ATEA SUSTAINABILITY FOCUS

March 2026

Rethinking minerals

An urgent call for a new approach on minerals

YOU HAVE JUST opened Atea Sustainability Focus's (ASF) ninth report on sustainable development in the IT industry. Since 2017, front-runners representing Nordic organizations have addressed key areas for change through the ASF initiative. The mission is to spur action by issuing recommendations to the Responsible Business Alliance (RBA), brand owners, and their peers on how to address the most critical sustainability topics.

Minerals hold our future

The 2026 theme puts the spotlight on an area whose urgency is escalating rapidly: minerals. These tiny components are critical enablers of the green and digital transformations, but challenges are mounting fast. Demand is surging while geopolitical tensions are increasing. Current social and environmental issues related to extraction are far from resolved, and secondary markets remain underdeveloped.

This is a major concern for Nordic IT buyers, who place responsible mineral sourcing high on their agenda. They see a need for a fundamentally new approach where collaboration, creativity and transparency are at the core.

Atea Sustainability Focus provides the IT industry with valuable insights of the expectations and preferences of the Nordic market as well as recommendations on how to address urgent sustainability issues. The recommendations are crafted by the ASF Advisory Board consisting of representatives from leading Nordic public and private companies with a background in IT, sustainability or purchasing.

See the position statement from the Advisory Board and the full list of recommendations on p. 6.

Key recommendations are:

- **FOR THE RESPONSIBLE BUSINESS ALLIANCE** – to strengthen advocacy and cross-sector collaboration.
- **FOR BRAND OWNERS** – to broaden reporting, diversify supply chains and reduce reliance on virgin minerals through increased investments in circularity.
- **FOR BUYERS** – to accept transparent, true-cost pricing and reward actors at the forefront, and to build sustainable procurement capabilities that fully account for the risks and cost implications of irresponsible sourcing.

These recommendations build on extensive dialogue with the Nordic market and are a valuable indicator for the global IT industry – to get an understanding of buyers' future priorities and expectations.

Slow but visible progress

Communication on progress is an integral part of the ASF initiative. Alongside an overview of progress on living wage – the 2025 focus theme – the report updates on previous focus areas like circularity and transparency, which remains equally

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relevant for a sustainable transition. Progress may be gradual, but it is visible across all areas.

Advancing together

In the current regulatory and geopolitical landscape – marked by growing uncertainty and backtracking on sustainability ambitions – ASF plays a vital role in keeping sustainability firmly on the agenda. We provide a platform for dialogue among value-chain actors that is increasingly critical to sustaining progress. Through interaction between buyers, brand owners and the RBA, we firmly believe that our work helps generate a positive cycle in which collective actions drive stronger and shared outcomes. In 2026, we put this force in motion to rethink minerals. ■

The analyses on minerals, AI/data-center efficiency, and circular business models, as well as the progress on living wage have been produced in collaboration with sustainability consultant Ethos.

The triangle of impact

THE ATEA SUSTAINABILITY FOCUS initiative (ASF) was launched in 2017 to be a catalyst for sustainable development in the global IT industry by leveraging the leadership of the Nordic market. The unique theory of change reads as follows:

1. Views of the Nordic market on sustainable IT are gathered through the ASF Dialogue and shared with the industry.

2. The insights help actors in the IT industry to focus their efforts on what is material to their most advanced customers.

3. Increased maturity means that suppliers can meet customer demands.

4. Progressive buyers can then raise expectations further.

The ASF initiative provides a platform for continuous improvement by connecting and delivering value for three actors that are fundamental for driving change: organizations that buy and use IT (buyers), brand owners/manufacturers and the industry's main sustainability coalition, The Responsible Business Alliance (RBA). We call it the Triangle of impact (table 1).

Buyers drive change through their IT purchases and how they organize their IT operations. Understanding of buyers' future priorities and expectations help individual brands respond to the needs and expectations of their customers faster and better – progress that can be scaled more effectively through the RBA collaboration.

We believe that impact happens when we connect these dots.

Camilla Cederquist
Head of Atea Sustainability Focus

See an overview of the ASF initiative on page 23.

Deep dives on all three topics are avaialable in the digital version of this report.

See Circular Economy (2019), Closing the Loop (2020) and "Get more from less" (2022) that can be found at atea.se/en/sustainable-it/atea-sustainability-focus/

ASF not only addresses key areas for change but also outlines approaches to reach these goals. This is done by the ASF Advisory Board that consists of a group of dedicated individuals and sustainability front runners representing Nordic organizations. Their mission is to spur action by issuing recommendations to the RBA, brand owners, and their peers on how to address the topic deemed to be most material.

Rethinking mineral use

For his report The Advisory Board reviewed three themes identified as critical for the industry by the Nordic IT buyers: responsible sourcing of minerals, circular business models and AI/data-center efficiency.

Circularity has been the topic of several previous reports, and the Advisory Board reasoned it might be too early to focus on AI. Rethinking how we use minerals incorporates all three proposed themes as minerals are indispensable for AI technology and circularity is crucial to meeting increasing demand.

Responsible sourcing of minerals is one of the greatest challenges facing the IT sector. A complete reset of mineral sourcing is needed to meet the growing

The ASF reports 2018–2026. The themes have addressed all major sustainability challenges for the IT industry.

demand. Innovative mindsets, shared responsibility and new collaborations are urgently requested to scale up the secondary market and to ensure that new minerals are extracted with minimum harm to people and ecosystems.

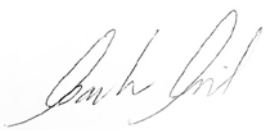
Never has the triangle of impact had a greater task to solve – but the Nordic buyers are ready to act.

You can read the Board's position statement and their recommendations on page 6.

Taking ASF to the next level

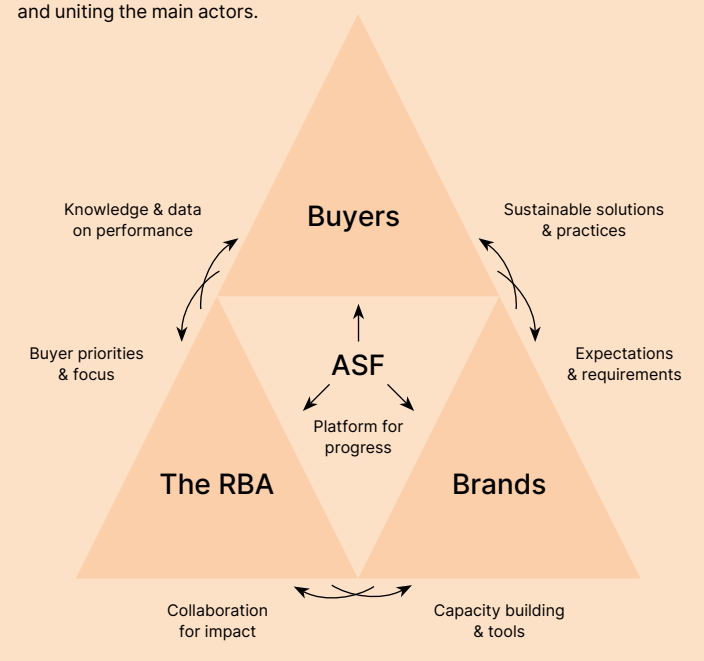
In 2026 we will revamp the ASF initiative to spur more action and accelerate transformation. Building on the insights we want to empower buyers with practical tools and create measurable impact – to build a leading platform for sustainable development in the IT industry, based on the triangle of impact. We will extract more value from the data collected, develop a clear path for success, and closely monitor progress.

No matter who you are reading this, you are an essential part of this journey – so stay tuned. We are excited for you to join us as we move forward. ■



CAMILLA CEDERQUIST
Head of Atea Sustainability Focus

Table 1. The triangle of impact illustrates how the ASF initiative influences sustainable development in the IT industry by targeting and uniting the main actors.



Turn the tide now – rethink minerals

THE WHOLE WORLD is on the hunt for minerals*. Major technology shifts like AI/digitalization, electrification and the clean energy transition escalate demand in a sector already challenged by human rights abuses and environmental degradation. If left unaddressed, this will lead to supply shortages and severe harm to affected communities and ecosystems. It will be a race to the bottom.

From a Nordic perspective, the sustainability and resilience of critical mineral supply chains is not only a matter of corporate responsibility – it is a strategic necessity. Nordic buyers operate in markets with high expectations on environmental integrity, respect for human rights, transparency, and long-term value creation. As demand accelerates, we see an urgent need to act faster and set clearer expectations to ensure the green and digital transition upholds these values rather than undermines them.

For more information about the significance of minerals, the current situation and projected development, see "Industry analysis" on p. 11.

We recognize the progress made over the years, but the urgency of the situation demands a radical overhaul of how minerals are sourced, circulated, and governed. We need to do more, do things differently, and do better.

Without minerals, there can be no transition and no digitalization. Together, we must find a better way.

