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Industry snapshot

An overview of the latest trends, insights and developments in the direct air capture industry

June 2022

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Introduction

Welcome to our DAC Industry snapshot report

“We are at a crossroads. The decisions we make now can secure a liveable future. We have the tools and know-how required to limit warming,” said IPCC Chair Hoesung Lee in the press release announcing the latest IPCC report published in April. The outcome was clear: in order to meet our climate goals of keeping temperature increases below 1.5 degrees Celsius, commitments to drastic emissions reductions are a priority and carbon removal solutions at gigaton scale are “essential.”

Over a decade after we founded Climeworks, amidst the ever-rising urgency of reaching net-zero by 2050, policymakers and business leaders alike are embracing direct air capture (DAC) as an important avenue to mitigate climate change. Yet there is still significant work to do to reach the projected 3-12 billion tons of annual removal needed.

We are incredibly excited to see the unprecedented attention and traction that DAC has received over the last 12-18 months: fast-growing demand, increased financing and support and public funding. However, transforming this momentum into actual capacity will necessitate a new level of global growth. Indeed, our nascent industry needs to continue its rapid scale-up in the coming years and decades, which will require even further political action and investment.

Time has come to super-charge the carbon removal sector. So where do we currently stand when it comes to DAC? With contributions by scientists, experts, and field actors, this “Industry snapshot” provides a comprehensive overview covering recent developments in the CDR space, investing into DAC, and how to ensure the sustainability of climate technology.

It‘s a global process, and we strongly believe in the power of collective sharing as a catalyst of rapid implementation for the greater good.

We hope you enjoy the below insights and wish you a happy reading.

Christoph Gebald
Founder & CEO

Jan Wurzbacher
Founder & CEO

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Introduction

What is direct air capture?

Sabine Fuss

Head of Resources & International Trade Working Group, Mercator Research Institute on Global Commons & Climate Change

> “CO_2 removal serves the purpose of either offsetting residual emissions that are difficult to reduce quickly enough to reach net zero emissions on time or to return from an overshoot of the temperature target.”

What is DAC and how is it different from carbon capture and storage (CCS)?

“Direct Air Carbon Capture and Storage (DACCS) captures CO_2 from the ambient air by means of a chemical reaction and subsequently durably stores it, most notably in geological formations. It is one of the methods that have been proposed to actively remove already emitted CO_2 from the atmosphere again and thereby contribute to reaching the ambitious climate goals set in the Paris Agreement. CO_2 removal serves the purpose of either offsetting residual emissions that are difficult to reduce quickly enough to reach net zero emissions on time or to return from an overshoot of the temperature target. This makes DACCS different from capturing and storing CO_2 from fossil sources, which does not remove CO_2 from the atmosphere on a net basis.”

Why do major scientific reports (IPCC) consider technological solutions as a necessary complement to natural carbon capture solutions?

“Alternative ways to remove CO_2 from the atmosphere involve sequestration through photosynthesis, e.g. by planting trees. While good designs of such programs can deliver important co-benefits, the scales of CO_2 removal that IPCC scenarios show need to be achieved would require large areas of land to be set aside for additional carbon storage – land that is also an important factor for the achievement of other policy goals such as ensuring food supplies for a growing population. In addition, the storage medium is typically of lower permanence than geologic storage and also subject to reversibility: under ongoing climate change, increasing disturbances such as droughts, wild fires and bark beetle pests can be observed, which can lead to a release of previously stored CO_2. These risk factors require a more diversified removal portfolio that also encompasses technological solutions like DACCS. Additional considerations that have been entering the debate involve also the demand of carbon in industry, which will be unlikely filled sustainably with biogenic CO_2 while phasing out fossil fuels.”

Global DAC policies outlook and status

An update on DAC policy

Giana Amador

Policy Director and Co-founder, Carbon180

What policies are needed and expected to build a framework that supports continued growth for DAC in the future?

