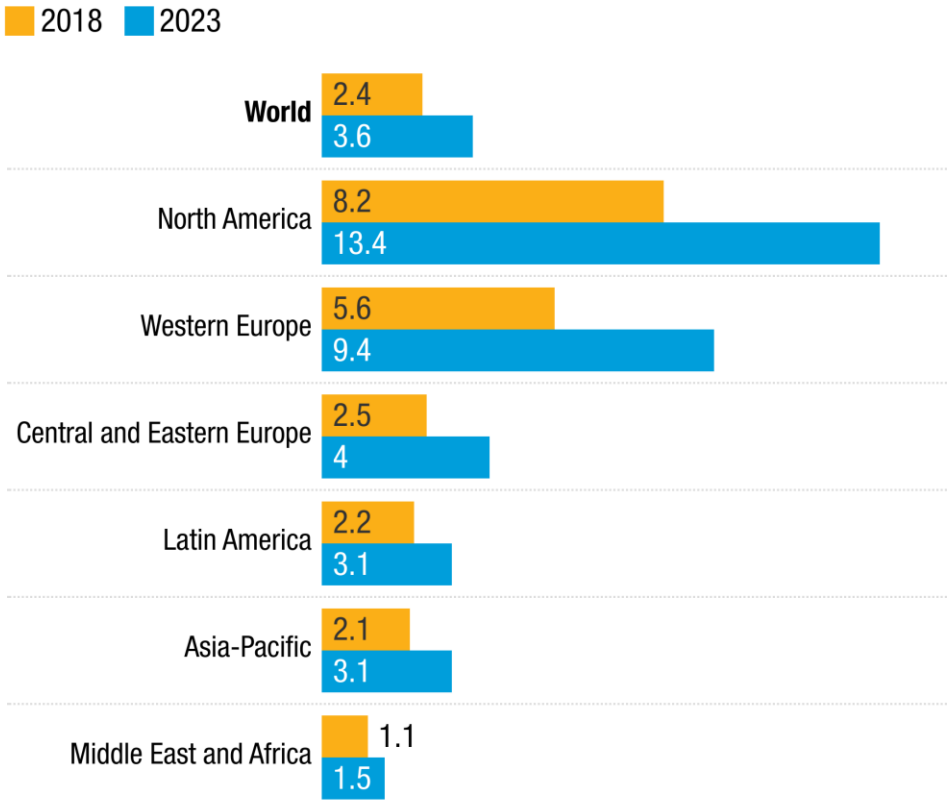
Significant increase in devices per capita in developed countries

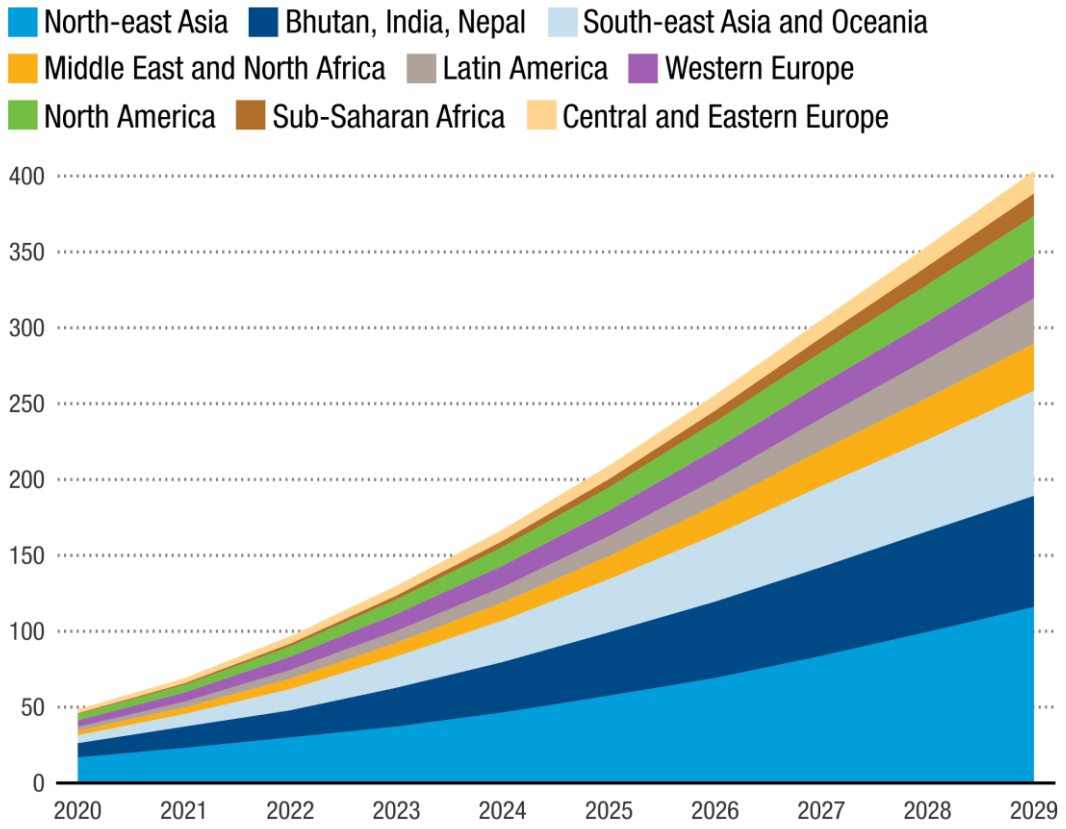
Average number of devices and connections per capita, by region, 2018 and 2023



