

Carbon Accounting at Microsoft



Our approach,
challenges, and
path forward

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Objective:

Our objective in publishing this briefing paper is to contribute to corporate carbon accounting transparency and offer potential insights for our partners and other stakeholders in the carbon accounting community. Similar publications include:

- [Microsoft carbon removal: Lessons from an early corporate purchase](#)
- [Microsoft carbon removal: An update with lessons learned in our second year](#)
- [Reducing embodied carbon in construction](#)
- [Accelerating global decarbonization efforts](#)

Target audiences:

- Corporate peers, customers, partners, investors, and other entities who want to know more about how Microsoft is approaching carbon accounting
- Policymakers and nongovernmental organizations who are involved in creating standards for corporate carbon accounting

Disclaimer:

The innovations described in this report represent the leading edge of Microsoft's work to improve carbon accounting. They do not necessarily represent the data sources and methodologies used in Microsoft's corporate emissions reporting. For detail on the data and methodologies used in Microsoft's emissions reporting, please see Microsoft's annual [Sustainability Report](#).

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Foreword

To ensure we reach net zero carbon emissions by the middle of this century, the world needs robust carbon data and accounting. As the saying goes, you can't manage what you don't measure. In the corporate sustainability world, strong carbon accounting standards are essential to ensuring the credibility and impact of the increasing number of corporate carbon reduction commitments. UN Secretary-General Antonio Guterres emphasized this importance in tasking a group of experts with developing a [report](#) intended to bring "integrity, transparency and accountability to net zero" commitments from non-state entities "by establishing clear standards and criteria."

The Greenhouse Gas Protocol (GHGP), as the most prominent source of corporate carbon accounting guidance, has made a critical start by providing guidelines for companies to adopt when disclosing their carbon emissions. The voluntary nature of these guidelines has offered important flexibility for early adoption.

But today, the on-the-ground practice of corporate carbon accounting is far from ideal. When developing a greenhouse gas inventory, corporate sustainability managers face data quality, format, traceability, and availability challenges, as well as wide variation in tracking and reporting practices. These roadblocks can hinder internal reliability, cross-company comparability, and, ultimately, assurances that individual companies—let alone the planet—are on track to meet critical carbon reduction goals.

Recognizing that the roadblocks of carbon accounting cannot be overcome by any one entity alone, Microsoft joined other organizations in February 2022 to establish the [Carbon Call](#), an initiative to accelerate the development of reliable and interoperable carbon accounting technologies and methodologies. Microsoft is committed to working with the GHGP, civil society, policymakers, and other corporations to drive greater clarity and consistency in how we collectively track our emissions and make progress on climate goals.

In the meantime, we are taking this opportunity to reflect on Microsoft's recent experience with carbon accounting, including our efforts at improvement and the challenges we continue to face. We believe that when large companies are candid about these issues, the private sector can be quicker and more effective in advancing emissions accounting, identifying the most impactful reduction strategies, and tracking collective progress on climate targets. At the end of the day, our collective global response to the climate crisis is faster and stronger when we are clear-eyed about the road ahead.

Executive summary

The need for climate change mitigation, and the economic opportunity associated with decarbonization solutions, have never been clearer. Today's corporations are under increasing pressure to do their part by transparently reporting and measurably reducing their emissions in line with a global net-zero transition. However, gaining a true picture of climate impact and progress is challenging given inconsistencies and inaccuracies in on-the-ground corporate carbon disclosure. The solutions to these challenges, in the form of better emissions data and analytical tools, represent enormous opportunities to build new lines of business, services, and even sectors.

Carbon accounting—the body of rules that govern tracking and reporting of carbon emissions—is not simple. Today's de facto corporate standard, the Greenhouse Gas Protocol (GHGP), provides invaluable guidance, but efforts to achieve widespread adoption of common practices are beset by numerous challenges, including limited corporate commitment, limited data availability, and inconsistent application.

At Microsoft, we are working to evolve our internal emissions accounting approach, focusing on achieving greater accuracy, consistency, completeness, transparency, and alignment with real-world emissions impact. This briefing paper presents our firsthand reflections from tracking and reporting our emissions and the impact of our mitigation strategies. In it, we discuss our top four challenges, as well as what we're doing to overcome them:

1. **Current electricity emissions accounting practices rely on out-of-date, low-resolution data and broad assumptions.** We are pursuing more timely, granular, impact-relevant data to apply to our electricity consumption, our clean electricity purchases, and the use of our devices, software, and gaming systems.
2. **Accurate supply chain data is challenging to collect.** We are incentivizing supply chain emissions reporting, engaging with suppliers directly, and employing new tools for calculating embodied carbon in our products and services.
3. **No comprehensive accepted framework exists for crediting indirect reductions and removals.** We are collaborating with other organizations to explore how to appropriately credit indirect reductions (notably in Scope 3 electricity and aviation emissions) and removals.
4. **Carbon removal lacks clear, commonly accepted quality standards.** We have established and shared our own carbon removal [purchasing criteria](#)

while also advocating for strong voluntary standards and independent oversight.