"Over the past few years, direct air capture (DAC) has evolved from largely theoretical, lab-scale research to dozens of operational projects capturing tens of thousands of tons of CO_2 per year. This shift is in no small part due to increased policy support from governments across the globe. In the US, federal funding for R&D has risen from essentially zero to hundreds of millions of dollars per year, and the most recent Bipartisan Infrastructure Law allocated $3.5 billion to four direct air capture hubs. Governments across the globe have also turned their attention towards direct air capture. For example, as part of its net-zero strategy, the UK has committed £100 million to the advancement of DAC and other carbon removal technologies.

As DAC advances and we set our sights on removing billions of tons of CO_2, new challenges will arise. In the coming years, DAC will need to not only become more cost-effective and scalable, but also prove that it can provide economic and environmental benefits to the communities where it's deployed. Like clean energy technologies that came before, government support can help developers rise to this challenge. In particular, DAC would benefit from:

1. Continued investments in RD&D to test new approaches and support technological breakthroughs, bringing DAC down the cost curve,
2. Improved regulatory clarity to ensure that DAC facilities can come online quickly, with strong safeguards and protections in place,
3. Robust first markets created through government procurement that can set clear standards for projects,
4. Dedicated support for community education and engagement, as well as funding to drive local job creation and community wellbeing.

Together, these types of policies can serve as a launchpad for a thriving, gigaton-scale direct air capture industry that serves the climate and communities across the globe."

Global DAC policies outlook and status

DAC and US policy

Julio Friedmann

Chief Scientist, Carbon Direct

What is the current state of DAC investment in the USA?

"The Intergovernmental Panel on Climate Change (IPCC) has spoken decisively in their most recent Working Group III report – valid, durable CO_2 removal is essential; engineered pathways have the most potential; nature-based pathways are important but insufficient; and nations must invest in innovation and infrastructure to scale valid, durable CDR. The IPCC highlights four approaches to durable CO_2 removal: direct air capture (DAC), biomass carbon removal & storage (BiCRS), including bioenergy with CCS (BECCS), carbon mineralization (Cmin) and ocean alkalinity enhancement (OAE).

All four pathways will prove important, although today markets undervalue these approaches and lack standards and protocols that facilitate investment in projects. From a policy perspective, DAC has a special place in U.S. policy and is a good place to start the process of innovation and infrastructure through market aligning policies.

On innovation, the 2022 Consolidated Appropriations Act and 2021 Investment and Innovation and Jobs Act (IIJA) give the DOE $62 billion funding– an enormous change, from last year – with $49M/y going directly to CO_2 removal technology. The bill also includes a $115M DAC technology prize. On infrastructure, the IIJA provides a whopping $3.5 billion (!) investment in four DAC hubs (details pending). IIJA also includes investments in CO_2 pipeline infrastructure and $500M/y for CO_2 storage site characterization.

These represent an important set of policies and commitments, but are themselves insufficient to deliver the projects, private capital, and tonnage of removal needed to achieve key global and U.S. national climate goals. However, the discussion remains active; in particular, the 117th Congress continues to negotiate specifics of the budget reconciliation bill. That discussion includes proposed amendments to the 45Q tax credit, including three key provisions for DAC: 1) To increase the credit value for DAC-sourced CO_2; recently proposed changes include increase from $35/ton to $180/ton for saline storage ($135 for use); 2) improving access to the tax credit (via direct pay); and 3) extending project eligibility from a start-construction date of 2026 to 2030.

These changes would be historic and would place the US firmly on a path of scaling DAC to useful tonnage. However, there is one additional bill under consideration that would further accelerate and support DAC and other valid, durable engineered approaches. Rep. Paul Tonko (D-NY) has proposed a bill that would direct the U.S. government to buy CO_2 removal services directly."

Global DAC policies outlook and status

DAC and EU policy

Anna Dubowik

Secretary General, Negative Emissions Platform

What is the current state of DAC investment in the EU?

"While there is no DAC specific legislation in the EU there are good reasons to be optimistic that the technology will be getting an increasing visibility and regulatory support among a suite of available carbon removal methods in the coming years.

First, in the Commission's communication on sustainable carbon cycles we see a commitment to permanently remove and store 5Mt/CO_2 per year by 2030 through frontrunner carbon removal projects. If this objective gets translated into higher, ideally binding, targets, beyond 2030 and is accompanied by other incentives and a robust certification framework, it will provide a much needed investor certainty. DAC is eligible for financial support under the EU Innovation Fund among a suite of other decarbonisation technologies.

