Assessing the life cycle environmental impact of Dutch ICT in 2024: baseline and intervention modelling

Scope of the study

End-user devices (personal and professional)

Telecommunication networks (fixed and mobile)

Datacentre

Key results (headline figures, 2024)

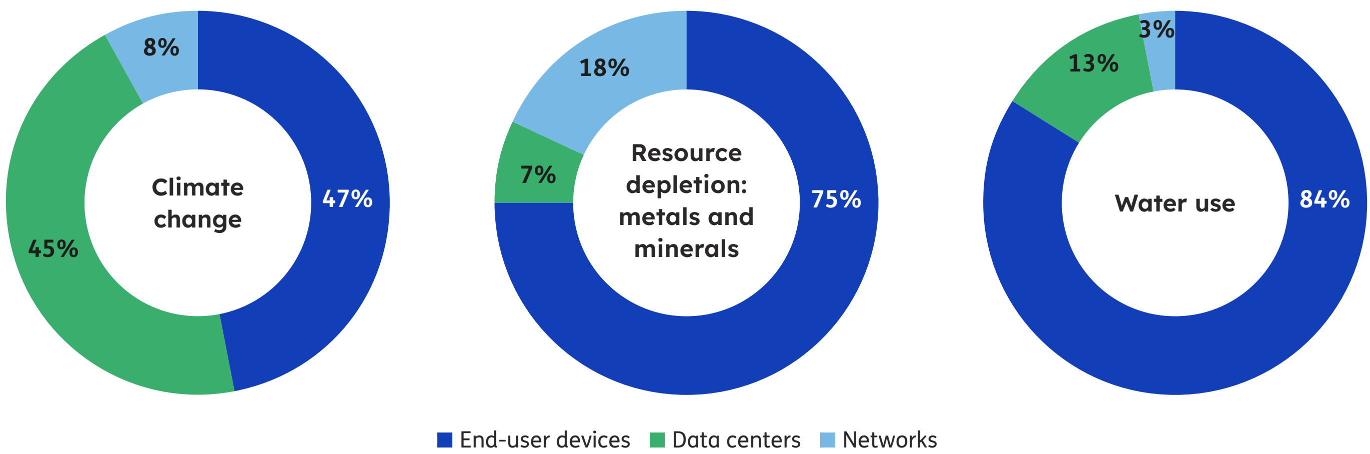
- **5.5 Mton** CO_2 eq. of climate change impact, equals **3.7%** of national CO_2 emissions
- **12TWh** electricity use, equals **10%** of national electricity use.
- **130 t** Sb eq. of metal and mineral resource depletion
- **3.2 billion** of **m^3** eq. of water use

4 key interventions

Potential cumulative **reduction** of total ICT CO_2 footprint of up to ~**15%**

- Device **lifespan extension** by 0.5 year
- **Datacentre** server utilisation **optimisation**
- **Waste heat reuse**
- **Traffic-aligned** datacentre utilization

Largest impacts (split per impact category across tiers, 2024)



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Context and Objective

The Netherlands is one of Europe's most digitally mature countries: 98.5% household internet connectivity, near-universal daily use, and a central position as a European connectivity hub anchored on the Amsterdam Internet Exchange (AMS-IX). This makes the country one of Europe's prime locations for datacentre. This digital position creates social and economic value, but also significant environmental pressure that has so far been only partially measured.

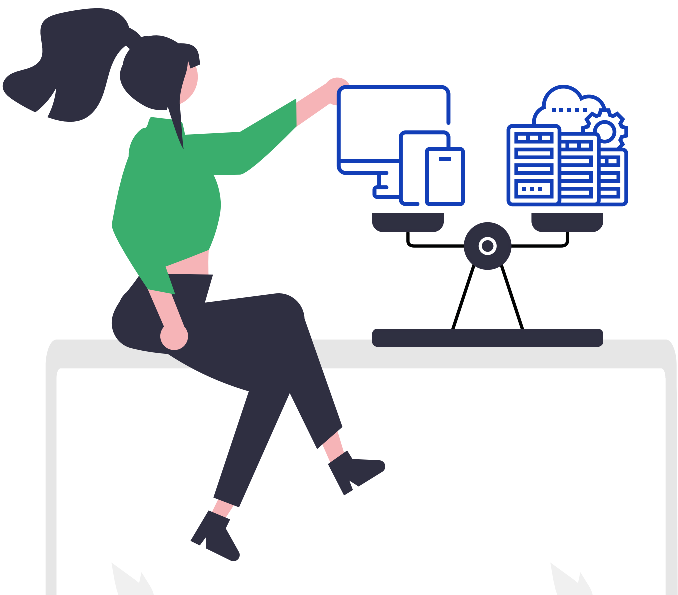
The Ministry of Economic Affairs and Climate Policy (EZK) recently set out a Sustainable Digitalisation Action Programme highlighting three concerns: CO_2 emissions, dependence on critical raw materials, and energy use. Existing studies cover only parts of the picture — most focus on operational electricity and leave out upstream manufacturing impacts — so policymakers lack a complete baseline from which to act.

