Microsoft carbon removal

Lessons from an early corporate purchase

Microsoft

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Foreword

Stabilizing the global climate system will require a heroic societal effort. The world must drastically reduce carbon dioxide and other greenhouse gas (GHG) emissions. But reductions won't be enough. As a global society we must also remove large amounts of carbon from the atmosphere, to avert the worst social, economic, and environmental impacts of a rapidly changing climate. And we must do so while recovering from a pandemic.

The International Energy Agency estimated an 8% (2.8 gigaton) drop in GHG emissions in 2020, due to the economic downturn from the global pandemic.[1] Now comes the challenge of this era—rebuilding the economy post-COVID while continuing to drop emissions 8% per year, every year, until 2030 while also successfully scaling the deployment of carbon removal approaches. Failure to achieve carbon removal at scale places a fantastic burden on reduction efforts, nearly doubling the required global reductions to 15% every year through 2040 if the world is to have a real chance of limiting warming to 1.5 degrees Celsius.

That stark reality is why Microsoft and other entities committed to climate action need to take what is currently an immature market for negative emissions technologies—or carbon removal—and expand it as quickly as possible.

This priority is a crucial part of Microsoft's carbon negative commitment that we announced in January 2020 and why we started to build our carbon removal program last year. While we believe that projects that help avoid emissions are crucial, we are exclusively focused on those that remove carbon from the atmosphere. The reason is simple: looking ahead 10 years shows we simply can't meet our global climate goals without carbon removal.

As we said in our carbon negative announcement, those of us who can afford to move faster and go further should do so. The more transparent a company like Microsoft is about our experience—from our due diligence and the early purchases we are making—the stronger collective intelligence everyone will have to create a healthy, high-integrity, and affordable market in the coming decade.

Lucas Joppa

Chief Environmental Officer
Microsoft Corporation

Elizabeth Willmott

Carbon Program Manager
Microsoft Corporation

[1] IEA (2020), *Global Energy Review 2020,* IEA, Paris https://www.iea.org/reports/global-energy-review-2020.

Executive summary

Achieving our carbon negative goal by 2030 will require more than carbon reduction—Microsoft must also physically remove carbon from the atmosphere. Today, carbon removal is far from mainstream, however, and the market for corporate procurement of carbon removal is relatively undeveloped.

Microsoft is one of the first corporations to conduct due diligence on carbon removal procurement. In July 2020, we issued a request for proposals (RFP) and received proposals representing 189 projects. We chose to purchase from 15 suppliers representing more than 1.3 million metric tons of carbon removal ($mtCO_2$). We based our choices on specific criteria including clarity of carbon accounting, additionality, durability, potential leakage, and other environmental and social considerations.

More than 99% of the carbon removal volume we selected was from natural solutions with durability terms of 100 years or less, such as forest and soil projects. Looking ahead, we hope to increase the overall durability of our portfolio by helping to expand the market for long-term engineered solutions such as direct air capture and storage.

By sharing our experiences, we want to catalyze discussion and collaboration that will lead to the development of a more robust global market for corporate procurement of carbon removal solutions. Since our first RFP, we've already learned several key lessons, most notably that the market lacks clear carbon removal accounting standards, particularly around the key criteria of additionality, durability, and leakage.

Looking ahead, we will be focused on getting carbon out of the atmosphere quickly and keeping it out for as long as possible. We will advocate for clear accounting and high-quality standards for carbon removal. And we want to buy and invest together with other corporations to drive scale.

Highlights	
1.	We can't meet our carbon negative commitment without carbon removal.
2.	Clear accounting of carbon removal is vital.
3.	Additionality, durability, and leakage are crucial criteria but lack clear standards.
4.	Corporations do not yet have an easy way to source affordable, high-integrity carbon removal.
5.	We can't do it alone—we need other corporate buyers to accelerate market development.

Introduction

On January 16, 2020, Microsoft announced a new climate commitment: we will be carbon negative by 2030.[2] This builds on our commitment since 2012 to being operationally carbon neutral, extending it in both scale—to beyond net-zero emissions—and scope—to include the emissions not just from our operations but also from our supply and value chains.

Carbon removal (also known as carbon dioxide removal [CDR]) is a major factor underpinning our strategy to achieve this commitment. Although deep carbon reduction is our top priority, physically removing carbon from the atmosphere will also be essential to our ability to meet our net-negative target scale and timeframe.

This white paper explains our rationale for focusing on carbon removal, our approach to selecting carbon removal projects, details of the projects we selected in 2021, and the lessons we have learned so far. By sharing our experiences, we hope to both inspire action and uptake from others and accelerate the development of the carbon removal market.

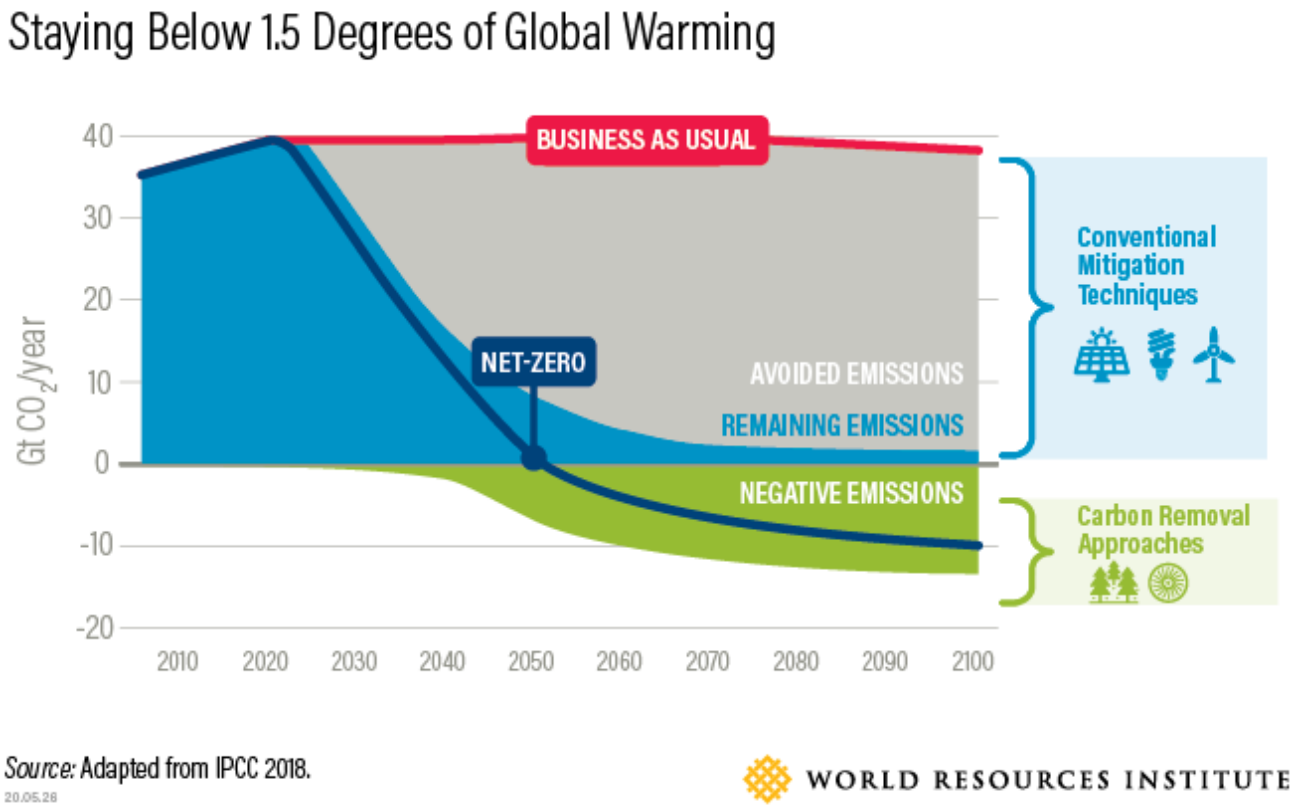
The big picture: the world can't get to 1.5°C without carbon removal

The Paris Agreement, a landmark agreement signed by all 197 member countries of the United Nations Framework Convention on Climate Change (UNFCC), aims to combat climate change by keeping global temperatures well below 2°C above pre-industrial times and, if possible, below 1.5°C.