I. Risk Escalation in the green and digital transition

A. Current Challenges

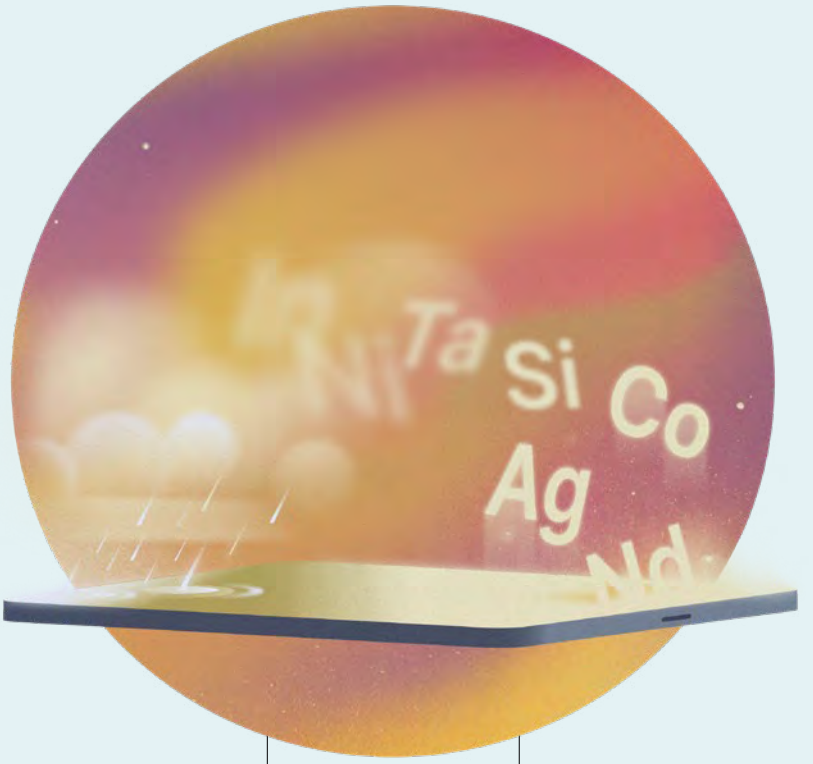
Extraction of many minerals critical to the green and digital transition is directly connected to deadly conflicts, systemic human rights abuses (child labor, forced labor), major environmental damage, and growing mining waste. Although the IT industry is working hard to improve sourcing and traceability, significant challenges still exist and will likely worsen as demand surges.

B. Supply scarcity and geopolitics

Minerals are finite resources, and demand is projected to exceed supply for lithium and copper already in the mid-2030s[1]. Scarcity leads to increasing geopolitical tensions between the dominant players over access, especially as a few countries sit on most of the supply and control large

* The minerals in scope include those essential for IT, renewable energy, and electrification. This includes both the so called conflict minerals (tin, tungsten, tantalum and gold) as well as transition-critical minerals like copper, lithium, cobalt, nickel, manganese, graphite, aluminium and rare earth elements.

1 https://www.iea.org/reports/global-critical-minerals-outlook-2025/overview-of-outlook-for-key-minerals



parts of the value chain. Increased competition may compromise due diligence efforts, especially with the regulatory and political backlash on corporate sustainability and due diligence we are experiencing in both the EU and US.

II. The Accountability Gap

Despite established frameworks, such as those governed by the Responsible Business Alliance (RBA) and its initiatives, few quantified results about impact on rightsholders and affected communities can be obtained, making it difficult for downstream actors to assess impact and identify effective measures.

III. Taking the minerals issue to the next level

To make sure minerals will be a positive mechanism for sustainable transformation and not turn into a major industry and sustainability crisis, we need to do two things:

1. Secure future supply by increasing the availability of recycled minerals while at the same time limiting overall demand through greater resource efficiency.

2. Make sure virgin minerals are responsibly extracted in a way that can be verified by downstream actors.

This requires a holistic transformation that includes the diversification of supply chains, proactive support for responsible mining, and a stronger focus on innovation. We need to accelerate circular practices and drastically increase recycling rates, material efficiency and product longevity. We also see an opportunity for a stronger industry voice, increased adoption of new technologies to increase traceability, and improved collaboration and communication around tangible impact.

We, the Nordic buyers, look forward to collaborating with all stakeholders in building a better, fairer and more resilient path for minerals. ■

Recommendations to the Responsible Business Alliance

1. Improve tracking and communication of impact

- Increase efforts to improve tracking of real impact in the supply chain and communication on progress with buyers. This will enhance buyers' ability to contribute to positive change. Considering the projected development, the first step in identifying and exploring new pathways is to assess what has worked and where the gaps are.

2. Advocacy & collaboration

- Reinforce the industry's voice and advocacy efforts, not least in the EU, to secure a sustainable supply of critical minerals, strengthen the position of rightsholders and enforce implementation of existing frameworks.
- Invite rightsholders to the table to make affected people part of the solution.
- Build cross-sector collaboration with the automotive and clean-energy industries, to increase the impact of advocacy efforts and enable solutions that are sustainable in the long term.

3. Tools

- Leverage new technology to improve product-level traceability and transparency across sectors. Explore the potential of collaborating with other mineral-heavy industries.

Recommendations to brand owners

4. Scope & communication

- Broaden the scope of reporting beyond the so called 3TGs (tin, tantalum, tungsten, gold) to include lithium, cobalt, nickel, graphite, copper, aluminum, and rare earth elements.
- Provide structured updates on progress on pre-defined measures. This includes actions taken to mitigate identified gaps across the product life cycle, so buyers can understand the risks and support the targeted improvements.
- Increase transparency on the true cost of responsibly sourcing minerals and investigate ways to guarantee that a price increase will benefit this work.

5. Circularity and innovation

- Take further steps to embrace circularity, focusing on integrating service models, minimizing the reliance on virgin minerals, and curbing material throughput.
- Increase R&D efforts on circular design, recycling of minerals and increased product longevity. Collaborate with other brand owners in a pre-competitive manner.

6. Sustainable supply chains

- Explore opportunities to diversify the mineral supply chain to increase resilience to geopolitical fluctuations and deadlocks.

- Move beyond traditional auditing and identify alternative measures that foster a collaborative partnership with suppliers and shared goals with buyers.

We commit to, and recommend our fellow buyers to:

7. Incentivize responsible sourcing

- Actively contribute to promoting responsible sourcing by accepting transparent true-cost price adjustments and reward actors at the forefront.

8. Capacity training

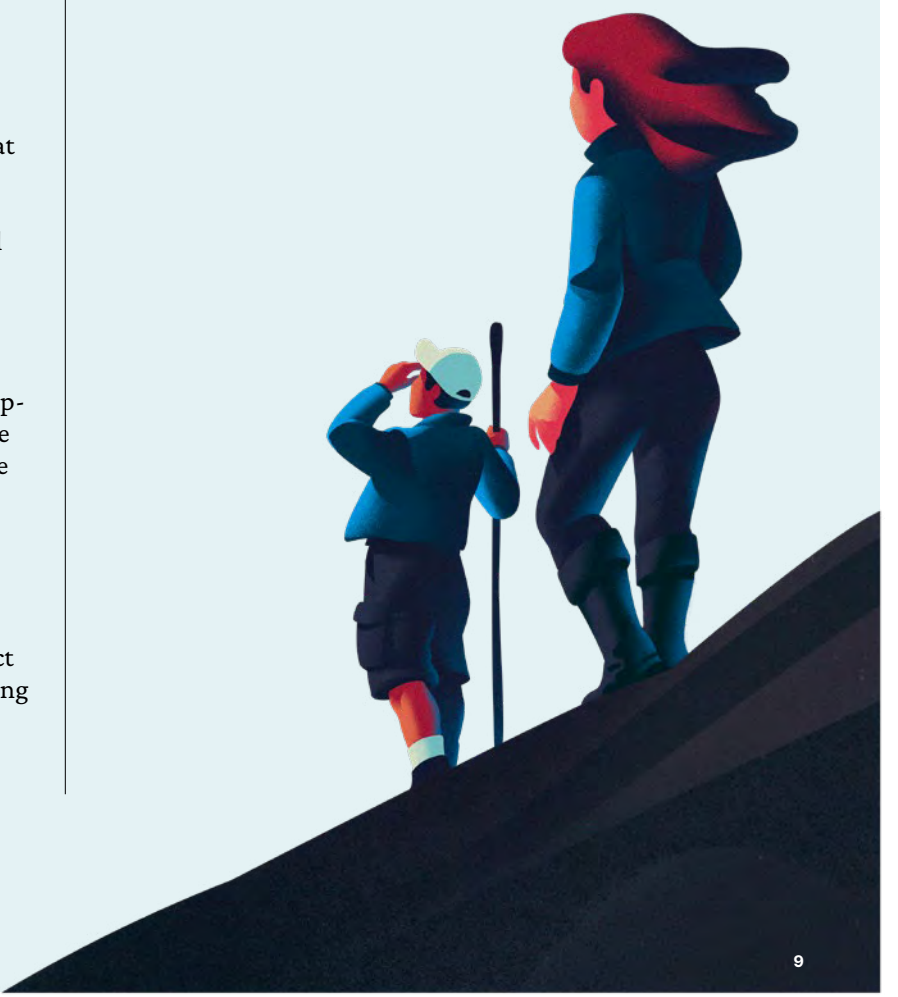
- Build procurement capabilities that prioritize sustainability, ensuring every sourcing decision reflects an understanding of the risks and full cost implications of irresponsible sourcing.

9. Procurement process changes

- Encourage and support the development of certification models on the product level (through for example RMI /IRMA).
- Rethink procurement processes to account for life-cycle cost and circularity.
- Advance the respect for social and human rights by including contract clauses, e.g. Responsible Contracting Project[2], where responsibility for a sustainable supply chain is shared among value-chain actors.

10. Use buying power to shape markets

- Use coordinated buying power to send clear, long-term market signals that transparency, responsible mineral sourcing, and circularity are baseline expectations.
- Align requirements and follow-up mechanisms where possible, to support suppliers in scaling solutions efficiently across global IT value chains. ■



2 https://www.responsiblecontracting.org/

Minerals and circularity top buyers' agenda

THE ASF DIALOGUE captures the priorities and expectations of Nordic IT buyers regarding sustainability in procurement and forms the theme and recommendations of this report. With a strong tradition of progressive purchasing, the Nordic market continues to set the tone for the global IT industry. This year's survey shows that circular solutions remain central and that responsible sourcing of minerals is high on the agenda.

The ASF Dialogue survey was distributed to target organizations of all sizes and sectors across the Nordics. Respondents were segmented based on their prioritization of sustainability, ensuring insights from both frontrunners and those earlier in their journey.