What could help further is application of separated targets for removals and emission reductions within the Fund's design. Earmarking a dedicated amount of the EU ETS revenues for the scale-up of technological removal would play in favour of achieving carbon neutrality at a sectoral level, since the EU ETS covered entities are often referred to as hard-to abate sectors. This will support a cost effective and faster deployment, with costs shared among industrial players. In that space there is also the Catalyst recently launched by Breakthrough Energy. This vehicle co-managed by the Commission and European Investment Bank, pulls together corporate, governmental and philanthropic funds to support DAC and four other breakthrough technologies, with low cost project capital. Beyond filling critical funding gaps the catalyst creates early demand for green outcomes of projects thanks to the involvement of private sector, much like the Frontier fund launched recently by Stripe Climate with a group of corporate partners.

On the regulatory side of things in the EU we welcome proposals for inclusion of technological removals in the EU ETS and the Effort Sharing Regulation. Integration of DAC into the EU carbon market could be operationalised with Carbon Contracts for Difference to fill in the gap between the market price for carbon and what is necessary to make the project financially viable. On the other hand, inclusion of DAC for a capped level of compliance under the Effort Sharing Regulation (non-ETS) would incentivise the Member States that choose this route, to utilise public procurement, state aid or dedicated grants and loans for different parts of DAC value chain. In the long run shared learnings and effective dissemination of best practice between Member States would help realise spillover effects and synergies in the EU."

Defining what is needed

Conventional offsets vs. removals

Mark Preston Aragonès

Policy Manager, Bellona

Can you explain the need for high-quality carbon removal offsets and verification?

"The discussion about carbon offsets is a fraught one. On the one hand, offsets can be a useful way to provide finance to climate mitigation activities which would otherwise not be viable. On the other hand, these offsets mostly get in the way of real climate action.

A large part of the issue is that offsets currently available on the market are mostly emission reductions and are very low quality, with low permanence and additionality, and are therefore unreasonably cheap. This means that companies wanting to portray themselves as climate friendly will simply purchase a portfolio of cheap emission reduction offsets instead of pursuing the more expensive option of reducing their own emissions: it's simply cheaper for them to emit and spend very little on offsets which are portrayed as climate action, even though they don't necessarily achieve the desired outcome.

To move away from this, it will be necessary to demand that offsets be of much higher quality, and thus more expensive, thereby discouraging stakeholders from 'offloading' their responsibility with cheap and unreliable offsets. It's also important to note that in the context of net-zero targets, only high quality carbon removal can be used to balance out emissions that we cannot eliminate. Emission reduction offsets have no place in a net-zero future.

Core to this issue is the lack of a reliable supply of high quality carbon removal. It is actually very difficult (i.e. expensive) to permanently remove carbon from the atmosphere, especially when compared to not emitting CO_2 in the first place. On top of that, some CDR methods can be very expensive to reliably monitor to verify that carbon is permanently stored and it's important that this is reflected in the price. Ultimately, removals and offsets need to be understood as a limited and premium product which are only available for those stakeholders who are unable to fully eliminate their emissions: there will simply not be capacity to remove enough carbon to meet our climate goals if emissions aren't sufficiently reduced."

Defining what is needed

Standardized verifications

Eve Tamme

Founder and Managing Director, Climate Principles

> "The European Commission is currently working on a new policy proposal on certification for carbon removals, due at the end of 2022. There's a good reason for DAC companies like Climeworks to be excited about it. The proposal will establish the main principles, criteria and requirements for the carbon removal certification in Europe and help fill the regulatory gap for carbon removal."

Why are defined and standardized verifications for carbon credits so important?

"Climate policy is an essential tool to incentivise and scale up carbon removal. One missing piece that hinders the scale-up of DAC is the lack of existing accounting rules and standards for carbon removal. For example, the EU's climate targets - and policies like the EU ETS used to achieve these targets - do not currently include DAC. The voluntary carbon market also lacks widely accepted carbon removal standards for DAC to issue carbon credits.