Why does 1.5°C matter? According to climate scientists, **a 1.5°C increase is the limit required to avoid the worst impacts of climate change**. In October 2018, the Intergovernmental Panel on Climate Change (IPCC) published a *Special Report on Global Warming of 1.5°C*. It found that "all analysed pathways limiting warming to 1.5°C with no or limited overshoot use CDR to some extent to neutralize emissions from sources for which no mitigation measures have been identified." As the following graphic shows, avoiding emissions through more conventional means (such as transitioning to renewable energy) will be vital but insufficient. **Carbon removal—the process of extracting carbon dioxide from the air and storing it—will be crucial to avoiding the most catastrophic impacts of climate change.**

For those readers wishing to understand carbon removal more deeply, we recommend the National Academies of Sciences, Engineering, and Medicine 2019 report and the 2021 Carbon Dioxide Removal Primer.

[2] We set our commitments based on the Microsoft fiscal year, which runs from July 1 through to June 30 (for example, our fiscal year 2030 is from July 1, 2029 to June 30, 2030).



Challenges of removal today

Carbon removal is far from mainstream. For more than a decade, the corporate world has met its climate commitments primarily by offsetting carbon dioxide and other greenhouse gas (GHG) emissions by purchasing "credits" from projects that *avoid* or *reduce* emissions (for example, renewable energy and energy efficiency projects, and avoided deforestation).[3] Engineered removal solutions are costly, and although the market offers some natural climate projects that physically result in carbon *removal* (such as reforestation and afforestation), project accounting of the resulting carbon removal is often unclear.

Partly as a result, **the market for corporate procurement of carbon removal is nascent and undeveloped**. This presents some fundamental challenges:

- The global carbon credit economy as it exists today was not set up for carbon removal, and instead has an undifferentiated focus on avoidance of emissions.
- Assessing the quality and validity of carbon removal projects is very difficult in the absence of strong protocols and verification infrastructure.
- Without a way to get clear and valid credit for funding removals, such as alignment with the Greenhouse Gas Protocol and the Science Based Targets Initiative, corporations do not have a strong business case to support removal projects.

[3] Corporate actions to reduce and avoid emissions continue to be crucial to getting the global economy on a path to net-zero emissions.

- The limited supply of high-quality carbon removal projects today means that a commitment like Microsoft's—let alone others—will be difficult to meet.

Though much needed, a distinct carbon removal market simply doesn't exist today. Our goal is to help establish this market by sparking a paradigm shift as soon as possible.

Growing corporate momentum

Although carbon removal represents a small fraction of corporate climate procurements and investments today, a handful of other organizations, including Amazon, Apple, BCG, Delta, Facebook, Google, Mars, Shopify, Stripe, SwissRe, United, and Velux, are incorporating carbon removal into their climate strategies. Shopify and Stripe, like Microsoft, are making carbon removal a core focus.

A crucial element of our approach is our commitment to deep transparency. We know that we are one of the first corporations to conduct research and due diligence on carbon removal. We believe it is incumbent upon us to share what we have learned, to inspire other organizations to adopt carbon removal into their own strategies, to set a high bar for quality, and to help develop the market. In addition to the information we share in this paper, we are publishing all non-confidential project information submitted to our RFP, through an online project portal at **aka.ms/msftcarbonprojectsubmissions**.

Developing our carbon removal strategy

To achieve our carbon negative commitment, we needed to form our strategy and then get tactical—quickly. This section outlines how we approached our removal work plan.

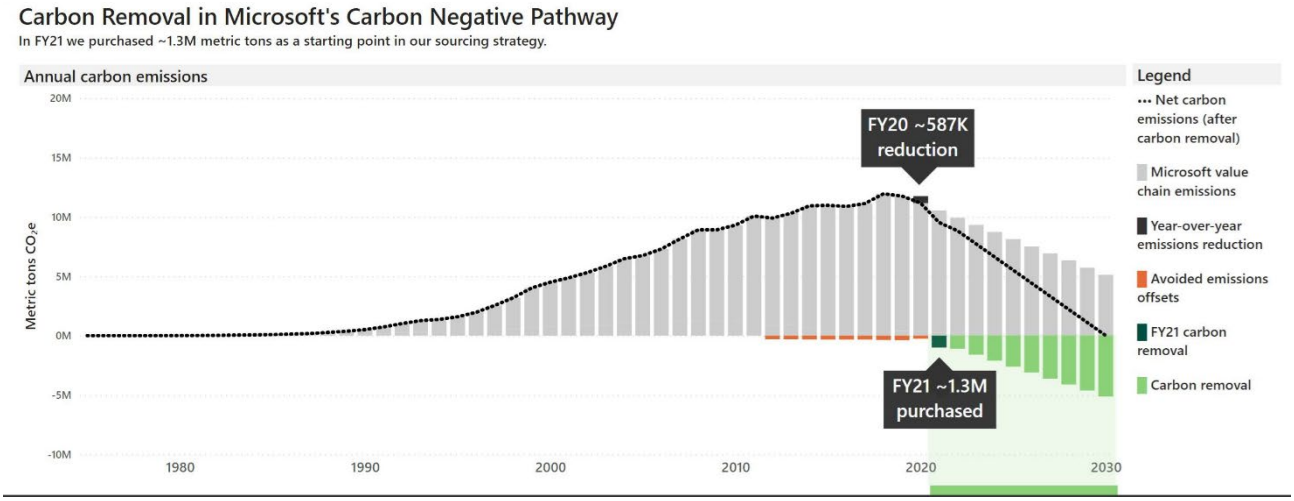
Setting our scope

When we made our carbon negative commitment, one key tenet was that those of us who can afford to move faster and go further should do so. This principle is grounded in our recognition of global climate inequity, recognizing that those countries and communities who are most responsible for the emissions causing climate change are not those who are likely to feel its greatest impacts.

Accordingly, by 2030, we will remove more carbon than we emit—including emissions we incur directly through our operations and those from our value chain (such as those associated with the manufacturing, distribution, and use of our products). In addition, by 2050, we will remove from the atmosphere the equivalent of all carbon emissions associated with our business operations and electricity procurement from the time our company first started, in 1975.

We assessed our options to achieve these commitments, grounding our strategy in science. We closely studied the IPCC *Special Report on Global Warming of 1.5°C*. We consulted with external experts in climate science, decarbonization, and carbon removal. And we came to some key conclusions:

- **We can't meet our carbon negative commitment without carbon removal.** We are committed to reducing our value chain emissions by over half by 2030. However, to cover the residual, hard-to-eliminate emissions, we estimate that we will need to remove 6 million tons of carbon in 2030 (and annually in subsequent years). And to compensate for our historical operational emissions dating back to 1975, we must remove an additional 24 million tons between 2030 and 2050. In 2021—as we begin expanding our coverage of our value chain—we targeted 1 million tons of removal.
- **We need to use clear carbon math.** To achieve net zero, we must first make deep cuts in our GHG emissions, and then for every ton of residual GHG emissions that we emit into the atmosphere, we need to remove a ton of carbon dioxide. To be carbon negative, we will need to remove more carbon from the atmosphere than we emit in any given year. Sound and straightforward carbon removal accounting will be vital.



Moving from offsets to removal

As we shifted our focus from carbon offsets to carbon removals, we entered a relatively new landscape. We could no longer rely as heavily on carbon registries to validate project quality, because their standards were designed almost exclusively to measure and verify the claims of projects that avoid or reduce emissions, and we experienced a lack of consistency in how the standards address key criteria. We are eager for standards to address these issues in their crediting systems. For now, although we did look to existing standards for some guidance, we largely needed to set our own course.

We assembled a team of third-party technical experts from the advisory firm Carbon Direct and nongovernmental organization (NGO) Winrock International to help inform our criteria and due diligence process. This team gave us a much clearer idea of how to determine which types of purchases would be of high integrity and lead to real, long-lasting removal of carbon from the atmosphere. We established our selection criteria through this process (see Appendix A for a breakdown of these criteria).

As we built our strategy, three key points formed the foundation:

- **Be realistic about the durability of carbon removal.** Unfortunately, "permanence," a concept that is central to traditional carbon offsetting, is no guarantee with most projects available today. Instead of permanence, we consider the "durability" of a removal claim—the time that the specified tons of carbon dioxide will remain removed and sequestered from the atmosphere. For example, although natural climate solutions—such as tree planting and soil carbon sequestration projects—are a vital part of carbon removal portfolios, they are also less durable. They represent dynamic natural carbon cycles (as trees eventually die and decay, and soil is turned), and consequently require additional monitoring to track how long they keep carbon dioxide out of the atmosphere. See the Durability and risk section for more detail.
- **Take a thorough and transparent approach to vetting.** The issue of durability is just one example of risk with carbon removal projects. For example, we sought forestry projects in which carbon removal would not have happened without the existence of the project, also known as additionality. Unfortunately, there is no consistent market standard for additionality today, and different stakeholders rate project additionality differently. As project controversies inevitably surface, we take an approach of openness, learning, and transparency to help improve our own

portfolio and drive broader market learning. See the Portfolio risks and remedies section for an overview of the risks that we see in our portfolio and the remedies we are using to mitigate those risks.