Source: UN Trade and Development (UNCTAD) calculations based on Cisco.
Note: Country groups are those of the source.

Mobile data traffic is expected to more than double within the next 5 years

Data traffic by region, exabytes per month, 2020–2029

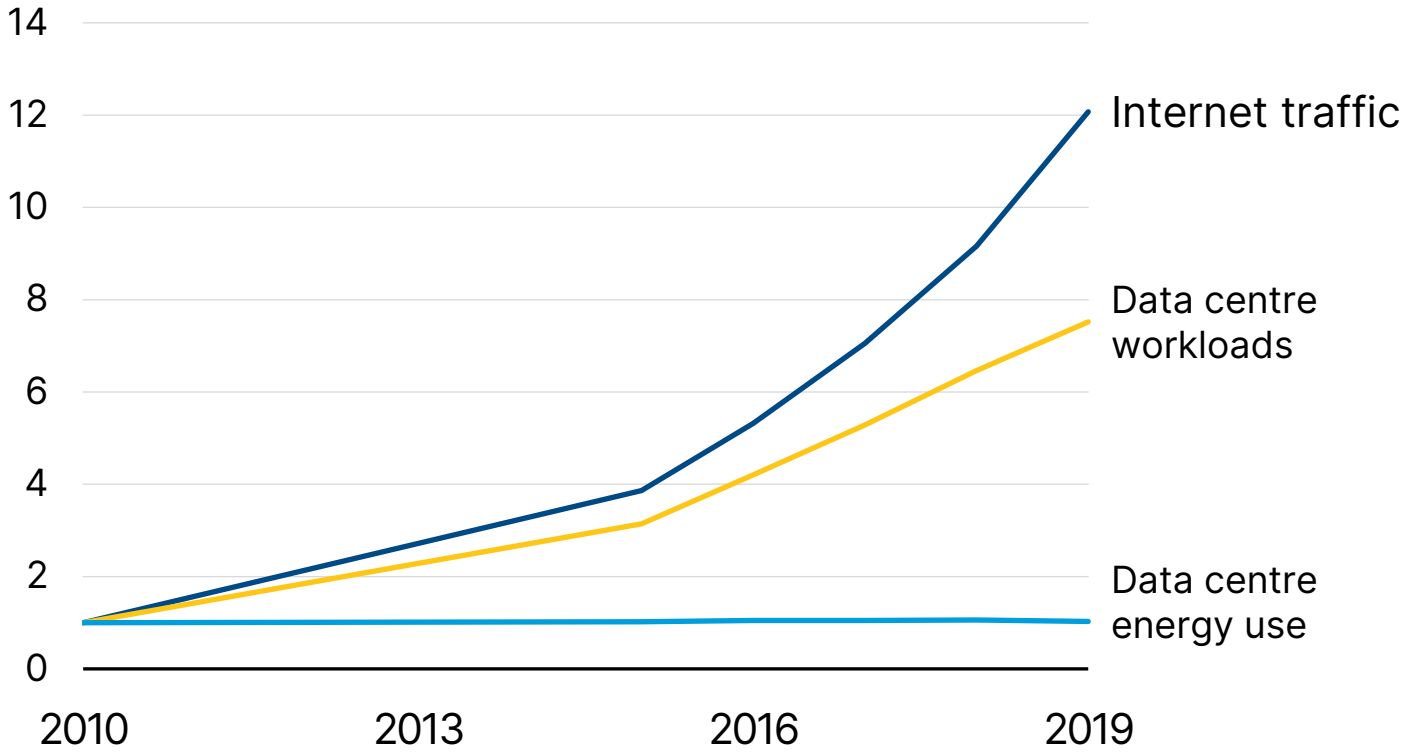


Source: UN Trade and Development (UNCTAD), based on Ericsson Mobility Visualizer.
Note: Country groupings are as defined by the source.

Until recently, efficiency gains kept up with growth in demand for data centres

Internet traffic, data centre workloads and energy use, 2010–2019

(Index: 2010 = 1)



Data centres: around 1% of global electricity use

Sources: Masanet et al. (2020): Recalibrating global data center energy-use estimates. IEA (2020): Data centres and data transmission networks; Cisco (2018): Global Cloud Index; Cisco (2019): Visual Networking Index. Slide source: George Kamiya (IEA).