We believe that corporate climate leaders should play a proactive role in progressing common carbon accounting standards. In sharing our own experiences, we hope to inform changes in the broader emissions data and accounting ecosystem and to support a planetary move toward true net-zero carbon emissions.

Introduction

The world faces a serious challenge in tracking progress against global climate goals. Corporate carbon claims have been [subject to inaccuracy and skepticism](#), particularly given variability across organizational approaches and a historical lack of oversight by regulatory bodies.

With a heightened sense of urgency to address the global climate crisis, corporations face unprecedented pressure from internal and external stakeholders to track, report, and reduce their carbon emissions in the transition to a net-zero world. The European Union's (EU) [Corporate Sustainability Reporting Directive](#) will soon require companies doing business in the EU to report sustainability information publicly. [Proposed rule changes from the US Securities and Exchange Commission \(SEC\)](#) similarly reflect this momentum: under the SEC's proposal, companies would be required to report on climate emissions, impacts, and risks in 10-K filings.

In this broader context, in May 2023, Microsoft released its [third annual Environmental Sustainability Report](#), reporting that, while our overall emissions were down 0.5 percent in 2022 relative to 2021, our Scope 3 emissions increased by 0.5 percent and represent more than 96 percent of our total emissions. In the report, we reflect on the adjustments we are making to help us meet our [commitment to be carbon negative by 2030](#) (including reducing our Scope 3 emissions by more than half from a 2020 baseline).

As important as our emissions performance is, just as critical is *how* we arrived at those numbers. For external parties to make a reasoned assessment of how we are doing against our carbon negative commitment, they must be able to understand how we are accounting for our progress, including the tradeoffs and informed judgments we make in developing our accounting approach.

With this framework in mind, the objective of this briefing paper is to provide a detailed inside look at Microsoft's carbon accounting experience, as a reflection on our own journey and as an indication of areas for improvement in the broader system of corporate carbon accounting.¹ This examination of the challenges we face, our lessons learned, and our future direction may offer some insight into how other corporations and accounting partners could improve collective practices for tracking and reporting carbon emissions. Our view is that if a mature sustainability program at a large company such as Microsoft is grappling with important carbon accounting questions, other companies are likely to be as well.

¹ We use "carbon accounting" to refer broadly to the practice of tracking and reporting all greenhouse gas emissions, including accounting for indirect reductions (for example, energy attribute certificates, or EACs) and removal.

The state of carbon data and accounting today

Carbon data and accounting practices must mature considerably in the coming years—both to respond to increasing external scrutiny of corporate emissions performance and to better reflect the impact of a growing range of decarbonization solutions. Specifically, although Scope 1 and 2 calculation methodologies have been relatively clear and stable to date, Scope 2 accounting could benefit from improved data and better alignment to the outcomes of electric-sector actions. Even more critically, current Scope 3 practices are subject to methodological uncertainties and data limitations that result in significant variability in implementation across sectors and organizations.

Carbon data and accounting practices must mature considerably in the coming years—both to respond to increasing external scrutiny of corporate emissions performance, and to better reflect the impact of a growing range of decarbonization solutions.

The [Greenhouse Gas Protocol](#) (GHGP) is the most widely used *de facto* standard for corporate carbon accounting. It is intended as guidance for companies to use voluntarily, and as such it is designed to be broad and flexible to apply to different sectors and organizations of different sustainability maturity levels. Over the past two decades, the GHGP has provided a critical service to help early movers in the corporate climate action space understand how to track and report, take accountability for, and begin to reduce their emissions.

However, there are broad challenges in real-world implementation of any carbon accounting standard today, including:

- Limited commitment by organizations to report emissions.
- Limited data availability.
- Flawed application of guidelines (for example, due to time and resourcing constraints or ambiguity about what constitutes good practice).
- Unevenness in approach across suppliers, resulting in inconsistent carbon accounting practices in the life cycle of a product or service and when looking at a customer company's end-to-end value chain.
- Lack of comparability of carbon accounting metrics across products and services, hindering businesses from competing on low-carbon emissions performance.

Microsoft's efforts to improve its carbon accounting practices sit within the context of these widespread challenges, which reflect the complexity and evolving nature of carbon accounting.

Our approach

Like many companies, Microsoft is on a journey toward both more accurate, real-time, activity-based data and more consistent corporate-wide governance and implementation of methodological best practices.

In our carbon accounting work, we adhere to the GHGP principles, with our own interpretation as follows:

- **Accuracy.** We strive to use appropriate data that correctly capture the emissions attributable to Microsoft.
- **Completeness.** We seek to account for all sources and activities within our organizational and operational boundaries comprehensively and to disclose and justify exclusions and biases.
- **Consistency.** To the extent possible, we drive consistency across operational reporting, sustainability products, and marketing claims.² We seek to enable meaningful performance comparisons over time.
- **Transparency.** We design carbon accounting practices to enable clear and accessible communications to key stakeholders and to avoid unnecessary complexity or confusion.
- **Impact relevance.** We view carbon accounting as a critical tool in service of emission reduction. We favor accounting approaches that reflect and incentivize actions that reduce real-world emissions.
- **Continuous improvement.** We incorporate novel, high-quality methodologies into internal corporate practice, including but not limited to using advanced technology and data systems to track and report on performance. We advocate with the external standards community for improvement of common practice.

