The AI footprint

What consumer goods companies need to know about AI's environmental impacts

June 2026

The Consumer Goods FORUM

Disclaimer

The Consumer Goods Forum (CGF) and its Climate Transition Coalition are committed to full compliance with applicable competition laws.

This report is intended to share both the potential challenges of AI on Scope 3 emissions across consumer goods value chains and the emerging innovations that can support companies to mitigate AI's environmental impact. It also outlines practical steps end user companies can take today to better understand and manage these effects.

At this stage, there is great uncertainty in any projection of AI usage, compute efficiency, and clean energy uptake. The projections in this report are based on assumptions by credible institutions, but outputs should nevertheless be considered directional and for understanding order-of-magnitude, not as precise predictions.

The report reflects areas of broad alignment but does not necessarily represent the detailed views of every participating organisation on all aspects of the analysis or conclusions. It is not legally binding and does not constitute any form of commitment on the part of the CGF or its members.

Furthermore, the report references various potentially helpful sources of additional information; no such references should be treated as an endorsement by the CGF or any individual member. The information contained herein is for informational purposes only and should not be construed as legal or professional advice.

Companies should adapt the information provided in this document to their specific circumstances and seek independent legal counsel as needed.

Driving emissions reduction and resilience, together

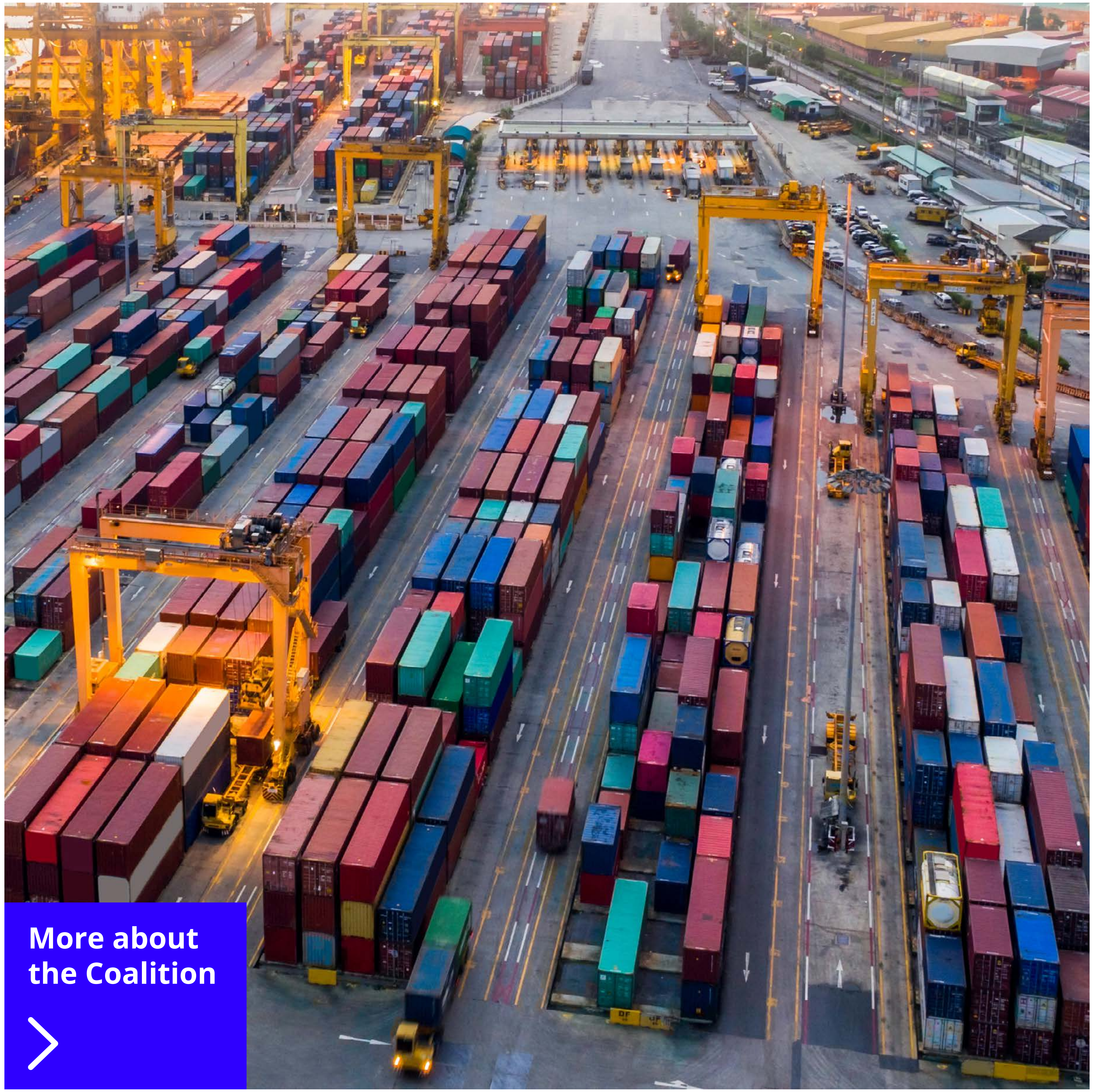
The Consumer Goods Forum's (CGF) Climate Transition Coalition brings companies together to accelerate meaningful progress on the sector's climate journey. Its ambition is to drive both emissions reduction and climate risk mitigation, recognising that cutting emissions must go hand in hand with building resilience, particularly across complex global supply chains.

By fostering collaboration, sharing knowledge and tools, and supporting data-driven action, the Coalition equips businesses and their suppliers to make practical progress on emissions measurement, reporting, and reduction, while strengthening their ability to adapt to a changing climate.

As part of this work, the Coalition has a focus on 'AI for Climate' and commissioned this report with the help of Boston Consulting Group (BCG) to help answer three questions raised by members:

- What is the environmental impact of AI?
- How does AI affect consumer goods companies' Scope 3 emissions?
- What actions can downstream users take to reduce and manage scope 3 emission generated through AI?

This report is intended to help consumer goods manufacturers and retailers better understand the role that AI usage plays in their Scope 3 emissions. It is not intended to be an exhaustive review of all impacts of AI build-out and use, environmental or otherwise. AI has and will continue to have profound effects beyond what is covered in this focused review.



More about the Coalition

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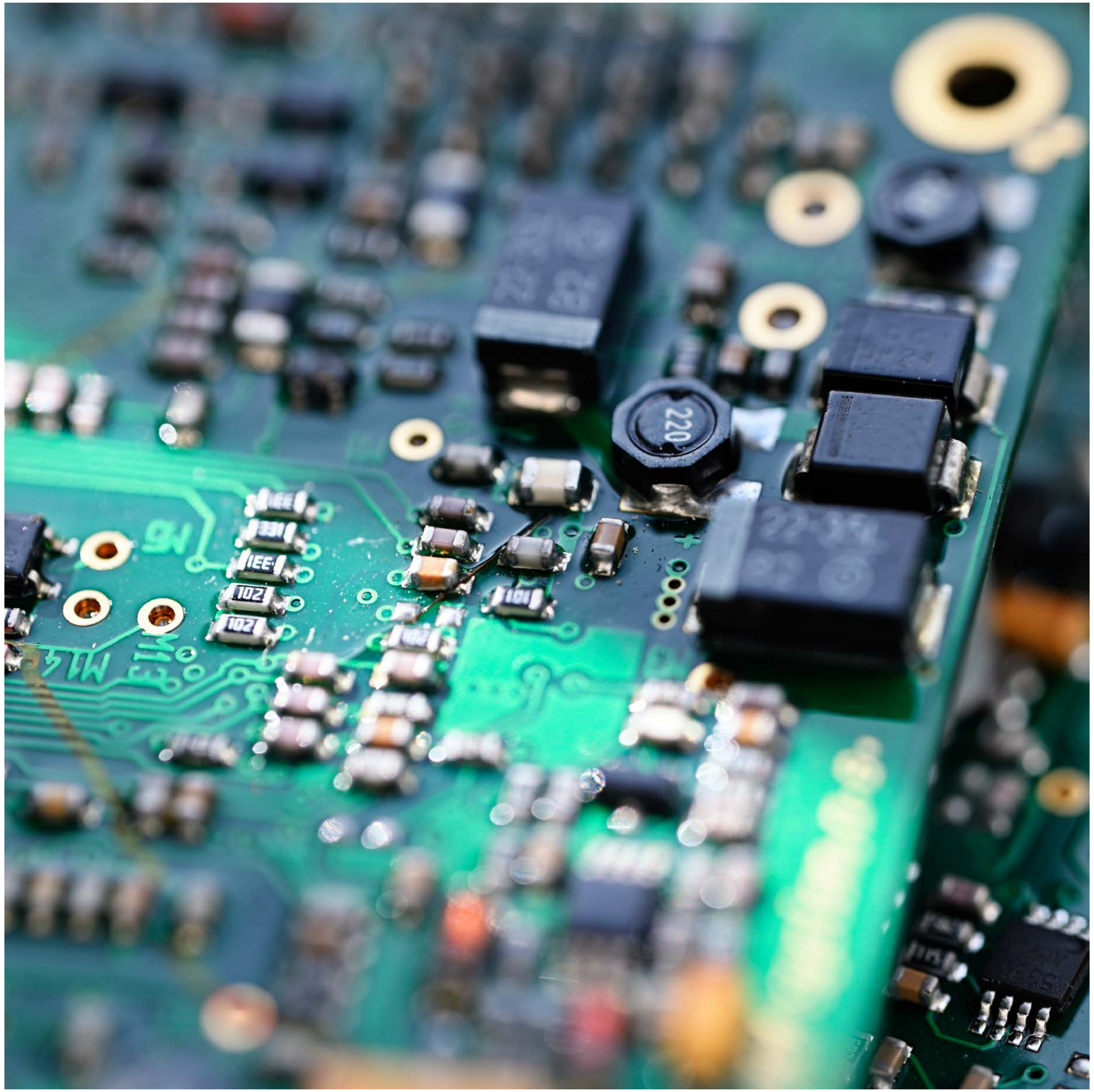


Executive summary

1. **At the company level, AI's impact is small today but expect a steep growth curve**
   GenAI + cloud account for <1% of a typical end user's Scope 3 today, but the AI market is expected to grow 25x by 2033, and end users' Scope 3 could grow by 6-8x.

2. **Impacts span the data centre lifecycle, with use phase accounting for ~70% of emissions**
   High-impact challenges include embodied carbon in concrete, steel, and hardware, surging power and water (often in stressed regions), diesel for backup power, and rising e-waste from ~4-year hardware refresh cycles.

3. **Credible innovations at every stage**
   Tech majors, builders, hardware manufacturers, and energy providers are all innovating rapidly around lower-carbon hardware and building materials, clean baseload power, zero-water cooling, diesel replacement, and hardware harvesting.

4. **AI solutions may be a sustainability accelerator**
   Deploying current AI capabilities across sustainability sectors like renewable energy and water management could generate ~ $600 billion in global annual value by 2028. This figure reflects only the sustainability-specific value; the broader AI opportunity in each sector is substantially larger.

5. **Current GHG accounting constraints end users wanting to track and address impact**
   Procurement often bundles AI inside "IT/cloud", spend-based emissions factors undercount AI's compute intensity, and most companies' climate roadmaps predate the AI boom. Standard setters are closing the gap, but companies shouldn't wait to start collecting and organising the right data.

6. **Several "no regrets" actions that end users can take today:**
   - internally, track tokens, queries, storage, region of compute;
   - track AI usage and enable its appropriate management over time;
   - push AI hyperscaler suppliers for emissions and embodied-carbon transparency;
   - over time, advocate for hyperscalers to prioritise greater energy efficiency and clean energy use;
   - explore applying internal carbon pricing to Scope 3, including digital/AI products and services.