- **Place bets for the greatest opportunities for scale.** The importance of mitigating risk is obvious (particularly given the unknowns and relative newness of this market), but at the same time, we need to move quickly to achieve our goals. We can't afford to simply play it safe. Our aim is to build the market and drive wide-scale adoption of carbon removal, and for that to be successful we need to purchase from projects with the greatest potential to scale. We accept that to push the limits in this way, we can't wait for perfection. We will fund the projects that we believe are the best available today, and those most likely to reach maturity in the short and medium term. As a result, this means purchasing some carbon removal units that are not currently verified and therefore not formally applicable to our GHG inventory. Some of our early bets may fail. If they do, we will be transparent about our experience and share our learnings.

Catalyzing a market

We knew that choosing how to fund carbon removal would be difficult—the types of projects we want to support are fundamentally different from what's widely available through today's carbon markets. This is one reason why, when we announced our carbon negative commitment, we also announced a $1 billion Climate Innovation Fund, designed specifically to help support new, early-stage ventures in carbon removal and generate more supply. This investment will help expand a growing pool of suitable carbon removal projects that we and other corporations can draw from in the coming decades.

We also wanted to make a clear statement about the types of projects that would fit our requirements and identify the best candidates from around the world. This meant that we could not work with a single supplier—we had to cast our net as wide as possible. In July 2020, we issued a request for proposals (RFP) to source our first carbon removals. The RFP was open to a broad array of project types, including natural climate solutions and engineered solutions. Although designed to help us meet our own carbon commitments, the RFP was, in effect, a mini-blueprint for what we feel the global market requires (see Appendix B).

The broad market response to our RFP indicated a need for standard definitions and thresholds of key removal concepts (additionality, leakage, and durability), how to account for removal consistently across diverse project types, and how corporations can credibly claim credit for funding removal outcomes. Corporate buyers, NGOs, policymakers, and project developers should answer these questions together, and we want to participate in shaping those conversations.

Constructing our FY21 portfolio

We received proposals from 79 applicants representing 189 projects from over 40 countries, far more than we expected. Of these proposals, more than **55 million** *unvetted* $mtCO_2$ were available this year, although based on our review the current-year proposals meeting our basic prerequisites totaled approximately 2 million $mtCO_2$.[4] From these proposals, we chose to purchase from **15 organizations** in FY21 from projects representing more than **1.3 million metric tons of carbon removal**. (See Appendix C for a full list of the respondents and **aka.ms/msftcarbonprojectsubmissions** for our online project portal.)

The projects we selected can be categorized based on the type and durability of solution they represent:

- **Short-term** natural solutions with up to 100-year durability, such as forests and soils.
- **Medium-term** blended solutions with 100- to 1,000-year durability, such as biochar and specific types of carbon dioxide utilization.
- **Long-term** engineered solutions with more than 1,000-year durability, such as direct air capture and storage, and bioenergy with carbon capture and storage.

For our initial year of procurement, more than 99% of the total volume we purchased was from short-term natural solutions, with less than half a percent from medium-term blended or long-term engineered solutions. This reflects how today's available solutions align with our criteria.

[4] Some proposals lacked technical grounding, and others conflated removal with avoided or reduced emissions.

What we purchased

The following table describes the carbon removal purchases we made in FY21, in order of contracted volume (in metric tons of carbon dioxide, abbreviated as $mtCO_2$).

Supplier	Project(s)	Location	Type	Description	Certification	Contracted durability	Contracted volume
Green Diamond	Klamath East and West IFM	Oregon	Forestry	Improving forest management on 573,231 acres	American Carbon Registry	100 years	240,000 $mtCO_2$
Natural Capital Partners and Arbor Day Foundation	GreenTrees ACRE and CommuniTree Carbon Program	South Central US and Nicaragua	Forestry	Afforestation/reforestation of private land traditionally used for agriculture and reforestation of under-utilized farmland that was historically deforested	American Carbon Registry and Plan Vivo	40 years (GT) and 30 years (CCP)	209,800 $mtCO_2$
The Nature Conservancy	Clinch Valley Conservation and Washington Rainforest	Virginia and Washington	Forestry	Improving forest management across four areas in Virginia representing 22,000 acres and in Washington on nearly 22,855 acres	California Air Resources Board, Climate Action Registry, American Carbon Registry	100 years (VA) and 40 years (WA)	202,369 $mtCO_2$
SilviaTerra	Natural Capital Exchange (NCAPX)	US Southeast	Forestry	Deferring timber harvests annually, increasing the average age (and carbon removal capacity) of forests	N/A (under development)	Under discussion[5]	200,000 $mtCO_2$
Cumberland Forest, LP managed by The Nature Conservancy	Cumberland Forest Project	Kentucky, Tennessee, and Virginia	Forestry	Improving forest management on 108,182 acres	American Carbon Registry, California Air Resources Board, Climate Action Registry	100 years	153,000 $mtCO_2$
ClimateCare Oxford and PUR Projet	Jubilación Segura	Peru	Forestry	Agroforestry and reforestation with small-scale farmers	Verified Carbon Standard	49 years	100,000 $mtCO_2$
Truterra/ Land O'Lakes	Soil Carbon Best Practices	US	Soil	Science-based cropland management	N/A (under development)	20 years	100,000 $mtCO_2$

Supplier	Project(s)	Location	Type	Description	Certification	Contracted durability	Contracted volume
Regen Network Development	Cavan, Wangella, Wilmot, and Woodburn	Australia	Soil	Increasing soil organic carbon through holistic cattle grazing management practices on four ranches totaling more than 18,000 hectares of grasslands	Regen	25 years	93,338 $mtCO_2$
Shell Energy North America	TIST India	India	Forestry	Restoration of historic dense forests by encouraging farmers to replant on degraded/unused land	Verified Carbon Standard	13 years	9,000 $mtCO_2$
Charm Industrial	Bio-liquid geologic sequestration	Oklahoma	Bioenergy with carbon capture and storage (BECCS)	Storing carbon dioxide in deep geologic storage as carbon-containing fluid produced from biomass	N/A (under development)	10,000 years	2,000 $mtCO_2$
Climeworks	Carbon Dioxide Removal	Iceland	Direct air capture	Removing CO2 from air and storing it underground	N/A (under development)	10,000 years	1,400 $mtCO_2$
Carbon Cycle via Puro.earth	Carbon Cycle	SE Germany	Biochar	Producing high-quality biochar from sustainable feedstock for use as soil additive and animal feed	Puro.earth (pending ICROA approval)	800 years	1,000 $mtCO_2$
Carbofex via Puro.earth	Carbofex	Finland	Biochar	Biochar from combined heat-and-power system, with the biochar used as horticultural substrates and water filter	Puro.earth (pending ICROA approval)	800 years	500 $mtCO_2$
Coöperatieve Rabobank U.A.	Acorn	Brazil, Colombia, Peru	Forestry	Agroforestry with 50+ smallholder farmers	N/A (under development)	10 years	500 $mtCO_2$
$ECHO_2$ via Puro.earth	$ECHO_2$	Australia	Biochar	Diverting green waste from landfill and converting to bio energy and biochar	Puro.earth (pending ICROA approval)	600 years	400 $mtCO_2$

[5] SilviaTerra is developing a conversion factor from ton-years to tons in collaboration with carbon market registries.

Short-term natural solutions

Forestry projects

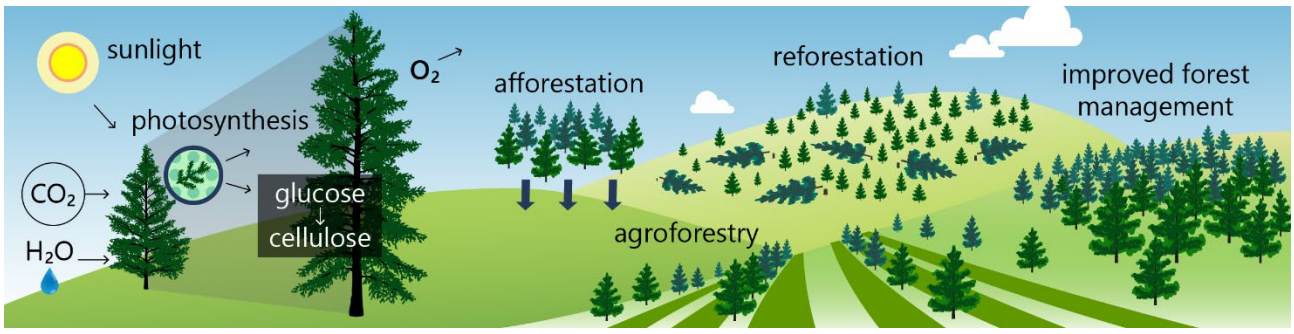
As trees grow, the photosynthesis process naturally converts carbon dioxide into wood and fruit. According to the Arbor Day Foundation, one mature tree can absorb 48 pounds of carbon dioxide from the atmosphere each year and supply enough oxygen for up to four people per day. Forestry projects can also provide additional environmental benefits, such as cleaning our drinking water and helping to protect endangered species through restored habitats.