To tackle this, the European Commission is currently working on a new policy proposal on certification for carbon removals, due at the end of 2022. There's a good reason for DAC companies like Climeworks to be excited about it. The proposal will establish the main principles, criteria and requirements for the carbon removal certification in Europe and help fill the regulatory gap for carbon removal. It will not include the list of protocols and methodologies for specific carbon removal approaches yet - that work will follow shortly. As a first of its kind piece of legislation globally, this can make the EU the trailblazer in the regulatory certification of carbon removals."

How to scale up the DAC industry

Scale-up for the future

Ryan Hanna

Assistant Research Scientist, University of California, San Diego

How is DAC scaling up and how is the necessary infrastructure being built?

"IPCC scenarios that map transitions to net zero greenhouse gas emissions rely, to some extent, on negative emissions (IPCC, 2018). Among options for negative emissions, direct air capture could prove attractive for multiple reasons: DAC CO_2 removals are verifiable, permanent, and controllable, and plants are modular. Today, though, total CO_2 removal capacity is tiny, with a small number of pilot plants and even fewer number operating commercially (IEA, 2022) as bespoke arrangements that take advantage of local pore space, waste heat, and/or cheap, clean electricity. Larger, more coordinated visions of DAC scaleup envision CO_2 sequestration hubs—centrally managed injection sites and networks of pipelines that can accept large quantities of CO_2 from numerous diffuse sources, verify and monitor sequestered CO_2, and thus lower costs and risk for all."

Are future outlooks for scaling up positive? Will costs go down?

"Whether scaleup over the next several decades will unfold as many envision depends on numerous factors that span policy, technology, and industry. In some jurisdictions, tax credits for CO_2 removal are on the books, and there's been lots of new focus on applied RD&D.

But more is probably needed. The direct air capture industry is capital intensive, and costs are high; so too are per-ton-CO_2 removal costs. Costs are widely anticipated to fall with time—but that will require that new firms enter the space, learn by doing, and continuously iterate, innovate, and improve upon designs and performance. The industry will benefit from new financing and business model arrangements that connect direct air capture providers with buyers, such as firms from economic sectors, like aviation, with hard-to-abate emissions. Solar photovoltaics, which are small, highly modular, mass produced and globally marketed, have set a high water mark for learning and cost declines (Nemet 2019). DAC, by comparison, is lumpier, and future demand and policy support for the technology is uncertain. Its future might come to mirror the more moderate and slower cost declines of concentrated solar power (Lilliestam et al. 2017) rather than that of photovoltaics. What policymakers should understand is that financial support for direct air capture today buys greater certainty in these learning rates and, in turn, in the potential for future upscaling."

How to scale up the DAC industry

Scaling up via investing

Nili Gilbert

Vice Chairwoman, Carbon Direct

> “But we should not accept the false claims that capturing and storing carbon is nascent or optional. The most recent IPCC report reinforces what we already knew – that all likely scenarios to limit warming below 2°C will require many billions of tons of carbon dioxide removal annually, hundreds of billions of tons by the end of the century.”

How can individuals and companies invest into and support combatting climate change?

“We see many investors and companies who want to invest in climate solutions because they are inspired by the opportunity and the impact of building the new green economy. We know what we need to do on the road ahead to net zero - we can see where the puck needs up go and now we just need to mobilize the actions required to get it there.

Direct air capture will be an important part of this equation. At Carbon Direct, we greatly welcome the rising interest in investing in and creating new companies focused on climate change, importantly including direct air capture. We do caution that both individuals and companies should prioritize the science of carbon management in any investment strategy to maximize impact. For example, in every investment that we make in carbon management technologies, we complete a lifecycle carbon analysis as part of the evaluation. Properly evaluating more advanced solutions does demand greater expertise.

But we should not accept the false claims that capturing and storing carbon is nascent or optional. The most recent IPCC report reinforces what we already knew – that all likely scenarios to limit warming below 2°C will require many billions of tons of carbon dioxide removal annually, hundreds of billions of tons by the end of the century. People have been successfully capturing and storing carbon for 75 years. What is needed now is a massive scale up, which will also lower costs.”