Considerations

As Generative AI proliferates, companies must be aware of critical operational, sustainability and ethical risks

In focus

Not Exhaustive

Environment

The construction and operation of advanced data centres is emissions intensive and strains key resources like electricity and water, while quick turnover of specialised hardware creates a waste problem. Further, GHG accounting guidance and emissions factors have not yet caught up with the AI boom, making it difficult for enterprise users to incorporate AI usage into Scope 3 calculations and climate roadmaps.

Labor market

AI is disrupting business models by completing daily tasks with high efficiency, risking employee displacement and low job satisfaction.

Security

When training and using AI models, companies transmit sensitive data, often under insufficient security standards.

The race to AI dominance changes geopolitical dynamics, risking further instability.

Innovation and copyright

AI models excel at reproduction, not true invention. AI reliance poses risks of homogenisation and copyright infringement.

Under-delivery of promised impact

AI transformations driven by overexuberance do not always deliver promised results.

Limitations such as bias and hallucinations persist, jeopardising user trust and work quality.

AI is neither a purely destructive force nor a magic bullet…

There are acute environmental impacts, and AI's 25x market growth trajectory demands attention

The immediate strain on local grids and watersheds is creating an urgent crisis in many communities. In the US, residential electric rates have risen 34% since 2020[1] amid rising demand and infrastructure pressures. A rapidly growing AI market likely means foundational shifts in infrastructure and ways of working that can't be ignored.

Recent innovation and regulation may curb resource demand

In the long-term, recent trends suggest ongoing gains are possible in energy efficiency, low-carbon energy deployment, waste reduction, and water efficiency. Tech companies are investing heavily in data center sustainability while regulators in Asia and Europe are leading the way in minimum performance standards for water, power, and carbon usage effectiveness (PUE (Power Usage Effectiveness), WUE (Water Usage Effectiveness), CUE (Carbon Usage Effectiveness)).

AI may even unlock and scale environmental solutions

The AI market in 2023 was $190 billion[2], and is expected to reach several trillion in the next decade. Even with technological advances, resource demands will multiply significantly. AI can help teams expand both breadth and depth of discovery, unlocking significant efficiencies and avoided emissions.

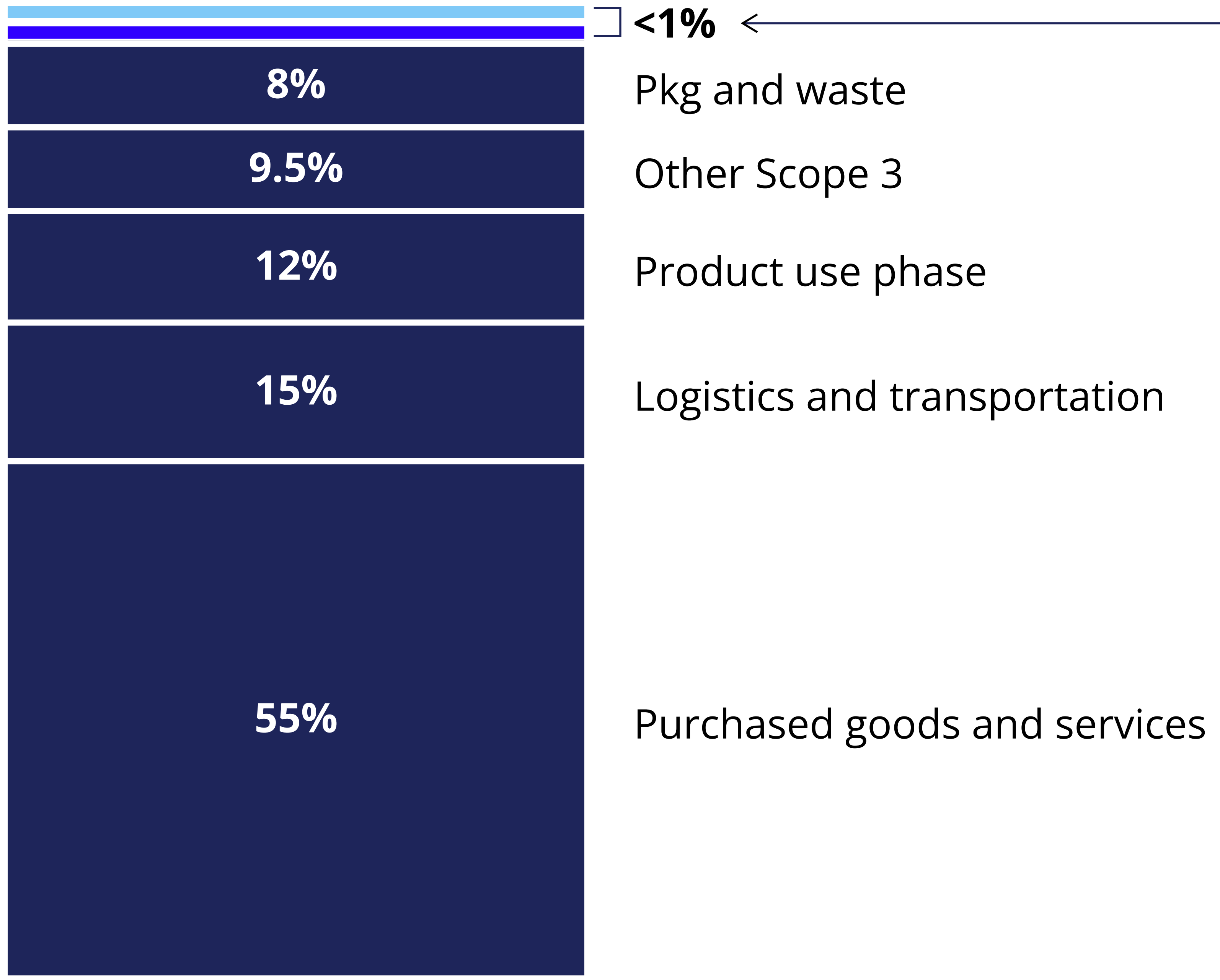
Choices made this decade will shape AI's environmental legacy

Site selection, cooling technology, and energy procurement decisions made today can shape AI into a long-lived environmental burden or the foundation of a sustainable digital era.

Environmental impacts

GenAI and cloud represent <1% of Scope 3 for CPG/Retail; 25x usage growth trajectory demands attention but may still be small contributer to total Scope 3 emissions[3]

Illustrative Scope 3 breakdown for a typical consumer goods / retail company (= 100% of total Scope 3 emissions)



Segments shown represent share of total Scope 3 emissions

All Cloud and AI

Traditional Cloud / IT hosting

Data centres, SaaS, e-commerce hosting

Generative AI usage

LLM inference, training amortisation (per-query: ~0.01–0.05 kWh × grid intensity).[4]

Estimate uses a grid intensity of 0.3 kg CO_2e/kWh, the average of Virginia, where nearly 70% of global internet traffic is served. Number of queries estimated to be 50,000/day. Note: Per-query estimates can vary 10x by model, provider, and grid mix.

GenAI emissions could grow 6–8x but will likely remain low single-digit contribution to Scope 3 – end user behaviour matters in three main ways

	Driver	2026	2028	2030	2035	Action for end users
	AI usage volume[5]	1x	~10x	~20x	~30x	Track internally
1	Compute power per task[6] (agentic and multimodal are heavier)	1x	~2x	~4x	~8x	Training and governance
2	Energy per token[7] (efficiency gain, divides)	÷1	÷4	÷8	÷16	Transparency and improvement
3	Clean energy as % of data center's energy use[8]	~30%	~40%	~50%	~60%	Responsibility of hyperscalers and data center operators
4	**Net AI emissions**	1x	~5x	~7x	~10x	
	AI share of total Scope 3[9] (central, with range)	**~0.15%**	**~0.5%** (0.3–2%)	**~1%** (0.4–4%)	**~1.5%** (0.5–8%)*	

*Range reflects four compounding drivers: low end assumes efficiency outpaces demand; high end assumes agentic workloads outrun efficiency; central (~1.5%) reflects rough balance, contingent on architecture and procurement choices being made now.

Assumptions include: AI usage volume scales with IEA Base Case for AI-optimised data centre electricity – usage evolves in three phases: human-led copilots bounded by the ~8-hour workday (today–2027). semi-autonomous agents integrated into automatic processes and unbounded by workday (2027–2030), autonomous agents acting across the value chain (2030+); compute-per-task reflects shift to agentic and reasoning-heavy workloads; energy-per-token efficiency continues at current trajectory but with diminishing returns post-2030, based on hyperscalers' reports.

See Conclusion section for full list of next step actions.

Impact is concentrated in the use phase of AI, but physical assets pose embodied carbon and waste challenges

GHG accounting challenges touch every point of the lifecycle

Not Exhaustive

Construction	Powering the use phase	End of life
Raw material inputs for data centres, chips, and network infrastructure	**Electricity and diesel** for computing power **Water and refrigerants** for cooling	**Waste** from spent hardware

~70%

of total lifecycle emissions of a data centre[10]
(Estimate based on a representative model of a data centre in Germany. Actual emissions vary by data centre location, grid carbon intensity, server refresh cycles)

Primary concerns across lifecycle are embodied carbon of building materials, electricity consumption, water use, and waste

Construction

Data centres rely heavily on high-emissions materials like steel, concrete, and chip manufacturing.

Lower-carbon materials, modular design, and maximising green space are reducing building footprints. For example, **Microsoft's emissions grew by 30% between 2020 and 2023,** largely due AI-related builds.[11]

Use phase

The powering and cooling of data centres requires significant electricity, water, and refrigerants, sometimes at the expense of affordability and accessibility for local communities.

Forecasters predict half of growth in US energy demand by 2030 will be from data centres.[12]

End of life

AI is increasing hardware waste due to both intense system strain from high-demand workloads and rapid technology innovations incentivising frequent upgrades.

Many data centre systems and components are now replaced on average every 4 years.[13]

Landscape overview

Tech majors compete on parts of the value chain but provide critical enabling services, creating an interdependent web

Not Exhaustive

LLM developers and platforms

ChatGPT by Open AI	Claude by Anthropic	Gemini by Google	LLaMA by Meta
Mistral AI	X by Grok		

