

What's Next for Sustainable Business?

Trends Report

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The SustainAbility Institute by ERM

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Introduction

We released the 2022 iteration of our annual trends report "What's Next for Sustainable Business?" in January of this year. In that publication we explored 10 enduring sustainability trends, how they are evolving, and how business is responding to them.

While many of the trends and developments we touched affect all industries and businesses in similar ways, we are conscious that there are also nuances across sectors. In this supplement we explore our 2022 trends from the perspective of the technology sector.

The ESG risks and opportunities facing the tech sector are striking. While for many sectors COVID-19 has posed significant challenges, for technology it has also opened numerous new opportunities. During the pandemic, the sector has experienced significant growth as people and businesses were forced to go online and rapidly embrace digital solutions to continue economic, social, educational, and welfare activities when lockdowns were introduced across the world.[1] Pandemic-initiated growth is likely to continue, as remote working and many other uses of technology to connect people in more innovative ways are likely to stick long term.

The pervasiveness and ubiquitous nature of technology also means it faces regulatory and civil society scrutiny in areas like data ethics. Edelman's 2021 Trust Barometer shows that public trust in the sector is waning; in fact, while trust in business overall is growing, trust in the technology sector has consistently declined over the past decade.[2] The sector has high-profile environmental challenges as well, including e-waste management, the sustainable sourcing of critical minerals, and data center sustainability.

In this supplement, we focus on the environmental, social, and governance-related trends we anticipate will most impact the technology sector over the course of the next few years.

Each of the five sustainability trends we highlight as especially relevant to technology companies – climate, supply chains, circularity, nature, and data ethics – is explored to identify what is unique about it for the technology sector now and what businesses operating in this sector might expect to result from the trend as the decade advances.

The technology sector has great potential to help society and other industries manage the transition to a sustainable economy. To do so, it must manage its own environmental, social, and governance-related risks, especially considering the sector's exponential growth. Tech companies already provide technological solutions to other sectors to support their transitions to sustainable operations. If the sector can build and maintain public trust regarding data privacy and digital innovation – so that more digitally-enabled solutions can be embraced in everyday lives – then the low-carbon transition can be a digitally enabled one.

Headlines

Through research and by drawing on the insight of ERM's technology sector experts, we have identified five key sustainability trends that we believe are set to influence the tech sector in 2022 and beyond. Each of these trends is connected to one of the 10 broad trends highlighted in our main trends report.

1. Technology's climate impact

Even having set world-leading climate commitments, technology firms will face increasing scrutiny of their delivery against those promises and the energy intensity of the sector.

- Scrutiny of tech industry climate ambitions and performance will rise.
- Corporate climate commitments will increasingly focus on supply chains.
- Concern will grow around the energy intensity of digital technologies and impacts on local infrastructure.

2. Supply chain sustainability

Digital services and solutions are enabling improvements in the environmental and social performance of supply chains economy-wide. The technology sector is also actively securing its own supply chain against complex and evolving social, political, and environmental risks.

- Tech firms will be required to go beyond due diligence of conflict minerals.
- The regulatory focus on supply chain due diligence will become stronger.
- Digital technologies will be expected to improve the transparency of value chains.

3. The circularity gap

Despite momentum in moving towards circular business models and adopting zero waste policies, technology companies will face pressure to align operations with the development of a circular economy.

- New regulation will set minimum eco-design standards and incentivize development of circular business models.
- The technology sector will embrace zero waste and delve deeper into the handling of e-waste.
- Efforts to retrieve critical raw materials from used electronics will increase.

4. Nature-related impacts

While already recognized as a significant investor in natural climate solutions to compensate their carbon footprint, we will see regulatory pressures and awareness of the tech sector's dependence on healthy ecosystems and water increase.

- Technology firms will make stronger commitments towards a nature-positive future.
- The technology sector will increase investment in biodiversity and water-related rehabilitation.
- More technology firms will strive to be water positive.

5. Digital ethics

Technology companies will develop stronger capabilities to tackle the social risks posed by digital technologies while adapting to new frameworks and governance models.

- Tech firms will expand their capacity to manage social risks.
- New models will emerge to tackle misinformation.
- New frameworks will be developed to increase AI trustworthiness.

Trend 1
Technology's climate impact

Even having set market-leading climate commitments, technology firms will face increasing scrutiny of their delivery against those promises and the energy intensity of the sector.

Context

The technology sector has positioned itself to be a leader on climate change. The proportion of technology firms (by revenue) committed to the UN Framework Convention on Climate Change (UNFCCC) campaign the *Race to Zero* leapt from 6 percent at the beginning of 2021 to 40 percent in the months before COP26 in Glasgow in November 2021.[3] The sector has market-leading targets such as Microsoft's carbon negative pledge to remove all the carbon emissions it has emitted during its existence.[4] Tech companies are also leaders in scaling the purchase of renewable energy via Power Purchasing Agreements,[5] and tech firms are innovating to develop and deliver climate solutions like climate data platforms,[6] smart thermostats,[7] electric vehicles, and climate tech incubators.[8]

Even with these encouraging advances, there is concern that the sector's rapid growth will lead to a rise in energy demand that outpaces the sector's ability to deploy renewable energy to offset it. This is leading to calls for tech firms to move faster to secure emissions reductions and means that they will face increased scrutiny as to whether their climate action claims are underpinned by action.[9]
In addition, companies in the sector that have not yet made substantial commitments to climate action can expect to find themselves under pressure to set them. In doing so it will be crucial that they ensure the scopes of their climate pledges cover all value chain emissions and assume limited reliance on carbon offsetting.

On the next page we highlight three developments for technology companies to watch, understand, and address.