Key findings

- Circularity remains a key priority in procurement practices as well as expectations on the industry, with desires for longer product lifespans, asset recovery, and refurbished devices.
- The private sector's participation is growing, likely driven by regulatory developments.
- 46 percent of respondents rate sustainability as a high priority in IT procurement. Sustainable purchasing measures are widely applied even among those that claim that sustainability in IT is a low or fairly low priority.
- The appetite for refurbished devices is rapidly increasing, with nearly half of respondents having purchased or planning to purchase refurbished IT equipment.
- There is a strong business case for sustainability: 47 percent have paid or plan to pay a premium for more sustainable products, and nearly a third have excluded suppliers that did not meet their sustainability standards.
- Emerging topics include AI and data-center efficiency, as well as addressing software-driven hardware obsolescence — areas expected to gain prominence in the near future.

579

Number of respondents

27%

Share of respondents from organizations with 5,000+ employees

The case for minerals

43%

of respondents that have a strong focus on sustainability favor suppliers that promote responsible extraction of minerals

43%

of respondents picked minerals as the top industry focus for sustainable supply chains.

Upcoming priorities

- Those that claim sustainability is a low or fairly low priority in IT procurement will put more focus on requirements that promote longer product lifespans, while the advanced buyers will include requirements on RBA membership, refurbished devices and software updates.
- Both groups will increasingly expect suppliers to submit carbon footprint reports. They also intend to increase recovery of used assets.

Advanced buyers' expectations

- For sustainable supply chains, Nordic IT buyers at the forefront request an industry focus on responsible sourcing of minerals.
- Within climate, the industry is expected to improve AI and data-center efficiency.
- To improve circularity, Nordic buyers want the industry to combat e-waste and implement circular business models. ■

Disclaimer: The survey was distributed through Atea's channels across the Nordics and is open to anyone. Therefore, the results more likely reflect the views of sustainability engaged organizations than the views of a random selection.

Minerals matter

MINERALS ARE the indispensable foundation of modern IT. They enable everything from the speed of a processor to the lifespan of a battery. Given the vast environmental, social, and geopolitical challenges associated with mineral extraction and processing, companies are under growing pressure from regulators, investors, and consumers to ensure their products are sourced responsibly and sustainably.

Critical raw minerals include a variety of rare earth elements as well as nickel, lithium, cobalt, mica, copper, aluminum, and 3TGs (tin, tantalum, tungsten, and gold) also known as conflict minerals as control of mining operations is marked by conflict.

A list of references can be found in the Appendix, available in the digital version of this report.

Why they matter

The green and digital transition requires high amounts and a great variety of minerals. Many of these are deemed critical due to their economic importance to new technologies and the risk of supply chain disruption. Recycled minerals cannot meet the rapidly increasing demand (UN Department of Economic and Social Affairs), and studies show that the demand for critical minerals could fourfold by 2030 (UNCTAD).

Social Impacts

Mineral extraction is frequently linked to human rights abuses, such as child labor, forced labor and poor working conditions. Risks are heightened at artisanal and small-scale mining (ASM) sites, which often lack legal status or regulatory oversight.

The Democratic Republic of Congo (DRC) is a major source of conflict minerals (3TGs). Some artisanal mines are controlled by armed groups involved in massacres of civilians, mass rapes, looting, and other crimes, according to UN experts and human rights groups (Reuters). Large industry actors are re-evaluating their strategies, including Apple who instructed suppliers to stop sourcing from the region in June 2024, citing escalating conflict as well as smuggling and illegal taxation (Apple).

Geopolitics

The supply of critical minerals is dominated by a few countries, making sourcing vulnerable to geopolitical shifts, trade alliances, and increased competition for resources. The DRC accounts for 50 percent of global cobalt reserves and 70 percent of global production, while Indonesia is estimated to control 51 percent of nickel production (IEEFA). The processing is dominated by China, see table 2.

Country	Nickel	Copper	Lithium	Cobalt
China	68%	40%	59%	73%

Table 2.
Share of refining controlled by China.

This domination over the value chain has exposed global vulnerability to the critical mineral supply. Beginning in 2023, China has escalated its export controls with various forms of restrictions and export bans (Deloitte, 2025).

Consequently, strengthening domestic recycling and midstream manufacturing and processing, particularly in the US and the EU, is key to reducing reliance on imports and to enhance supply chain security (RMI).

Environment

The environmental impact of mining and mineral processing include pollution of air, water, and soil, harm to wildlife and habitat, deforestation, encroachment on protected areas, and significant carbon emissions.

Mining activities may also lead to water withdrawal in water-scarce locations, followed by population displacement and land conflicts (Berthet et al.) as well as waste management problems (SGU, 2022), and negative impacts on biodiversity.

Mining waste can pose a significant health risk to people and environment. Failure to address these risks threatens the green and digital transition, and causes major business consequences such as limited market access, litigation and legal barriers, reputational harm, reduced investment, and stakeholder opposition (including indigenous peoples and local communities), resulting in costly operational disruptions (OECD, 2025).

Progress on responsible sourcing

Transparency and traceability are key to shed light on complex supply chains and ensure ethical and sustainable practices – from origin to product.

Transparency

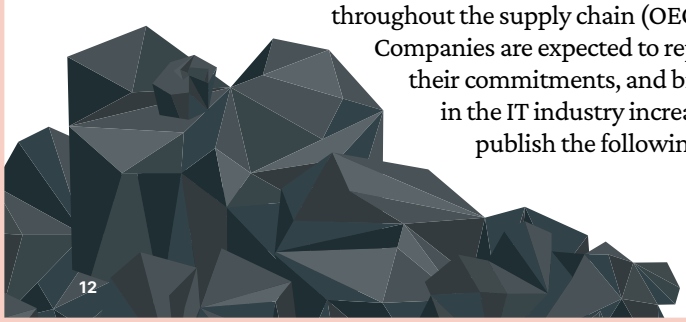
Transparency means clear, timely, and comprehensive disclosure of information about the origin, production, and movement of materials, as well as the social, environmental, and governance practices throughout the supply chain (OECD, 2016).

Companies are expected to report on their commitments, and brands in the IT industry increasingly publish the following:

- **Conflict Minerals Reports.** Mandatory report to the United States Securities and Exchange Commission (SEC) if listed.
- **Responsible sourcing reports** – details supply-chain due diligence (ICC).
- **Life-cycle assessments** for specific products provides a systematic and comprehensive understanding of environmental impacts (Ericsson).

Operational tools

OECD and the RBA provide operational tools that form a backbone for achieving transparency.



Transparency and traceability are key to shed light on complex supply chains and ensure ethical and sustainable practices – from origin to product.

- **OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas** (OECD Guidance) – a government-backed, five-step framework requiring annual reporting on due diligence efforts that mandate public disclosure of policies, risks, and mitigation strategies.

- The RBA provides through the Responsible Minerals Initiative (RMI) the **Responsible Minerals Assurance Process (RMAP)** that conducts independent, third-party audits of high-risk smelters and refiners.

- **The RMI Public List** discloses the names of facilities that are determined to be conformant with the OECD standard, offering companies a frequently verified, sourcing assessment to de-risk supply chains and supply credible reporting on the origins of critical minerals (OECD, RMI).

- **RMI's Conflict Minerals Reporting Template (CMRT)** facilitates the identification of new smelters and refiners to potentially undergo an assessment via the RMI's RMAP.

- **The OECD Handbook** has increased the comprehensiveness of disclosure (OECD).

Traceability

For a product to be defined as traceable it must be possible to determine its origin with a certain degree of confidence – to trace where it has travelled, who has handled it, and what modifications it has undergone (OECD, 2025).

Chain of Custody Models
The ISO 22095:2020 outlines several models, including:

- **Segregation:** Certified and non-certified materials are kept physically separate throughout the supply chain (which is extremely challenging for minerals).

- **Mass Balance:** Allows the mixing of certified and non-certified materials, with proportions disclosed.

- **Book and Claim:** Tradable certificates ensure that an amount of product with certified characteristics has been produced (ISO 22095). Fairphone's "Cobalt Credits" is one example.

Digital Tools

Digital solutions can replace traditional paper documentation, serving as powerful audit tools by immediately flagging non-compliances.

- **Geographic Information Systems (GIS)** platforms create visual, map-based representations of the supply chain, integrating mineral deposit locations, processing facilities, logistics infrastructure (ports, rail), and environmentally sensitive areas (ESRI, 2025).

- **Responsible Business Transparency Protocol (RBTP)** is a data exchange framework developed by the RBA that builds on the UN Transparency Protocol. Designed to work with existing tools and technology platforms, its main purpose is to enable verifiable, portable, and interoperable sharing of supply chain data across companies in the automotive, electronics, and related sectors (RBA, RBTP).

> Recycled minerals typically incur 80 percent less greenhouse gas emissions compared to their counterparts.

Supply-Chain Mapping

Companies undertake extensive supply-chain mapping, identifying smelters, refiners, sub-contractors, and sub-suppliers for key materials. This generally includes information on entities involved at various tiers in the operator's supply chain – raw material producers, traders, processors, manufacturers, transporters, distributors – and their geographical locations. Mapping provides a snapshot of the operator's supply network at a specific point in time, showing all players involved in producing and delivering a particular category of products (Apple, 2024; OECD, 2025). However, national data-protection laws can directly impede cross-border traceability efforts.