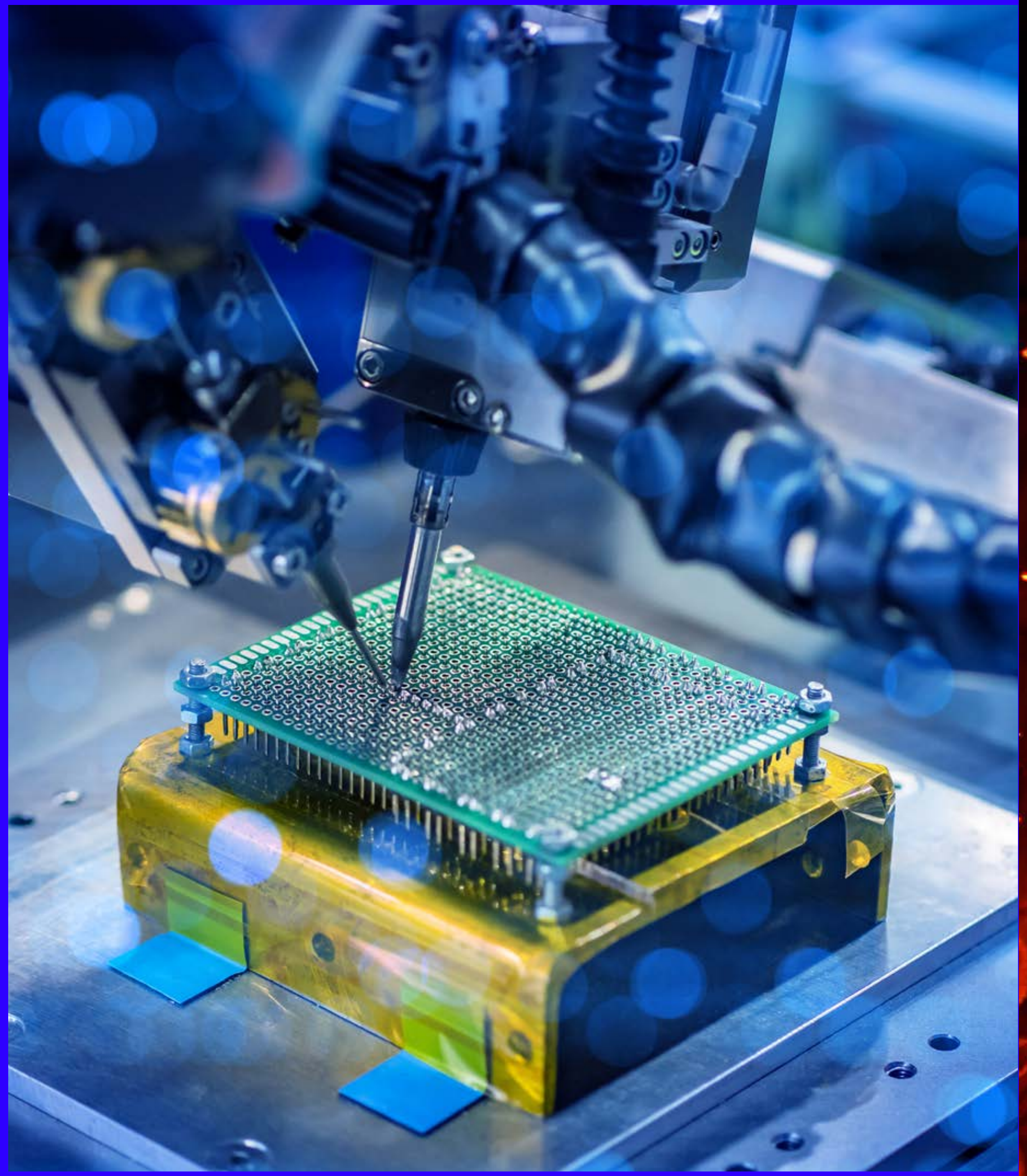
Data centre and cloud hosts

Amazon Web Services	Google Cloud	Oracle	Meta
Microsoft Azure	Core Weave	Dell	

Infrastructure and servers

Nvidia	AMD	Vertiv	Bloom Energy

Note: A meaningful share of hyperscaler capacity is leased or co-located, affecting emissions reporting and accountability. In addition to the metrics included in the Conclusion section, end users wishing to compare data center operators may consider asking for Scope 3 treatment of leased data center capacity.



Deep dive

Construction

Steel, concrete, semiconductors

Challenge

Embodied carbon from materials used to support AI build-out is rapidly increasing

Embodied carbon of building materials

Data centres rely heavily on concrete and steel, which carry high embedded emissions. For example, in 2024, 63% of Meta's Scope 3 footprint came from capital goods, including construction materials like concrete and steel. Lower-carbon materials, modular design, and maximising green space can reduce building footprints.[14]

Carbon intensive hardware materials

Manufacturing AI hardware relies on energy intensive semiconductor fabrication, and mining of rare earths and critical minerals such as cobalt and lithium. Additionally, the global nature of these operations make the supply chain logistics carbon intensive.

Short hardware lifecycles

Fast innovation cycles lead to quick replacement of functional hardware. The replacement-before-failure practice amplifies carbon intensity by increasing emissions per unit output and limits the benefits of efficiency gains.

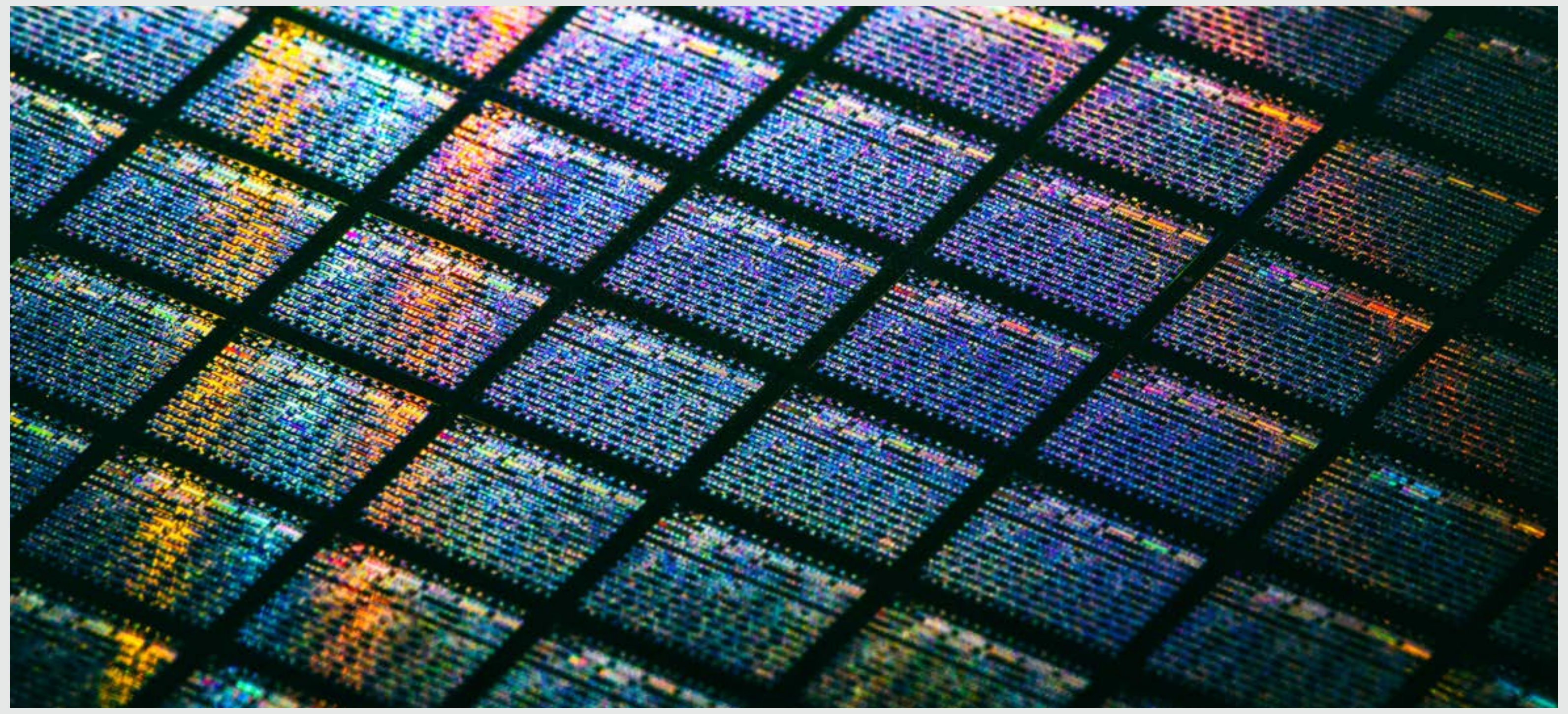
Current innovators

Meta

Meta is **deploying low-carbon concrete in new data centres** through partnerships with Arup and Ozinga and recently launched an open-source tool to accelerate low-carbon concrete design.

Google

Google developed a **new metric to measure lifecycle emissions of AI chips.** Complementary software further reduces the chip's operational emissions.



Innovation[15]

Meta deploys AI-optimised low-carbon concrete and open-sources the design tool for the industry

Context

- Concrete is a major building material for data centres, and the cement it contains accounts for roughly 8% of global CO_2 emissions. Meta partnered with Arup, Ozinga, Amrize, and the University of Illinois Urbana-Champaign to reduce the embodied carbon of concrete in its builds.

What took place

- **Meta cut the concrete carbon footprint in its latest data centre designs up to 30%** by eliminating concrete from electric and telecom duct banks and reducing slab volumes
- For areas still requiring concrete, Meta incorporated low-carbon specifications (e.g., substituting cement with fly ash and slag) that **lowered carbon intensity by up to 20%** below regional baselines.
- Meta developed BOxCrete, an open-source Bayesian optimisation AI model that **predicts strength curves and optimises mix designs** for sustainability, strength, and cure speed simultaneously.
- The AI-optimised mix was deployed at Meta's Rosemount, MN data centre, curing to full structural strength 43% faster while achieving **35% lower carbon intensity at comparable cost.**

Benefits

- Reduces Scope 3 embodied emissions from concrete by up to **40%.**
- **Accelerates construction timelines** by producing faster-curing mixes.
- **Open-sources the AI tooling,** enabling the broader construction industry to adopt low-carbon concrete formulations without proprietary barriers.

Innovation[16]

Google cuts embodied carbon per AI compute 3.7x through TPU hardware-software co-design

Context

- Aside from significant embodied carbon from manufacturing and packaging, AI chips consume a lot of energy. In an effort to address this driver of data centre emissions, Google ran a first-of-its-kind cradle-to-grave LCA on its Tensor Processing Units (TPUs) to systematically reduce embodied carbon per unit of useful compute.

What took place

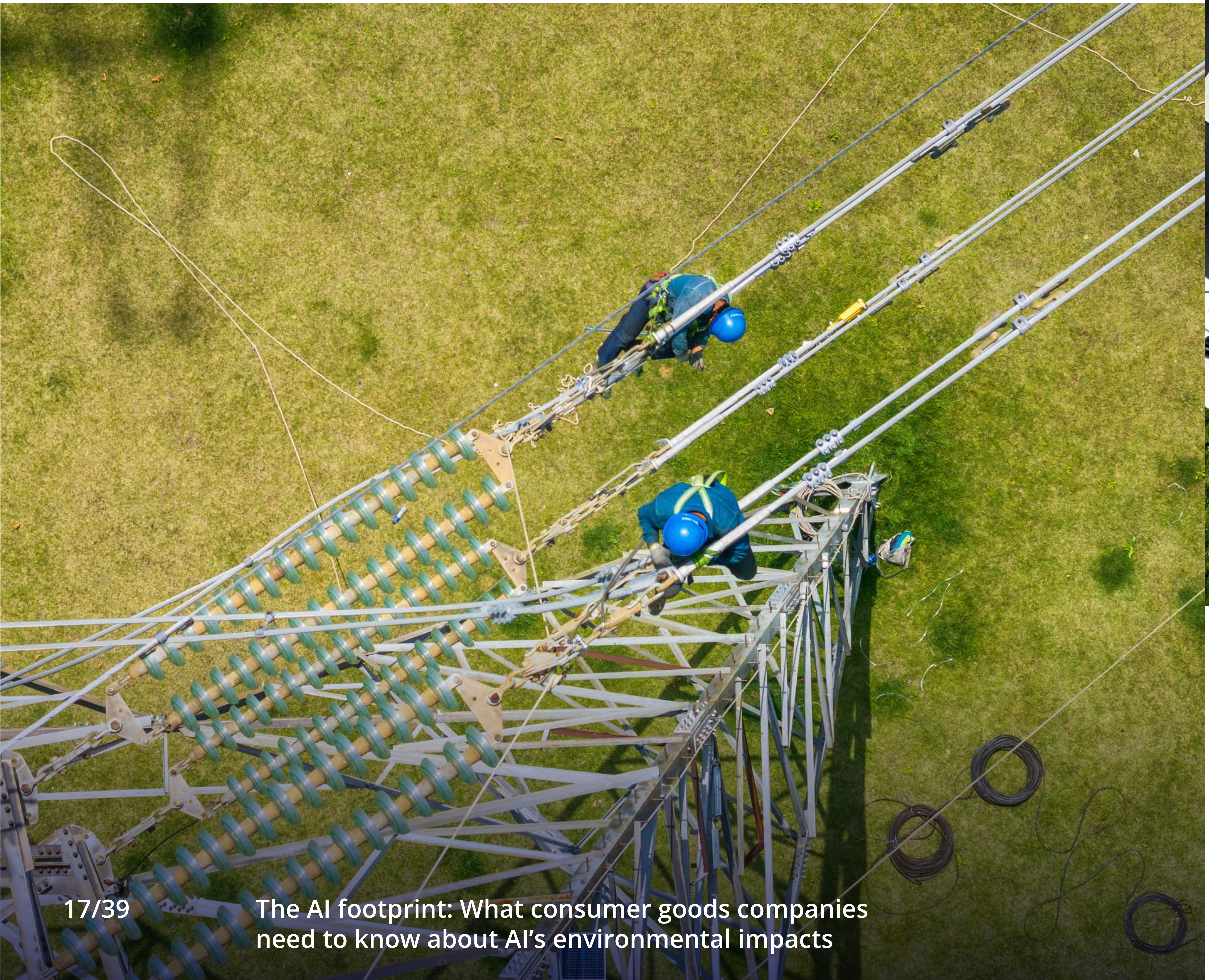
- Google published the **first detailed industry LCA of an AI accelerator chip** in February 2025, introducing a new metric – **Compute Carbon Intensity (CCI), in** **gCO_2e per Exa-FLOP** – that combines embodied and operational emissions.
- The next generation chip is 4.7x more powerful but only takes 1.8x more emissions to manufacture, reducing the "carbon cost per unit of power" by 66%.
- Smarter software amplifies the hardware gains by using techniques like only activating the necessary parts of an AI model (Mixture-of-Experts) and using lower-precision math (FP8).