> **"Digital infrastructure underpins every aspect of our daily lives and is a critical enabler of many technologies that help us improve efficiency and reduce emissions. However, it's critical that this physical infrastructure itself is efficient, sustainable, and secure. Operators and developers must address increasing public concern about sector growth and energy consumption by ensuring that their goals and actions are ambitious, transparent, and accountable."**
>
> **– Emma Fryer**
> Partner, ERM

What to expect

Scrutiny of tech industry climate ambitions and performance will rise

Despite pledges to reduce their greenhouse gas emissions and become carbon neutral or even carbon negative,[10] NGOs such as Greenpeace and the New Climate Foundation have highlighted ambiguities in carbon disclosures and criticized some companies' climate action ambitions for a lack of alignment with the Paris goals, insufficiently clear definitions around climate pledges, opacity on the use of carbon offsets, and for failing to account for value chain emissions.[11,12] For example, in its Corporate Climate Responsibility Monitor – a review of the climate strategies and pledges of 25 major global companies – the New Climate Foundation challenged whether companies' net zero goals can be substantiated, criticizing what they perceive as a lack of transparency regarding how companies will use carbon offsets. In particular, they press companies to disclose quantified interim carbon reduction targets.



Corporate climate commitments will increasingly focus on supply chains

The race to net zero will be played out in corporate supply chains. Salesforce's announcement in 2021 that it requires all suppliers to set science-based targets was a powerful early signal of how expectations for suppliers are rising. With 97 percent upstream Scope 3 emissions, the U.S. computer manufacturing industry surpasses the industry average of 75 percent.[13,14] Furthermore, analysis shows that the sector consistently underreports Scope 3 emissions.[15] Despite such challenges, the sector is well positioned to improve its performance with new digital platforms and emerging technology applications designed to create more visibility in sources of emissions for upstream suppliers.

Concern will grow around the energy intensity of digital technologies and impacts on local infrastructure

The energy intensity of data transmission is decreasing by half approximately every two years due to energy efficiency improvements. And in central processing units (CPUs) – the main brain of the computer – computations per kilowatt-hour have doubled every 1.5 years or so, helping drive down power consumption.[16,17] Despite these (and other) strides made by the sector, public and government concern about the energy intensity of digital technologies and infrastructure is becoming more commonplace. Examples include Swedish regulators' discussions about banning Bitcoin mining due to its increasing use of fossil fuels,[18] climate demonstrators protesting against data centers in Dublin,[19] and academic research challenging the excessive energy consumption of training AI models and the energy associated with internet use.[20,21] Local planners are also scrutinizing new digital infrastructure as they seek to manage competing energy and water demands. The Dutch province of Flevoland's temporary data center moratorium in June 2021 is one example of this.[22]

Trend 2
Supply chain resilience

Digital services and solutions are enabling improvements in the environmental and social performance of supply chains economy-wide. The technology sector is also actively securing its own supply chain against complex and evolving social, political, and environmental risks.

Context

The COVID-19 pandemic has put supply chains in every industry under pressure. The technology sector has not been excluded from having to manage disruptions affecting material sourcing and logistics, and it has had to do so while meeting unprecedented demand for digital services and products.

Even after the disruption caused by the global pandemic subsides, challenges will endure in the sector's own supply chain. For example, the technology industry is heavily dependent on the use of so-called conflict minerals like tin, tungsten, tantalum, and gold – the 3TGs – and other materials increasingly demanded by other parts of the economy including the renewables sector. Supply chain challenges do not stop at sustainable mineral sourcing either. For example, increasingly stringent regulatory developments for human rights due diligence in supply chains are proliferating globally.

As well as meeting expectations for their own sector's supply chain management, technology firms play a critical role in delivering innovative tools that can bring much-needed transparency and traceability to other companies' supply chains. For instance, while respondents to a recent KPMG survey of nearly 150 manufacturing company CEOs identified supply chain risks as the greatest threat to their organization's growth, they also noted that leveraging digital innovation to improve monitoring of their supply chains was the most critical way they could improve resilience.[23]

On the next page we highlight three developments for technology companies to watch, understand, and address.

> **"We have never seen such significant drivers for human rights due diligence in the supply chain. Our clients are having to rapidly respond to evolving legislation and business expectations. Technology companies are no longer asking 'Why should we do this?' but rather, 'How can we turn policy into practice across our global and diversified supply chains to manage our human rights responsibilities in a meaningful way?'"**
>
> **– Caroline Vail**
> Partner, ERM

What to expect

Tech firms will be required to go beyond due diligence of conflict minerals

Mandatory reporting requirements for technology companies' sourcing of conflict minerals (the 3TGs) pushes tech ahead of other sectors in in terms of required disclosure of information on suppliers below the first tier.[24] Yet risks remain for materials even beyond 3TG. Global Witness recently reported on a swathe of anticipated supply chain risks in the Democratic Republic of Congo's "nascent but potentially globally significant lithium sector," which is set to begin production in 2023, while growth in demand for cobalt in the same region has also long been linked to fears it will trigger militarization of mines.[25,26] Meanwhile, nickel has been identified as the mined commodity most exposed to biodiversity risks.[27]

The regulatory focus on supply chain due diligence will become stronger

More countries around the world are signaling their expectations for companies to take greater accountability for environmental and social conditions in their complex global value chains. The European Union's proposed Directive on Corporate Sustainability Due Diligence will link environmental and social supply chain due diligence to board directors' duties.[28] National legislation has been introduced or is pending in Germany, the Netherlands, Belgium, Spain, and Finland. Similarly, new guidance in Japan seeks to make companies responsible for due diligence across their entire value chains. In the U.S., the Uyghur Forced Labor Prevention Act, passed by U.S. Congress in December 2021, will require proof that goods imported into the country aren't linked to forced labor in China – particularly in the Xinjiang region, one of the world's most productive areas of polysilicon, a material used in the manufacturing of photovoltaics, electronics, and semiconductor components.