We are driving this evolution internally as part of our path to meet our [carbon negative commitment](#), as well as in response to strong customer and stakeholder feedback. These learnings are also informing the design of new products and services, such as our [Microsoft Cloud for Sustainability](#), that help our customers make sense of the complexities of carbon accounting. We have advocated for the public, private, and NGO sectors to help drive greater consistency and comparability—through [our submission on SEC disclosure requirements](#), our co-

² All methodological improvements can lead to short-term inconsistencies, with the most important aim being consistency of long-term best practice.

founding of the [Carbon Call](#), our responses to [GHGP surveys](#), and our engagement with standards organizations such as the Global Reporting Initiative.

The cycle and evolution of Microsoft carbon accounting

Microsoft has disclosed its greenhouse gas emissions through CDP since 2004 and in an annual Environmental Sustainability Report since 2021. See [Appendix A](#) for a breakdown of GHGP scopes and categories relevant to Microsoft emissions.

Timeline: Led by Microsoft’s sustainability reporting team, our inventory process kicks off at the beginning of each fiscal year in July, with several months of data collection and analysis that adhere to our Inventory Management Plan (our internal corporate protocol for how we calculate emissions). Our reporting team then engages in a third-party limited assurance of the results prior to publication. This process will adapt to new internal and external requirements over time.

Trade-offs: We face trade-offs in pushing ourselves to be more accurate, consistent, and innovative. For instance, as we invest in new data sources and methodology improvements—such as device telemetry (automated device data collection), improved life cycle assessments, and approaches to calculating embodied carbon (see [What is embodied carbon?](#) callout box)—we gain greater accuracy but also have to recalculate and republish our baseline. As we refine our measurement approaches, we will recalculate our emissions and transparently explain how we are improving our methodologies over time. This will be especially true in the first half of this decade as carbon accounting methodologies and standards evolve.

Governance: In 2021, in recognition of the need to balance measurement consistency with innovation, we established an internal Methodology Governance Council (MGC) to review and approve methodologies for use as our corporate practice. The goal of the MGC, as part of a “One Microsoft Sustainability Measurement” framework, is to drive consistency in our public disclosures and to mitigate the risk of conflicting external statements. The MGC, which meets biweekly, consists of sustainability subject matter experts and business owners from across the company.

Our top challenges and how we're responding

This section presents Microsoft's top four challenges with carbon data and accounting in the early stages of our carbon negative journey, starting with those most related to our direct operational impact and extending out to our broader value chain and involvement in carbon markets. These issues affect all major building blocks of our carbon negative commitment:

- Decarbonization of electricity and fuel consumed by our datacenters, suppliers, and products.
- Reduction of embodied carbon in the materials we use.
- Carbon removal.

These reflections echo the broad challenges with carbon data and accounting we noted [earlier](#), with additional commentary from our firsthand experience.

1. Current electricity emissions accounting practices rely on out-of-date, low-resolution data and broad assumptions

The majority of Microsoft's operational carbon emissions footprint comes from electricity.³ As such, our carbon reduction work has centered on using less electricity, while at the same time supporting the adoption of carbon-free energy

³ In 2022, Scope 2 (electricity consumption) represented 98 percent of Microsoft's operational emissions under the location-based method and 67 percent under the market-based method.

in the grids where we operate.⁴ Beyond our direct procurement of electricity for our datacenters and office buildings (Scope 2), electricity is also consumed by our Xbox and Surface devices (Scope 3 Category 11), and by our suppliers (Scope 3 Categories 1 and 2).

Like many companies, our practice has been to calculate our electricity-related emissions using available annual, regional average emissions factors.

Description and rationale of current approach: Consistent with GHGP Scope 2 guidance, Microsoft estimates and reports the emissions associated with its Scope 2 procurement of electricity in two different ways: market-based and location-based. Under the market-based method, Microsoft purchases and applies energy attribute certificates (EACs) associated with renewable generation that takes place in the same year and energy market as its load to reduce its reported Scope 2 footprint on a megawatt-hour (MWh) for MWh basis. We then multiply any remaining, uncovered load by a supplier- or region-specific annual average emissions factor to arrive at our reported market-based emissions. Under the location-based method, we multiply all consumption by annual, national, or regional average emissions factors to arrive at reported emissions.⁵ Until recently, electricity-related emissions data has been largely unavailable at greater temporal and geographic precision.

Microsoft also calculates emissions from product-related electricity consumption (primarily Scope 3 Category 11)⁶ in two different ways. Under the standard GHGP approach, we rely on product sales counts, with assumptions about product life cycles, usage patterns, and the geographies where our customers reside, to estimate lifetime electricity consumption from sold products. We then multiply estimated lifetime consumption by the same annual, regional average emissions factors we employ for Scope 2. Under Microsoft's novel methodology, we calculate annual electricity consumption using telemetry data from all Microsoft devices active during the reporting year. We then apply EACs to reduce reported emissions on a MWh for MWh basis and multiply any remaining uncovered load by annual average emission factors, similar to the standard Scope 2 market-based approach.