Benefits

- **Reduced compute carbon intensity by 66%,** generation-over-generation, enabling AI scale-up while moderating emissions growth.
- Establishes a **transparent LCA methodology** and CCI metric that makes AI chip **lifecycle emissions comparable** and informs **sustainable chip design choices.**

Deep dive

Use phase



Energy, cooling, backup generation

Challenge

AI's rapid growth is a significant driver of global energy demand, placing increased importance on grid decarbonisation

AI is driving an unprecedent surge in electricity demand

There has been a sharp increase in data-centre power use due to the AI boom. Data centres made up 1.5% of global electricity demand in 2024 but are expected to grow 15% per year, more than 4x the growth of total electricity consumption from all other sectors.[17]

Regional grid constraints push operators towards fossil fallback

In many regions, grid capacity cannot keep pace with AI-driven demand. Long development and interconnection delays for clean power often force operators to rely on fossil-based electricity or on-site generation, raising emissions.

AI computing has extreme power density and load concentration

AI hardware uses far more power than traditional computing, creating "hotspots" near where data centres and server farms are located, which strain grids and increase emissions where electricity is carbon-intensive. Further, redundancy safeguards lead to more capacity for the same amount of data.

Current innovators

Google

Google has deployed a **first-of-its-kind geothermal energy plant to supply 24/7 carbon-free baseload power** to their Nevada data centre operations.

Nvidia

Nvidia is delivering highly energy efficient hardware. The new **HGX B200 array is 15x more energy efficient, translating to 93% energy savings.**

Innovation[18]

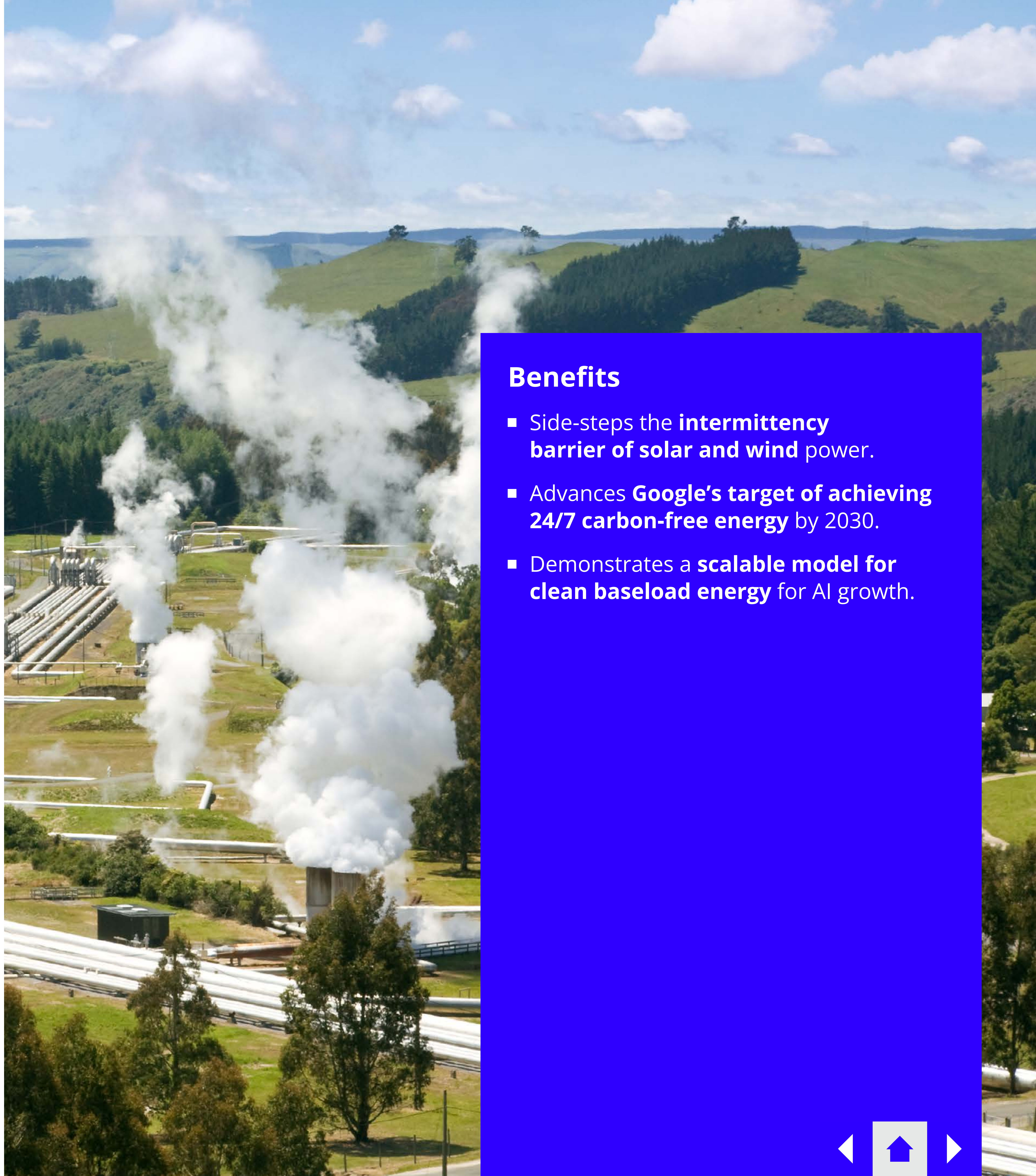
Google deploys geothermal energy to run data centres with clean-power

Context

- Google partnered with Fervo Energy to develop a first-of-its-kind geothermal energy plant to supply 24/7 carbon-free baseload power to Google's Nevada data centre operations.

What took place

- Fervo uses horizontal drilling and fiber-optic sensing to unlock geothermal resources in regions not previously viable.
- This process heats water under the earth's crust to power thermal turbines.
- This unlocks continuous non-intermittent clean power that Google can then use for large AI training clusters.



Benefits

- Side-steps the **intermittency barrier of solar and wind** power.
- Advances **Google's target of achieving 24/7 carbon-free energy** by 2030.
- Demonstrates a **scalable model for clean baseload energy** for AI growth.

Innovation

NVIDIA's HGX B200 delivers higher AI performance with 15x energy efficiency gain

Context

- NVIDIA set out to deliver a generational leap in computational performance while reducing the carbon intensity of its GPU platforms, addressing both the energy requirements and growing embodied emissions footprint of AI hardware.

What took place

- NVIDIA released the HGX B200, a hardware array composed of eight graphic processing units (GPUs) with **twice the memory of the previous model** and a second-generation Transformer Engine supporting greater precision.
- **The HGX B200 is 2.3x faster and up to 15x more energy efficient** for inference than its predecessor, translating to a **93% reduction in energy for equivalent workloads.**
- Product carbon footprint (PCF) summaries also revealed a **24% reduction in embodied carbon intensity**[19] driven by reductions in thermal components, ICs, and memory. Intensity measured as gCO_2e per FLOP at FP16 precision executed over the lifetime of the product.

Benefits

- Delivers a projected **90% reduction in operational carbon emissions** per million inference tokens.
- **Reduces upstream Scope 3 embodied emissions** per unit of compute by 24%, lowering the manufacturing carbon intensity of AI infrastructure.
- **Enables infrastructure consolidation as** higher per-platform performance means fewer servers, less material, and less waste.

Challenge

AI's computing intensity generates major cooling needs, sharply increasing water consumption within data centres

Data centres can add strain to local water-stressed communities

Many new AI data centres are being built in water-stressed areas, where withdrawals compete with agriculture and households. In some regions, the DCs already consume 5–10% of the local water supply. Google's water withdrawals increased by 17% in 2023 (to 29 billion liters),[20] and Microsoft's by 34%,[21] with AI identified as a major driver.

Cooling is less efficient in arid climates, driving up water use

Facilities in arid regions rely on water-intensive cooling, often consuming millions of liters per day. The same AI workload can use 3–4× more water in an arid climate than cooler ones, making siting critical to water intensity.[22]

Refrigerants often tied to hard-to-abate fugitive emissions

Cooling systems require refrigerants, and emissions from refrigerants are often tied to small leaks during operation and maintenance, making them hard to detect and quantify. Even low leakage rates can materially increase emissions at the facility level.

Current innovators

Amazon Web Services

Amazon Web Services (AWS) is **shifting data-centre cooling from drinking water to treated reclaimed water** to reduce their resource footprint.

Submer

Submer develops **zero-water, energy efficient, and heat recycling cooling systems for data centres.** They have deployed their systems with Dell and Intel.

Innovation[23]

AWS utilises reclaimed water in US data centre fleet

Context

- To reduce the resource footprint of cooling systems and cut dependence on potable municipal water, Amazon Web Services (AWS) is shifting data centre cooling from drinking water to treated reclaimed water.

What took place

- AWS partnered with regional utilities to deliver **treated wastewater** directly to its cooling systems.
- By 2023, **reclaimed water was already in use at 20 AWS data-centre sites** across California and Virginia.
- AWS announced plans to **expand the program to over 120 locations** by 2030, deploying multi-cycle treatment that allows the same water to be reused repeatedly before discharge.
- The company estimates that the reclaimed-water program will **avoid over 530 million gallons (~2 billion liters) of municipal water withdrawals** per year once fully scaled.
- Reduced reliance on potable water also **extends the lifespan of cooling hardware,** reducing replacement demand and upstream material waste.

Benefits

- Reduces **freshwater dependency** for AI workloads.
- Reduces **material throughput of cooling infrastructure,** lowering upstream Scope 3 embodied emissions.
- Extends **cooling system lifecycle by reducing scaling, corrosion and mechanical wear** risk of untreated water.

Use phase – Cooling

Innovation[24]

Submer deploys zero-water immersion cooling with heat recycling, validated in partnership with Dell and Intel

Context

- With CPU thermal design power reaching 200–400W and GPUs pushing beyond 1,000W, traditional air cooling can no longer keep pace. Traditional air systems consume up to 40% of a data centre's energy and rely heavily on water for evaporative heat rejection. Submer developed single-phase immersion cooling to address all three constraints simultaneously.