Digital technologies will be expected to improve the transparency of value chains

Companies continue to grapple with the need for increased supply chain resilience. A key part of this is transparency, and new technologies are helping to increase visibility across value chains. Blockchain, Internet of Things (IoT) enabled sensors, and digital twins – digital replicas of products, processes, and physical assets that allow them to be monitored in real time and which support scenario planning – are making supply chains more transparent. Blockchain company Circulor, IoT firm Arvieumand, and WWF-backed OpenSC (which combines IoT, AI, blockchain, and satellite imagery capabilities) are just a few examples of technology companies focused on enabling better capture of environmental information from across supply chains.[29] Regulators too are exploring the potential of these technologies. For instance, the EU is considering digital "product passports" for batteries to facilitate information sharing across value chains in which batteries are present, while the UK is exploring the introduction of mandatory digital tracking of waste movement.[30]



Trend 3
The circularity gap

Despite momentum in moving towards circular business models and adopting zero waste policies, technology companies will face pressure to align operations with the development of a circular economy.

Context

The technology sector produces an estimated 50 million tonnes of electrical waste (e-waste) a year, with some suggesting this could increase to 120 million tonnes a year by 2050.[31] Within these discarded electrical products are a wealth of materials – up to 60 elements can be found in complex electronics, some of which are difficult to source, difficult to recycle, and/or hazardous. Some of this e-waste also includes materials needed to develop technologies crucial to decarbonization efforts.

Market drivers, regulatory developments, resource scarcity, and consumer pressure are driving more technology companies to respond to the waste crisis by embracing circular approaches. Tech companies are increasingly setting stronger commitments to tackle e-waste, exploring vertically integrated supply chains, and developing circular business models to ensure products are designed for durability, are easy to repair/upgrade and take apart, and that more materials can be captured at the end of life. For example, 2021 saw Apple announce its "Self Service Repair" program, while Dell introduced a prototype modular laptop, Concept Luna, which is designed to be easier to repair and upgrade. Similarly, April 2022 saw Google announce a new partnership with iFixit, the online repair company, to make it easier for independent repair professionals and skilled consumers to repair Pixel phones.[32]

Despite these examples of action by some companies, there is strong public support for regulatory interventions to make these sustainable design considerations common to all electronics.[33]

On the next page we highlight three developments for technology companies to watch, understand, and address.

> **"Technologies, from renewable power to electric vehicles, are essential enablers of the net zero transition, but have environmental impacts of their own, from cobalt mining to waste management challenges. Demand for the critical minerals underpinning green tech will soar in coming decades. Designing electronics for resource efficiency and circularity can cut the risks associated with accessing these materials."**
>
> **– Dustin Benton**
> Policy Director, Green Alliance

What to expect

New regulation will set minimum eco-design standards and incentivize development of circular business models

New regulations targeting improved circularity within the manufacturing, use, and disposal of electronics are gaining momentum, a pattern set to increase in 2022. Examples include U.S. President Joe Biden's 2021 Executive Order that aims to make repair more accessible and affordable, and the EU's Circular Electronics Initiative (CEI).[34,35] Due to be adopted in 2022, the CEI will mandate product design changes to smartphones, laptops, and computers to improve energy efficiency, increase product longevity, and address material efficiency issues.[36] In addition, across the EU's member states, as well as in the UK, new legislative proposals are set to emerge in 2022 with the aim of increasing the efficacy of Extended Producer Responsibility for e-waste, seeking to improve e-waste collection rates, and introducing new fee structures to incentivize circular product design.[37]

The technology sector will embrace zero waste and delve deeper into the handling of e-waste

As e-waste generation continues to surge, there is growing recognition that true circularity cannot be achieved without successful collection, materials recovery, and recycling of electronics. Technology companies will pay greater attention to the impacts of their downstream value chains, particularly around environmental, labor, health and safety, and human rights impacts stemming from the informal processing of e-waste. These impacts are substantial: the WHO estimates that almost 13 million women and more than 18 million children and adolescents are working in the informal e-waste sector, which potentially exposes them to harmful chemicals.[38] In response, with support from organizations like the Responsible Business Alliance and the Circular Electronics Partnership, tech companies will take greater accountability for reducing waste by setting corporate zero waste goals and implementing more stringent due diligence strategies for reverse supply chains.

Efforts to retrieve critical raw materials from used electronics will increase

The deployment of clean energy technology brings with it new challenges and opportunities related to the growing demand for critical raw materials (CRMs) such as rare earth metals, lithium, and cobolt.[39] Electronics and battery manufacturers, which both need CRMs for their products, will increasingly compete for the same materials.[40] For instance, a recent report from UK think tank Green Alliance highlighted how demand for critical minerals to support growth in data center infrastructure could create material supply problems for wind turbines and electric vehicles.[41] With studies indicating that enhanced collection and recycling could enable secondary materials to meet at least a third of demand for critical raw materials in low-carbon technologies, policy makers will continue to explore new strategies and encourage new technologies that help to secure CRMs from electronic and battery waste at end of life.[42,43]



Trend 4
Nature-related impacts

While already recognized as a significant investor in natural climate solutions to compensate their carbon footprint, we will see regulatory pressures and awareness of the tech sector's dependence on healthy ecosystems and water increase.

Context

Biodiversity is deteriorating worldwide, a decline projected to worsen under business-as-usual scenarios. Our planet is now losing species at 1,000 times the natural rate, and 30-50 percent of all species may be lost by 2050.[44]

Despite these jarring facts, estimates suggest only six percent of technology companies recognize biodiversity loss as a risk.[45] The sector's biggest biodiversity impacts are related to its energy use and climate impacts, a supply chain reliant on minerals and metals, the siting and associated resource use of data centers and offices, and the potential impact of hazardous substances released by electronics at the end of their life.

Regardless the still relatively low recognition of the issue in the industry, technology has a vital role to play in supporting biodiversity. For example, cloud computing, IoT, artificial intelligence (AI), and digital twins are just some of the technologies that scientists, policy makers, and businesses leverage to support wildlife conservation. Microsoft's AI for Earth provides cloud computing and AI to conservationists to help them monitor, model, and manage natural systems.[46] Google's Wildlife Insights Platform, enabled by its cloud and AI services, helps conservationists share, identify, manage, and analyze wildlife images online.[47] And the European Commission also recently announced Destination Earth – a new digital twin of the Earth designed to help monitor and assess ecosystem health.