While forests are essential to carbon removal, it is a scientific reality that these projects are inherently dynamic and impermanent. We assume that carbon removed via these projects today will need to be removed at some point again in the future, such as when trees are lost to wildfires or when harvested wood products decay.

Forestry projects we considered were in four primary categories:

1. **Reforestation** restocks existing forests that have been depleted, often through deforestation or logging.
2. **Afforestation** introduces trees to create a new forest in an area that has not been forested previously (or in recent history) and where tree growth is beneficial.
3. **Agroforestry** intentionally integrates trees into agricultural areas.
4. **Improved forest management (IFM)** aims to increase the carbon stored in forests, including increasing the average age of trees in timber harvesting areas by avoiding or delaying conversion to timber.

We also received proposals from avoided forest conversion and REDD+ (Reducing Emissions from Deforestation and Forest Degradation) projects, with the recognition that intact forests play an important role in removing carbon dioxide from the atmosphere. These represented a smaller percentage of our candidate pool.



We favorably viewed forestry projects that:[6]

1. Have conservative baselines that clearly and credibly delineate business as usual, showing how the projects lead to additional carbon removal (that is, not overestimating harvesting to generate more credits). We saw a high level of inconsistency in this regard, especially in IFM projects.
2. Clearly distinguish between carbon removal and avoided emissions. This was also a missing element of many proposals.
3. Sufficiently account for activity and market leakage within and beyond the jurisdictional boundary of the project. We feel that any forestry project with a zero-leakage deduction is simply unrealistic given the dynamic nature of resource markets. In the near term, if a forestry project in our portfolio does not account for leakage, we will make our own internal deduction.
4. Incorporate strong risk management and recourse provisions, recognizing the dynamic nature of the forest carbon cycle and showing how a developer would adjust if a project did not meet its anticipated volume.
5. Use technology for ongoing monitoring beyond existing standards, providing more confidence in actual carbon removal and helping to set expectations higher for other projects in the future.

What makes an ideal forestry project?
Clear, conservative baselines and additionality
Distinction between carbon removal and avoided emissions
Sufficient accounting for activity and market leakage
Strong risk management and recourse provisions
Uses technology for monitoring and verification

We selected the following projects this year (with supplier names in parentheses):

- The **Klamath East and West IFM projects** (Green Diamond), located in Oregon, address impacts of overharvesting by previous owners. This legacy left the forest carbon stocks significantly below the common practice baseline set by the California Air Resources Board (CARB). Forest thinning and other silvicultural tools are being used to improve forest health, manage fire hazard, and maximize long-term forest growth. Atmospheric carbon removal is achieved through incremental tree growth as evidenced by increases in baseline carbon stocks for the project areas.
- **Natural Capital Exchange (NCAPX)** (SilviaTerra) is a data-driven forest carbon marketplace in the United States that bridges operational, acre-level forest management with holistic, landscape-level carbon removal. The backbone of the project is a high-resolution, nationwide forest inventory called SilviaTerra Basemap, developed in collaboration with the Microsoft AI for Earth program. This tool uses remote sensing to measure baseline and performance on an acre-by-acre basis across the entire project area, providing transparency and precision to the resulting credits while lowering measurement and monitoring costs, making participation more accessible for landowners of all sizes, including those with smaller plots of land.
- **Clinch Valley Conservation** (The Nature Conservancy) is a project in southwestern Virginia. The Clinch River is one of the last free-flowing tributaries of the Tennessee River system and harbors the nation's highest concentrations of globally rare and imperiled fish and freshwater mussels. The Nature Conservancy has protected its lands and waters since 1990. It launched the Conservation

[6] The projects in our portfolio did not uniformly fulfill all these preferences, which is an indication of the challenges of the market today.

Forestry Program in 2002 and now manages some 22,000 acres to model sustainable forestry practices. Its on-the-ground operations are designed to provide economic opportunity for forest owners and enhance forest resources such as soil and water quality, high-value timber, sensitive wildlife habitat, and carbon storage.

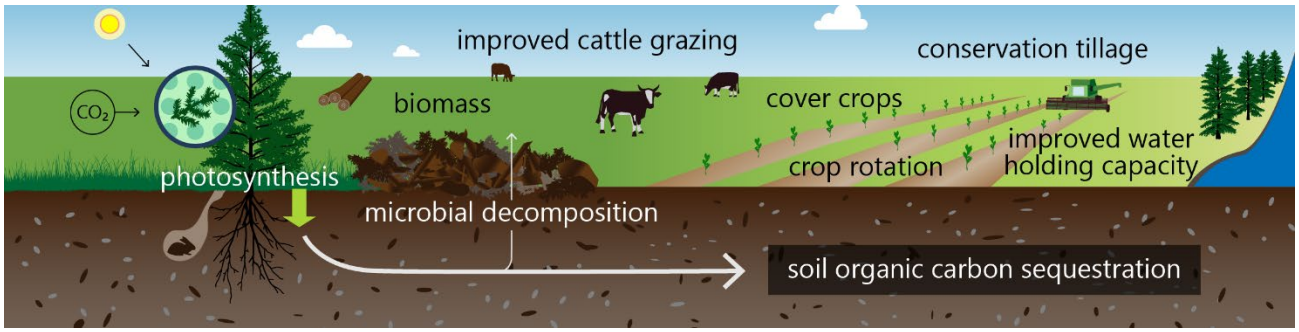
- **Cumberland Forest Project** (The Nature Conservancy) is a 253,000-acre conservation impact investment located in the Central Appalachian region of Kentucky, Tennessee, and Virginia, of which Microsoft's purchase supported 108,182 acres. It aims to improve the health of working forestland to benefit local economies, wildlife habitat, clean water, and climate resilience in a globally significant biodiversity hotspot. Managed through its NatureVest impact investing team, the project seeks to achieve financial returns for investors and environmental outcomes generated by sustainable timber management, carbon sequestration, recreational access, and nature-based local economic development.
- **GreenTrees ACRE (Advanced Carbon Restored Ecosystem)** (Natural Capital Partners and Arbor Day Foundation) aims to reforest one million acres in the Mississippi Alluvial Valley, one of the most important wetland ecoregions in North America. The project focuses on restoring degraded agricultural lands back to a highly beneficial, native forest ecosystem by helping landowners establish and grow trees on private lands that have been in continuous agricultural use for decades. Reforestation supports this vital watershed across seven states in the South Central United States, restore habitat for threatened and endangered wildlife, and support the economic livelihoods of over 550 small- to medium-sized landowners. All the carbon credits generated through the project reflect carbon removal from the atmosphere.
- **Jubilación Segura** (ClimateCare Oxford and PUR Projet), a grouped afforestation and reforestation project within the Amazon Andean foothill forest in the San Martin region of Peru, addresses widespread deforestation caused by the expansion of agriculture, typically driven by international demand, degraded lands, and low farmer income. Small-scale farmers increase land productivity and diversify incomes through agroforestry and reforestation on previously degraded land. The project is certified under the Verified Carbon Standard, with timber harvesting certified under the Forestry Stewardship Council Certification.
- The **CommuniTree Carbon Program** (Arbor Day Foundation, Natural Capital Partners), managed by Taking Root, is the largest reforestation initiative in Nicaragua. It helps farming families to grow native tree species and build forest-based enterprises on underused farmland that has been historically deforested, creating sustainable livelihoods for the long term. The project team is made up of cross-disciplinary local and international experts in forestry, business, smallholder economics, computer science, and remote sensing, and the project has been used as a best practice reforestation model by organizations including the United Nations and European Union.
- The **Washington Rainforest Project** (The Nature Conservancy) is based in the lowland areas of the Washington coast—areas heavily affected by more than a century of industrial forest management that has almost eliminated old-growth forests. By managing Conservancy-owned forests to restore old-growth forest habitat and function, this project can sequester a significant amount of carbon and at the same time restore habitat for wild salmon and other wildlife. It aims to connect forests from summit to sea through a combination of philanthropic capital and proceeds from carbon sales, supporting restoration efforts in the Olympic Rainforest and Willapa Bay.
- **International Small Group and Tree Planting Program (TIST) India** (Shell Energy North America) is a reforestation and sustainable development project enabled by subsistence farmers. It is one of many solutions in Shell's global portfolio spanning five continents aimed at helping its customers in their decarbonization journey. Managed locally, the program uses a community-led approach to tree planting and reforestation, with small groups of farmers planting and maintaining trees on degraded

or unused land, restoring what a century ago was dense forest. These groups receive 70% of the profits generated from carbon credit sales.