Data centres exert growing impacts

Data centres globally consume an estimated 460 TWh of electricity – similar to all of France's

Their energy consumption is expected to more than double by 2026

Pressure on local electricity grids is growing

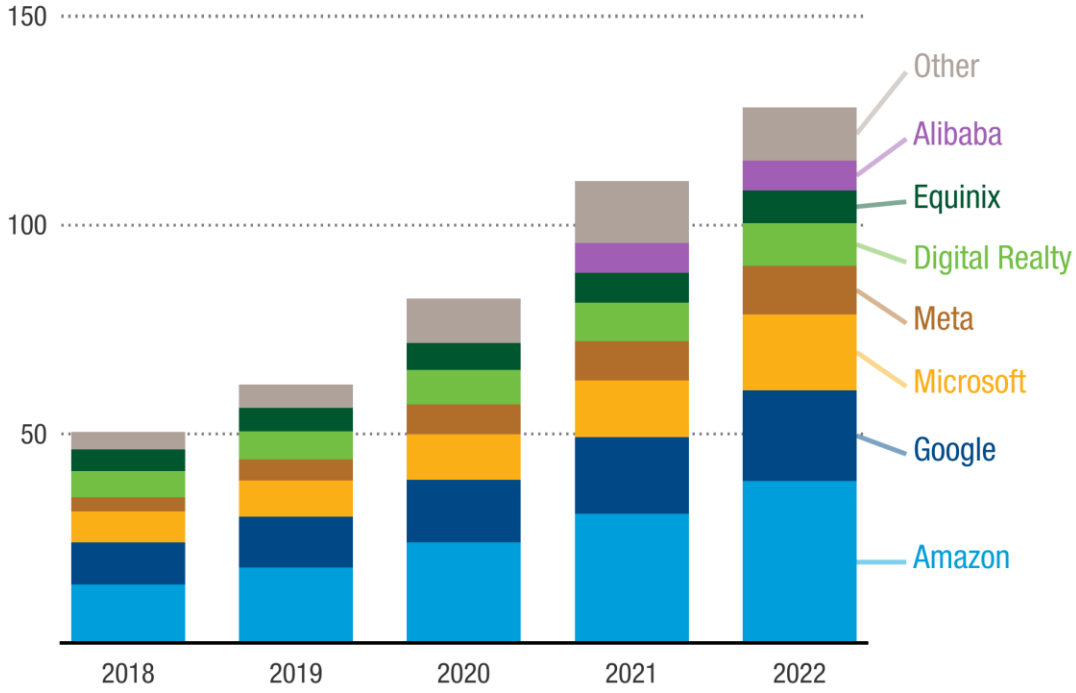
- Ireland: now 20% of total electricity consumption
  …and 50% in Dublin
- Singapore: 7%

Other local impacts

- Water use – for cooling and energy generation
- Noise

Electricity use by 13 of the world's largest data centre operators more than doubled between 2018 and 2022

Annual electricity consumption by selected data centre operators, terawatt hours, 2018–2022



Source: UN Trade and Development (UNCTAD), based on company reports.
Note: Other includes: Apple, Baidu, Chindata, GDS, Tencent, VNET.