Remaining challenges

Ensuring traceability for critical minerals involves creating a complete and verifiable digital or physical record that tracks the material's origin, physical transformation, chain of custody (ownership), and geographical path from the mine to the final product. The challenges include:

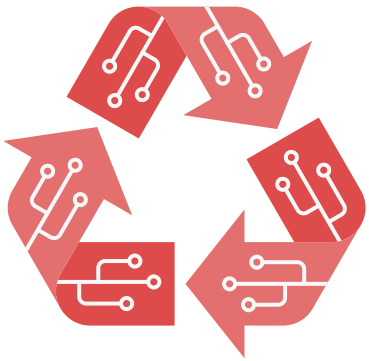
- **Data quality** as data received from supply chains is often self-reported and unverified; manual work retrieving and entering data across different platforms can lead to data errors.
- **Reporting fatigue** when expanding ESG reporting may require resource-intensive, overlapping sets of data entered into different systems or report templates.
- **Trade & legal confidentiality concerns** with data disclosure complicates information sharing in conflicting regulatory landscapes, i.e. China's Anti-Foreign Sanctions Law.
- **Suppliers' dependencies** – companies fear that imposing overly stringent or time-consuming due diligence requirements strain relationships with specialized key suppliers.
- **Informal Sector Integration** – the ASM sector often operates in unsupervised, marginalized, and even criminalized environments. Integrating these sectors responsibly remains a major hurdle.
- **Geographical Scope/Accessibility** – some regions may be inaccessible for independent assessments due to conflict or heightened security risks.

The value of recycling

Recovery of materials can secure a valuable supply source. Recycled minerals typically incur 80 percent less greenhouse gas emissions compared to their counterparts – producing aluminum from raw ore requires 95 percent more energy than recycling aluminum (Allied Salvage).

The challenges

- **Insufficient availability.** The current pool of recycled materials cannot meet the rapidly growing demand (DESA). From 62 million metric tons of e-waste. generated globally in 2022 only 22.3 percent was formally recycled (UNITAR).



- **Quality performance** and purity specifications can make it challenging to integrate recycled content (Nature).

- **Informal sector risks,** as the recycling value chain can be opaque with large proportions of e-waste treated by unknown means or moved across borders without control (E-Waste Monitor). Millions of workers globally are involved in handling e-waste, often facing hazardous conditions and without regulatory protection (E-Waste Monitor).

The industry approach

The RBA and its initiatives, the Responsible Environment Initiative (REI) and the Responsible Minerals Initiative (RMI), are working to ensure that due diligence processes for minerals and metals can be applied to scrap and recycled content, emphasizing data standardization, improved supply-chain design for integrating reclaimed materials, and greater assurance in e-waste processing (RBA).

Companies have pioneered the use of recycled rare earth elements in electronics. For example, nearly all magnets across Apple devices use 100 percent recycled rare earth elements (Apple). Lenovo uses recycled metals and rare earth metals such as aluminum, magnesium, copper and steel. Fairphone focuses on fair sourcing principles for recycled materials, including batteries and post-consumer recycled (PCR) materials (Fairphone).

Industry collaboration

Industry collaboration and capacity building are key to surpassing individual company limits and shaping policy and practice.

Collaboration initiatives

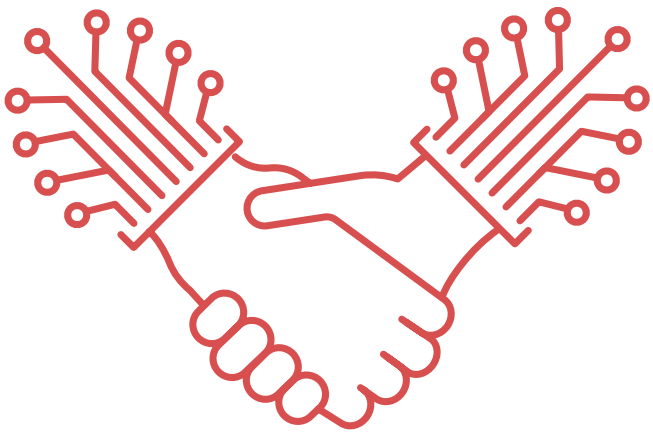
- **OECD and RBA** – through RMI and REI – promote industry collaboration as a fundamental principle for responsible mineral sourcing.

- **The London Bullion Market Association** (LBMA) collaborates with the RMI through cross-recognition of audits and alignment with OECD guidance (RMI) and works with the Swiss Better Gold Association (SBG) to improve responsible sourcing in precious metals (SBG).

- Co-founded by Fairphone, the **Fair Cobalt Alliance (FCA)** brings together major industry players, governments, and civil society to address pressing issues in the artisanal cobalt mining sector in the DRC, focusing on capacity building and empowering local communities (Fairphone, 2020).

Capacity-building initiatives

- **The Extractive Industries Transparency Initiative (EITI)** provides guidance and capacity building to help implement requirements relevant to the extractive sector and supports multi-stakeholder dialogues and workshops to engage communities in a just transition.



- **RMI** offers in-dept and in-person training in multiple geographies.

- **The West Africa Capacity Building Program** on the OECD Due Diligence Guidance, (2019 to 2020) in Burkina Faso, Mali, and Niger, aim to increase the scope of the OECD Guidance among mining stakeholders.

The policy Landscape

- **The Critical Raw Materials Act (CRMA)** – an EU legislation that aims to diversify supply chains away from single dominant sources, with established targets for domestic recycling (25 %) and processing (40 %) of critical minerals by 2030.

- **EU Conflict Minerals Regulation** directly enforces due diligence for EU importers of tin, tantalum, tungsten, and gold (3TGs), and makes the OECD Due Diligence Guidance a legal requirement when sourced from Conflict-Affected and High-Risk Areas (CAHRAs).

- **Corporate Sustainability Due Diligence Directive (CSDDD)** mandates large EU companies, and certain non-EU companies, to identify, prevent, mitigate, and account for adverse human rights and environmental impacts throughout their entire value chain.

- **Dodd-Frank Act, Section 1502** is the pioneering piece of legislation that requires US Securities and Exchange Commission (SEC)-listed companies to investigate and report on whether the 3TGs in their products originated in the DRC or adjoining countries – to curb the use of minerals that finance regional conflict.

- **Inflation Reduction Act (IRA)**, primarily a climate and energy funding package that exerts massive influence over sourcing. To qualify for consumer tax credits for electric vehicles (EVs), a percentage of the critical minerals must be extracted or processed domestically or in countries with which the US has a Free Trade Agreement (FTA), or be recycled in North America. It favors partners who adhere to higher labor and environmental standards to drive responsible sourcing of minerals (US Treasury). ■

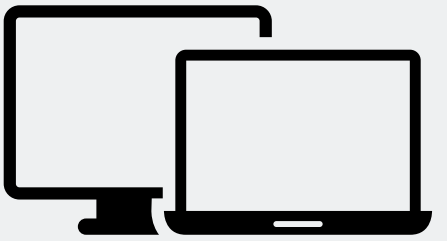
Case studies

Fairphone

Fairphone's vision of "Fair Circularity" aims to ensure that materials benefit people and communities involved in their production and processing with a focus on inclusion and support of artisanal and small-scale miners (ASM), which is estimated to be the livelihood of 44 million people globally (Fairphone 2020). See examples in the right column.

- **Supporting artisanal and small-scale mine operators (ASM) to improve their practices.**
- **Preventing child labor by supporting school enrollment and providing vocational training.**
- **Increasing household income by investing in off-site community programs to create sustainable livelihoods.**
- **Being the first company to purchase Cobalt Credits and pay a premium for cobalt from sites that meet basic sustainability criteria and commit to continuous ESG improvements.**

- **By the end of 2025, all Apple-designed batteries will contain 100 percent recycled cobalt, magnets in Apple products use 100 percent recycled rare earth elements, and all Apple-designed printed circuit boards use 100 percent recycled tin soldering and gold plating. In 2024, 76 percent of cobalt in Apple products came from certified recycled sources.**
- **Apple operates a Material Recovery Lab (MRL) in Texas, and advanced recovery centers to develop and operationalize new recycling technologies on scale.**
- **The same rigorous, responsible sourcing standards apply to recycled materials as to primary materials, including tracing the supply chain and requiring due diligence in accordance with OECD Guidance from all suppliers and material processors (Apple, Newsroom, 2025, 2025 Progress Report, How we work with suppliers, 2022).**



Apple

Apple has pledged to buy American-made rare earth magnets, a deal that includes establishing a rare earth recycling line in California and developing novel magnet materials and processing technologies – to strengthen the domestic supply of critical materials.

See examples of how Apple integrates recycled materials in the left column.

Progress despite headwinds

IN 2025, the obstacles to sustainable development intensified. At a time when global collaboration is more critical than ever – just four years away from the Paris Accord – the world is marked by war, protectionism and nationalism. The subsequent focus on security, resilience, and competitiveness has sidelined sustainability and triggered pushbacks against related policies and initiatives.

However, the forces set in motion for a better future are hard to halt. Second-hand markets are growing, renewable energy is made more available and electric vehicles are taking over the roads. In the IT sector, data centers are becoming more energy-efficient, products made more durable and repairable, and technological advances are improving transparency and traceability across supply chains. Overall, 2025 shows progress, but it still falls short of what is required.

This overview focuses on last year's theme – living wage, but development in other areas raised by the ASF initiative should also be highlighted:

More info about the RBTP can be found on p. 13.

On transparency

- RBA's data exchange framework, The Responsible Business Transparency Protocol (RBTP), will enable sharing of supply-chain data across companies.

On circularity

- Several brands offer OEM certified refurbished devices.
- Increased repairability, like modular USB-C ports (Dell Technologies) and customer-replaceable batteries (Lenovo).
- RBA is leveraging RMI tools to ensure the same due diligence approach for both virgin and recycled materials.
- Increased industry collaboration around circular design with, for example, an updated design guide from the Circular Electronics Partnership.

On climate

- RBA developed guidance to support members and suppliers in transitioning to renewable energy.
- RBA is collaborating with Global Electronics Association to develop Scope 3 category 1 reporting guidance with the aim to increase harmonization around GHG reporting.