- The **Acorn project** (Coöperatieve Rabobank U.A.) provides long-term food security for developing countries with indigenous agricultural practices by helping smallholder farmers in their transition to agroforestry with the help of local partners. The benefits of agroforestry for the farmer include a more diversified and higher yield, improved soil health, and better resilience against climate change and weather events. The project uses scalable, transparent, and inexpensive remote sensing technologies to accurately measure yearly biomass increase. Rabobank measures the carbon storage yearly, sells ex-post carbon credits, and pays the farmers 90–95%, reducing the cost of entry to the market for farmers.

Soil projects

Carbon sequestration in soil is the process by which carbon dioxide is removed from the atmosphere and stored as soil organic matter, often in cropland and grazing lands. Through photosynthesis, plants assimilate carbon, which is then consumed by animals or added to the soil as residue when plants die and decompose. According to the Ecological Society of America, although oceans store most of the earth's carbon, soils contain approximately 75% of the carbon pool on land—three times more than the amount stored in living plants and animals.



The long-term conversion of grassland and forestland to cropland and grazing lands has resulted in historic losses of soil carbon. However, there is significant potential for reversing this trend through restoration of degraded soils and widespread adoption of regenerative soil conservation practices, which can also help improve water quality and increase crop yield. Conservation tillage, cover cropping, crop rotation, and improved cattle management are a few practices that can increase carbon storage in soil. As with forests, we also recognize that soil projects are inherently impermanent and that sequestered carbon can be released to the atmosphere, such as through erosion, tillage, or land use changes.

What makes an ideal soil project?
Baseline and verification in-soil sample measurements to supplement modeling, aiming for 30–50cm depth in the long term
Distinct and measured tallies of removal and avoided emissions
Net-negativity claims account for all program inputs/outputs (such as fertilizer)
Ecologically sustainable farming practices
Democratization and equity for farmers

The soil carbon market is relatively immature, and the certainty of soil carbon removal estimates is dependent on rigorous and appropriately designed measurement approaches. As with forest projects, baseline sample measurements are essential, and projects must clearly delineate removals from avoided emissions. We realize that the process of extracting and processing soil samples is expensive today and will need to become more affordable in the future for more widespread adoption.

On land where fertilizers are used, we expect net-negativity claims to take nitrogen use into account as carbon sequestration benefits can be offset by nitrous oxide (N_2O) emissions.[7] We also expect soil projects to promote ecologically healthy farming practices and that project sponsors provide full transparency of all agricultural supplements, including fertilizer and pesticide use. Lastly, we believe that farmers should not be unduly burdened with program requirements that increase risk for their livelihoods, crops, animals, or local ecological health.

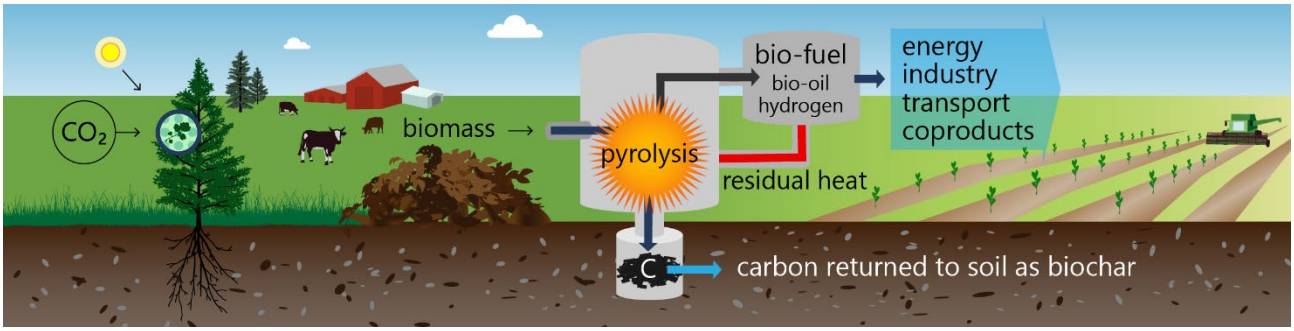
We selected the following two soil projects this year:

- The **Truterra/Land O'Lakes Soil Carbon Best Practices** project, based in various regions of the United States, focuses on building an innovative and best-in-class soil carbon program into the Gold Standard Soil Organic Carbon Framework, which currently only covers "improved tillage." Covering a broader range of soil carbon best practices accessible to US production will create an economy of scale, generate greater awareness of benefits, and incentivize growers to adopt best practices for carbon removal.
- With **Regen**, four **soil organic carbon sequestration** sub-projects in Australia focus on increasing soil organic carbon through better cattle management practices across more than 18,000 hectares of grasslands. The projects, located at the Cavan, Wangella, Wilmot, and Woodburn sites, use practices such as time-controlled rotational grazing, increased stock density, and decreased paddock size. These practices are leading to outcomes including increased ground cover, increased biomass production, and increased water-carrying capacity.

[7] Nitrous oxide is a greenhouse gas that is approximately 300 times more potent than carbon dioxide. It comes primarily from fertilized soil and animal waste in agriculture.

Medium-term blended solutions

Biochar is the only medium-term, blended solution type we chose to purchase from this year. Biochar is a charcoal-like substance that is produced by pyrolysis, which is the heating of organic agricultural and forestry waste (biomass) in the absence of oxygen. Without oxygen, the material doesn't combust but the chemical compounds (that is, cellulose, hemicellulose, and lignin) that make up the biomass thermally decompose into charcoal and combustible gases, some of which may be further condensed into a bio-oil. The proportions of these byproducts vary based on biomass feedstock and pyrolysis process parameters.



Biochar is a highly porous stable solid that is rich in carbon. It is commonly used as a soil additive and helps reduce the need for fertilizers. It can endure in soil for hundreds of years, helping to bind and retain water and nutrients. Although biochar is considered a more recent approach to carbon sequestration, adding charred biomass to improve soil quality dates back 2,500 years to the Amazonian basin, where indigenous people created areas of rich, fertile soils called *terra preta* (meaning "dark earth").[8]

What makes an ideal biochar project?
Net negativity claims include full life-cycle assessment
Reliable availability of sustainable feedstock with 10–20% moisture and high lignin content
Safe and appropriate disposal of biochar to avoid any human health hazard

We found relatively few biochar projects available to purchase, and their pricing was substantially higher than shorter-term natural solutions. We required a full life-cycle analysis for each project to assess the net negativity of the process. We also learned that the best projects use clean biogenic feedstock with low moisture and high lignin content (a polymer that is an essential structural element in plant cell walls), including crop field residues and woody biomass. Finally, we required that all projects attested to safely and appropriately disposing of biochar to avoid any human health hazard.

We selected three biochar projects this year:

- **Carbon Cycle**, a sustainable agriculture company based in southeast Germany, produces high-quality biochar from untreated wood chips sourced locally from Programme for the Endorsement of Forest Certification (PEFC)–certified forests, both for animal feed and as a soil additive. The product helps reduce the loss of nutrients and nitrate leaching from the soil, reduces the need for fertilizers, helps protect groundwater, and improves soil fertility, all while binding carbon dioxide for centuries. One metric ton of biochar removes 3.091 $mtCO_2$. As Carbon Cycle is a small operation, income from

[8] US Biochar Initiative, https://biochar-us.org/biochar-then-now

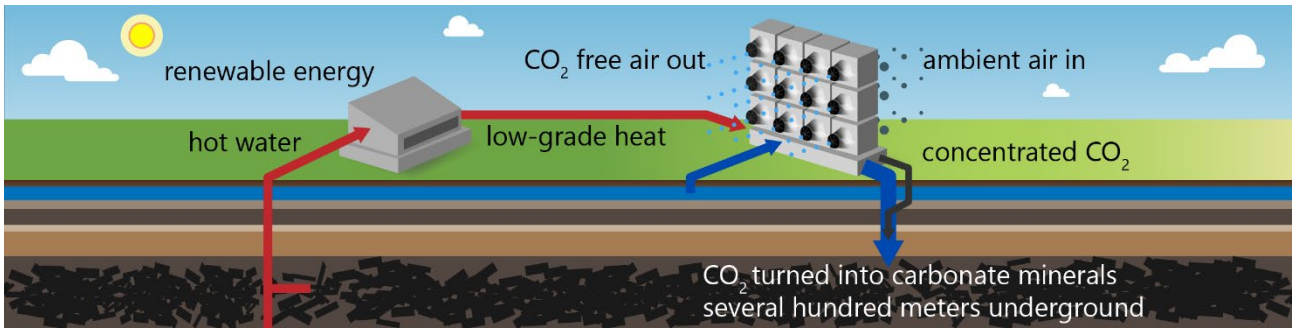
carbon removal helps expand its production. The project receives CO_2 Removal Certificates (CORCs) through the Puro.earth marketplace.