With nations reconvening in 2022 in China for the second half of the COP 15 Convention on Biological Diversity to agree a post-2020 Global Biodiversity Framework, the technology sector will want to demonstrate the part it is playing in protecting natural ecosystems.

On the next page we highlight three developments for technology companies to watch, understand, and address.

> **"Nature or biodiversity is the 'new kid on the block'– following right after climate in terms of new topics that companies need to integrate into their business strategies. We are seeing increasing pressures to disclose impacts on biodiversity and water. Just like with early investment in natural climate solutions to offset carbon emissions, we expect the technology sector to be an early mover on nature-positive commitments."**
>
> **Dr. Kerstin Pfliegner,**
> Partner, ERM

What to expect

Technology firms will make stronger commitments towards a nature-positive future

CEOs of more than 1,000 companies, including Google, Microsoft, Salesforce, and other technology leaders, published a call to action in 2020 that called on governments to adopt policies to reverse nature loss by the end of the decade.[48] In April 2020, Microsoft made a commitment to permanently protect more land than it uses by 2025, also publishing its land footprint (11,000 acres), along with how much land it is seeking to protect (over 17,000 acres) in its most recent sustainability report.[49] We expect that other companies in the sector will soon take similar actions.

The technology sector will increase investment in biodiversity and water-related rehabilitation

More businesses are realizing that combatting climate change requires accelerating towards a nature-positive economy. As of 2019, spend on biodiversity conservation globally was $124-$143 billion a year as compared to total projected need calculated at $722-$967 billon.[50] The cash-rich tech sector can help address this gap and realize its companies' ambitious climate targets by investing in conservation and land management programmes that increase carbon storage and reduce emissions.[51] Some companies have already started acting. For example, last year Apple created a $200 million fund for nature-based climate solutions.[52] In September 2021, Amazon committed $21 million in funding for nature-based projects across Europe as part of its Right Now Climate Fund.[53] Microsoft is actively requesting tenders for carbon removal projects that include forestry and soil projects and, earlier this year, Samsung confirmed its investment in a project to plant two million trees in Madagascar.[54]

More technology firms will strive to be water positive

As the proportion of the world suffering from water stress due to climate change and increased water demand increases, the technology sector will have to set progressively more rigorous commitments to tackle its own water use.[55] Demand for water in the sector is predominately driven directly by data centers using water for cooling as well as semiconductor manufacturing, and indirectly via water demand created by non-renewable energy generation.[56] In 2020, Intel and Microsoft committed to become water positive for their direct operations by 2030 by reducing their water intensity and replenishing more water than they consume.[57] In 2021, more tech companies, including Meta and Google, made similar commitments.[58] Delivery on these promises will include managing and collecting water-related data, setting clear targets to reduce consumption of potable water, reporting on progress, and restoring the local watersheds upon which they depend.



Trend 5
Digital ethics

Technology companies will develop stronger capabilities to tackle the social risks posed by digital technologies while adapting to new frameworks and governance models.

Context

Digital technologies have evolved incredibly rapidly. Technologies including AI, machine learning, and augmented/virtual reality have transformed society and industries in just a few decades, and the COVID-19 pandemic has further accelerated this digital shift.

The ubiquity of these new technologies, coupled with their ability to influence and scale, is forcing companies to confront existential ethical challenges. For example, debates around content moderation to counter fake news, misinformation, and hate speech have been renewed in the wake of Russia's invasion of Ukraine.[59] AI biases – often created by poor, incomplete, or skewed data used in algorithmic decision-making – also continue to be highlighted in a range of contexts including employee recruitment, criminal justice, and education.[60]

All this is having an impact on the technology sector's reputation. A 2021 survey of 33,000 people in 28 countries found the public's trust in the sector to be at an all-time low, with the steepest declines in trust found in developed (and more digitally mature) countries such as the U.S., France, Japan, and the UK.[61] Steps are being taken to address falling trust and the issues driving it in the form of accelerated development of new governance models, frameworks, and systems that enable tech companies to improve social performance and ensure their technologies are both accountable and transparent.

On the next page we highlight three developments for technology companies to watch, understand, and address.

> **"As data and AI become an accepted part of everyday modern life, it is vital that the public can trust innovation in these areas."**
>
> **– Edwina Dunn**
> Interim Chair of the UK's Centre for Data Ethics and Innovation's (CDEI) Advisory Board

What to expect

Tech firms will expand their capacity to manage social risks

In January 2022, Google appointed the company's first ever Senior Vice President of Technology and Society. Reporting directly to the CEO, this individual will be "shaping and sharing" the company's understanding of the social impacts of digital technology, including AI, the future of work, and sustainability.[62] Developments like this signal that some technology companies are trying to think holistically and strategically about digital technologies' impacts on customers, society, and the environment. Some have been doing so for years; in 2018, Salesforce developed an Office of Ethical and Humane Use of Technology to encourage ethics by design, ethical use policies, and product accessibility and inclusive design.[63] More technology firms are likely to follow in these companies' footsteps.

New models will emerge to tackle misinformation

The spread of misinformation is increasingly recognized as one of the greatest challenges faced by society.[64] In 2021, the European Commission set up a voluntary Code of Practice on Disinformation to address the spread of fake news.[65] These standards are endorsed by several businesses including Meta, Google, and Twitter. The standards will evolve towards a co-regulatory instrument that will create a legal requirement for companies have misinformation incorporated into their codes of conduct, as outlined in the Digital Service Act. At the same time, technology companies are developing self-policing models to help moderate content on media platforms. For example, Meta's Oversight Board is an independent body responsible for evaluating high-profile content moderation cases.[66]

New frameworks will be developed to increase AI trustworthiness

The rapid adoption of AI to support decision-making across society and business has been accompanied by calls for AI models to be explainable, fair, safe, accountable, compliant with regulation, and able to operate without bias. The tech sector has responded by developing guidance mechanisms such as Google's AI principles, creating advisory groups like Salesforce's Office of Ethical and Human Use of Technology, and forming partnerships including the Data & Trust Alliance whose members include Meta and IBM.[67,68] Alongside these efforts, there is evidence of a nascent market in AI third-party assurance emerging as well as regulation targeting AI such as the UK's Centre for Data and Ethics' AI assurance ecosystem roadmap and the EU's draft AI Regulation.[69,70]



Conclusion

The ESG risks and opportunities facing the technology sector are unique. The sector's extraordinary growth and the ubiquitous nature of technology mean it will continue to face scrutiny from a range of stakeholders on its wide-ranging interactions with people, society, and the environment.