Finally, we collect data on electricity consumption in our supply chain (Scope 3 Categories 1 and 2) through our suppliers' disclosure of their Scope 2 emissions. See the next section, "[Accurate value chain data is challenging to collect](#)," for more information on data challenges specific to these Scope 3 categories.

Challenges: Current electricity-related carbon data sources can lead to inaccurate estimates of emissions impact and therefore may not effectively support decisions

⁴ See Microsoft's annual [Sustainability Report](#) for more details on Microsoft's electricity decarbonization commitments and strategies.

⁵ Generally, these emission factors are at the level of [eGrid regions](#) within the United States and at the national level in most of the rest of the world.

⁶ A small amount of electricity is also consumed in the activities pertaining to Categories 9 and 12.

about how to best contribute to electricity decarbonization. Improved data would better incentivize companies to site facilities in less carbon-intensive locations, to shift electricity consumption to less carbon-intensive times, and to support renewable projects that displace the most carbon. Four issues for improvement include:

- **Time-based specificity.** Emission factors are typically annual, and market-based matching of EACs to load is done on an annual basis. These data and approaches do not adequately account for hourly and sub-hourly variation in grid emissions intensity.
- **Geographic specificity.** Emission factors are typically regional or national, and market-based matching of EACs is typically done on a country or continental basis. These data and approaches do not adequately account for within-region or within-country differences in emissions intensity.
- **Timeliness.** Electricity-related emission factors used in carbon accounting are typically one to two years out of date. Given the evolving nature of the world's electric grids, this data lag reduces the accuracy of emissions reporting.
- **Emission factor type.** The generation-based average emission factors typically used in carbon accounting fail to capture the flow of electricity across regions and are therefore not well suited to conveying the emissions impact of electricity consumption and generation.

These issues mean that common carbon accounting practices are ill-equipped to reflect impact in the electric sector. What was once "good enough" for estimation is now insufficient for robust corporate transparency, business decision making, and rapid energy decarbonization.

Microsoft's response: In working to address these challenges, we are prioritizing improvements to electric-sector data. For example, to develop electricity data alternatives that may offer improved timeliness, impact relevance, and temporal and locational granularity:

- We have partnered with RESurety on their [locational marginal emissions data product](#) for a range of possible use cases. RESurety's Locational Marginal Emissions data tool evaluates the project-specific carbon impact of solar, wind, and energy storage, and offers more accurate and timely inputs for calculating the emissions impact of our electricity consumption.
- We are participating in an [LF Energy](#) initiative to develop clearer specifications for electricity-sector carbon emissions data, and in an [EnergyTag](#) initiative to develop clear standards for more temporally granular EACs.

We are still in the early stages of evaluating these data innovations and approaches and are not currently using them in our corporate emissions reporting. We are assessing how these efforts could apply to our future reporting, and we are exploring a range of use cases for more granular, timely data across our operations, products, and services.

Meanwhile, as electricity data continues to improve, Microsoft is advocating for GHGP guidance to evolve to support more detailed electric-sector carbon accounting. Specifically, Microsoft supports the addition of an “emissions impact” Scope 2 accounting framework that focuses on measuring, as directly and accurately as possible, the time- and location-specific emissions impact of electricity consumption, generation, and storage projects. In addition, Microsoft supports a shift toward the use of more time- and location-specific requirements and measurement practices within existing location-based and market-based Scope 2 accounting frameworks.



Takeaways

- Standard electricity emission factors are **out of date** and **lacking in temporal and geographic specificity**.
- Electricity-related emissions impacts vary by **location** and **time** of consumption and generation.
- Microsoft is engaged in efforts to **develop and apply more detailed, impact-relevant** grid emissions data and to track electricity generation and consumption on a more granular basis.

2. Accurate value chain data is challenging to collect

In 2022, Scope 3 categories comprised more than 96 percent of Microsoft’s reported emissions.⁷ Data quality and availability challenges affect many of these categories, including the purchased goods and services (Scope 3 Category 1), capital goods (Scope 3 Category 2), and use of sold products (Scope 3 Category 11) value chain emission categories, which are far and away the biggest drivers of Microsoft’s reported emissions.⁸ Developing an accurate picture of value chain data is thus critical to understanding our emissions drivers and effective reduction strategies, as well as to making thorough emissions disclosures.

Calculating our supply chain emissions (Scope 3 Categories 1 and 2) requires data on our suppliers’ consumption and selection of energy, materials, and chemicals, which is difficult to collect—especially for large, complex supply chains with

⁷ See Microsoft’s [2022 Sustainability Report](#) for more information.

⁸ In 2022, Category 1 represented 47 percent of Microsoft’s total reported (management criteria) emissions, Category 2 accounted for 31 percent, and Category 11 represented 10 percent. Categories 4 and 9, relating to logistics and transportation, are among the other Scope 3 categories that face substantial data challenges, but these represent a smaller portion of Microsoft’s emissions (collectively less than 3 percent in 2022).

numerous entities and varying degrees of sustainability maturity. In addition, methodological guidance is underdeveloped, which further amplifies the uncertainty of supply chain emissions calculations. Different suppliers use different methodologies to calculate emissions outputs, with varying levels of data quality. Calculating emissions from the use of our sold products (Scope 3 Category 11) requires data regarding how, where, and when Microsoft devices are used.