On scaling impact

- RBA promotes membership development by clearly defining activities that are considered baseline or leadership (beyond the RBA Code of Conduct).
- Expanding stakeholder engagement is one of the key areas in RBA's strategy for the next five years. ■

Atea Sustainability Focus 2025: The path to living wages.

The fight for living wages

IN THE ASF REPORT "Focus on people: The path to living wages" in 2025, Nordic IT buyers made the following recommendations to the Responsible Business Alliance (RBA):

1. **By the end of 2025, produce a roadmap for the implementation of living wages**

2. **Set a baseline**

3. **Build awareness**

4. **Advocate for including living wages in the next update of the RBA's Code of Conduct**

In the IT sector, where global sourcing and complex supplier networks are common, living wage plays a pivotal role in ensuring social sustainability and operational resilience. It reflects a supplier's maturity in ethical labor practices and living wage policies reduce exposure to severe labor risks – issues that carry reputational and regulatory consequences.

It is estimated that 28 million people are trapped in forced labor globally, often due to wage underpayment (Shen et al. 2025).

According to a study by the Living Wage Foundation (WEF), 75 percent of businesses offering a living wage reported increased employee motivation and retention rates (WEF). The same study reports that 87 percent of companies surveyed experienced an improved reputation after adopting living wage policies. Workers earning a living wage are less reliant on overtime, experience less stress, and show reduced absenteeism and higher morale, which contributes to a more stable and resilient supply chain.

What the RBA is doing

The RBA leads a taskforce on living wage with major IT brands, providing a forum for members to share practices on implementation, discussing best practices and how a living wage clause could be included in the RBA code of conduct.

Industry stakeholders, led by the RBA, are actively collecting wage data to establish benchmarks and define fair wage

thresholds across the IT supply chain. The RBA has made significant strides in mobilizing its member companies around this issue, fostering collaboration and transparency.

The RBA Code of Conduct sets minimum standards for labor practices, including fair wages, working hours, and humane treatment. While it does not mandate living wages outright, it encourages companies to go beyond legal minimums and align with international standards such as those from the OECD Guidelines for Multinational Enterprises, International Labor Organization (ILO), and UN Guiding Principles on Business and Human Rights (RBA). Living wage will likely be part of RBA's Code of Conduct in 2026 (Interview with RBA, October 2025).

What's stopping progress

Despite growing awareness and regulatory pressure, several systemic and structural barriers continue to limit progress on living wages in the IT supply chain. **Lack of harmonization** across regulations, certifications and standards is a barrier. Absence of standardized data collection and reporting on wages makes it difficult to measure progress or identify best practices. Without consistent metrics or benchmarks, companies struggle to assess wage gaps or track improvements. This opacity limits the ability of stakeholders – buyers, auditors, and regulators – to hold suppliers accountable or reward good performance (Atea).

Defining a living wage is challenging, as the necessary income to cover basic needs varies significantly based on geography, household composition, and changing economic conditions. In many production countries, governments set minimum wages that fall far below living wage estimates (Living Wage Indicator). These legal thresholds are often influenced by political and economic considerations rather than actual cost-of-living data (Sustainability Directory). As a result, there is no regulatory pressure to implement living wages, and suppliers are not incentivized to go beyond compliance. In a complex

and cost-competitive global market, with narrow margins and limited buyer support, suppliers may also cap wages to remain competitive (Shen et al. 2025).

All above underscores the need for coordinated action and clearer frameworks to bridge the gap between principle and practice. The concept of living wage requires pioneering organizations and businesses willing to champion its adoption – along with a business case that clearly demonstrates the value of paying a living wage (interview with Vattenfall, November 2025).

The Operationalizing Living Wages event, hosted by the ILO in April 2025, convened global stakeholders such as the RBA to transform living wage principles into action, emphasizing evidence-based methodologies. The event introduced ILO's new Living Wage Programme to integrate these principles into national wage-setting systems.

Who is leading the way?

There are examples of companies and organizations actively working with living wage.

- In their latest update, the ecolabel EPEAT incorporates criteria for living wage (EPEAT).
- Vodafone and HP have goals relating to living wages for their direct employees, but they lack a clear plan for tackling supplier living wages (Vodafone) (HP).
- Samsung is working with Business for Social Responsibility (BSR) to calculate a living wage for its workers. They conducted a comprehensive analysis of the living wage gap across 20 manufacturing sites. Based on the findings, they are actively enhancing wages and benefits at selected subsidiaries to better align with the living wage benchmarks established (Samsung).
- In 2023, Apple worked with external partners including the RBA, ILO, and the Fair Wage Network to collect and map wage data in key countries and regions across Apple's supply chain. The data is used to inform the global conversation on a universally agreed upon definition and calculation methodology, while identifying the tools, resources, and support they need to develop for their suppliers (Apple).

Frontrunners

Two companies stand out: Schnieder Electric and Fairphone.

Schneider Electric ensures that 100 percent of its employees receive at least a living wage, a commitment that has been recognized for the second year in a row in 2024 through the Living Wage Employer Certification awarded by the Fair Wage Network (Schneider).

In 2024, the company launched a three-year partnership with the WageIndicator Foundation, a global, independent non-profit organization dedicated to collecting, analyzing, and sharing data on living wages worldwide (WageIndicator) – to enhance transparency around global wage practices and support Schneider Electric and its suppliers to achieve living wages across their operations.

Communication is transparent. In their annual report from 2024, Schneider Electric indicates that living wage is the

A list of references can be found in the Appendix, available in the digital version of this report.

most frequent non-conformance with suppliers, where 90 percent lack a policy on living wage.

Fairphone aims to bridge the gap between actual and living wages for workers at its tier-1 suppliers. The strategy at the facility in Suzhou, China, was to calculate the living wage gap based on local data and determine the amount needed to supplement workers' existing wages. The living wage estimates were found to be double the legal minimum wage.

Fairphone then provided a financial, not performance-based, bonus to the supplier by increasing the product price (figure 1). This was distributed directly to workers as cash payment separated from regular wages or incentives to ensure it reached all eligible workers equally (Fairphone).

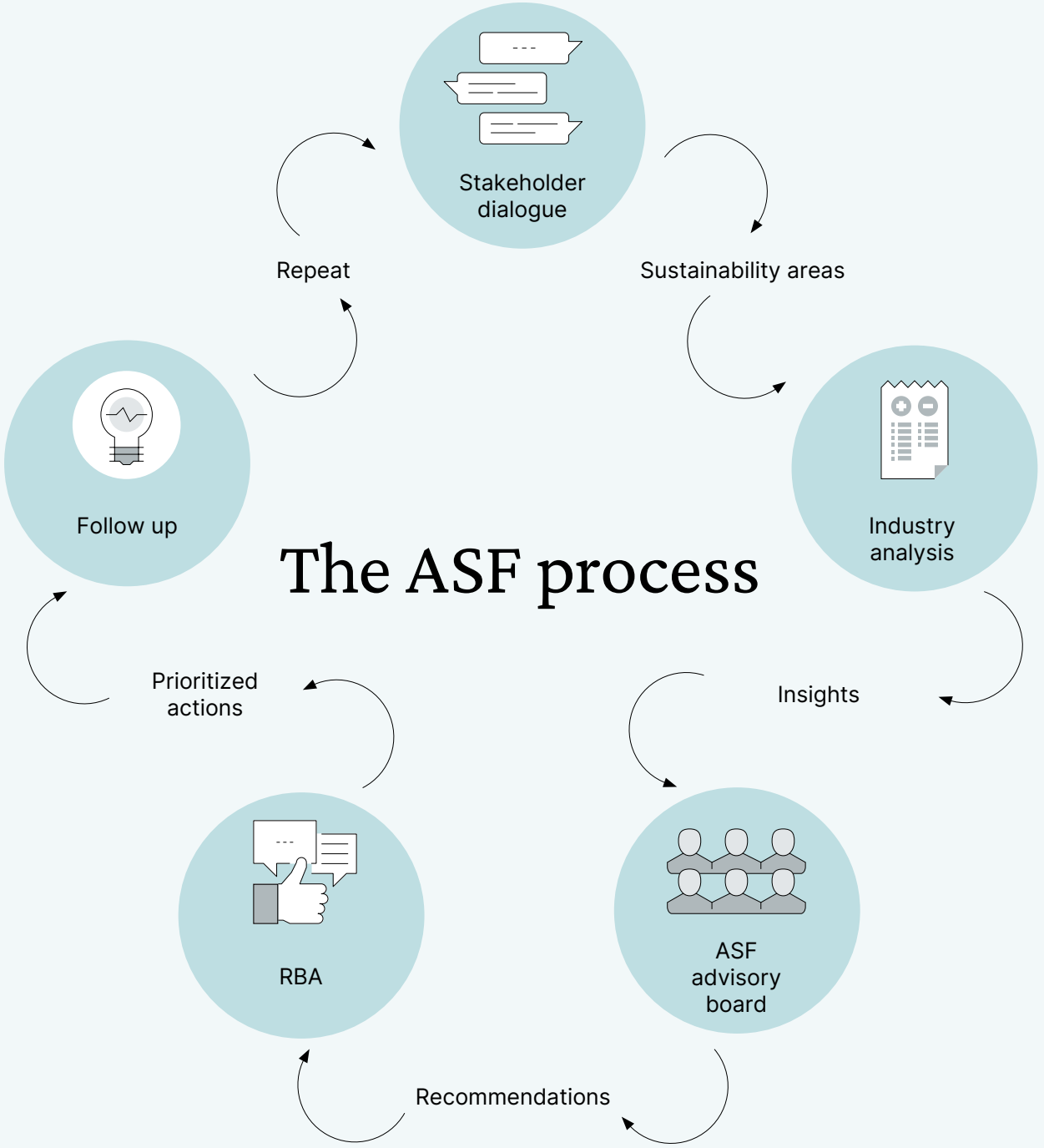
According to Fairphone, the initiative has positively affected worker satisfaction, with employees reporting improved morale and financial stability. It also encourages transparency and collaboration between Fairphone and its suppliers, setting a precedent for ethical sourcing practices.