What took place

- Submer partnered with Dell and UNICOM Engineering to bring **immersion-ready PowerEdge servers (powered by Intel and NVIDIA)** to market, fully converted, tested in fluid, and ready to deploy at scale.
- Submer and Intel co-developed the Forced Convection Heat Sink (FCHS), a **breakthrough package capable of cooling chips above 1,000W TDP (thermal design power)** in single-phase immersion, rivaling the thermal performance of direct liquid cooling.
- Submer now has **300 MW in active deployment globally,** with hundreds of additional MW planned across Europe, operating from a Gigafactory in Houston, TX.

Benefits

- **Achieves zero water consumption for cooling,** removing dependency on municipal water supplies.
- Delivers up to **30% energy savings over traditional air cooling** by removing server fans, facility air handlers, and in some configurations, compressors from the cooling chain.
- **Enables waste heat capture and reuse,** turning a cost centre into a potential revenue or efficiency gain.

Challenge

Diesel backup systems used in data centres drive emissions and impact local air quality

Diesel generation for back-up power

Although data centres are increasingly run on low-emission electricity, they often rely on diesel-powered generators to ensure continuity. As capacity scales, even temporary testing and outage events can generate significant emissions.

Local air pollution impact

Diesel generators emit high levels of CO2, NOx and particulate matter contributing disproportionately to local air pollution, especially in dense data centre regions. Regional public health costs due to increased pollution from data centres in the Northeast US may reach up to $260M per year.[25]

Regulatory advances

Global air quality regulations will limit the use of heavy diesel and energy usage. In 2024 the EU launched the European Efficiency Directive[26] which mandates reporting on energy consumption and water usage from all data centres in effort to start benchmarking and enforcing improvements overtime.

Current innovators

Microsoft

Microsoft piloted a **1.5 MW project powered by a hydrogen fuel cell + battery storage system.** These systems are being tested to replace traditional diesel backup generators.

Redwood Energy

Redwood Energy deploys low-cost, tariff-free, circular storage system by **reusing EV batteries** sourced in North America. Systems are modular for easy scaling, monitoring, and servicing.

Innovation[27]

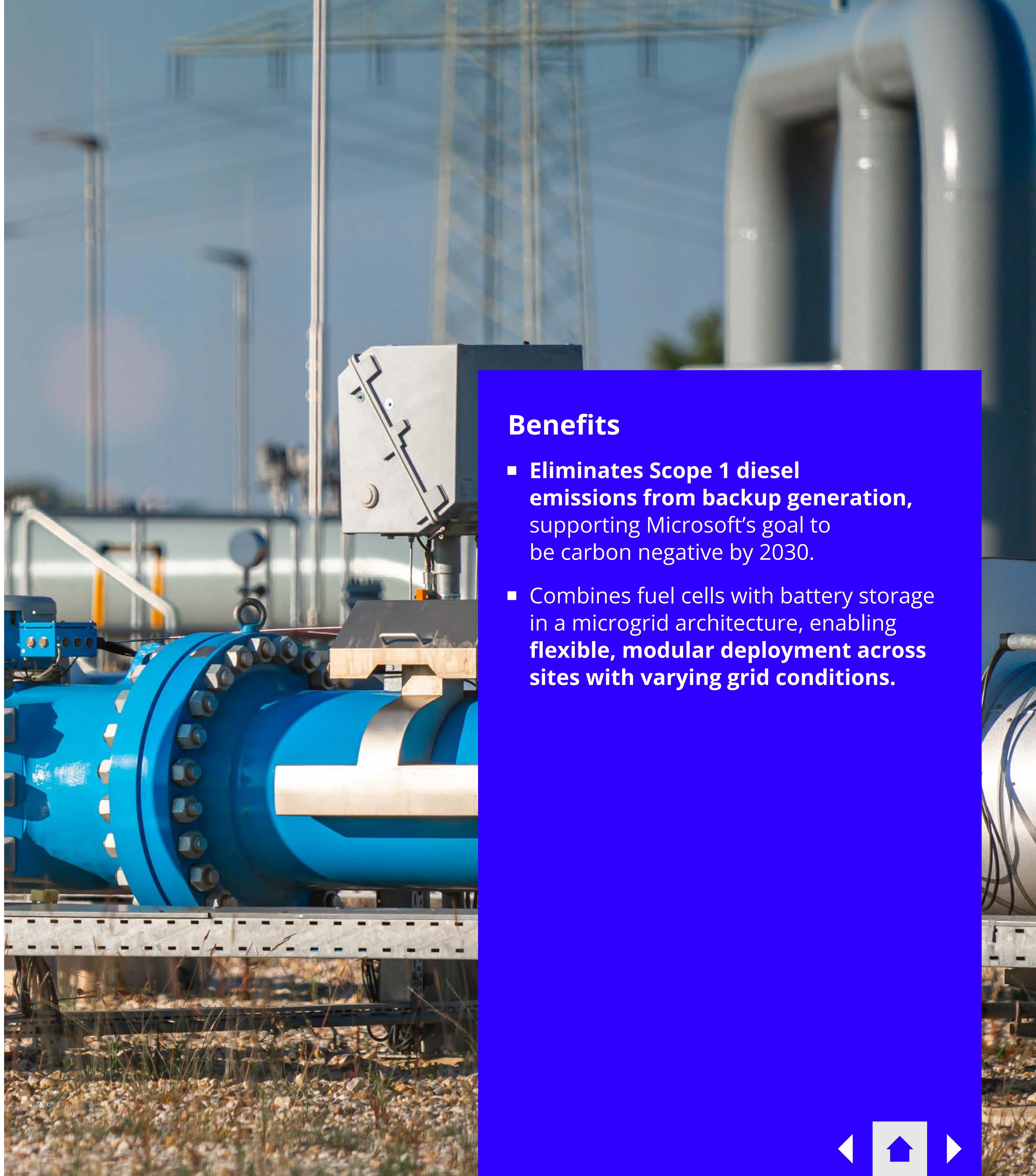
Microsoft pilots hydrogen fuel cell backup power to replace diesel generators at data centres

Context

- Data centres rely on diesel generators for backup power during grid outages, contributing to Scope 1 emissions and local air pollution. Microsoft collaborated with Caterpillar and Ballard Power Systems to demonstrate that hydrogen fuel cells could meet the same reliability standard with zero direct emissions.

What took place

- A **1.5 MW hydrogen fuel cell** from Ballard was integrated into Microsoft's data centre in Cheyenne, Wyoming, paired with two Caterpillar battery energy storage systems and a microgrid controller.
- The system **successfully simulated a 48-hour backup power event, validated at 6,086 ft elevation and in below-freezing conditions,** matching the harsh operating profile diesel generators must handle.
- **The U.S. Department of Energy partially funded the three-year project** under the H2@Scale initiative; NREL conducted independent analysis of safety, techno-economics, and GHG impacts.
- **The demonstration confirmed the system can meet Microsoft's 99.999% uptime requirements,** with the fuel cell's only byproduct being water vapor.



Benefits

- **Eliminates Scope 1 diesel emissions from backup generation,** supporting Microsoft's goal to be carbon negative by 2030.
- Combines fuel cells with battery storage in a microgrid architecture, enabling **flexible, modular deployment across sites with varying grid conditions.**

Use phase – Backup generation

Innovation[28]

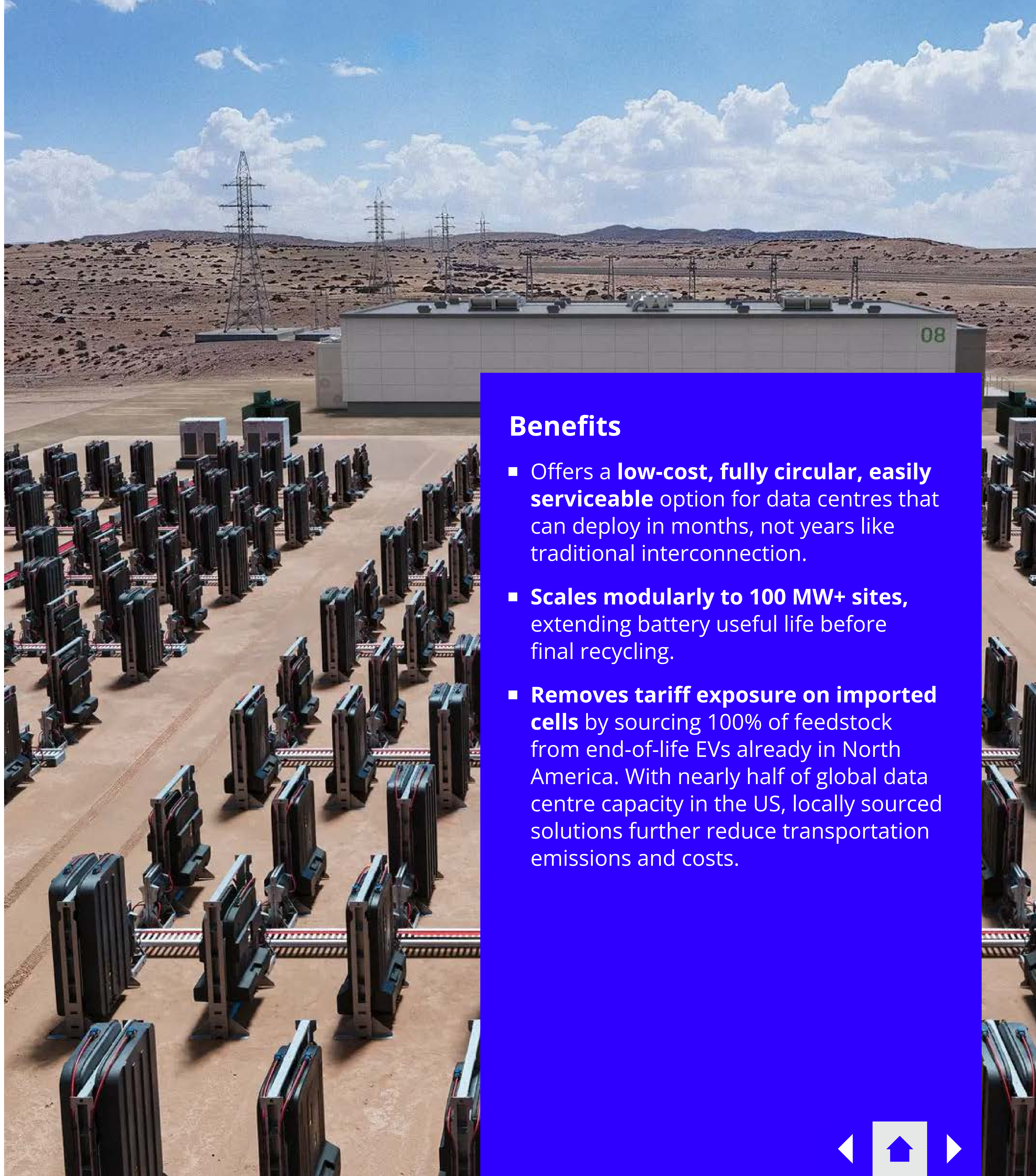
Redwood Energy offers low cost, scalable battery storage by reusing EV batteries

Context

- Data centres face multi-year grid interconnection queues as AI demand surges, while new lithium-ion storage carries tariff exposure on imported cells. Redwood Energy repurposes retired EV packs, which typically retain 50–80% capacity, into microgrid storage.