Microsoft views reporting Scope 3 emissions as an important component of corporate carbon accounting. Here, we highlight the challenges with Scope 3 accounting to motivate efforts to improve it.

Description and rationale of past approach: Until recently, Microsoft estimated emissions from purchased goods and services (Scope 3 Category 1) and capital goods (Scope 3 Category 2) by multiplying spend data from supplier contracts by average industry emissions factors. As noted previously, to calculate emissions from the use of sold products (Scope 3 Category 11), we have historically relied on product sales counts and general assumptions about product life cycles, usage patterns, and the geographies where our customers reside. Given the complexity of collecting supplier and downstream emissions data, using expenditures and sales as proxy data was the most practical approach for our initial needs.

Challenges: In Microsoft's early days of carbon accounting, expenditures and industry average emissions factors were the most practical, available data sources for estimating our supply chain emissions, especially for categories such as indirect services and marketing. The same was true of using sales counts and general usage assumptions to estimate emissions from the use of our sold products. However, these approaches:

- Do not tell us how much is *actually* being emitted due to the activities of our suppliers and product users.
- Do not reflect work by individual suppliers to reduce their emissions, and therefore do not incentivize individual supplier engagement to drive emissions reductions.
- Do not sufficiently reflect or incentivize efforts by Microsoft and its product users to reduce device and gaming energy consumption and [shift consumption](#) to times when the electricity grid is cleanest.
- Disincentivize emission reduction activity by translating spending more on low-carbon materials into an *increase* in reported emissions, not a decrease.

The use of expenditure data and industry average emission factors for supply chain calculations, and of sales counts and general usage assumptions for sold products, is therefore insufficient for designing and tracking effective emissions reductions.

Microsoft's response: To improve our data sources and methodology for both purchased goods and services (Scope 3 Category 1) and capital goods (Scope 3 Category 2), we have undertaken the following efforts:

- In 2020, we expanded [our internal carbon fee](#) to include all scopes, including Scope 3, to fund internal decarbonization efforts and additionally incentivize internal business groups to reduce their upstream and downstream emissions. This has had the additional benefit of driving internal improvements in Scope 3 data quality. In 2022, we [increased the overall carbon fee rate and restructured it to charge based on cost of abatement](#).
- In a 2020 update to the [Microsoft Supplier Code of Conduct \(SCOC\)](#), we began requiring our suppliers to disclose their carbon emissions. In 2022, we further updated our SCOC to require suppliers to establish and achieve emission reduction targets that align with ours. In conjunction with these updates, we have rolled out a targeted supplier sustainability program, including [resources](#) and webinars to help suppliers collect and analyze the necessary data, report their emissions, and integrate sustainability into their business processes.⁹
- Microsoft now calculates emissions from suppliers who report their emissions by multiplying the supplier-specific emissions factors, derived from their reported emissions, by our annual spend with the supplier. All other spend is mapped to corresponding industry sectors and then multiplied by cradle-to-gate emission factors by sector from UK DEFRA (Department for Environment, Food and Rural Affairs)—updated per the latest inflation and currency conversion rates.

We note that this evolution does not itself correct the problem of using spend-based data to calculate emissions. We have found that even supplier-specific spend-based accounting approaches can produce misleading and unhelpful results, particularly where suppliers provide a wide range of goods and/or services. Corporate spend remains a practical source of baseline data for calculating supplier emissions but is suboptimal for tracking progress. As such, Microsoft has been working to further progress its data practices and methodology toward more product-specific upstream emission estimates. For example:

- To better calculate emissions associated with capital goods in the construction of our buildings and datacenters, Microsoft’s real estate teams have adopted the [Embodied Carbon in Construction Calculator \(EC3\)](#) (developed by the Carbon Leadership Forum and C Change Labs) in their construction project decision making. The EC3 tool uses building material quantities from construction estimates and models and a database of third-party verified Environmental Product Declarations (EPDs) to calculate the emissions of a specific construction project. To date, the EC3 data has served primarily as a tool for specifying and procuring lower carbon construction materials, but we are evaluating how best to incorporate it in a methodology that can support more accurate emissions

⁹ Many suppliers use annual, regional, and industry averages for their emissions calculations, which is an area for future improvement.

disclosure. As such, we do not currently reflect it in our corporate emissions reporting.

- To better calculate emissions associated with upstream manufacturing of our devices, accessories, gaming products, and cloud hardware, we have been developing an innovative approach rooted in product-specific life cycle assessments (LCAs). This approach replaces many standard LCA assumptions with primary data collected from our supply chain, thus improving the accuracy and transparency of LCA results. The approach utilizes a cloud-based tool that incorporates AI and third-party impact datasets to automate and scale the modeling of the thousands of different components that go into complex electronic products. Particularly when grounded in primary data, LCAs are a valuable tool for identifying hotspots over a product's life cycle and for helping to measure and track emission reduction. As we continue to develop and refine our approach to product-specific LCAs, we do not currently reflect this approach in our corporate emissions reporting.