The challenges have been ensuring the sustainability and scalability of the bonus program across more suppliers and navigating local wage structures and regulations to maintain compliance while promoting fair compensation. ■

Figure 1: Fairphone's calculation for determining the additional product price needed for living wages in Suzhou, China (Fairphone)

Additional wage per hour needed for an average production line worker to reach the target wage	**(monthly target wage 5000 RMB – average monthly wage of production line workers)/173 hours**
	X
Additional amount needed for all workers on Fairphone production line	**# of workers on production line**
	/
Amount needed per phone	**# of phones produced per hour**
	=
	1.50 EUR per phone

The ASF process



Stakeholder dialogue
Key sustainability aspects for Nordic IT buyers are identified through different kinds of dialogues and screening of procurement documents.

Industry analysis
Sustainability experts conduct an industry analysis to identify how the industry performs on the aspects identified by the buyers.

Recommendations
The ASF Advisory Board, comprised of leading IT and sustainability professionals from Nordic companies, municipalities and organizations, formulates concrete recommendations.

Handover to the industry
RBA and its member companies decide on specific activities to implement the recommendations from the ASF Advisory Board.

Appendix:

Deep dives on AI/data-center efficiency and circular business models.

This section offers an in-depth study of two topics central to Nordic IT buyers: AI/data-center efficiency and circular business models. This year's main theme – minerals – connects these areas as minerals are essential for AI technology, and since improved circularity is necessary to secure a long-term supply.

Contents

The surge for more power

Increasing AI and data-center efficiency

THE RAPID PROLIFERATION of AI and digital services, such as cloud computing and streaming services, is causing an unprecedented surge in resource consumption, particularly electricity and water, within data centers globally.

Electricity consumption

Globally, data centers accounted for approximately 1.5 percent of the world's electricity consumption in 2024, or 415 TWh which is equivalent to the electricity consumption of France. The growth rate has been about 12 percent per year since 2017 (IEA), a significant increase from previous estimates, driven largely by the rise of AI.

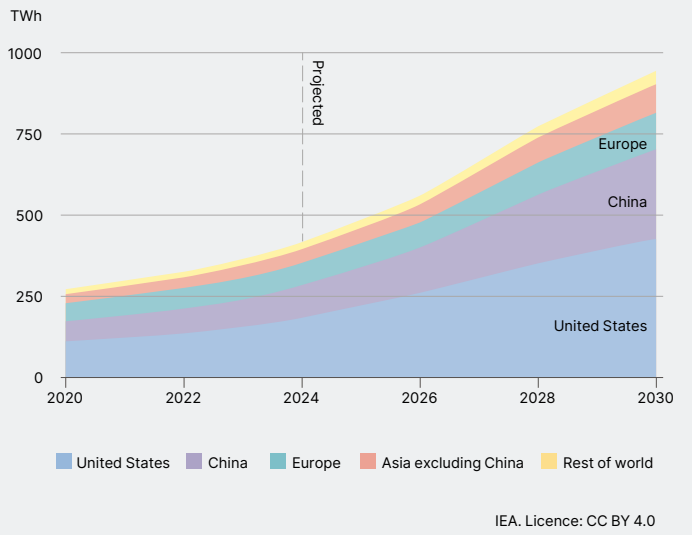


Figure 2. Projected data-center electricity consumption by region, Base Case, 2020–2030 (IEA).

Rapid growth

The base case scenario for global data-center electricity is that consumption will more than double by 2030 (IEA). Other estimates are even higher: Goldman Sachs projects that AI could drive a 165 percent increase in the same time (Goldman Sachs). In a lift-off case, assuming a strong uptake of AI and limited local constraints on data-center buildout, consumption could reach over 1,260 TWh by 2030, a threefold increase from today (IEA).

The range of how much electricity demand that comes – and will come – from AI is very wide. There is no comprehensive data on the share of the different kinds of workloads, and service providers often have limited visibility on the specific workloads running in their facilities.

AI and dead data drive the increase

The primary driver for this accelerated increase is the rapid emergence and deployment of power-intensive AI hardware, specifically Graphics Processing Unit (GPU)-accelerated servers. These servers, designed for workloads such as training and inference for large language models, consume significantly more power than conventional servers (Penn State IEE). In the US alone, GPU-accelerated AI servers grew in energy usage from less than 2 TWh in 2017 to more than 40 TWh in 2023 (Penn State IEE).

Moreover, 50 percent of stored data is rarely or never reused – a phenomenon called "dead data," or "dark data" – while it continues to consume energy for storage and associated cooling (RMI). The constant accumulation of data, particularly with the growth of AI applications, exacerbates this issue, necessitating

sustainable data-management practices to offset rising energy consumption (Semarchy).

Matches aviation emissions

Data centers produce about the same number of emissions as the aviation industry (AI Magazine). Utilities emphasize AI and data centers as key drivers of projected increases in electricity demand. However, the surge in demand should also be understood within the context of much larger electricity demand expected over the next few decades from electric vehicle adoption, onshoring of manufacturing, hydrogen utilization, and the electrification of industry and buildings (Shehabi et al., 2024). For reference, a single AI-focused data center can consume as much electricity as 100,000 households, with the largest under construction potentially consuming 20 times that amount (IEA).

Water consumption

Data-center operations require substantial amounts of water, both directly for cooling on-site and indirectly for non-renewable electricity generation (Mytton, 2021).

Accenture estimates that cooling AI data centers may consume around three billion cubic meters of freshwater by 2030, which is more than the total annual freshwater withdrawals of countries like Norway or Sweden (Accenture).

Water use drivers

Water consumption varies significantly based on cooling technology, local climate, and the source of electricity supply (Accenture)(EESI).

Cooling systems are a primary consumer of water (Equinix). For example, liquid IT cooling, while energy-efficient, can consume substantial amounts of water if it relies on evaporative cooling systems. Location in water-stricken areas can be challenging for data centers using this system.

Advanced cooling technologies like direct-to-chip liquid cooling and immersion cooling aim to minimize water and power consumption (EESI). Microsoft, for instance, has implemented a two-phase liquid immersion cooling technique, reducing power consumption by five percent per server, and establishing a closed-loop cooling system that eliminates the need for freshwater (All About Circuits). A 2024 survey by data center industry body AFCOM found that 40 percent of surveyed data-center operators were considering newer liquid cooling options, such as the technique used by Microsoft, but that only 17 percent of them presently use the technique (Spectra).

These trends are expected to continue, with hyperscale data centers in the US projected to consume between 60 and 124 billion liters of water per year by 2028 (Shehabi et al., 2024). This demand raises concerns about competition for water resources, particularly in drought-stricken areas (Accenture).

Reduce & optimize

Power usage effectiveness (PUE)*

PUE is a key metric that measures how efficiently a data center uses its energy, focusing on the amount of energy used by computing equipment. A lower PUE indicates high efficiency, meaning reduced operational costs and environmental impact.

Data life cycle management (DLM)

To mitigate the energy footprint of stored data, a multi-faceted approach focusing on DLM and optimized storage practices is crucial. Sustainable data management focuses on cutting energy consumption across the entire data life cycle, starting with optimizing data creation.

Efficiency is then boosted by leveraging existing hardware smartly: using storage

* **PUE** is the ratio of the total amount of energy used by a computer data center facility to the energy delivered to computing equipment. An ideal PUE is 1.0. (Wikipedia)

> Green coding is a software development practice aimed at reducing the energy consumption of code execution and IT infrastructure.

tiers to place frequently accessed data on fast drives like SSDs (Solid-State Drives) and less-used data on slower, power-saving media like tape or MAID (Massive Array of Idle Disks), which power down when not accessed. Techniques like Software-Defined Storage (SDS), where software manages storage capacity separate from the physical devices, enhance utilization.

Reducing volume

A major energy saver is reducing data volume through methods like data compression, deduplication (saving only one unique file copy), snapshot technology (storing only data changes), and thin provisioning (allocating storage only when it is actively needed).

Finally, efficiency is achieved by utilizing energy-efficient equipment, lower-speed hard drives, and appropriate RAID (Redundant Array of Independent Disks) levels, combining multiple physical hard disk drives (HDDs) or solid-state drives (SSDs) into one or more units, all of which aim to prevent costly over-provisioning and keep cooling and power costs low (Energy Star).

Key techniques and strategies

Grid-friendly flexibility

The massive, continuous, and spatially concentrated power demands of data centers strain existing electricity grids (IEA). This leads to long queues for grid connections and risks of local bottlenecks (IEA).

Data centers are exploring ways to become more “grid-friendly” actors by improving flexibility in operations. For example, shifting non-urgent AI workloads to low-carbon or off-peak periods, using on-site generation and battery storage to manage peak demand and support the grid (IEA), and relocating tasks to regions with more readily available low-carbon energy sources (RMI). Google, for example, uses day-ahead forecasts of grid carbon intensity to intelligently schedule tasks (Accenture).

Strategic siting

Optimizing data-center locations is crucial to minimizing carbon emissions. Siting in regions with high power and grid availability, where cleaner energy is readily available, or where natural cooling opportunities exist (e.g., Nordic countries), is increasingly important (RMI, Accenture).

Optimizing system-level

Most AI energy today is consumed in large cloud and hyperscale data centers. However, deploying AI at the edge on devices like smartphones and laptops, can reduce latency and decrease carbon emissions by processing data closer to its source. To enable this, manufacturers are adding specialized chips like Neural Processing Units (NPUs) in edge devices. An NPU on a smartphone is estimated to consume about 80 percent less energy than a Central Processing Unit (CPU)for the same task (IEA).