This study fills that gap by quantifying the full life cycle environmental footprint of Dutch Information and Telecommunication Technologies (ICT) in 2024 and identifying **where interventions can have the greatest effect.**

Methodology

The study employs a Life Cycle Assessment (LCA) methodology with a hybrid accounting approach:

- **Consumption-based** perspective for end-user devices, attributing impacts to Dutch ownership and use.
- **Production-based** perspective for networks and datacentres, measuring impacts physically occurring within the Netherlands.



The system covers all hardware and infrastructure used in the Netherlands over one year (2024), assessed across six midpoint indicators:

- Global warming potential
- Resource depletion: metals and minerals
- Resource depletion: fossils
- Particulate matter formation
- Land use
- Water use.

Data was assembled in with TNO, CBS, the ACM, the Dutch Datacenter Association, the RVO (EED reporting), the SDIA, one ministry and one of the three main Dutch network operators. Environmental data was drawn from Resilio Database, CODDE and Ecoinvent databases.

Key Baseline Results (2024)

Total Environmental Footprint

The total Global Warming Potential (GWP) of Dutch ICT in 2024 represents approximately **5.5 million tons of CO_2 eq**, corresponding to about **3.7% of national CO_2 emissions**. While direct comparison with national totals is complicated by the hybrid methodology, this figure underscores the significant climate impact of the sector.

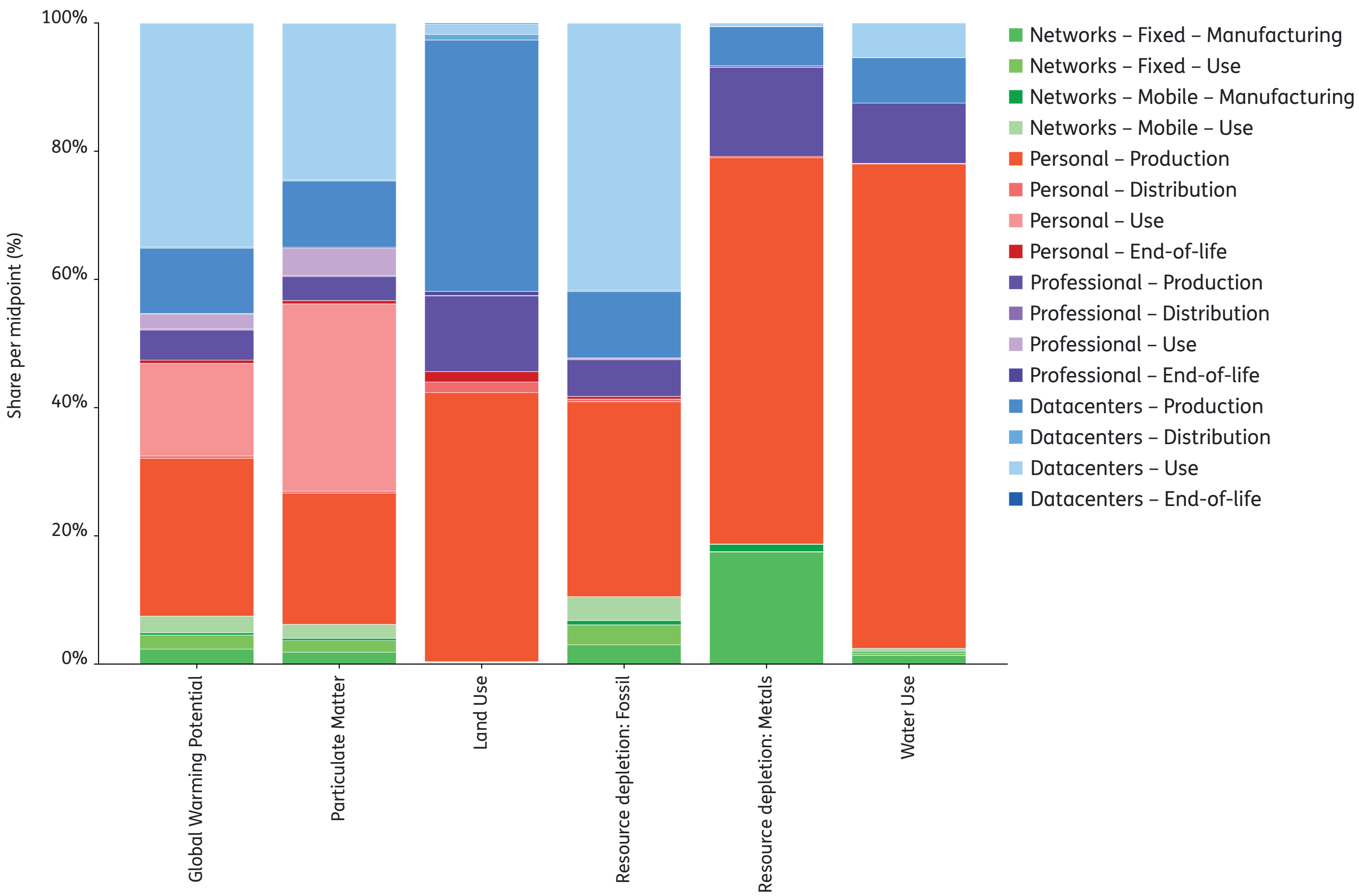
Midpoint Indicator	Total Impact (2024)
Global Warming Potential (GWP)	5.51 Mton CO_2 eq
Particulate Matter (PM)	216.2 disease incidences
Land Use (LU)	2.85 billion (dimensionless)
Water Use (WU)	3.2 billion m^3 eq
Resource Depletion: Fossils (ADPf)	66.77 billion MJ
Resource Depletion: Metals and Minerals (ADPe)	0.13 kton Sb eq