What is embodied carbon?

Embodied carbon refers to the net cradle-to-grave greenhouse gas (GHG) emissions associated with the life cycle of a product or service, excluding the product use phase. This includes:

- **Upstream or “capital” carbon**—emissions from the extraction of raw materials, manufacturing of components, assembly, and transportation of a product.
- **Downstream or post-utilization carbon**—emissions from end-of-life processing, except for emissions from recycling or reuse of the product in a secondary life cycle.

Accounting for embodied carbon allows Microsoft to track and address emissions impacts of its actions that extend beyond the operational emissions that arise from the use of a product or service.

We are also working to improve our calculations of the carbon emissions associated with the use of our sold products (Scope 3 Category 11). We now have access to real-world insights from users of our Surface and Xbox devices who opt to share their information with us. We use this rich dataset to calculate high-quality estimates of daily energy use in different geographies. In the future, we are exploring how to increase accuracy by pairing more detailed energy use data with the more granular, impact-relevant grid emission rate data discussed previously.

Scope 3 data availability and quality are challenging topics for many corporations and will remain a rich area for innovation.



Takeaways

- **Expenditure and sales data** are coarse proxies for emissions. Using such data does not adequately incentivize emissions reductions and means that spending more on low-carbon materials leads to an increase in reported emissions, not a decrease.
- **Industry average emissions factors** fail to represent individual supplier emissions and reductions.
- Microsoft is working to improve its Scope 3 emission calculations by increasing its use of **supplier- and product-specific** emissions data.

3. No comprehensive accepted framework exists for crediting indirect reductions toward Scope 3 emissions

In these early years of global decarbonization, it can be difficult for a large corporation to directly reduce Scope 3 emissions over which it, by definition, lacks operational control. On a transitional basis, corporations can financially support projects that they do not own physically in exchange for indirect carbon reduction credits.¹⁰ The underlying philosophy is that corporate funding of decarbonization technologies yields climate value, and corporate support contributes to market development of these critical climate solutions. However, today there is no comprehensive, consistent framework to accurately account for indirect reductions in Scope 3 emissions.

Description and rationale of current approach: The GHGP is not currently designed to reflect credit to a corporation for indirect reductions funded to mitigate Scope 3 emissions. This understandably reflects the priority that GHGP places on direct emissions reductions.

The GHGP was originally set up to reflect the different levels of control an organization has over its emissions and has evolved to recognize the market impact of reduction strategies outside of direct corporate control. Specifically, companies are generally required to report Scope 2 emissions as “market-based”

¹⁰ [The Science-Based Targets Initiative \(SBTi\) net zero guidelines](#) provide information on this topic, but more guidance is needed on how to give credit for indirect carbon reduction in Scope 3 accounting.

(reflecting credit for renewable energy purchases, as described previously), alongside disclosure of “location-based” emissions. This is an acknowledgment of the transitional importance of corporate renewable electricity procurement, even when there is no direct physical relationship between a company’s procured renewable generation and its electricity consumption. However, a similar framework does not exist for Scope 3.

Challenges: The GHGP does not provide guidance on how to account for indirect Scope 3 decarbonization strategies, including how to report the impact of supplier and customer EAC and sustainable aviation fuel (SAF) certificate purchases. The absence of a framework for crediting indirect emissions reductions (outside of Scope 2 market-based accounting) means that corporations are under-incentivized to support supplier and customer electricity decarbonization or to fund newer decarbonization pathways such as SAF and low-carbon materials.

Microsoft’s approach: Microsoft is in the early days of engagement in this space. Our preliminary efforts include funding indirect reductions (as discussed further in the [Indirect decarbonization](#) callout box) in renewable electricity and SAF markets:

- We [participated in the world’s first SAF book-and-claim pilot](#), in partnership with United Airlines, the Roundtable for Sustainable Biomaterials, Air bp, and the Sustainable Aviation Buyers Alliance. The resulting approach (detailed in a [World Economic Forum paper](#)) enables corporations to fund SAF and get credit against emissions reduction goals without directly owning or using the physical volume of fuel. Starting in 2022, Microsoft now incorporates SAF book-and claim accounting in our corporate emissions reporting.
- Our use of telemetry data to determine the annual electricity consumption associated with the use of our sold products has enabled us to begin applying a market-based accounting approach to reduce our reported downstream emission (Scope 3 Category 11). This approach enables us to apply EACs to reduce reported emissions on a MWh for MWh basis, similar to the standard Scope 2 market-based approach.

Indirect decarbonization

The long-term aim of Microsoft’s carbon negative commitment is to contribute to the full-scale decarbonization of the global economy. In this early stage of global decarbonization, Microsoft pursues projects that contribute to both direct and indirect emissions reductions. Direct reduction of carbon emissions—through design and other changes that physically reduce energy and material consumption within Microsoft’s value chain—is ideal. For Microsoft, examples include building energy-efficient datacenters, installing onsite renewable electricity, and using lower-carbon materials. But until renewable energy, SAF, and other decarbonization approaches are ubiquitous, we must partner with electricity, travel, and material suppliers to fund indirect reductions (through mechanisms known as market-based instruments) within the sectors that are relevant to our operations. Examples of impactful indirect reductions include renewable electricity power purchase agreements (PPAs) and purchase of high-quality SAF certificates. When informed by due diligence, these are credible, practical actions a corporation can take to help develop the markets for zero-carbon electricity, lower-carbon transportation, and lower-carbon materials.