Sources: IEA (2024), Ireland CSO (2023), Singapore MCI (2021).

Compute-intensive technologies boost emissions, energy and water use

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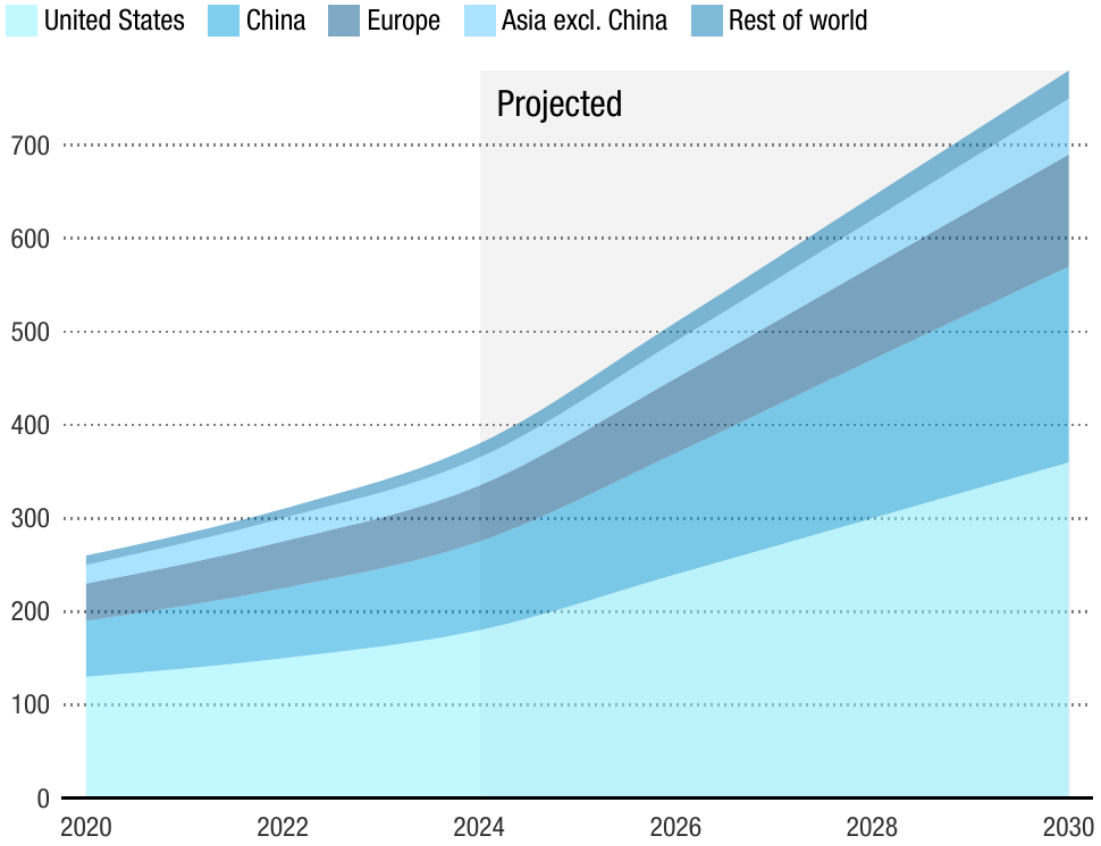
AI, blockchain, 5G and IoT increase data processing needs and the environmental footprint of ICTs

- AI searches may use 10x more electricity than a conventional Internet search
- Alphabet's emissions rose 48% in 2019–2024, Microsoft's more than 30%
- Microsoft's data centres reportedly used 700,000 litres of potable water to train GPT-3 in the US
- By 2030, data centres electricity consumption in the US may exceed the need for producing aluminium, steel, cement, chemicals and all other energy-intensive goods