Challenges around digital ethics, supply chain integrity, and the environment – particularly climate, e-waste, and the sector's relationship with nature – are among those the sector will have to manage. If the technology sector can manage these effectively, digital technology has the potential to be an even more powerful tool and partner in our transformation to a truly sustainable and low carbon economy.



Endnotes

[1] OECD. 2020. *Digital Transformation in the Age of COVID-19: Building Resilience and Bridging Divides, Digital Economy Outlook 2020 Supplement.* Online posting. OECD. Accessed 4 May 2022. https://www.oecd.org/digital/digital-economy-outlook-covid.pdf

[2] Edelman. 2021. *Edelman Trust Barometer 2021*. Online posting. Edelman. Accessed 4 May 2022. https://www.edelman.com/trust/2021-trust-barometer/trust-technology

[3] Certo, Margherita. 2021. *Over a third of tech firms join Race to Zero campaign*. Online posting. TechUK. Accessed 4 May 2022. https://www.techuk.org/resource/over-a-third-of-tech-firms-join-race-to-zero-campaign.html

[4] Smith, B. 2020. *Microsoft will be carbon negative by 2030*. Online posting. Microsoft. Accessed 4 May 2022. https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/

[5] Henze, V. 2022. *Corporate Clean Energy Buying Tops 30GW Mark in Record Year*. Online posting. BloombergNEF. Accessed 4 May 2022. https://about.bnef.com/blog/corporate-clean-energy-buying-tops-30gw-mark-in-record-year/

[6] Talbott, C and Conkling, J. 2021. *Announcing new tools to measure—and reduce—your environmental impact.* Online posting. Google Cloud. Accessed 4 May 2022. https://cloud.google.com/blog/topics/sustainability/new-tools-to-measure-and-reduce-your-environmental-impact

[7] e.g., Amazon (https://www.amazon.com/Amazon-Smart-Thermostat/dp/B08J4C8871) and Google (https://store.google.com/gb/magazine/compare_thermostats? gclid=CjwKCAjw9LSSBhBsEiwAKtf0n8RHYwriAoiwFBw _KpY39usQ_7Bny3evWxbRk_3iWFdxykzQ0ZGBcxoCnKEQAvDBwE&gclsrc=aw.ds&pli=1&hl=en-GB)

[8] e.g., Microsoft Climate Innovation Fund (https://www.microsoft.com/en-us/corporate-responsibility/sustainability/climate-innovation-fund?activetab=pivot1%3aprimaryr6) and Amazon Climate Pledge Fund (https://sustainability.aboutamazon.com/about/the-climate-pledge/the-climate-pledge-fund)

[9] Kamiya, G. and Kvarnstrom. 2019. *Data centres and energy – from global headlines to local headaches?* Online posting. IEA. Accessed 4 May 2022. https://www.iea.org/commentaries/data-centres-and-energy-from-global-headlines-to-local-headaches

[10] Amazon. N.D. *Amazon Sustainability*. Online posting. Amazon. Accessed 4 May 2022. https://sustainability.aboutamazon.com/; Apple. 2020. *Apple commits to be 100 percent carbon neutral for its supply chain and products by 2030*. Online posting. Apple. Accessed 4 May 2022. https://www.apple.com/newsroom/2020/07/apple-commits-to-be-100-percent-carbon-neutral-for-its-supply-chain-and-products-by-2030/; Smith, B. 2020. *Microsoft will be carbon negative by 2030*. Online posting. Microsoft. Accessed 4 May 2022. https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/; Facebook. 2020. Facebook's Net Zero Commitment. Online posting. Facebook. Accessed 4 May 2022. https://sustainability.fb.com/wp-content/uploads/2020/12/FB_Net-Zero-Commitment.pdf

[11] Jardim, E. 2020. *Microsoft, Google, Amazon – Who's the Biggest Climate Hypocrite?* Online posting. Greenpeace. Accessed 4 May 2022. https://www.greenpeace.org/usa/microsoft-google-amazon-energy-oil-ai-climate-hypocrite/

[12] Day, T. et al. 2022. *Corporate Climate Responsibility Monitor 2022*. Online posting. New Climate Institute. Accessed 4 May 2022. https://newclimate.org/wp-content/uploads/2022/02/CorporateClimateResponsibilityMonitor2022.pdf

[13] Matthews, S., Hendrickson, C. & Weber, C. 2008. *The importance of carbon footprint estimation boundaries*. Online posting. Environmental Science & Technology. Accessed 4 May 2022. https://pubs.acs.org/doi/10.1021/es703112w

[14] Huang, Y., Weber, C. and Matthews, S. 2009. *Carbon footprinting upstream supply chain for electronics manufacturing and computer services*. Online posting. 2009 IEEE International Symposium on Sustainable Systems and Technology. Accessed 4 May 2022. https://ieeexplore.ieee.org/document/5156679

[15] Klaaßen, L and Stoll, C. 2021. *Harmonizing corporate carbon footprints. Online posting*. Nature Communications. Accessed 4 May 2022. https://www.nature.com/articles/s41467-021-26349-x

[16] Aslan, J. et al. 2017. *Electricity Intensity of Internet Data Transmission: Untangling the Estimates*. Online posting. Journal of Industrial Ecology. Accessed 4 May 2022. https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.12630