Going forward, we are encouraging the GHGP to enable a parallel reporting structure to reflect the climate value of indirect reduction credits on Scope 3 emissions, similar to market-based emissions accounting for Scope 2. Although establishing commercial incentives for decarbonization is outside the core mission of the GHGP, we take a practical view that any corporate carbon accounting standard will send *de facto* market signals about what the private sector should prioritize.

We welcome new collaborations that help to improve measurement of the impact of upstream and downstream decarbonization efforts.



Takeaways

- Existing GHGP guidance does not provide a clear way to account for **indirect Scope 3 decarbonization** strategies.
- Microsoft has piloted **Scope 3 “market-based” accounting** approaches to address emissions associated with employee travel and the use of its products.

4. Carbon removal lacks clear, commonly accepted quality standards

Over the past three years, Microsoft has purchased more than 4 million metric tons of carbon removal to meet our annual carbon neutrality goals and to help set us on the path to being carbon negative by 2030. As an early buyer and due to the lack of common standards for carbon removal quality, we have crafted and implemented an extensive due diligence process to confidently purchase high-quality carbon removals.

Description and rationale of current approach: Because the carbon removal market is small and nascent, corporate removal buyers tend to rely on standards for carbon offsets—which are often focused on avoided emissions and until recently did not differentiate removals—to validate claims.

Challenge: Without a consistent set of definitions and standards explicitly written for carbon removal accounting, there is no clear way to distinguish carbon removal credits from offsets that cover avoided or reduced emissions. Furthermore, different credit systems have different approaches to how they treat various types of carbon removal solutions, which vary greatly in the number of years for which they will sequester carbon (their “durability,” anywhere from less than a dozen years to thousands of years).

Microsoft’s approach: As outlined in our [2022 carbon removal briefing paper](#), we developed and published our own [criteria for high-quality carbon removal](#)¹¹—and other corporations have adopted their own approaches. While this helps us ensure that we are purchasing credits that align with our own internal minimum standards, it increases the risk that we are working in isolation from others. The result is cumbersome for suppliers and poses roadblocks to both consistent reporting and large-scale market development. We are actively advocating for strong standards and independent oversight of carbon removal quality. We support the creation of definitions and protocols for carbon removal by GHGP and public sector entities.¹²

¹¹ These criteria are similar to those laid out by other parties elsewhere, as in the [Carbon Offset Guide](#).

¹² GHGP guidance on removals is under development; see <https://ghgprotocol.org/land-sector-and-removals-guidance>.



Takeaways

- Companies need a consistent set of **carbon removal definitions and standards**.
- Microsoft has previously published its own **criteria for high-quality carbon removal** and is actively advocating for strong standards and independent oversight of carbon removal quality.

Looking forward

As the urgency of the climate crisis increases, corporate climate leaders must drive clarity and common approaches in carbon accounting practices—especially in Scope 3. Microsoft will continue to work on solutions to the needs articulated in this paper, including but not limited to:

- More timely, granular, impact-relevant electricity data.
- Improvements in supply chain emissions calculations.
- Contributions to common practice on how to report the impact of decarbonization efforts.
- Stronger quality standards for carbon removal.

As with our overall decarbonization effort, we recognize we cannot do this work alone. Cooperative action is essential. Going forward, we will continue to pursue opportunities to partner with similarly motivated organizations in improving carbon data, accounting practices, and, ultimately, decision-making.

We will continue to transparently share changes in our own methodologies and practices through our annual [Environmental Sustainability Report](#).

For more information, please visit our other resources, including:

- Website: [Microsoft sustainability](#)
- White papers:
 - [Reducing embodied carbon in construction: An inside look into how Microsoft is reducing emissions during the construction of new buildings and datacenters](#) (2021)
 - [A new approach for Scope 3 emissions transparency](#) (2021)
 - [Microsoft carbon removal: Lessons from an early corporate purchase](#) (2021)
 - [Microsoft carbon removal: An update with lessons learned in our second year](#) (2022)

Appendix A:

Greenhouse Gas Protocol categories relevant to Microsoft emissions

This table provides a quick reference guide to the Greenhouse Gas Protocol (GHGP) categories that are relevant to Microsoft emissions and for which we report emissions data.