- **Carbofex** produces high-stability biochar manufactured with spruce thinnings from sustainably managed Finnish forests, which would otherwise decompose. Examples of use include city plantations in Stockholm, Sweden and landfill leachate water filtration in Tampere, Finland. The additional income from CORCs will allow Carbofex to grow its production and develop new biochar-based products such as phosphorus filtration for lakes and water ecosystems. The biochar removes 3.11 $mtCO_2$ from the atmosphere per one metric ton of product. The project receives CORCs through the Puro.earth marketplace.
- **$ECHO_2$**, based in Australia, focuses on developing and supplying modular systems to transform biomass residues to energy and biochar. It tackles the issue of green waste from food, agriculture, and wood processing that is burned or landfilled each year, converting it into high-carbon biochar and clean syngas. Each metric ton of biochar removes 2.88 $mtCO_2$ for centuries. The additional revenue from CORCs allows the next $ECHO_2$ modules to be commissioned and new biochar commercial products to be developed, increasing the volume of carbon dioxide that is removed and stored in biochar. The project receives CORCs through the Puro.earth marketplace.

Long-term engineered solutions

While we are hopeful that innovation will spawn many more long-term solution options, we funded only one **direct air capture** project and one **bioenergy with carbon capture and storage** (BECCS, in the form of bio-oil) project this year. At more than 50 times the cost per metric ton of most natural climate solutions, long-term solutions today are both limited in availability and practically cost prohibitive.

- Direct air capture with storage is a process of filtering air through large scrubbers, chemically capturing carbon dioxide from the air, and storing the carbon dioxide underground permanently. As today's direct air capture solutions are very energy intensive, plentiful zero-carbon energy is essential to achieving net negativity (removing more carbon from the atmosphere than is emitted).
- Bio-oil is a liquid byproduct of the same pyrolysis process that produces biochar. When not used for other commercial purposes, it can be sequestered by injecting it into underground salt caverns.



Knowing the end use of the carbon dioxide captured is essential to verify that it is truly net negative. Is it stored responsibly with ongoing monitoring? Is a risk mitigation covenant recorded in relevant jurisdictions? Is the carbon dioxide used for durable products (when used commercially rather than being stored underground)? What is the full life-cycle impact of the project?

We selected the following two engineered projects this year:

- US-based **Charm Industrial** has created a novel process for preparing and injecting bio-oil and other carbon-containing liquids into geologic storage. The process takes atmospheric carbon dioxide captured in biomass, converts the biomass to a carbon-containing liquid, and injects it into deep geologic storage. The company has reported that it has completed its first demonstration injection of 80 $mtCO_2$ and is rapidly scaling up to meet demand.
- **Climeworks** developed a direct air capture technology solution that captures carbon dioxide from the air and stores it underground using a mineralization process developed by Icelandic company Carbfix. Climeworks has direct air capture plants in Europe, with plans to scale up rapidly and increase capacity to a scale of removing billions of tons of carbon dioxide.

What makes an ideal direct air capture project?
Net negativity
Affordability
Use of zero-carbon energy
Responsible storage of CO_2, including ongoing monitoring for geologic storage
Existence of a risk mitigation covenant recorded in relevant jurisdictions

Under construction: Climeworks' new large-scale direct air capture and storage plant "Orca" (Credit: Climeworks)

Project selection considerations

In our review process, we considered the prerequisites and criteria listed in Appendix A. In parallel, we modeled portfolio scenarios based on project costs and our overall budget.

We reviewed every proposed project for carbon accounting integrity, additionality, durability, and leakage to identify whether it was offering carbon removal. The findings of this review were not as clear as we had anticipated. We also identified a list of red flags that caused us to ask more critical questions about some projects.

Additionality: How much removal would have happened without the project?

One of our criteria for carbon removal is whether it would have happened without the existence of the project, also known as additionality. For natural climate solutions, this is a complicated and controversial topic—relying on logic that can be difficult to prove in either direction. At least two significant issues make it challenging to assess the carbon additionality of natural climate solutions today:

1. There is not a single, clear market agreement for how to calculate the baseline against which a project's impact gets measured. Project developers can misuse baselines, resulting in inflated credit values. Baselines against which removals are estimated must be set conservatively to minimize risk of over-crediting.
2. No common authoritative standard exists on how carbon finance and corporate procurement of credits contribute to additionality. Some projects have received criticism because payments for carbon credits are only a percentage of the entire project funding stack or because landowners don't know that the project is generating carbon credits. In the view of some market players, carbon finance is the "last mile" source of funding to help a project achieve viability and is very often paired with other sources of funding to make the project happen, like financing of renewable energy and affordable housing.

Going forward, we believe that an open debate leading to clearer market agreement about what counts as "carbon additionality," why, and who gets paid for what will be crucial to build trust and integrity in the system overall.

Durability and risk: How long will the carbon dioxide be kept from the atmosphere?

We assess carbon removal projects in part based on their durability, categorized as short term (up to 100 years), medium term (100 to 1,000 years), and long term (more than 1,000 years).

Forests and soil—the basis for most carbon project volume on today's market—are part of Earth's natural carbon cycle, in which carbon storage is short term (measured in the span of decades). Their carbon removal is inherently impermanent, in contrast to engineered solutions, which can store carbon for the long term (measured in the span of millennia).

Today's carbon markets often use "buffer pools" from which a project developer can replace tons that revert to the atmosphere (for example, through forest fire or illegal logging), but we think that a full, healthy market will require stronger protections for such scenarios, to ensure that tons stay out of the atmosphere for the duration for which they are contracted. We required transparency about the projected durability of removals, timely reporting on reversals, and a recourse provision in our contracts to provide this type of protection, but durability is still difficult to project and substantiate for natural climate solutions.

Going forward, we will increasingly seek low risk of carbon loss for the stated term (including from the effects of climate change), strong measures that minimize that risk, and conservative carbon estimates that account for the reversal risk. As the market scales, we feel that there is much more that can and should be done to develop collective solutions to mitigate the risk of reversal (for example, insurance products, more robust buffer pools that differentiate between removal and avoided emissions, and technology-enabled project monitoring). See the Contractual provisions section in Appendix B for examples of the durability and recourse provisions we used in our contracts.

To date, however, we have found that the current carbon market language of "permanence" masks the true durability of a solution—especially natural climate solutions, which could range from 1 year to 100 years. Another way to think about this is that natural carbon removal has a hidden cost of replacement when the associated tons revert to the atmosphere—almost certainly sooner than the engineered removal tons.

This disparity makes it hard to compare natural and engineered solutions. We want to help change this mindset by developing a more comparable metric that incorporates the immediate availability of some solutions relative to their durability.

Leakage: Will the same emissions just occur elsewhere?

Some projects inadvertently shift emissions from one geographic area to another area (including internationally) that is not counted in the project claim. Activity leakage occurs when an activity is displaced from one geographic area to a nearby area. Market leakage occurs when a project reduces supply of a specific product but market demand encourages others to provide that product instead. An IFM project, for example, might lead to carbon removal in one area by letting trees grow longer but may indirectly result in trees being cut elsewhere to satisfy timber market demands, thereby negating removal.

Our approach to mitigate leakage is twofold: (1) make an internal deduction of credits we purchase from projects that have a material risk of leakage not already accounted for, and (2) encourage carbon market registries to develop stronger science-based benchmarks for leakage that are informed by peer-reviewed research. We strongly prefer the latter, as it is not efficient to commission our own independent analyses of leakage outside of what standards already require.