[17] Stauffer, N. 2013. *Energy-efficient computing*. Online posting. MIT Energy Initiative. Accessed 4 May 2022. https://energy.mit.edu/news/energy-efficient-computing/#:~:text=Over%20the%20past%2070%20years,have%20improved%20even%20more%20quickly

[18] Schickler, J. 2001. *Sweden, EU Discussed Bitcoin Proof-of-Work Ban: Report.* Online posting. CoinDesk. Accessed 4 May 2022. https://www.coindesk.com/policy/2022/04/21/sweden-eu-discussed-bitcoin-proof-of-work-ban-report/

[19] Judge, P. 2021. *Climate protesters stage demo outside Data Centres Ireland event in Dublin*. Online posting. Data Center Dynamics. Accessed 4 May 2022. https://www.datacenterdynamics.com/en/news/climate-protesters-stage-demo-outside-data-centres-ireland-event-in-dublin/

[20] Hao, K. 2019. *Training a single AI model can emit as much carbon as five cars in their lifetimes.* Online posting. MIT Technology Review. Accessed 4 May 2022. https://www.technologyreview.com/2019/06/06/239031/training-a-single-ai-model-can-emit-as-much-carbon-as-five-cars-in-their-lifetimes/

[21] Obringer, R. 2021. *The overlooked environmental footprint of increasing Internet use.* Online posting. Resources, Conservation and Recycling. Accessed 4 May 2022. https://www.sciencedirect.com/science/article/abs/pii/S0921344920307072?via%20percent3Dihub

[22] Moss, S. 2021. *Updated: Dutch province of Flevoland enforces temporary data center moratorium.* Online posting. Data Center Dynamics. Accessed 4 May 2022. https://www.datacenterdynamics.com/en/news/dutch-province-of-flevoland-enforces-temporary-data-center-moratorium/

[23] Zambarano, D. et al. 2021. *M&A trends in the industrial manufacturing sector: A record smashing year for IM as companies double down on digital.* Online posting. KPMG. Accessed 4 May 2022. https://home.kpmg/xx/en/home/industries/industrial-manufacturing.html

[24] Know the Chain. 2022. *Closing the gap*. Online posting. Know the Chain. Accessed 4 May 2022. https://knowthechain.org/wp-content/uploads/2022-KTC-mHREDD-brief.pdf

[25] Global Witness. 2021. *As global interest in DR Congo's lithium deposits soars, the industry could be "seriously undermined" by governance, environmental and social risks – investigation*. Online posting. Global Witness. Accessed 4 May 2022. https://www.globalwitness.org/en/press-releases/as-global-interest-in-dr-congos-lithium-deposits-soars-the-industry-could-be-seriously-undermined-by-governance-environmental-and-social-risks-investigation/

[26] Callaway, A. 2018. *Powering Down Corruption: Tackling Transparency and Human Rights Risks from Congo's Cobalt Mines to Global Supply Chains.* Online posting. Enough Project. Accessed 4 May 2022. https://enoughproject.org/reports/powering-down-corruption

[27] Nichols, W. 2021. *Mining operations face growing biodiversity risks.* Online posting. Verisk Maplecroft. Accessed 4 May 2022. https://www.maplecroft.com/insights/analysis/mining-operations-face-growing-biodiversity-risks/

[28] European Commission. 2022. *Just and sustainable economy: Commission lays down rules for companies to respect human rights and environment in global value chains.* Online posting. European Commission. Accessed 4 May 2022. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1145

[29] https://www.circulor.com/; https://opensc.org/

[30] European Union Law. 2020. *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020*. Online posting. European Union Law. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0798; Taylor, K. 2021. *EU plans 'digital product passport' to boost circular economy*. Online posting. Euractiv. Accessed 4 May 2022. https://www.euractiv.com/section/circular-economy/news/eu-plans-digital-product-passport-to-boost-circular-economy/; Department for Environment, Food & Rural Affairs. 2022. *Introduction of mandatory digital waste tracking*. Online posting. UK Government. Accessed 4 May 2022. https://consult.defra.gov.uk/environmental-quality/waste-tracking/

[31] UN Environment Programme. *UN report: Time to seize opportunity, tackle challenge of e-waste. Online posting*. UN Environment Programme. Accessed 4 May 2022. https://www.unep.org/news-and-stories/press-release/un-report-time-seize-opportunity-tackle-challenge-e-waste

[32] Corrales, A. 2022. *Coming soon: More ways to repair your Pixel phone.* Online posting. Google. Accessed 4 May 2022. https://www.blog.google/outreach-initiatives/sustainability/pixel-phone-repairs/

[33] The Restart Project. 2021. *Poll: Overwhelming Support for a Universal Right to Repair in Great Britain.* Online posting. The Restart Project. Accessed 4 May 2022. https://therestartproject.org/news/overwhelming-support-right-to-repair-britain/

[34] The White House. 2021. FACT SHEET: *Executive Order on Promoting Competition in the American Economy.* Online posting. The White House. Accessed 4 May 2022. https://www.whitehouse.gov/briefing-room/statements-releases/2021/07/09/fact-sheet-executive-order-on-promoting-competition-in-the-american-economy/

[35] European Parliament. 2022. *Circular Electronics Initiative / Before 2022-1*. Online posting. European Parliament. Accessed 4 May 2022. https://www.europarl.europa.eu/legislative-train/api/stages/report/current/theme/a-european-green-deal/file/circular-electronics

[36] Ibid.