Scope	Category
Scope 1 (direct emissions)	<ul style="list-style-type: none"> • Diesel, gasoline, liquefied petroleum gas (LPG), and jet kerosene from: <ul style="list-style-type: none"> ○ Fossil fuel consumption from stationary sources ○ Owned and leased fleets (vehicle and corporate jets) • Natural gas from: <ul style="list-style-type: none"> ○ Campus buildings and real estate (heating) ○ Datacenters • Refrigerants and SF₆ in: <ul style="list-style-type: none"> ○ Campus buildings and real estate (cooling) ○ Datacenters
Scope 2 (electricity indirect emissions)	<ul style="list-style-type: none"> • Electricity consumption in datacenters, campus buildings, and real estate • Steam in real estate • Chilled water in datacenters
Scope 3 (other indirect emissions) ¹³	<ul style="list-style-type: none"> • Category 1: Purchased goods and services • Category 2: Capital goods • Category 3: Fuel- and energy-related activities • Category 4: Upstream transportation and distribution • Category 5: Waste generated in operations • Category 6: Business travel • Category 7: Employee commuting • Category 9: Downstream transportation and distribution • Category 11: Use of sold products • Category 12: End-of-life treatment of sold products • Category 13: Downstream leased assets

¹³ Category 8: Upstream leased assets, Category 10: Processing of sold products, Category 14: Franchises, and Category 15: Investments are not relevant to Microsoft.

Appendix B:

Glossary

- **Carbon accounting**—Tracking and reporting anthropogenic greenhouse gas emissions and removals based on commonly agreed rules and standards.
- **Carbon negative**—Removing more carbon dioxide from Earth's atmosphere than a business or activity produces. At Microsoft, our carbon negative commitment means that we will (1) reduce our Scope 1 and 2 emissions to near zero; (2) engage suppliers and our business groups to cut our Scope 3 emissions by more than 50 percent; (3) remove the equivalent of any remaining emissions; and (4) remove the equivalent of our historical emissions.
- **Carbon removal**—The process of physically extracting carbon dioxide from the atmosphere and storing it. See our [2022 carbon removal white paper](#) for more information.
- **Embodied carbon**—The net cradle-to-grave GHG emissions associated with the life cycle of a product or service, excluding the product use phase. This includes the emissions associated with the materials and processes used in the construction of buildings or infrastructure.
- **Emission factor**—Emissions per unit of activity data. Emission factors are used in the preparation of a GHG inventory. They reflect the emission source type and account for factors such as when and where the emissions were produced.
- **Greenhouse gases (GHGs)**—Gases in the atmosphere that reflect infrared radiation and trap it as heat on Earth. The most common GHGs that contribute to climate change—or human-caused global warming—are carbon dioxide, methane, nitrous oxide, and fluorinated gases.
- **GHG inventory**—An inventory of a company's annual GHG emissions. The most common standard used in producing a corporate GHG inventory is the [Greenhouse Gas Protocol](#).
- **Indirect reductions**—Emission reductions beyond the direct operations of a company and its value chain partners that are claimed through the application of environmental credits against a like source. Microsoft pursues indirect reductions through actions such as entering into renewable electricity PPAs and purchasing SAF certificates.
- **Methodology**—Foundational methods, rules, and processes for quantification of emissions. In the context of carbon accounting, we mean the methods, rules, and processes used as the basis for determining GHG emissions and removals, including (but not limited to) the boundaries for the emissions we are tracking, how we source the data, how we estimate emissions where direct data is not available, and how we account for indirect reductions.

- **Net zero**—Balancing total GHG emissions being produced with an equal volume of carbon emissions being removed.
- **Offsets**—A reduction or removal of emissions to compensate for emissions associated with a different source, location, and time. Offsets have traditionally referred to activities that avoid or reduce emissions. Starting in 2020, Microsoft only purchases *carbon removal* offsets (versus *avoided emissions* offsets) on our path to becoming carbon negative.
- **Power Purchase Agreement (PPA)**—A long-term contract between an electricity generator and a customer. Corporate renewable PPAs typically include combined purchase of power and associated EACs. These contracts help enable financing of new renewable generation projects.
- **Renewable energy**—Energy from resources that are naturally and constantly replenished, such as sunlight, wind, rain, tide, and geothermal heat. The generation of energy from renewable resources generally does not produce GHG emissions.
- **Science-based targets**—Emissions reduction targets based on science that are measurable, actionable, and time bound. The [Science-Based Targets initiative](#) guides companies in setting science-based targets.
- **Scope 1 emissions**—Direct GHG emissions from sources that are owned or controlled by a company (such as from the use of fuel in vehicles and for heating).
- **Scope 2 emissions**—Indirect GHG emissions associated with the generation of the electricity purchased by an organization. There are currently two ways of accounting for Scope 2 emissions: (1) location-based emissions, which represent the emissions of the electricity physically consumed by the organization, reflecting the emissions intensity of the local grid area; and (2) market-based emissions, which reflect the emissions from the electricity that the organization has agreed to purchase through contractual instruments, such as PPAs (typically zero-carbon electricity).
- **Scope 3 emissions**—All indirect emissions beyond Scope 2 emissions related to a business’s full value chain. Scope 3 emissions are broken down into 15 categories (see [Appendix A](#) for a list of Scope 3 categories relevant to Microsoft).
- **Sustainable aviation fuel (SAF)**—Aviation fuel alternatives made from renewable sources that reduce the GHG emissions associated with air travel in comparison with the use of fossil fuel-based aviation fuel over its entire life cycle.