Data centre electricity consumption by region, 2020–2030

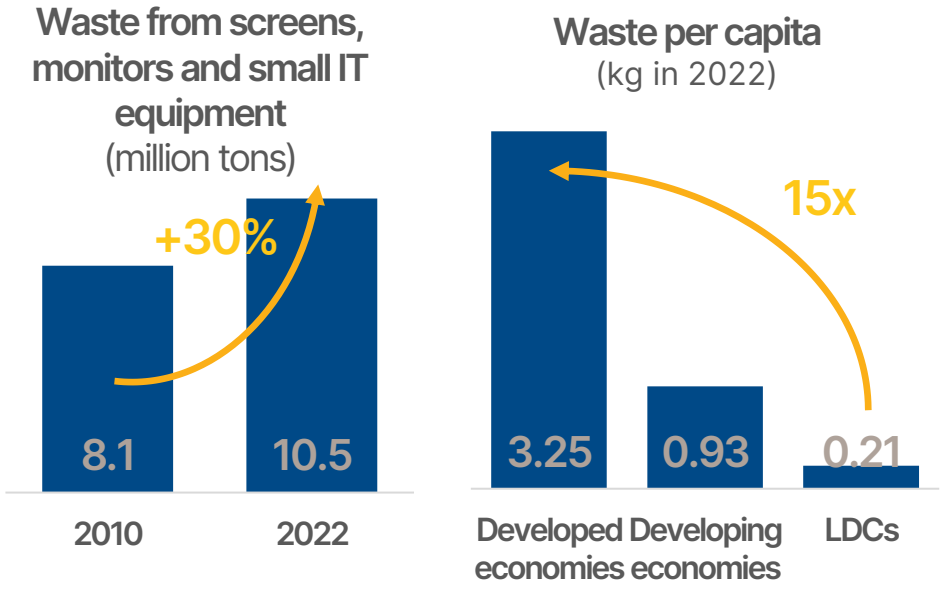
Annual electricity consumption, terawatt hours (TWh)



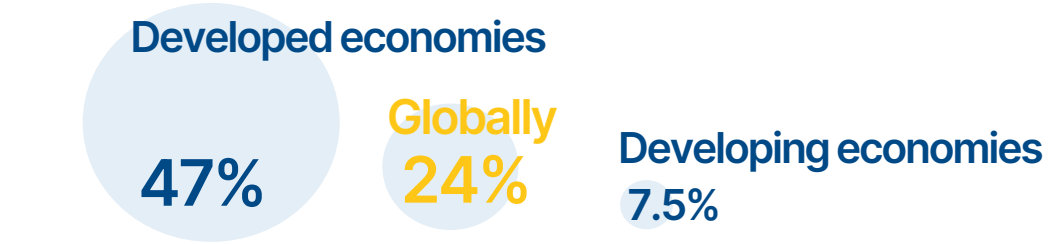
Source: IEA (2025).
Note: Base case as estimated by IEA.

Digitalization-related waste is growing, with uneven implications across countries

Regional disparities are significant and mirror digital divides



Formal waste collection rates



Challenges in developing countries

- Limited recording and documenting of waste flows
- Lack of formal collection systems
- Only 1 in 4 have relevant waste management legislation

Source: UN Trade and Development calculations based on UNITAR-SCYCLE.

An unequal ecological exchange marks digitalization, limiting development gains

Research remains scarce on environmental impacts of the digital economy on developing countries

Local environmental impacts, incl. on indigenous peoples and gender, are often overlooked

Negative impacts from device production and waste often affect regions located far from the principal location of use

Developing countries are less able to afford and harness digital technologies to mitigate environmental impacts

> **At present, the world is not on track for achieving either inclusivity or sustainability**

