

'Invisible' Materiality of Tech

Behind the cloud lies a heavy footprint

Information Technology (IT) has profound material impacts from the extraction of raw materials, manufacturing, energy consumption in operation, to final e-waste disposal. Yet, these physical and environmental externalities remain largely invisible in mainstream discourse.



IMAGE BY ANDRIJ BORYS ASSOCIATES

What's Driving This Invisibility?

- Computer science hides the physical stuff → focus is on code, not materiality.
- Tricky language → words like “cloud” make tech seem weightless.
- Big dreamy visions → stories of seamless, limitless tech ignore real-world limits.
- Hidden hardware → servers, cables, and data centers stay out of sight.
- Consumer culture → constant upgrades + emphasis on profit model = more waste, more impact.

Why should we care?

Every click, stream, and upload relies on energy, materials, and water, leaving behind pollution, waste, and carbon.

We risk celebrating innovation while accelerating environmental collapse.

What can we do?

Make tech's hidden environmental costs visible through clearer language, impact tracking, and education.

Use policy, regulation, and realistic visions to align digital progress with ecological limits.

“IT's environmental footprint is real but hidden. The invisibility stems from abstraction, language, utopian narratives, hidden hardware, and consumer economics. Ignoring this aspect prevents us from addressing the environmental costs we collectively bear.”

“The 'Invisible' Materiality of Information Technology”

'Invisible' Materiality of Tech

Information Technology (IT) has profound material impacts from the extraction of raw materials, manufacturing, energy consumption in operation, to final disposal (e-waste). Yet, these physical and environmental externalities remain largely invisible in mainstream discourse, which focuses heavily on IT's technical aspects and benefits.

The problem

- Projections estimate 20–30 billion connected devices (commonly referred to as the Internet of Things or IoT) by year-end, translating into massive material, energy, and waste footprints.
- Reports like the U.S. GAO's review of IoT barely mention e-waste (only 2 paragraphs in a 70-page report) and even less so raw materials or energy consumption
- Online information on IoT overwhelmingly emphasizes benefits and environmental costs are rarely discussed.

Why it matters now

- Ever-accelerating expansion of computing (e.g. proliferation of IoT, data centers, AI).
- As tech embeds deeper into everyday life, its material footprint escalates dramatically.
- Without critical reflection, the pace of innovation perpetuates environmental and social harms.



We are now in an era in which the safe operating boundaries for many processes and ecosystems are being transgressed by human activity.

There are some important examples of grappling with issues around sustainability and the material side of IT, but by and large the result of this invisibility is that discussions and debates about its positive versus negative material impacts are often simply not occurring.

"The 'Invisible' Materiality of Information Technology"

Factors that obscure material impacts

Academic Abstraction in CS

CS disciplines tend to abstract away hardware and prioritize conceptual efficiency over material consequences

Metaphors & Utopian Visions

Conceptual framings like "cloud computing" and "the Internet" mask their physical infrastructure

Hardware Invisibility

Users and developers seldom see production/disposal of hardware, instead viewing IT as "clean" and intangible

Economics & Growth Models

Market pressures prioritize scale, performance, and growth, rather than lifecycle impacts or sustainability.

Cultural Norms in Computing

The IT community values abstraction and innovation speed; materiality is often seen as "out of scope"

What we can do

Re-integrate materiality: Bring it into curriculum, research, and design; don't treat hardware as merely "infrastructure."

Promote visibility: Data center energy usage, e-waste statistics, supply chain footprints should be made central in discourse.

Foster new metaphors: Support narratives emphasizing sustainability and physical consequence.

Research & policy: Conduct lifecycle assessments; advocate for policies that internalize environmental costs.

Norm change: Embed environmental responsibility into developer and engineering values.