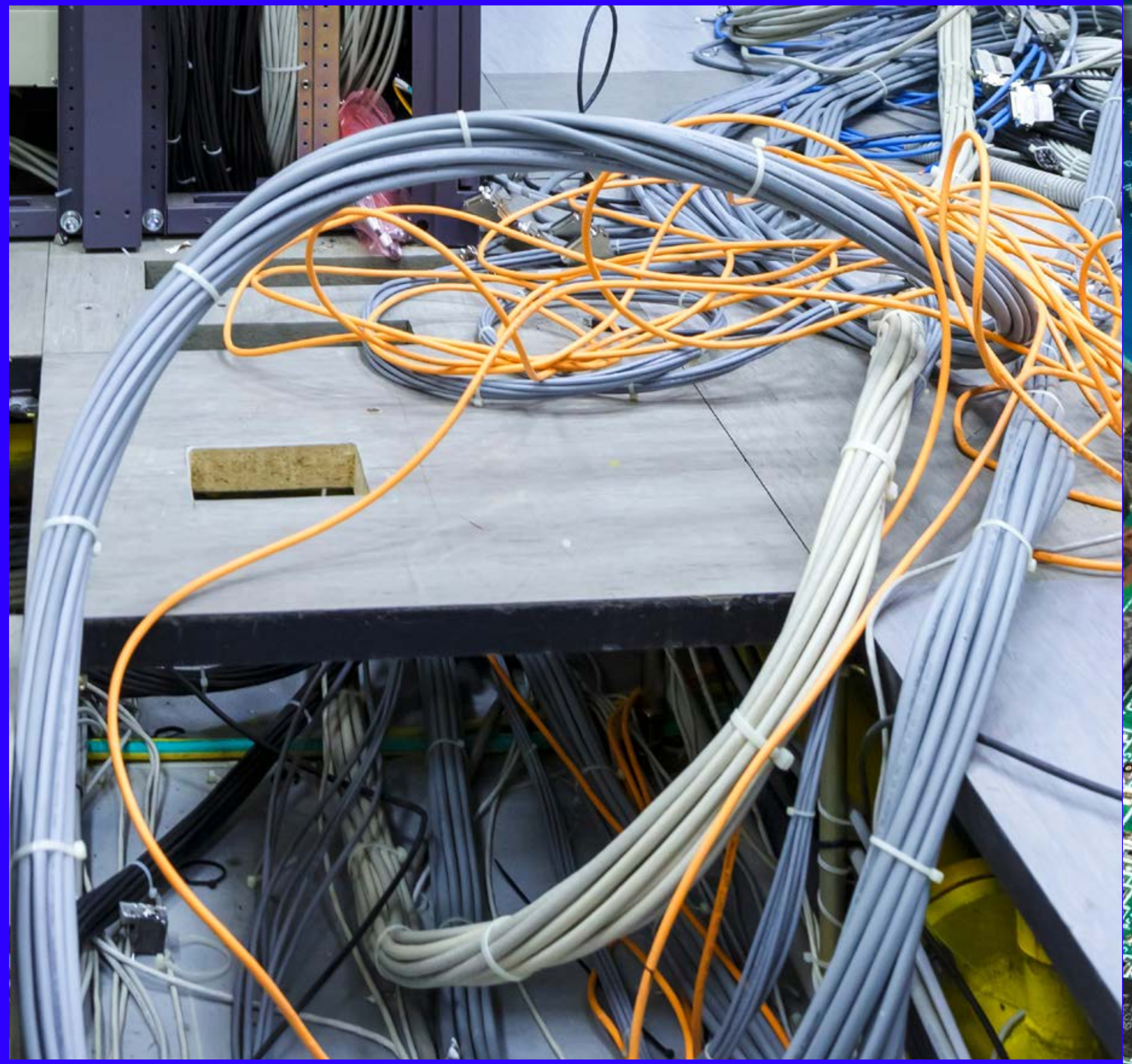
What took place

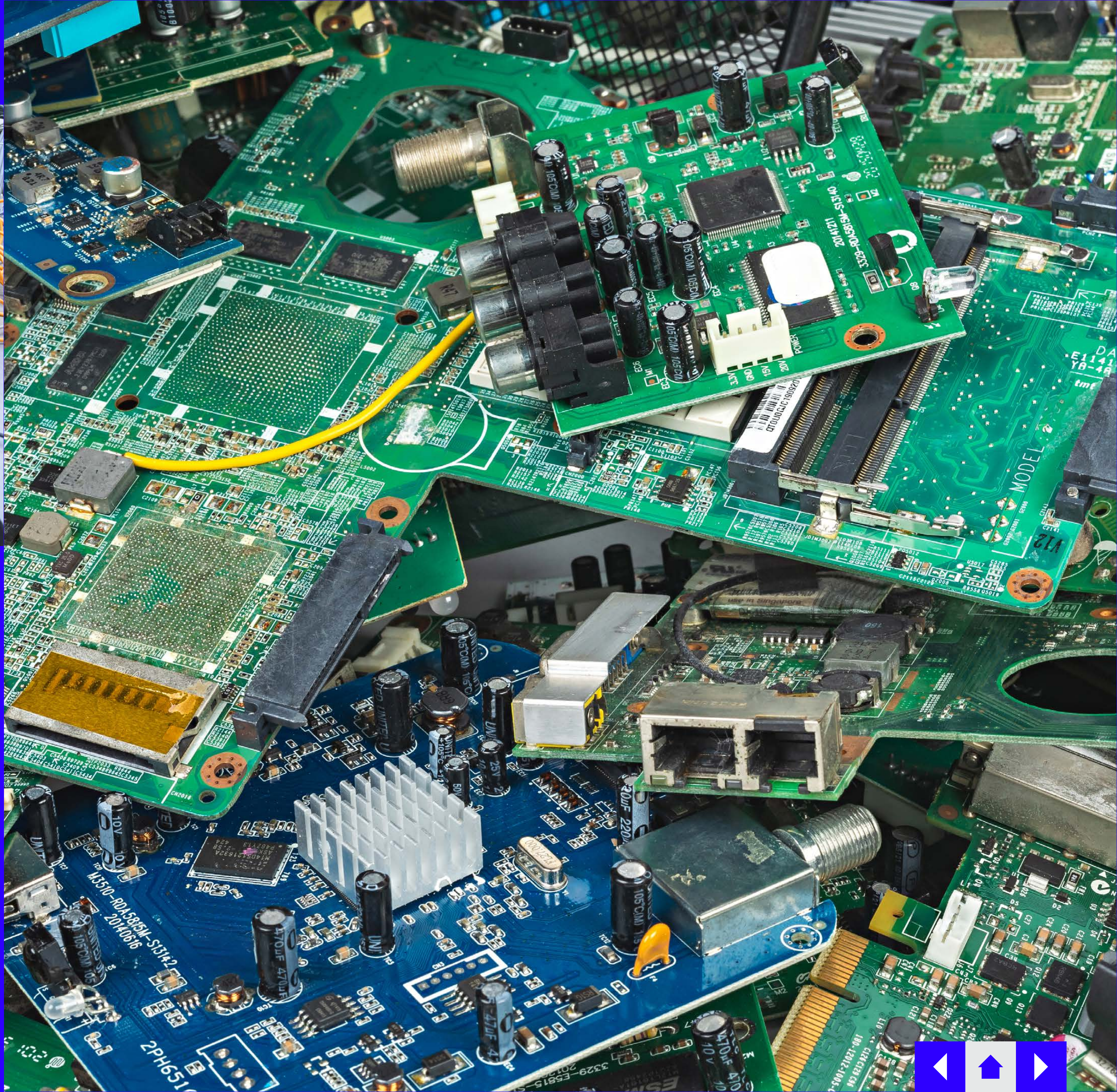
- Redwood Materials, North America's top battery recycler (90% market share), saw **EV battery intake double annually** so engineered a **first-of-its-kind, serviceable, low-cost storage system.**
- **GM, Ford, Rivian, Volvo and Toyota** supply feedstock and host on-site installations.
- In June 2025, Crusoe, an AI cloud platform, commissioned a 12 MW solar / 63 MWh battery microgrid for its data centre in Nevada, the **largest such deployment globally.**
- Over seven months, the system maintained **99.2% uptime**, convincing Crusoe to expand from 4 to 24 units, to serve roughly 7x compute capacity of initial install.
- Redwood Energy has **1+ GWh** in pipeline and **100MW+** projects in design.



Benefits

- Offers a **low-cost, fully circular, easily serviceable** option for data centres that can deploy in months, not years like traditional interconnection.
- **Scales modularly to 100 MW+ sites,** extending battery useful life before final recycling.
- **Removes tariff exposure on imported cells** by sourcing 100% of feedstock from end-of-life EVs already in North America. With nearly half of global data centre capacity in the US, locally sourced solutions further reduce transportation emissions and costs.





Deep dive

End of life and waste

Challenge[29]

Retired AI hardware creates large and complex e-waste streams due to high replacement rates

Heavy demand and rapid innovation accelerate churn

AI workloads put intense pressure on servers and accelerators, while fast-moving innovation makes older systems quickly obsolete. Operators are replacing hardware increasingly more frequently, driving up e-waste. The utility infrastructure supporting AI is also being rapidly replaced to meet increasing demand and transmission specifications.

Recycling rates are low, meaning valuable scarce materials are lost

Less than 25% of global e-waste is properly recycled, and only ~1% of rare earths are recovered. Most AI hardware ends up in landfills or informal recycling, wasting critical minerals needed for future compute.

Sourcing new hardware depends on high-risk critical minerals

Manufacturing replacement AI hardware requires rare minerals, many of which are sourced from unstable regions. This raises serious concerns around responsible sourcing and long-term material security.

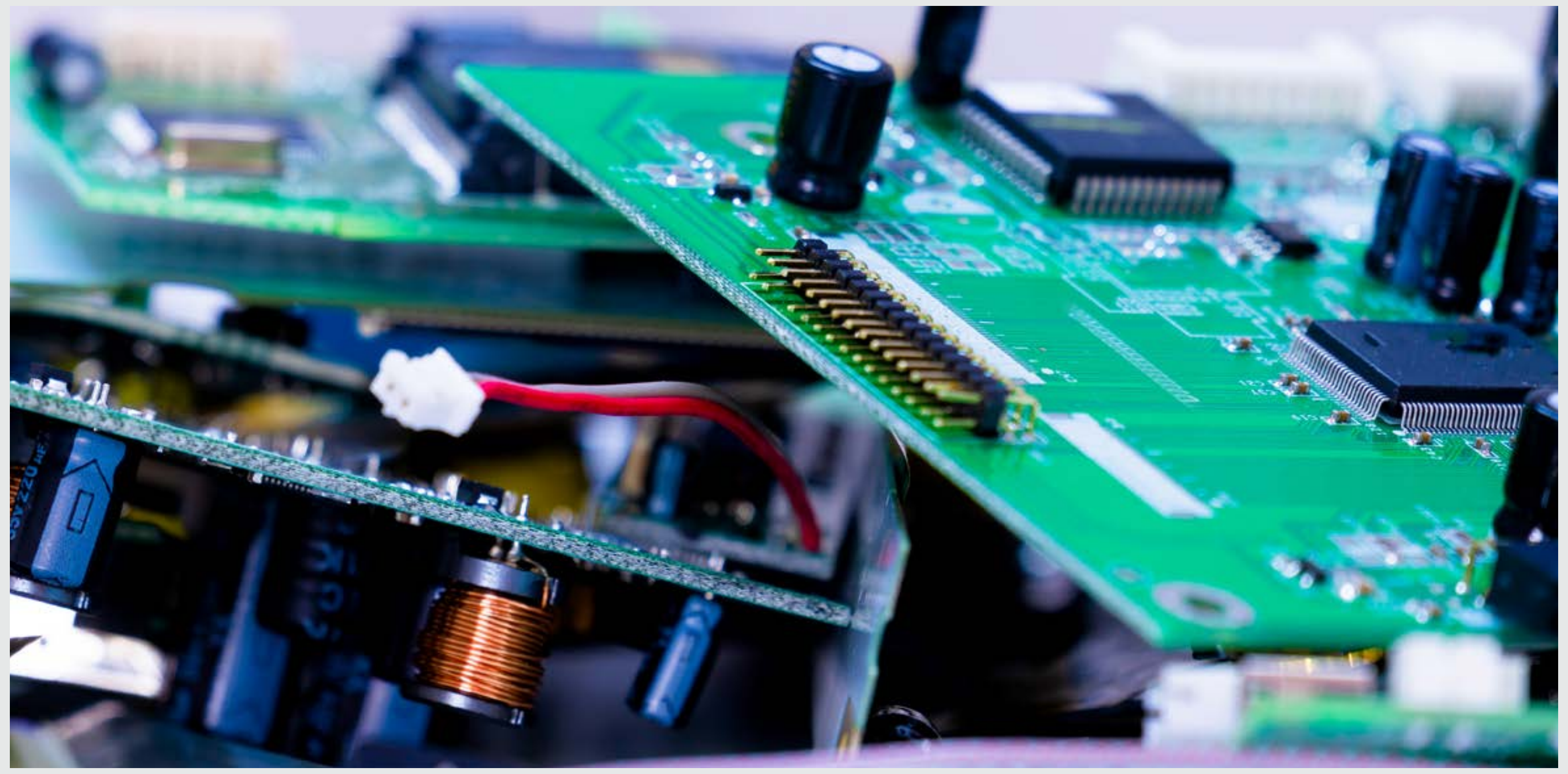
Current innovators

Amazon Web Services

AWS uses a global **reverse-logistics program to harvest, refurbish, and redeploy retired hardware,** with remaining parts resold, donated or recycled.