Breakdown by Tier and Life Cycle Stage

The analysis reveals that end-user devices and datacentres dominate the overall footprint, while networks contribute minimally. For the energy mix, the average Dutch energy mix is used in the calculations.

- **End-User Devices (Tier 1):** Contributes 47.1% of total GHG emissions. The production phase is the largest contributor across most midpoints, particularly for metal depletion and land use. **Production** of end-user devices alone explains roughly **60%** of the **metal and mineral depletion** footprint, reflecting the central role of critical raw materials in screens, chips and circuit boards. Smart TVs are the single largest device contributor with 6.5% of total ICT CO_2 footprint.
- **Datacentres (Tier 3):** Accounts for 45.4% of total GHG emissions which is **high compared to the European average** and due to a strong datacentre footprint in the country; this share is expected to increase with the growth of AI usage everywhere. The **use phase** (electricity consumption) is the **primary driver for datacenters** and accounts for around 37% of the total ICT climate change impact, though server production also contributes significantly with 7.5% of total ICT CO_2. Server production and use represent 86% of the datacenter climate impact.
- **Networks (Tier 2):** Contributes only 7.5% of GHG emissions. Impacts are primarily from electricity use, though the fixed network infrastructure contributes 15% to metal resource depletion.

The **average Dutch resident is associated with 307 kg CO_2 eq annually from ICT** (including personal and professional use), which falls in the middle range compared to similar studies in Switzerland (247 kg), France (253 kg), and the EU average (361 kg). This is equivalent to 31% of the "sustainable carbon budget", defined as the planetary boundary per capita for climate change (EU JRC, Consumption and consumer footprint, 2019).



Main Interventions and Reduction Potential

Extend the useful life of devices.
Increasing the average device lifespan by 0.5 years reduces GWP by 4%, depletion of minerals and metals by 7%, and water use by 6%. This is the single most impactful and robust intervention. This is best supported by right-to-repair regulation, longer software support, and consumer awareness.

Improve datacentre efficiency.
Raising server utilization from the current 15–40% average toward 75% could cut climate change impact by 5%, assuming server consolidation to achieve the actual effect. Aligning electricity use with the daily AMS-IX traffic pattern adds another 3%, and capturing waste heat (up to 4.8 TWh available annually) adds a further 2% while reducing fossil energy dependence.

Together, the modelled interventions show **a potential reduction of 15% in CO_2 eq., 17% in fossil resource dependence, and 7% in depletion of minerals and metal**, directly addressing the three pillars of the EZK action programme.

Conclusions and Recommendations

The study confirms that the environmental footprint of Dutch ICT is significant and driven by two main factors: the production of end-user devices and the electricity consumption of datacentres. To achieve sustainable digitalisation, the following actions are recommended:

1. **Prioritise Device Longevity:** policymakers should enforce and incentivise right-to-repair legislation, extended software support, and longer warranties.
2. **Mandate Datacentre Transparency and Efficiency:** strengthen reporting requirements (e.g., under the Energy Efficiency Directive) to include server utilisation rates and daily consumption patterns. Incentivise operators to optimise utilisation to 75% and integrate waste heat into local heating networks, which should be easier than in other countries due to the country density and wealth.
3. **Focus on Systemic Solutions Over Behavioural Tweaks:** while user behaviour matters, systemic changes in hardware durability and datacentre operations yield far greater reductions than minor changes in e.g. streaming habits.
4. **Establish Continuous Monitoring:** use this baseline as the foundation for a national monitoring dashboard (to be managed by the Netherlands Enterprise Agency, RVO) to track progress, update data as grid decarbonation advances, and refine interventions over time.

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