Red flags and other observations

As the carbon removal market evolves to meet increased corporate demand, important questions are surfacing about market design and integrity. Corporate buyers need to make decisions on what credits to buy without ideal standards or full information. Based on our survey of this nascent market, we have assembled a non-exhaustive list of red flags and observations that, if present, would make us hesitant to purchase from a project or, at least, ask more critical questions. These include projects that:

- **Are not measurable and verifiable.** Do not have a pathway to third-party scientific verification or accreditation. Do not have substantiation of their net-negativity claims (for example, through life-cycle assessments or clear project documentation).
- **Mix avoided or reduced emissions with removal.** Describe activities that avoid and reduce emissions without clear accounting of removal.
- **Inflate credit volumes.** Take advantage of project accreditation rules for baselining and project geographic boundaries to inflate credit volumes beyond what is truly happening (a difficult issue to spot without third-party scientific advisors). (Note that over-crediting may not be intentional but may result naturally from the current system in which baselines are not prescribed conservatively and consistently by crediting protocols.)

- **Have conflicts of interest.** Gain accreditation that was funded entirely or largely by entities with a direct financial interest in the project.
- **Do not mitigate risk of reversal.** Have no mitigation plan for risk of reversals (for example, wildfire, illegal logging, risk covenant for engineered carbon sequestration).
- **Have hidden environmental or social harms.** Inadvertently drive deforestation or land use competition. Involve widespread planting of non-native species without regard for water stewardship. Contribute negatively to water consumption, fossil fuel consumption, or toxic waste. Do not have substantiation of balanced community involvement, especially in cases of climate equity or social equity claims.
- **Play up market hype.** Make references to cutting-edge technology topics or topics "du jour" without basic substantiation.

There are many well-intentioned project teams who may need feedback on how to avoid these concerns. These red flag observations may not immediately disqualify a project from further consideration but strongly reinforce the need for well-balanced due diligence with qualified scientific advisors.

Portfolio risks and remedies

Despite our best efforts, we recognize that our portfolio has vulnerabilities due to the difficulty of sourcing affordable, high-integrity carbon removal in today's market. We will work to address known risks in our portfolio to continually increase the quality of projects and our confidence in carbon removal.

Risk	Remedy
Lack of clarity on additionality	• Get involved in the project at early stages of origination and/or review market purchases deeply. • Avoid IFM projects with baselines below initial carbon stocks. • Advocate for clearer standards guided by public policy.
Short durability terms	• Purchase from long-term solutions to extend overall portfolio durability.
Reversal risk	• Understand project-level risks from forest fire, insects, drought, and illegal logging through technology innovation. • Develop stronger recourse provisions and buffer pool requirements to ensure compensation for failed tons.
Lack of clarity about true market leakage	• Internally, deduct credits applied to footprint relative to what was purchased if we conclude that a project undercounted leakage. • Advocate for better leakage models and peer review process for alignment.

Risk	Remedy
Non-traditional removal accounting (for example, ton-year accounting)	• In the short term, count non-traditionally accounted tons as compensation for our scope 3 footprint (if the project is otherwise high quality). • In the long term, work with market stakeholders to adjust for relative radiative forcing values of different project types.
Ex-ante accounting	• Do not apply ex-ante credits to verified net-zero footprint—only apply when converted to ex-post.

Looking ahead

The world is at a critical inflection point in deciding what counts as credible corporate climate mitigation, and increased scrutiny of carbon markets is a healthy dynamic that we welcome in service of the planet. Our actions should help shape a broad conversation toward greater market integrity, transparency, and accessibility as preconditions for the large-scale removal that the planet needs. Along those lines, our first-year carbon removal procurement is simply a benchmark of what is available today that we must all improve upon.

Even after the deep due diligence we conducted, including reviewing project certifications, we still faced uncertainty in how to compare proposals on an apples-to-apples basis. The challenges in answering fundamental questions about carbon removal dominated our review process, resulting in less time and attention on important topics such as climate equity and other areas of sustainability, such as water and biodiversity co-benefits.

From our perspective, deeper investigation of natural climate solutions is warranted, to raise the bar on carbon removal accounting across forestry projects. And the market needs to set a strong foundation for the newer soil carbon offerings while that type of project is still relatively young.

But this need for accountability does not mean that corporations should divest from forestry and soil projects altogether. More corporate investment is required in *both* natural climate solutions and engineered solutions—it just needs to be transparently verifiable and should mitigate inherent risks of reversal. This higher bar requires common standards that are consistent, accessible, and understandable to all market players and technology innovations that support greater precision and efficiency in tracking outcomes.

Top five learnings

As we move ahead, we have learned lessons that we will use to shape our program going forward:

1. **Emphasize straightforward accounting of carbon removal.** Our definition of a net-negative emissions project is one that is additional (would not have happened without carbon finance) and avoids leakage (does not simply shift emissions to another geography). We are still in process of determining a preferred durability threshold in our project assessments. What we have found is that sound durability projections and clear removal accounting have not yet taken hold in the market, while additionality, accurate baselining, and leakage in forestry and soil projects continue to be sources of debate among market actors and experts. As a result, we constructed our portfolio with a lack of perfect confidence about these dimensions. The market needs clearer definitions and standards to protect the integrity of resulting credits.
2. **Place bigger bets.** To source the volume that we need by 2025, we will need a portfolio of at least several medium-sized or large projects (more than 100,000 $mtCO_2$ each). We are still interested in supporting small pioneering projects, but we will likely need to look to project models that offer a minimum level of aggregated supply from small sources (such as small landowners).
3. **Do the homework—and refine the process.** Due diligence requires deep focus and a heavy draw on team capacity, even for a large corporation. We developed a "go/no go" approach for triaging and prioritizing the review of proposals most likely to advance to serious consideration, but our inaugural process still took longer than we had anticipated. In the future, we could make the reviews more efficient through pre-screening of projects, educating candidates more deeply about what we are seeking, and scheduling more time for candidates to respond to an RFP.
4. **Advocate for stronger carbon removal standards.** Our first-year portfolio represents a mix of certified and uncertified tons for several reasons: first, there were not enough certified tons available today that met our other prerequisites; second, we wanted to support promising new approaches that have not yet been ex-post certified; and finally, we concluded that we could not rely solely on the standards in place today for full vetting of net negativity (specifically additionality, leakage, durability, and sound carbon removal accounting). For Microsoft and other companies to do this work efficiently in the future, we will need the market to adopt scientifically sound, common, and transparent standards for carbon removal.
5. **Source projects outside the existing carbon market infrastructure.** The current voluntary carbon market was not designed explicitly to measure, validate, and source carbon removal projects. Traditional carbon project types that were designed to avoid emissions (for example, IFM and REDD+) *can* result in real removals, but more work is needed to quantify, account for, and monetize these removals.

Our future outlook

As we contribute to growing and shaping the carbon removal market, we are prioritizing three focus areas.

- **Getting carbon out of the atmosphere quickly and keeping it out for as long as possible.** The urgency of the climate crisis demands that we not wait for a perfect solution at large scale and affordable cost but rather that we act now to lower the atmospheric concentration of GHG emissions today. This means continuing to support natural climate solutions, such as forestry and soil carbon projects, which are impermanent but immediately available. Meanwhile, we must also invest in scaling the supply and reducing the costs of engineered solutions, which will get carbon dioxide back in the ground and keep it there.
- **Establishing clear accounting and high-quality standards for carbon removal.** Scaling the carbon removal market quickly does not mean sacrificing integrity. On the contrary, trust and support in a removal market among NGOs, corporate buyers, investors, and policymakers requires credibility and will be crucially dependent on greater clarity, consistency, and transparency of carbon removal accounting principles and standards. This area is an opportunity for public policy oversight and governmental support, not only in the regulatory context but also in support of voluntary markets.
- **Buying and investing together to drive scale.** As we said in announcing our carbon negative commitment, those of us who can afford to move faster and go further should do so. Microsoft's commitment, let alone the global need, requires solutions that do not exist at large scale and affordable cost today. We know that our procurement of carbon removal is a fraction of the finance needed to develop this market, and we will take proactive steps with other companies and governments to drive the collective procurement, investment, and policies needed to support this market.

Please visit **aka.ms/carbonremoval** for more information.

Appendix A:
Prerequisites and considerations

In our RFP, we specified that we would *only* purchase tonnage from projects that meet the following prerequisites:

1. **Net negativity.** Remove net atmospheric carbon dioxide on a life-cycle basis, including the following considerations, with conservative assumptions regarding uncertainty:
    i. Additionality.
    ii. Durability.
    iii. Avoidance of leakage.
    iv. Clear removals attributes, as opposed to emissions avoided and/or reduced (that is, are either clearly 100% removals or are ex-post verified as removal volumes according to a credible, science-based measurement, reporting, and verification [MRV] methodology).