Google

Google is using **hardware harvesting to maximize reuse of data centre infrastructure,** with parts cleaned, repaired, and redeployed across the org.



Innovation[30]

AWS's global reverse logistics program helps reuse retired hardware

Context

- AWS operates a global reverse logistics program to maximise reuse of retired data centre hardware across its fleet. The initiative is designed to extend the useful life of server components and reduce the volume of equipment sent to landfill.

What took place

- AWS built a three-pillar circular economy strategy – **Design Better, Operate Longer, Recover More** – to extend hardware life in operation and recover value from decommissioned equipment
- When AWS data-centre hardware reaches the end of its primary use, it is **shipped to dedicated processing hubs for assessment.**
- Refurbished parts are either reused within AWS or passed on to non-profits, schools, and other organisations via resale or donation.
- Equipment that cannot be reused is disassembled, and valuable materials (e.g. copper, aluminum) are **recycled through certified vendors.**

Benefits

- **Extended the avg. server lifetime to 6 years,** an industry-leading feat.
- Diverts more than **99%** of retired equipment from landfills, with **23.5 million components** recycled or sold on the secondary market since 2023.

Innovation[31]

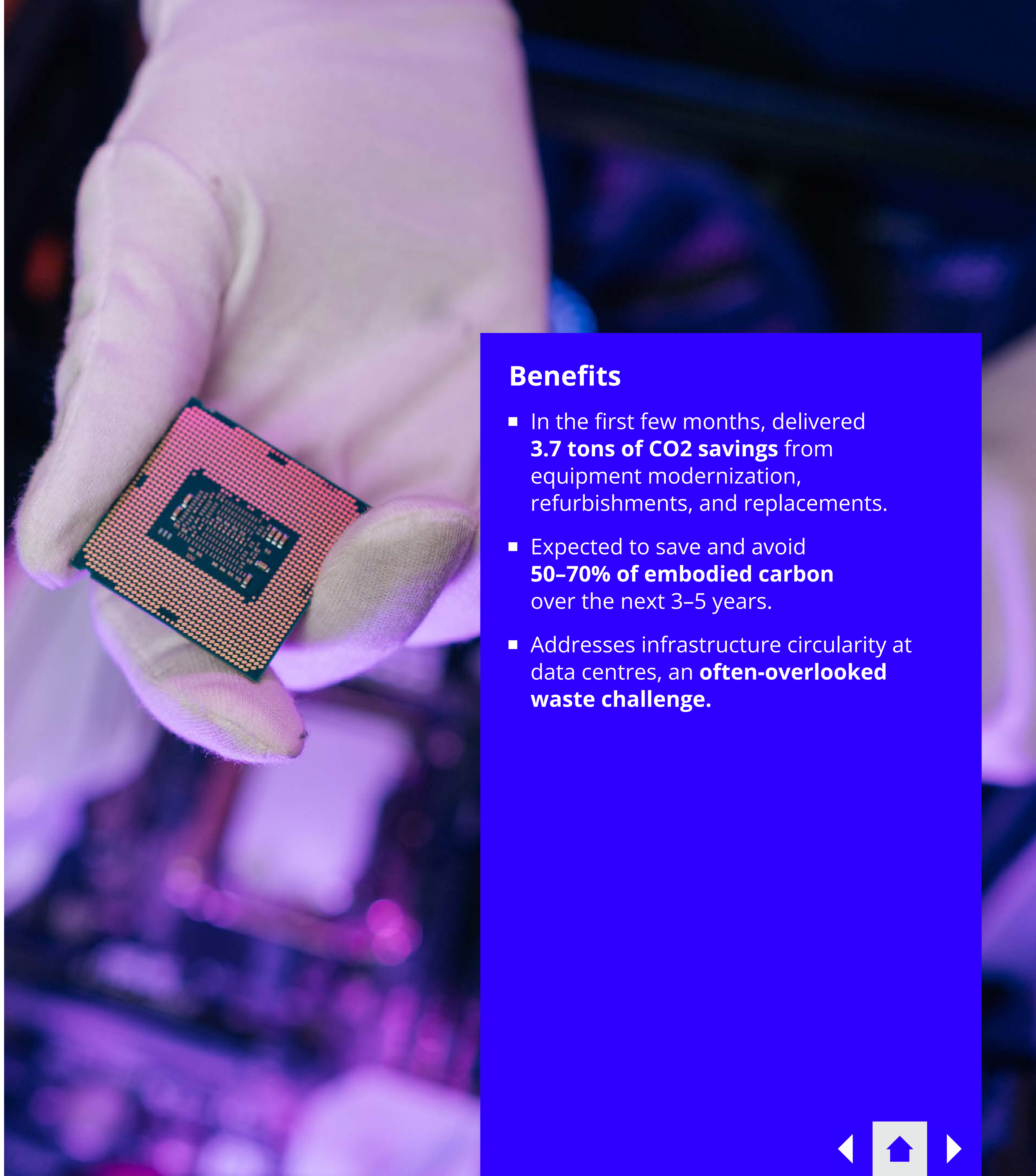
Google uses hardware harvesting to reduce data centre waste

Context

- Data centre electrical infrastructure – UPS systems, switchgear, and medium-voltage equipment – is typically replaced rather than refurbished at end-of-life. Schneider Electric partnered with Digital Realty at its PAR6 facility in Paris to test whether mission-critical power equipment could be refurbished, reused, and life-extended at scale without compromising data centre uptime.

What took place

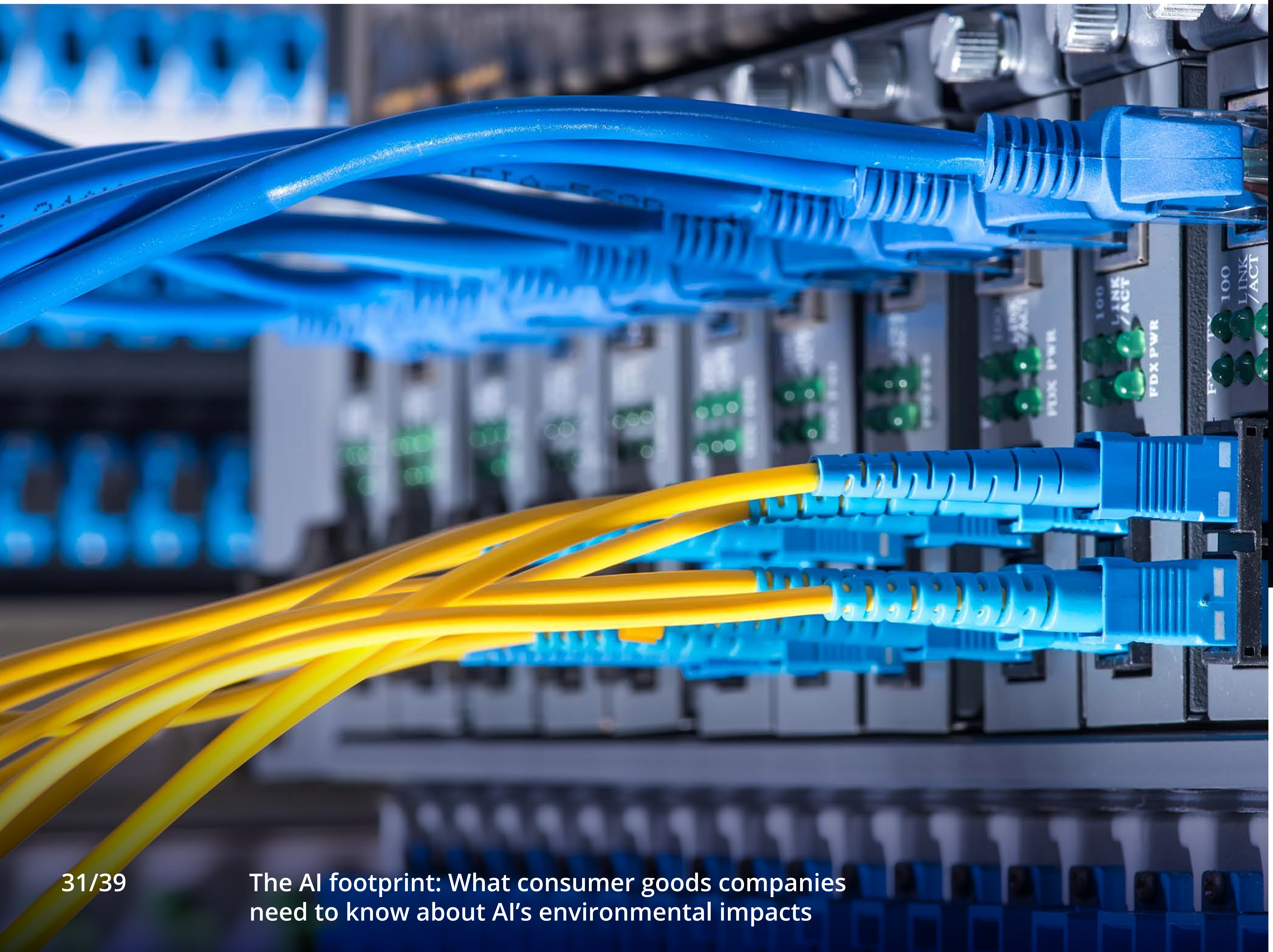
- **New take-back, recycle, and refurbishment programs** were deployed to **reuse key components and remove high-impact greenhouse gases** such as SF6 from retired switchgear, directly reducing Digital Realty's Scope 3 emissions and e-waste footprint.
- An industry-first VRLA UPS battery rejuvenation assessment was undertaken to **extend the lifecycle of valve-regulated lead-acid batteries already deployed at the site,** rather than replacing them on a standard schedule.
- The PAR6 project was **designed as a replicable roadmap, with the explicit goal of scaling the circularity model** across Digital Realty's European data centre portfolio (300+ facilities globally).



Benefits

- In the first few months, delivered **3.7 tons of CO2 savings** from equipment modernization, refurbishments, and replacements.
- Expected to save and avoid **50–70% of embodied carbon** over the next 3–5 years.
- Addresses infrastructure circularity at data centres, an **often-overlooked waste challenge.**

GHG accounting



Challenge

Consumers and companies have little influence on data centre/technological developments, and GHG accounting frameworks and emissions factors are slow to catch up

In procurement data, "IT/cloud services" are often bundled

It is increasingly difficult to pinpoint AI usage within purchased goods and services. Procurement data may not differentiate between AI and standard computing services, and vendors in other categories are embedding AI into their offers.