How to scale up the DAC industry

The need for renewable energy

Sarah Deutz

Chair of Technical Thermodynamics (LTT),
RWTH Aachen University

> “Efforts should be made to optimize energy efficiency, e.g., through material development and process design. Suitable locations with high shares of renewable energies and high full load hours are essential for a large-scale implementation of DAC.”

Why is renewable energy so crucial to steering CO_2-neutral DAC efforts?

“Climate benefits for DAC strongly depend on the energy source. The cleaner the energy supply, the more GHG emissions can be avoided, emphasizing the need to match large-scale DAC implementation to renewable energy pathways. The energy demand, which should be supplied by renewables, comes on top of the current demand. Thus, DAC is not a silver-bullet to CO_2 neutrality: we have to de-fossilize our current energy system, but since this is not enough, we need even more renewable energy to drive DAC and take the remaining CO_2 out of the atmosphere.”

How is Climeworks’ usage of geothermal energy to power DAC efforts in Iceland a key differentiator? Can this serve as a standard for DAC in general?

“The geological characteristics make Iceland an attractive place for DAC and subsequent CO_2 storage. Using geothermal energy, the DAC plant captures CO_2 that is directly stored on-site in basaltic rocks. Favorable geothermal regions are distributed variably around the globe and not available in every region. Furthermore, the environmental impacts of geothermal energy strongly depend on the selected location and need to be considered in developing DAC pathways.”

How should DAC and climate change-focused companies reduce their energy consumption? (e.g., net zero plans)

“Low-carbon electricity is likewise to be a limited resource in the future, and thus, an efficient use is necessary for a low-carbon and sustainable future. Consequently, energy efficiency will continue to play an important role, and DAC will compete with other low-carbon technologies for energy in the system. Hence, efforts should be made to optimize energy efficiency, e.g., through material development and process design. Suitable locations with high shares of renewable energies and high full load hours are essential for a large-scale implementation of DAC.”

Customer perspective

Insights from a corporate pioneer

Tom Spencer

Environmental Management Specialist, Swiss Re

> Swiss Re and Climeworks signed a ten-year carbon removal purchase agreement worth USD 10 million. It is thought to be the first of its kind in the voluntary carbon market for this type of high-quality carbon removal, and thus sends an important demand signal to developers, investors and other buyers.

"Swiss Re has committed to net-zero emissions in our own operations by 2030. We believe that for a credible transition path to net-zero operational emissions, companies need to focus first and foremost on reducing their value chain emissions wherever possible as fast as possible. In parallel, they should boost the demand for removals, thus preparing to balance all residual emissions in the target year. As the carbon removal market is still in its infancy, we are keen to catalyse its development through our early engagement.

Direct air capture removals are more durable and scalable than other removal solutions, but currently much more expensive, mainly due to their large energy requirements and early stage of development. Larger, more economic air-capture facilities can only be realised if they are considered bankable by investors. Buyers can contribute to this by committing themselves to long-term purchasing agreements that secure future revenue streams for developers.

In response to this challenge, Swiss Re and Climeworks signed a ten-year carbon removal purchase agreement worth USD 10 million. It is thought to be the first of its kind in the voluntary carbon market for this type of high-quality carbon removal, and thus sends an important demand signal to developers, investors and other buyers.

But bringing climate solutions to scale not only requires the right demand signals, it also creates a need for de-risking and financing. As our recent publication, The insurance rationale for carbon removal solutions, launched by Swiss Re Institute argues, the insurance sector is uniquely positioned to offer support on all three fronts.

This is why we have also agreed with Climeworks to collaborate on developing risk management knowledge and risk transfer solutions, as well as to explore future investment and project finance opportunities."

Contributor biographies

Giana Amador

Policy Director and Co-founder, Carbon180

At Carbon180, Giana has worn many hats — from guiding the team's strategy and communications to more recently, leading the organization's policy program. Across her work, Giana is focused on connecting economic development, social justice, and climate action. A native of the Central Valley in California, Giana has deep expertise in agriculture and soil carbon sequestration, in addition to ushering in foundational policy work across carbon removal solutions. Her past research focused on the political economy of renewable energy, with an emphasis on green industrial policy and coalition building. Giana was named to the Forbes 30 under 30 list in 2022. She holds a degree in Environmental Economics & Policy from UC Berkeley.