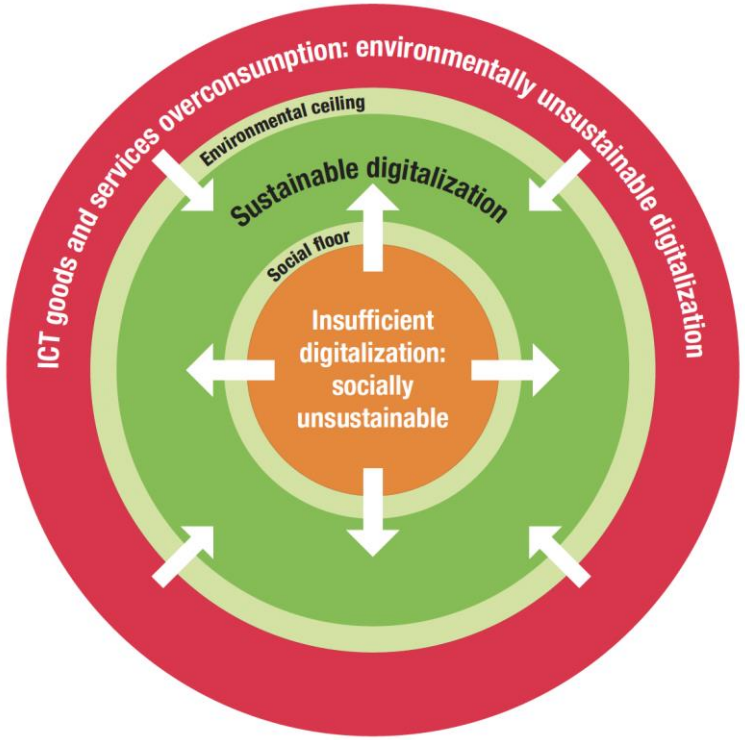
Sustainability requires consumption in the digital economy to be rethought

Aim to deliver human well-being within planetary boundaries

- High-income countries marked by overconsumption
- Digital divides persist in developing countries (in terms of access, affordability and use)
- Digitalization necessary for economic participation

Achieving sustainable "digital sufficiency" requires

- moderation of **overconsumption**
- allowing those **not sufficiently connected** to keep **digitalizing for development**



Source: UN Trade and Development, based on Wiedmann et al. (2020).

Shifting towards a circular digital economy for inclusive and sustainable development

Addressing the double bind of developing countries

Developing countries bear the **brunt of the costs of digitalization**

- Raw material extraction
- Digital waste
- Climate vulnerability
- Digital divide

Developed countries capture most benefits

Common but differentiated responsibilities

Policy implications

Digitally-developed countries should

- **lead** the shift to an inclusive and sustainable digital future
- **support** developing countries in building capacities to harness digitalization

Bold action is needed at national and international level

National level

- Integrate digital, economic and environmental sustainability strategies
- Focus on reducing GHG emissions, water use and waste by using digital solutions, while being mindful of the digital footprint

International level

- Strategies and policies that recognize countries' diverse needs and priorities, recognizing opportunities for esp. for developing ones
- Development partners should reinforce support to low-income countries to strengthen capabilities for digitalization and sustainability

Link between digitalization and the environment is getting recognized more

We commit, by 2030, to:

Promote sustainability across the life cycle of digital technologies, including context-specific measures to increase resource efficiency and to conserve and sustainably use natural resources and that aim to ensure that digital infrastructure and equipment are sustainably designed to address environmental challenges in the context of sustainable development and efforts to eradicate poverty

GDC para 11(e)

Summit of the Future
Our Common Agenda

Global Digital Compact
21 September 2024

An integrated global approach to digitalization and the environment that works for people and the planet

Multilateral and cross-sector dialogue between digital and low-carbon policy communities for international standards and policymaking

Multi-stakeholder partnerships across governments, businesses and academia for stronger outcomes

Focus on environmental impact of digitalization's role in global environmental processes and vice versa

UN Trade and Development calls on

The international community to develop **inclusive and integrated approaches** that

- **align digital and environmental policies at all levels** and drives collective action
- **track ICT sector's environmental footprint** comprehensively

A just and sustainable digital economy requires just and sustainable policies

António Guterres
Secretary-General
United Nations

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For more information

unctad.org/der2024

- What are the **main environmental impacts of digitalization over its life cycle** and how can they be addressed, and what are the **implications from the trade and development perspective**, particularly for **developing countries**?
- How can **sustainable development gains** from digitalization be ensured over its life cycle, looking particularly, among others, at critical minerals linked to the digital transformation process and waste management?
- How can **national, regional and international policymaking and cooperation** contribute to digitalization that is sustainable and inclusive and addresses environmental impacts, in particular for those furthest behind?