2. **Scientific verification.**

    i. Projects with carbon removal tonnage that has already been certified and independently verified ex-post under an existing methodology by a standard approved by the International Carbon Reduction and Offset Alliance (ICROA).
    ii. Projects that have not yet been certified but have a plan for ICROA-approved certification, whether because the project has not yet completed the certification process or because the relevant methodology is still under development.
    iii. Projects that do not have a plan for ICROA-approved certification but sufficiently document prerequisites through comprehensive independent review. Note that we may request that such projects pursue certification before agreement to purchase.

    All projects, regardless of certification status, go through comprehensive independent review of project documents and underlying scientific studies to assess the extent to which they fulfill Microsoft criteria.

3. **Avoidance of harm.** Avoid or minimize environmental and social harm (for example, continued reliance on fossil fuel energy, deforestation, environmental impact due to mining of raw materials, water consumption, impacts to indigenous/local rights, and violation of national sovereignty).

If projects did not meet the preceding prerequisites, they were not qualified for further consideration. Of the projects that met the preceding prerequisites, we considered the following criteria to help inform our final project selection:

- **Global carbon removal potential.** Projected to contribute meaningfully to a global CDR portfolio based on peer-reviewed science.

- **Affordability.** Have a path to being affordable at scale (for example, $100/mt in 5–10 years). Our current target average price per ton is $15/mt$CO_2$, but we will review proposals at any unit cost that provide a future projected cost curve.
- **Climate equity.** Engage and empower diverse stakeholders who have otherwise faced systemic barriers to accessing carbon finance (for example, small landholders, diverse suppliers, new voices from the Global South). Support projects that address the disproportionate impacts of climate change on low-income communities; vulnerable communities in developing countries; and communities that bear the brunt of industrial pollution or are transitioning to low-carbon economies. Work to ensure that under-represented and under-resourced communities are included in the transition to an environmentally just future.
- **Technology innovation.** Use technology innovation to improve carbon market outcomes (for example, reduce certification cost per metric ton of carbon dioxide, democratize selling/buying opportunities, and overcome other barriers to scale).
- **Other sustainability dimensions.** Proactively promote other measurable sustainability objectives (for example, water stewardship, waste reduction, biodiversity protection), especially in areas of Microsoft campuses and other operations.

Appendix B:
Sample contract language

In the contracting process for 2021, Microsoft and our project partners agreed to include several new contracting sections, including new definitions and provisions on durability and reversal risk. Following is sample language from those sections.

Definitions

Carbon Removal Unit or CRU: means a unit representing one metric ton of CO_2 removed from the atmosphere, net of any life-cycle process emissions, and intended to be permanently stored or otherwise sequestered.

Durability Period: means the period during which (i) the CO_2 represented by the Project CRUs Delivered under this SOW is required to remain removed and sequestered from the atmosphere and (ii) the Reversal Obligations under this Scope of Work (SOW) will remain in full force and effect.

Recourse Pool: means a pool of Replacement CRUs, in a quantity equal to such percentage of the Contract Quantity as Microsoft determines to be reasonable in light of the Reversal risks associated with the Project, that is required to be maintained by Supplier under this SOW in order to provide Microsoft with Replacement CRUs in place of Delivered Project CRUs in the event of a Reversal.

Reversal: means an escape or release into the atmosphere during the Durability Period, as a result of a Reversal Event, of any stored or otherwise sequestered CO_2 represented by Project CRUs Delivered to Microsoft.

Reversal Event: means any event or circumstance occurring after Delivery of any Project CRU and during the Durability Period, whether intentional or unintentional, that results, or that is reasonably likely to result, in a Reversal. Under no circumstances will a Reversal Event constitute a force majeure event, even if such Reversal Event is caused by or results from an event or circumstance that otherwise would constitute a force majeure event. *[Note that the separate treatment of Reversal Event and Force Majeure was meant to ensure that a supplier could not eliminate its duty to provide replacement CRUs by invoking Force Majeure.]*

Reversal Obligations: means the obligations of Supplier following any Reversal Event.

Contractual provisions

Durability Period: The Durability Period will be **XX** years from the date of creation of the Delivered Project CRUs.

Supplier Reversal Obligations; Microsoft's Remedies in Event of Reversal

- Supplier will provide the following performance assurance in favor of Microsoft: In anticipation of any type of Reversal during the Durability Period, Supplier will maintain a Recourse Pool of Replacement CRUs in an amount of XX% of total Project CRUs created under the Draft Protocol.
- Supplier will notify Microsoft in writing of such Reversal Event promptly (and in any event no later than in Supplier's quarterly report with respect to the calendar quarter in which the Reversal Event occurred) after becoming aware of the occurrence of such Reversal Event.
- Any Reversal Event notice provided by Supplier will include a written report assessing and evaluating the impact of the Reversal Event on Supplier's obligations under this SOW, including any potential Reversals resulting from such Reversal Event and any potential further Reversal Events.

Reporting, Monitoring, and Auditing

Before payment, Supplier will deliver a written report to Microsoft that details the following:

- Actual Project CRUs Delivered compared to the Contract Quantity;
- Proof of the Retirement of the Project CRUs by evidence reasonably acceptable to Microsoft which will include:
  - quantity of Project CRUs Retired;
  - Project location(s) (State);
  - Project type/methodology providing Project under;
  - statement that Retirement is voluntary; and
  - statement listing Microsoft as the owner or beneficiary of the Retirement.

Appendix C:
Responding organizations

Following are the respondents to the Microsoft FY21 Carbon Dioxide Removal RFP. We greatly appreciate the time that all respondents took to submit applications. They are leaders of a new approach to mitigating corporate carbon emissions, and their contributions enabled us to learn about the market today. This is a transformative time for the world, and we're excited to see how these organizations evolve in the coming years.

12Tree Finance GmbH
3Degrees Group, Inc
ACT Commodities
African Parks Foundation of America
Are Treindustrier
Ark 2030 C.I.C
Bamboo Ecologic, Corp dba RIZOME
Battelle Memorial Institute
Bayer Crop Science
BioChar Now LLC
Biorecro AB
Blue Source LLC
BP Products North America Inc
BTG Pactual Timberland Investment Group ("TIG")
Cambium Carbon LLC
Carbo Culture Inc
Carbofex Oy
Carbon Cycle GmbH
Carbon Engineering Ltd
Carbon Sequestration Inc
CarbonCure Technologies Inc
Cargill Incorporated
C-Combinator, Public Benefit Corporation
CCS Development Partners LLC
Charm Industrial, Inc
Clean Air Action Corporation
Climate Trust Capital Fund I LP (CTC)
ClimateCare Oxford Ltd
ClimeCo Corporation
Climeworks AG
Compensate Compensate Foundation (Kompensäätiö sr.)
Coöperatieve Rabobank U.A.
Corteva Inc
Drax Power Limited
DroneSeed Co
Ducks Unlimited Inc
EBS one Pty Ltd
Ecoera Ab
EcoTree International
Ecotrust Forest Management
EDF Trading Limited
Ekovilla Oy
Fondo Nacional de Financiamiento Forestal (FONAFIFO)
Green Diamond Resource Company
greenSand Stock NV
GreenTrees LLC
Hardwick Climate Business Limited
Hirsitaloteollisuus ry (Finnish Log House Industry Association)
Iberdrola SA
Indigo Carbon PBC
Intuit Earth Pty Ltd (carbonsync)
Investancia Paraguay SA
Land Life Company BV
Land O'Lakes Inc
Livelihoods Carbon Fund 3 (LCF3)
Moelven Limtre AS
NativeEnergy, A Public Benefit Corporation
Natural Capital Partners Americas LLC
NatureBank Asset Management Inc (on behalf of Coastal First Nations Great Bear Initiative)
Nori Inc
Ocean-based Climate Solutions, Inc
Operation Wallacea Ltd
Pachama Inc
Pan-African Environmental Conservation and Development Company (PECDC)
Project Vesta
PT Global Alam Lestari
RAINBOW BEE EATER PTY LTD
Regen Network Development Inc
Running Tide Technologies, Inc
Saving Nature Inc
Shell Energy North America (US) LP ("Shell Energy")
SilviaTerra LLC
Soil Value Exchange Public Benefit LLC
South Pole Carbon Asset Management Ltd
Spatial Informatics Group
Sterling Planet Inc
Stockholm Exergi AB
Termowood AS
Terra Global Capital Inc
Terraformation Inc
The Conservation Fund
The Nature Conservancy
Tree Global Inc
United States Endowment for Forestry and Communities Inc
World Wildlife Fund, Inc
XCHG (Xpansiv CBL Holding Group – Xpansiv, CBL Markets, H2OX and Carbon Finance Services)
Yara International ASA