Green coding

Green coding is a software development practice aimed at reducing the energy consumption of code execution and IT infrastructure. It emphasizes lean coding principles, minimizing unnecessary code, optimizing workloads, and leveraging technologies like microservices,

cloud-based DevOps, and multi-core processors for efficiency (IBM).

Renewable energy use

The expanding energy demand of data centers is driving a global shift towards renewable energy sources. However, this transition is complex due to the inherent characteristics of both renewables and data-center operational needs (White & Case LLP).

Renewables and nuclear are set to provide nearly 60 percent of the electricity consumed by data centers in 2030 (IEA). A key challenge is the intermittent nature of renewable energy sources like solar and wind, which cannot consistently meet data centers' 24/7 power demands (White & Case).

Transparency gap

Transparency regarding the environmental impacts of AI and data centers is limited, particularly concerning detailed resource demands like energy, water, and greenhouse gas (GHG) emissions (Shehabi et al., 2024). This opacity hinders effective decision-making, accurate impact assessment, and the ability of stakeholders to make informed choices (Shehabi et al., 2024).

When data does exist, it often lacks sufficient accessibility, detail, and scope. Competition is frequently cited as a reason for this opacity, but other competitive industries, such as healthcare, demonstrate that a balance between transparency and competition is achievable (Luccioni et al., 2025).

Data-collection challenges

Hyperscalers face several challenges in collecting the data required to calculate GHG emissions. As they operate thousands of data centers globally, having the systems in place to collect large amounts of data can result in using estimations instead of real data, reducing the accuracy of numbers reported and changes over time. Many also use leased facilities, making access to the data even more difficult. Finally, collecting real-time, granular data, for example, on server level, is technically demanding and expensive.

Emissions calculations

For electricity, under the GHG Protocol methodology, companies are required to calculate and report their emissions (Scope 2) via a dual approach: location-based and market-based. The location-based approach calculates emissions based on the average emissions intensity of the local grid where the energy is consumed, while the market-based approach calculates emissions based on specific energy purchases. In this way, stakeholders can compare the difference between actual grid impact and companies' sustainability efforts. As the GHG Protocol is a voluntary reporting standard, hyperscalers have not been bound to reporting on the location-based method, with many, including AWS, Microsoft Azure, and Oracle, opting for reporting the market-based approach only (Carbone 4). Having said this, companies under CSRD must report using the location-based method, and voluntary frameworks such as GRI and CDP (see below) require companies to report on both methods to assess credibility and ambition.

Additionally, Power Purchasing Agreements (PPA) used in the market-based method do not guarantee spatial and temporal consistency between the purchased "green" electricity and the electricity consumed by the hyperscaler, as the electricity physically consumed onsite still relies on the local electricity grid. Accounting for GHG emissions linked to electricity consumption as zero in a country such as Ireland, where the average carbon intensity of electricity is nearly 400 g CO_2e/kWh, is therefore misleading (Carbone 4).

> Emission-reduction goals that are not backed by the SBTi and those that aim to be "carbon neutral" or "carbon negative" lack scientific clarity as well as transparency.

Voluntary reporting frameworks and guidance

Various global initiatives encourage data centers to monitor and reduce emissions:

- **The Global Reporting Initiative** (GRI) has been a widely adopted framework for hyperscalers in terms of their ESG disclosures, enabling transparency and comparability across regions and data centers – particularly when it comes to energy use, water consumption, and social responsibility.

- **CDP** is also widely used by hyperscalers to disclose environmental data in detail, particularly emissions, water, and supply chain impacts. Microsoft, Alphabet, and Meta all respond to the annual questionnaire. CDP respondents are scored, allowing for easier comparison for stakeholders, and driving accountability and competitive differentiation, particularly as the scores are often used in investment decisions.

- **The Net Zero Initiative** has published in-depth guidance on the accounting of energy purchases (Net Zero Initiative). This has been created in response to how PPAs are generally accounted for in the market-based methodology, i.e., not considering spatial and temporal factors. As the methodology was published only recently, it is unlikely that hyperscalers are currently following this stringent accounting method – particularly as this means their emissions from electricity consumption would be higher than they are currently reporting.

Emissions reductions guidance

The European Code of Conduct for energy efficiency in data centers is a voluntary initiative that provides data centers with guidelines and best practices to reduce energy consumption (European Commission).

Some of the largest hyperscalers, such as Microsoft, Meta, and Alphabet have adopted Science Based Targets which prove that reduction targets are in line with science. Progress is not currently assessed by the Science Based Target initiative (SBTi), but it is something that is under discussion (SBTi).

Emissions reduction

Most major cloud providers have net-zero, carbon-negative, or carbon-neutral goals. Some of these targets are backed up by the SBTi but still lack transparency about how they will be achieved. Those that are not backed by the SBTi and those that aim to be "carbon neutral" or "carbon negative" lack scientific clarity as well as transparency.

Despite these pledges, the three largest cloud providers, Amazon, Microsoft, and Google, have yet to record any significant reductions in their induced emissions. In fact, in 2023, Google and Microsoft reported substantial increases of 13 percent and 20 percent respectively, most likely because of investments in hardware and infrastructure linked to AI (Carbone 4).

Google and Microsoft continue to state their emissions reduction goals, though Google has recently shifted its target and now aims for net-zero emissions by 2030, instead of claiming carbon neutrality.

Mandatory policy incentives

The EU addresses the transparency deficit, as some regulations make it mandatory

for companies to disclose resource use information:

- **Energy Efficiency Directive Recast and Delegated Regulation 2024/1364:** Data centers with an IT power demand of 500 kW or more are required to report specific metrics to a central EU database on an annual basis (EU Commission). This data will be used for benchmarking, rating, and enforcing improvements over time to reduce energy and water consumption, promote renewable energy use, increase grid efficiency, and encourage waste heat reuse.
- **EU AI Act:** Mandates providers of general-purpose AI models, especially those with systemic risks, to include comprehensive details in their technical documentation (European Union). Required disclosures including energy consumption and use of computational resources. The AI Act provisions will be fully operational by 2026.
- **Corporate Sustainability Reporting Directive (CSRD):** This EU directive requires large and listed companies to report direct and indirect greenhouse gas emissions (Scope 1, 2, and 3), energy usage (EU Commission). ■

Missing: Circular Business Models

HEAVY RELIANCE ON finite resources and the growing volume of e-waste have pushed circularity to the forefront of the IT industry. While there has been progress, major areas like design and business models remain largely unchanged.

Circularity gains

The sustainability benefit of circularity over the traditional "take, make, waste" model is widely recognized – reducing waste, conserving resources, and lowering greenhouse gas emissions. However, circular solutions are most often adopted for economic reasons: 97 percent of businesses implement circular initiatives to increase profitability and gain a competitive advantage (Bain). For the IT industry, a circular strategy can deliver estimated average cost savings of 12 percent. (WBCSD).

Several critical global challenges are associated with current business models, including the escalating e-waste crisis, climate and environmental impacts, disruptions to supply chains, and health and social concerns.

Waste reduction

E-waste is among the fastest-growing waste streams globally. Between 2019 and 2022 the amount of e-waste generated grew from 53 million tons to 62 million tons (CEP). Of this, only 22 percent is collected (WBCSD) and e-waste accounts for most of the hazardous waste that ends up in landfills (CEP). It also represents considerable value destruction as the e-waste generated in 2024 is estimated to contain metals worth USD 91 billion (Global E-waste Monitor). Instead of recovering resources like gold, silver, copper, and rare earth minerals, companies spend more money mining for virgin materials, while valuable materials are sent to landfills.

Reduced carbon footprint

The manufacturing of electronic devices generates 180 million tons of CO_2

annually (Lovehagen et al.), equivalent to powering 37.5 million homes with electricity in the US (EPA). Circular practices, such as extending product lifespans, can substantially lower these emissions. Increased e-waste management offers a substantial opportunity for further emissions reduction, equivalent to taking over 40 million gasoline cars off the road (CEP).

Reliable supply chains

The IT industry faces threats from supply chain interruptions and skyrocketing raw material prices because of geopolitical tensions and component shortages. In 2021 – 2022 supply shortages caused the price of lithium to increase by 500 percent (CEP).

Buyer fatigue

There are signs that consumers are not looking to constantly upgrade their devices to the latest models, and because of this, there may not be a business case for short replacement cycles anymore. Circular practices can address this growing consumer trend of "buyer fatigue" (Interview CEP, October 2025).

Circular business opportunities

Circular design efforts in the IT industry are maturing, with leading companies developing comprehensive, systemic frameworks intended to guide decision-making beyond minimal compliance. However, the tension between designing products for a longer life and a business model based on sales volume is one of the key barriers to becoming truly circular.

The traditional model favors frequent product replacement where conventional depreciation rules can incentivize some buyers to replace equipment with new products to exploit tax benefits (CEP). Products are often routinely replaced after about three years (Atea).

Circular design

Circular design ensures that products, materials, and resources are in use for as long as possible. Prioritizing recycled or renewable materials in the design stage ensures valuable resources are kept in circulation for longer and thus reduces the need for virgin materials. Similarly, designing efficient products that last longer and withstand wear and tear will also put less burden on finite resources.

Modular Design

Modular design breaks products into independent components that can be replaced. Modularity allows for cost-effective refurbishment and seamless upgrades without the replacement of the whole product. For example, Cisco's Catalyst IR1101 rugged router is designed to allow customers to upgrade or replace individual components when technology advances.

PaaS and DaaS

Product-as-a-service (PaaS) is a business model in which products are not sold to customers outright but are instead offered alongside additional services such as maintenance, repair and collection at end of use. End users can avoid large upfront costs and instead pay a monthly fee while suppliers get recurring revenue streams and increased financial stability compared with one-time product sales (Bain).