Emissions factors haven't caught up

Most companies use spend-based emissions factors to capture emissions from cloud/IT procurement. These factors are sector averages built on historical IT spend that was relatively more labour-intensive and don't reflect today's compute-intensive AI workloads. Salaries, wages, and payroll taxes are considered transfer payments that do not result in emissions and should be excluded. Emissions factors for labor-intensive fields may be undercounting emissions if the service shifts from labor to machine computation.

Climate roadmaps don't account for AI growth

Most emissions reductions roadmaps were created before the AI boom and have not been updated to reflect the rapid adoption and growth trajectory of AI tools.

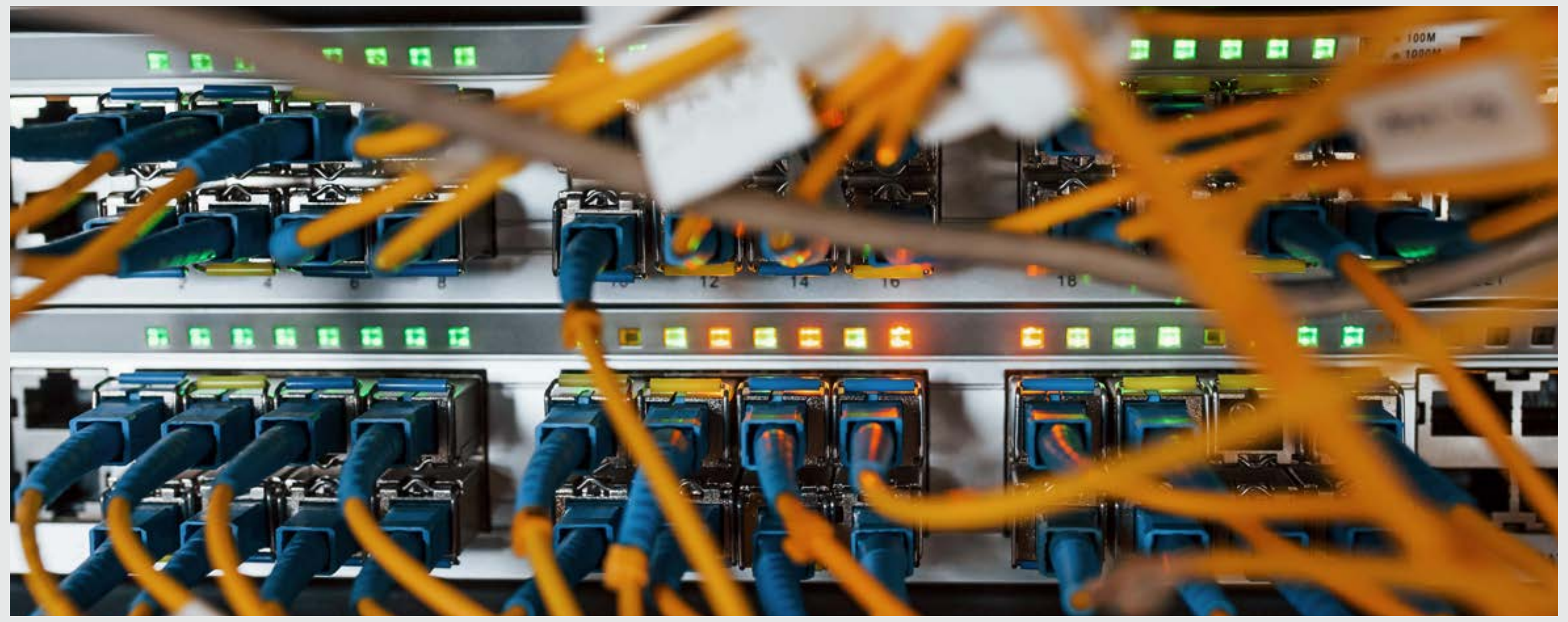
Current innovators

Persefoni and Watershed

Persefoni and Watershed are working on more **granular cloud emissions accounting integrations.**

Greenhouse Gas Protocol

GHG Protocol is developing an information and communications (ICT) sector sector guidance aimed at **improving allocation of AI-driven emissions.**



Conclusion

To navigate impacts of AI usage, individual companies should understand their role as consumers

Companies can take three critical steps:

1. Track the right internal data
2. Update internal governance, training, and modeling
3. Work with hyperscaler suppliers for greater transparency now and advocate for improved energy efficiency and clean energy use over time

Taking action

Companies don't need to wait for emissions factors to catch up; several steps to improve own data

Greater transparency will enable stronger GHG accounting, use and purchasing decisions, and tracking of emissions over time. End users may consider requesting KPIs aligned with ISO 30134:

- Power usage effectiveness (PUE)
- Water usage effectiveness (WUE)
- Carbon usage effectiveness (CUE)
- Energy Reuse factor (ERF)
- Renewable Energy Factor (REF)
- Water stress for data centre location
- Renewable matching approach
- Owned vs. leased/colo capacity
- Embodied carbon per unit of compute
- Hardware refresh cycles
- e-waste/circularity metrics

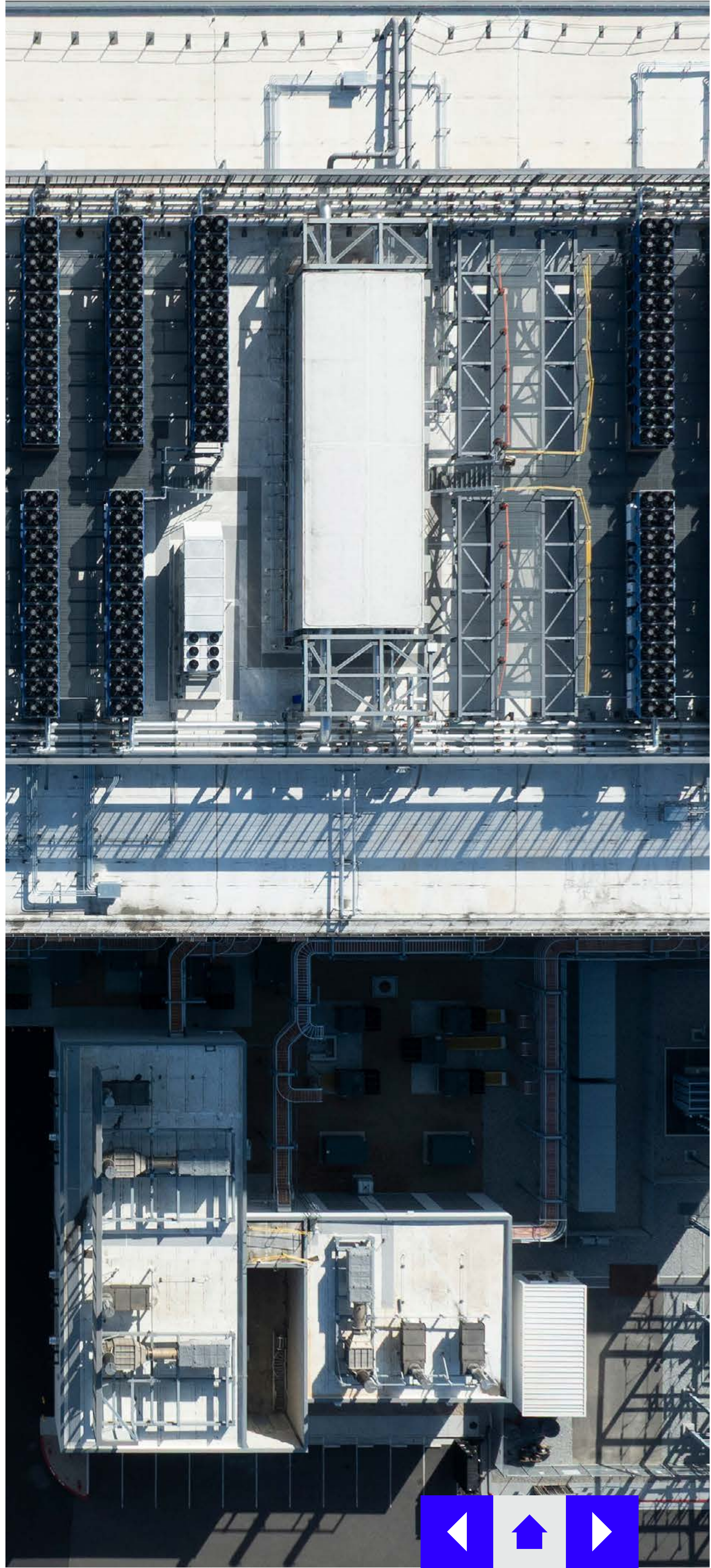
Over time, advocate for hyperscalers to prioritise sustainability via improved compute and energy efficiency and maximising use of clean energy at data centers

Track the right internal data to better understand usage trends and inform GHG accounting

- **Track token usage.**
- **Track other usage data that will improve emissions allocation:**
  - number of queries
  - models in use
  - storage volume (GB-month)
  - data transfer (GB egress)
  - region of compute (grid intensity varies)

Update internal modeling and governance to capture impacts on targets and roadmaps

- **Train employees on selecting the appropriate LLM model** to reinforce the importance of using high-powered models for only the most complex tasks.
- **Include AI growth in climate scenario modeling** and align near-term initiatives accordingly.
- **Practice good data hygiene** to reduce unnecessary redundancy, e.g., storing large datasets in multiple places when it does not serve a security purpose.
- **Explore application of internal carbon pricing** to digital infrastructure.



Learn more

Power moves: How CEOs can achieve both AI and climate goals.

Read the full article at BCG.com

Development and the migration of business operations to the cloud is fueling a surge in US energy demand, throwing net zero commitments into doubt.

CEOs across industries can work together to keep AI and climate goals on track:

1. **Energy companies** can identify spare grid capacity, explore how AI and other tech can unlock greater efficiencies, and accelerate new climate-friendly energy infrastructure through agreements with the hyperscalers at the forefront of AI development.
2. **AI hyperscalers** can deploy less energy-intensive hardware for inference workloads, bring smaller models into play when appropriate, adjust consumption during periods of high energy demand, and invest in climate-friendly energy solutions.
3. **Companies embracing AI transformations** can stay the course while staying on top of Scope 3 emissions and rigorously tracking and optimizing cloud costs.

The private capital opportunity in AI-enabled climate and sustainability sectors.

Read the full article at BCG.com

- AI is **improving the economics** in established sustainability sectors like renewable generation and water management while widening the lens to include areas such as industrial process control and grid congestion management.
- Deploying current AI capabilities across these sectors could generate around **$600 billion in global annual value by 2028.** This figure reflects only the sustainability-specific value; the broader AI opportunity in each sector is substantially larger.
- The report examines **five priority subsectors:** industrial equipment and systems efficiency; climate risk modeling (including insurance); grid, storage, and system flexibility; inclusive education; and materials discovery.
- **The investment opportunity spans the full capital spectrum:** venture, growth, buyout, and infrastructure. Companies that control the proprietary data and deployment setup AI requires to operate at scale are in the most defensible positions.



Amazon, Google, Meta and Microsoft initiative looks to boost sustainable data center tech.

Read the full article at ESG Dive

- **Tech giants Amazon, Google, Meta, and Microsoft have teamed up with Elemental Impact to launch the Data Center Innovation Initiative,** aimed at moving next-gen energy and materials technologies from pilot to deployment.
- Elemental will invest **$500,000 to $5 million per project** in up to **10 startups** through the end of 2027
- The hyperscalers will contribute **hands-on expertise** and **pilot the chosen technologies** in their own data center environments or demonstration sites
- **Philanthropic backers** include Breakthrough Energy Discovery, Builders Vision Philanthropy, Salesforce, and the Stolte Family Foundation.
- Per Amazon CSO Kara Hurst, the goal isn't just to prove the technologies work at scale but to **create a shared playbook that accelerates industry-wide adoption.**

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