[37] Hilton, M. 2020. *What are Modulated Fees and how do they work?* Online posting. Eunomia. Accessed 4 May 2022. https://www.eunomia.co.uk/modulated-fees-and-how-they-work/

[38] World Health Organization. 2021. *Children and digital dumpsites: e-waste exposure and child health*. Online posting. World Health Organization. Accessed 4 May 2022. https://www.who.int/publications/i/item/9789240023901

[39] IEA. 2021. *The Role of Critical Minerals in Clean Energy Transitions*. Online posting. IEA. Accessed 4 May 2022. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary

[40] European Commission. 2020. *Critical Raw Materials for Strategic Technologies and Sectors in the EU. Online posting.* European Commission. Accessed 4 May 2022. https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf

[41] Evans, S. et al. 2021. *Critical point: securing the raw materials needed for the UK's green transition.* Online posting. Green Alliance. Accessed 4 May 2022. https://green-alliance.org.uk/publication/critical-point/

[42] Karali, N. and Shah, N. 2022. *Bolstering supplies of critical raw materials for low-carbon technologies through circular*

economy strategies. Online posting. Accessed 4 May 2022. https://www.sciencedirect.com/science/article/pii/S221462962200041X

[43] e.g., UK Government. 2022. *Business Secretary opens latest meeting of the Critical Minerals Expert Committee. Online posting. UK Government. Accessed 4 May 2022.* https://www.gov.uk/government/news/business-secretary-opens-latest-meeting-of-the-critical-minerals-expert-committee

[44] Deutz, A. et al. 2020. *Financing Nature: Closing the Global Biodiversity Financing Gap*. Online posting. The Nature Conservancy. Accessed 4 May 2022. https://www.nature.org/content/dam/tnc/nature/en/documents/FINANCINGNATURE_FullReport_091520.pdf

[45] Gibson, M. 2021. *Survey of sustainability reporting at technology companies. Online posting*. KPMG. Accessed 4 May 2022. https://assets.kpmg/content/dam/kpmg/cr/pdf/tl-survey-of-sustainability-reporting-at-technology-companies.pdf

[46] Microsoft. *N.D. AI for Earth*. Online posting. Microsoft. Accessed 4 May 2022. https://www.microsoft.com/en-us/ai/ai-for-earth

[47] Google. 2021. *Wildlife Insights helps capture the beauty of biodiversity, as well as its fragility.* Online posting. Google. Accessed 4 May 2022. https://sustainability.google/progress/projects/wildlife-insights/

[48] Business for Nature. *N.D. Business for Nature's Call to Action.* Online posting. Business for Nature. Accessed 4 May 2022. https://www.businessfornature.org/call-to-action

[49] Microsoft. 2021. 2021 Environmental Sustainability Report. Online posting. Microsoft. Accessed 4 May 2022. https://www.microsoft.com/en-us/corporate-responsibility/sustainability/report

[50] The Nature Conservancy. 2020. Closing the Nature Funding Gap: A Finance Plan for the Planet. Online posting. The Nature Conservancy. Accessed 4 May 2022. https://www.nature.org/en-us/what-we-do/our-insights/perspectives/closing-nature-funding-gap-global-biodiversity-finance/

[51] Krantz, M. 2022. 13 Firms Hoard $1 Trillion In Cash (We're Looking At You Big Tech). Online posting. Investor's Business Daily. Accessed 4 May 2022. https://www.investors.com/etfs-and-funds/sectors/sp500-companies-stockpile-1-trillion-cash-investors-want-it/

[52] Apple. 2021. Apple and partners launch first-ever $200 million Restore Fund to accelerate natural solutions to climate change. Online posting. Accessed 4 May 2022. https://www.apple.com/newsroom/2021/04/apple-and-partners-launch-first-ever-200-million-restore-fund/

[53] Amazon. 2021. Amazon invests in nature-based solutions to tackle climate change across Europe. Online posting. Amazon. Accessed 4 May 2022. https://www.aboutamazon.co.uk/news/sustainability/amazon-invests-in-nature-based-solutions-to-tackle-climate-change-across-europe

[54] Microsoft. 2022. Carbon dioxide removal. Online posting. Microsoft. Accessed 4 May 2022. https://www.microsoft.com/en-us/corporate-responsibility/sustainability/carbon-removal-program

[55] United Nations. 2021. *Summary Progress Update 2021: SDG 6 — water and sanitation for all.* Online posting. United Nations. Accessed 4 May 2022. https://www.unwater.org/app/uploads/2021/12/SDG-6-Summary-Progress-Update-2021_Version-July-2021a.pdf

[56] Mytton, D. 2021. *Data centre water consumption.* Online posting. npj Clean Water. Accessed 4 May 2022. https://www.nature.com/articles/s41545-021-00101-w

[57] Intel Corporation. 2020. *Intel Corporation Water Restoration 2020 Report*. Online posting. Intel Corporation. Accessed 4 May 2022. https://www.intel.co.uk/content/www/uk/en/environment/restore-water-goal-report.html

[58] Meta. 2021. *Restoring More Water Than We Consume by 2030*. Online posting. Meta. Accessed 4 May 2022. https://about.fb.com/news/2021/08/restoring-water/

[59] Majid, A. *Ukraine information war: False claims spread on Twitter, Facebook, RT and Sputnik*. Online posting. PressGazette. Accessed 4 May 2022. https://pressgazette.co.uk/ukraine-fake-news/

[60] Fuller, J. et al. 2021. *Hidden Workers: Untapped Talent.* Online posting. Harvard Business School. Accessed 4 May 2022. https://www.hbs.edu/managing-the-future-of-work/Documents/research/hiddenworkers09032021.pdf; *How an AI grading system ignited a national controversy in the U.K.* (https://www.axios.com/2020/08/19/england-ex-ams-algorithm-grading); Sankin, A. et al. 2021. *Crime Prediction Software Promised to Be Free of Biases. New Data Shows It Perpetuates Them*. Online posting. The Markup. Accessed 4 May 2022. https://themarkup.org/predic-tion-bias/2021/12/02/crime-prediction-software-promised-to-be-free-of-biases-new-data-shows-it-perpetuates-them

[61] Edelman. 2021. *Edelman Trust Barometer 2021*. Online posting. Edelman. Accessed 4 May 2022. https://www.edelman.com/trust/2021-trust-barometer/trust-technology

[62] Roach, S. 2022. *Google hires first head of Tech and Society*. Online posting. protocol. Accessed 4 May 2022. https://www.protocol.com/bulletins/google-tech-society