Device-as-a-Service (DaaS) is a type of PaaS where the service provider handles the complete life cycle of the device. DaaS offerings are becoming commonplace in the IT industry, with a projected market growth from USD 212 billion in 2025 to USD 2.1 trillion in 2035 (Precedence Research). Global brands such as Lenovo, HP, and Cisco all have DaaS offerings.

Asset recovery

Asset recovery is the process where hardware is returned at end of use to facilitate

More about how transitioning to a circular business model can provide a solution to these challenges can be found in the ASF report "Get more from less" from 2022.

reuse, refurbishment, or material recycling. It is a vital component of circular business models that enables multiple life cycles and prevents e-waste.

Concerns about data security has been a major roadblock for asset recovery leading to many devices being disposed of in ways that offer no value retention (CEP). With the data-security certifications available today, there is little reason for these concerns; however, it continues to be viewed as a risk (Interview CEP, October 2025).

In this sense, asset recovery has the greatest success rate if integrated into a wider service solution, i.e., PaaS/DaaS.

Second-hand market

The market for remanufactured and refurbished products continues to grow in both B2B and B2C segments. The global second-hand market for smartphones, for example, was valued at USD ~46.52 billion in 2024 (Zion Market Research).

One of the primary drivers of growth is cost saving: refurbished phones typically cost 30 to 50 percent less than new devices (Zion Market Research). In addition, the second-hand market is particularly attractive to companies that have ambitious climate targets, as the total product emissions of refurbished products are significantly lower than those of new ones. For producers, the second-hand market offers an opportunity to extract additional value from already manufactured products, enhancing brand reputation, and attracting a new potential market of customers.

Remanufactured products are rebuilt to meet or exceed original manufacturer specifications using new or reused parts, while refurbished products are repaired to function like new, often with cosmetic updates, but not necessarily to original specifications.

Incentives and progress

Regulations

The EU has several regulations in place that are driving circular practices for consumer electronics. The Right to Repair Directive makes it easier and more cost-effective for consumers to repair existing products, while the Ecodesign for Sustainable Products Regulation (ESPR) requires manufacturers to consider repairability and recyclability of products in the design phase. The mandatory repairability index in France's Anti-Waste law (AGEC), also supports repair practices, and Austria has adopted financial incentives that support repair (ECESP).

Increased transparency

Digital product passports (DPPs) are a part of the ESPR that will require nearly all products sold within the EU to be digitally tagged with product information, including sustainability-related data (European Union). The ambition is to increase traceability as well as to provide actors across the value chain with valuable information that will aid repair, reuse, and recycling.

Once in effect, the regulation could be a key lever for supporting repair, reuse, and recycling by granting stakeholders access to previously non-mandated environmental information.

Standardization

Even though circular business models and design are mostly part of a company's own operations, there are several frameworks available to guide the development. Notably:

- **The Responsible Business Alliance (RBA)** is actively contributing to circularity in the IT and electronics sectors through a combination of frameworks, tools, and ongoing initiatives (RBA).
- **Circular Electronics Partnership (CEP) Roadmap** – provides stakeholders in the electronics industry with a clear strategy to transition to a circular model by 2030, outlining six pathways and 40 specific actions (CEP).
- **Circular Transition Indicatory (CTI) for Electronics** – a framework powered by

the World Business Council for Sustainable Development (WBCSD) and facilitated by the CEP, focused on empowering value chain stakeholders in the electronics industry to utilize a robust set of circularity metrics (WBCSD).

- **The Ellen MacArthur Foundation** established in collaboration with the NYU Stern Center for Sustainable Business 7 key benefit areas and 50+ metrics that can be used for quantifying the value and the impact of circular business models. (Ellen MacArthur Foundation).

Although these frameworks are constructive, the methods used by the IT industry in terms of analyzing circularity, calculating emissions savings, and prioritizing circular methods are inconsistent, making comparability between circular solutions difficult and potentially overwhelming for end users (Interview CEP, October 2025).

As a direct answer to this, the WBCSD launched the Global Circularity Protocol (GCP), which is specific to circularity for organizations across all industries, including IT. GCP builds on the CTI methodology and comes as a solution to the issue of comparability, by providing organizations with standardized guidance on target-setting, measuring, reporting, and disclosing (GCP).

Driving circular transformation

Buyer behavior is crucial for affecting and enabling upstream business models.

Switching to PaaS/DaaS offerings instead of buying products outright ensures a higher level of circularity.

Including circular criteria in procurement contracts – circular design, recycled content, maintenance, refurbished equipment, and take-back clauses – incentivizes the industry to offer more circular products and solutions

Governments also have a responsibility to mandate the inclusion of circular practices in public procurement contracts, increasing the levels of reuse, repair, and refurbishment of IT products. For example, France mandates that 20 percent of electronics purchased by public entities must be reused or refurbished (Ellen MacArthur Foundation).

Digital Product Passports will further enable buyers to make circular choices through greater transparency, potentially boosting demand for circular alternatives.

Collaboration benefits

There is an opportunity for collaboration between hardware and software manufacturers to increase the lifetime of hardware assets. Software updates that are not supported by existing hardware may result in premature disposal of hardware assets. For example, from October 2025, support for Microsoft's Windows 10 (including technical assistance and security fixes) ended alongside the introduction of the updated software, Windows 11 (Microsoft). If PCs are unable to upgrade to Windows 11, this encourages customers to replace their devices with a new one. In contrast, Google has partnered with Qualcomm to extend software updates on Android devices, pushing the theoretical lifespan of Android devices to eight years (Ars Technica).

Circular transition outlook

Three perspectives project the development of circularity:

1. Cost perspective

Operational costs in the electronics industry are projected to rise by ~15 percent from 2023 to 2035 (ECESP). Key cost drivers include:

- Increased costs for landfills
- Volatile raw material prices and scarcity of critical resources (e.g., copper, cobalt, lithium, gold)

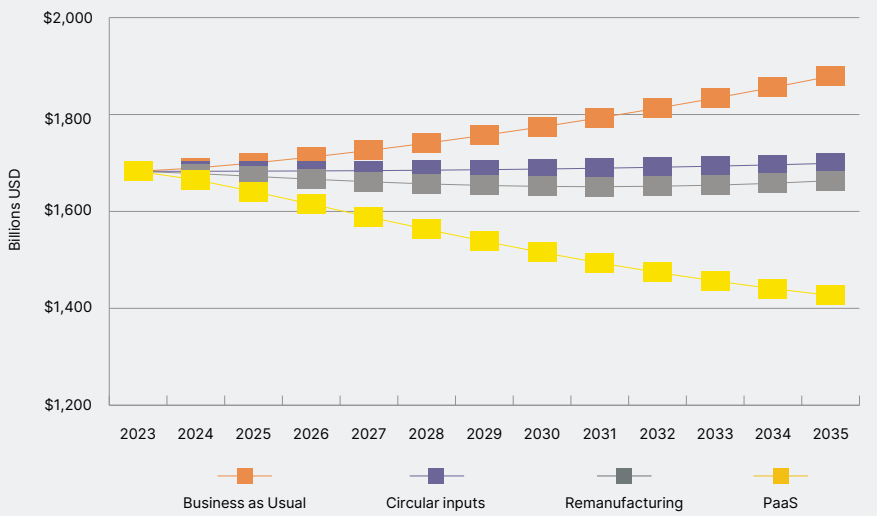


Figure 3: Cost over time for the electronics sector (USD) (ECESP)

- Rising carbon pricing for emissions-heavy industries and materials

A year-long study on the electronics industry undertaken in 2023 found that implementing a circular strategy can lead to an average of 12 percent in cost savings from 2023 to 2035 (ECESP). For PaaS, the cost savings could reach 34 percent (figure 3).

2. Investor perspective

The long-term financial benefits of circularity are becoming increasingly recognized across various investment channels: venture capital, private equity, bank lending, project financing, and circular insurance. The number of circular-focused private market funds grew tenfold between 2016–2020 (ECESP).

3. Buyer perspective

The demand for circular IT products continues to grow. For example, the global DaaS market is projected to grow from USD 212 billion in 2025 to USD 2.1 trillion in 2035 (Precedence Research). ■

Case study: Cisco

CISCO IS TRANSITIONING to a circular business model as part of its broader sustainability strategy, "The Plan for Possible" (Cisco). Instead of incorporating just one element of circularity, such as repair, Cisco emphasizes that its holistic approach towards a circular business model is an integral part of its progress towards achieving a circular transition.

Product design scoring

Cisco's circular transformation centers on embedding circularity into product design. 25 Circular Design Principles across five focus areas have been developed:

1. **Material Use**
2. **Standardization & Modularization**
3. **Packaging & Accessories**
4. **Smart Energy Consumption**
5. **Disassembly, Repair & Reuse**

These principles guide the design of all new products and packaging, with a target of 100 percent integration by 2025. As of 2023, 27 percent of new products and packaging met these standards.

A cross-functional model

Cisco established a three-tier governance structure to guide and oversee its circular design strategy:

1. **Steering Committee: Sets strategic direction and ensures alignment with corporate sustainability goals.**
2. **Oversight Committee: Provides cross-functional input from engineering, supply chain, and other key departments.**
3. **Audit Committee: Validates product scoring and ensures compliance with circular design standards.**

This model ensures that circularity is embedded across the organization, with accountability and collaboration at every level.

Interactive employee training

Cisco launched a gamified training program, completed by more than 6,900 employees, to educate staff on circular design principles and scoring methodology. This ensures that employees are educated and aligned with what designing for circularity means.

Business initiatives

Green Pay – offers a use-based solution at the end of which Cisco will refurbish, recycle, or reuse the equipment.

Cisco Refresh – Allows customers to purchase refurbished Cisco products. ■

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