Mark Preston Aragonès

Policy Manager, Bellona

Mark Preston Aragonès is the Carbon Accounting Policy Manager for Bellona Europa, where he has worked for 4 years, covering EU climate policy on transport and industrial decarbonisation, and on carbon dioxide removal. He manages advocacy on carbon dioxide removal policy at the EU level and across Bellona's national offices. Mark also leads the work on International and European Governance in the NEGEM H2020 project, which seeks to identify realistic deployment pathways for negative emissions technologies and practices. He holds a BA in International Relations and an MSc on Climate Change, Development and Policy from the University of Sussex, where he specialised on international climate mitigation policy and the feasibility of deploying climate technologies at scale.

Sarah Deutz

Chair of Technical Thermodynamics (LTT) RWTH Aachen University

Sarah Deutz pursues her Ph. D. thesis at the Institute of Technical Thermodynamics from RWTH Aachen University on the life-cycle assessment of low-carbon technologies considering development and deployment scales. She uses modeling approaches from screening to an integrated energy system design. In this context, she focuses on low-carbon technologies such as Carbon Capture Utilization and Storage, Carbon Dioxide Removal, and Power-to-X, assessing their potential contribution to decarbonization strategies.

Since 2020, Sarah has led the Energy System Engineering - Life-Cycle Assessment research group. The research group focuses on method development for assessing and designing sustainable systems in energy and process engineering. Model-based and computer-aided methods are used to analyze and design such systems to be reliable, efficient, flexible, and sustainable. For mathematical method development, basic principles of thermodynamics are used to evaluate and improve energy systems on different levels: from molecules over industrial production processes to multi-regional energy systems. In addition, technologies and systems are evaluated based on life-cycle assessments to identify environmental trade-offs and burden-shifting considering planetary boundaries.

Anna Dubowik

Secretary General, Negative Emissions Platform

Anna Dubowik is the Secretary General of Negative Emissions Platform - a Brussels-based trade association advocating for an investable policy framework for permanent carbon removals. She has over a decade of experience in climate and energy policy work at the EU level, including from Global CCS Institute, European Parliament, ENGOs and major industry associations. Her educational background is in European politics and climate change law. She serves as an advisor to Carbonfuture Catalyst, as a reviewer for Stripe Climate/Frontier and is involved with her local government on 'greening the city' policies.

Dr. Julio Friedmann

Chief Scientist at Carbon Direct

Dr. Julio Friedmann is Chief Scientist and Chief Carbon Wrangler at Carbon Direct. He recently served as Principal Deputy Assistant Secretary for the Office of Fossil Energy at the Department of Energy where he was responsible for DOE's R&D program in advanced fossil energy systems, carbon capture, and storage (CCS), CO_2 utilization, and clean coal deployment. More recently, he was a Senior Research Scholar at the Center on Global Energy Policy at Columbia University SIPA, where he led the Carbon Management Research Initiative. He has held positions at Lawrence Livermore National Laboratory, including Chief Energy Technologist, where he worked for 15 years.

Dr. Friedmann is one of the most widely known and authoritative experts in the U.S. on carbon removal (CO_2 drawdown from the air and oceans), CO_2 conversion and use (carbon-to-value), hydrogen, industrial decarbonization, and carbon capture and sequestration. In addition to close partnerships with many private companies, NGOs, Julio has worked with the U.S. State Department, the U.S. Environmental Protection Agency, and government agencies foreign and domestic. His expertise also includes oil and gas production, international clean energy engagements, and earth science.

Dr. Friedmann received his Bachelor of Science and Master of Science degrees from the Massachusetts Institute of Technology (MIT), followed by a Ph.D. in Geology at the University of Southern California. He worked for five years as a senior research scientist at ExxonMobil, then as a research scientist at the University of Marylan

Prof. Dr. Sabine Fuss

Head of working group Sustainable Resource Management and Global Change

Prof. Dr. Sabine Fuss leads the working group Sustainable Resource Management and Global Change, and is a professor at Humboldt-Universität zu Berlin. Her current research interests are:

- Natural resource management, energy and agricultural economics (bioenergy, land use implications)
- Decision-making under uncertainty, with a focus on portfolio selection, real options theory, stochastic optimization and robustness
- Integrated assessment with a focus on climate change mitigation and adaptation (including the role of international trade, negative emission options and technologies)
- Reconciling top-down and bottom-up assessments, science-policy nexus
- Mechanisms for carbon management, climate-compatible development, architecture of climate agreements

Sabine Fuss studied international economics, receiving an MSc from the University of Maastricht, where she also completed a PhD on sustainable development in the energy sector. Before coming to MCC, Sabine Fuss led a group working on the development of economic methods with emphasis on uncertainty and risk in the Ecosystems Services and Management Program of the International Institute for Applied Systems Analysis (IIASA). In that capacity, she was responsible for, among other functions, international and national projects in the area of climate change mitigation and adaptation, especially in the case of land use.

Nili Gilbert

Vice Chairwoman, Carbon Direct

Ms. Gilbert has a background in investment management and is a leader in the international climate community. Ms. Gilbert is a board member and the Chairwoman of the Investment Committees of both the David Rockefeller Fund and the Synergos Institute, and she is a Senior Advisor at Boston Consulting Group (BCG). Ms. Gilbert is the Chair of the Glasgow Financial Alliance for Net Zero Advisory Panel as well as a member of its CEO & Principals Leadership Group. Ms. Gilbert is the Chair of U.S. Policy for the United Nations-convened Net Zero Asset Owner Alliance, and is a member of the State of California's Climate-Related Financial Risk Advisory Group. Ms. Gilbert is also a member of the Social Mission Board of Seventh Generation, a wholly-owned subsidiary of Unilever. Ms. Gilbert was a Co-founder and Portfolio Manager at Matarin Capital. Prior to Matarin, Ms. Gilbert was a Senior Director and Senior Quantitative Analyst at Invesco. Ms. Gilbert is a permanent member of both the Council on Foreign Relations and the Economic Club of New York, where she sits on the Membership Committee. Ms. Gilbert holds an MBA from Columbia Business School and a BA in a Special Concentration in Economics & Social Studies from Harvard University magna cum laude.

Ryan Hanna

Assistant Research Scientist, University of California, San Diego

Ryan Hanna is a research scientist at the University of California San Diego (UCSD) and an affiliate in the UCSD Deep Decarbonization Initiative. His research focuses include energy systems analysis, energy resilience, and energy system transitions to zero carbon using a range approaches including techno-economic modeling, lifecycle analysis, simulation, optimization, elicitation, and behavioral experiments. His work spans electric power, transportation, carbon capture and storage, and carbon removal.

Tom Spencer

Environmental Management Specialist, Swiss Re

Tom Spencer is an Environmental Management Specialist at Swiss Re where he is managing the carbon removal purchasing with the aim of reaching net-zero operational emissions by 2030 and helping the nascent carbon removal industry grow. After authoring an educational course on carbon removal for the start-up charity Climate-Science, Tom understood the importance of supporting high-quality carbon removal that works for the people and the climate and so joined Swiss Re in 2021 with this in mind. He also has experience running Swiss Re's operational emissions reporting campaign. Tom previously studied Science, Technology & Policy at ETH Zürich and Earth Sciences at the University of Cambridge where he wrote his master's thesis on the impact of climate change on Post-Classic Maya Civilisation. He moved from England to Switzerland in 2020 and enjoys hiking and camping in the mountains and reading history, philosophy, economics and science fiction.

Eve Tamme

Founder and Managing Director, Climate Principles

Eve Tamme leads Climate Principles, a climate policy advisory. She works with private and public sector clients, providing strategic advice on European and international climate policy. Her expertise covers a broad range of policy tools and processes, including the Paris Agreement, the EU Emissions Trading System, carbon removal, international carbon markets and climate governance.

Working on climate policy since 2004, she has led the Climate Department in Estonian national administration, advised on climate policy in DG CLIMA in the European Commission, served as a diplomat at the Estonian Permanent Representation to the EU, and shaped international climate policy engagement at the Global CCS Institute.

Eve serves on the Board of Directors at Puro.earth carbon removal marketplace. She holds a Master of Science in Environmental Engineering from TalTech University.

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