[63] *Salesforce. 2020. How Salesforce Is Building a Culture of Responsible Technology — and Why it Matters. Online posting. Salesforce.* Accessed 4 May 2022. https://www.salesforce.com/news/stories/how-salesforce-is-build-ing-a-culture-of-responsible-technolo-gy-and-why-it-matters/#:~:text=The%20 Office%20of%20Ethical%20and%20 Humane%20Use%2C%20creat-ed,the%20basic%20human%20 rights%20of%20every%20human%20being

[64] *Gray, R. 2017. Lies, propaganda and fake news: A challenge for our age. Online posting. BBC.* Accessed 4 May 2022. https://www.bbc.com/future/article/20170301-lies-propaganda-and-fake-news-a-grand-challenge-of-our-age

[65] *European Commission. N.D. Code of Practice on Disinformation. Online* posting. European Commission. Accessed 4 May 2022. https://digital-strategy.ec.europa.eu/en/policies/code-practice-disinformation

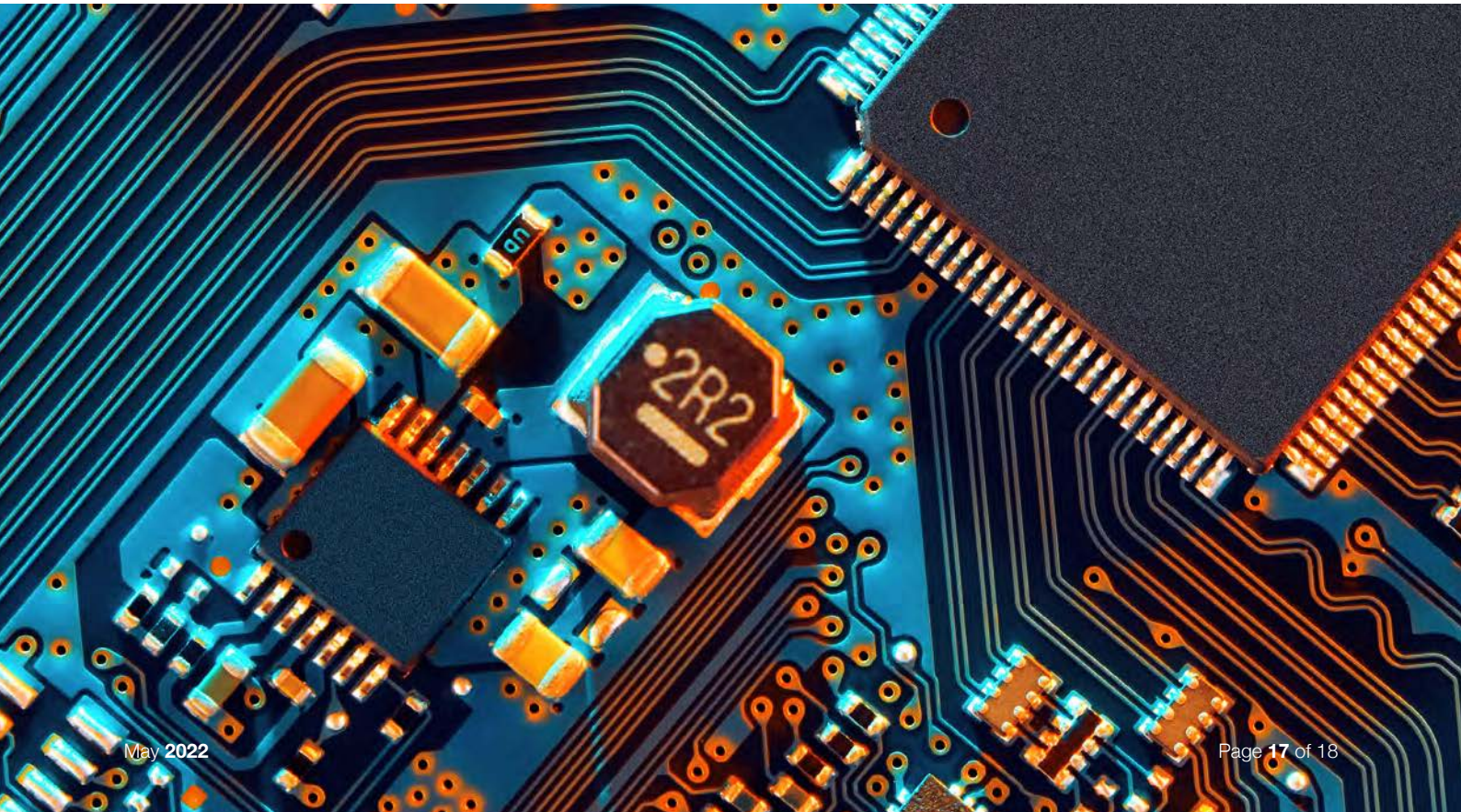
[66] Oversight Board. N.D. *Ensuring respect for free expression, through independent judgment*. Online posting. Oversight Board. Accessed 4 May 2022. https://oversightboard.com/

[67] Trailhead. N.D. *Meet the Office of Ethical and Humane Use of Technology. Online posting*. Salesforce. Accessed 4 May 2022. https://trailhead.salesforce.com/en/content/learn/modules/eth-ics-by-design/meet-the-office-of-ethical-and-humane-use-of-technology

[68] Data & Trust Alliance. 2021. *Leading Employers Adopt Criteria to Mitigate Algorithmic Bias in Workforce Decisions*. Online posting. Data & Trust Alliance. Accessed 4 May 2022. https://dataandtrustalliance.org/news

[69] Center for Data Ethics and Innovation. 2021. *The roadmap to an effective AI assurance ecosystem*. Online posting. UK Government. Accessed 4 May 2022. https://www.gov.uk/government/publications/the-roadmap-to-an-effective-ai-assurance-ecosystem

[70] European Union Law. 2021. *Proposal for a Proposal for a regulation of the european parliament and of the council laying down harmonised rules on artificial intelligence (artificial intelligence act) and amending certain union legislative acts*. Online posting. European Union Law. Accessed 4 May 2022. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206



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