Carbon Direct

Scaling carbon management with science and software

NZAOA

May 2023

NZAOA has set ambitious climate goals

These will require a reliable supply of high-quality carbon removal credits in order to decarbonize portfolio emissions that cannot be reduced or avoided operationally.

	Decarbonization	Carbon Removals
Investee climate commitments	Deep and rapid decarbonization is needed for 1.5°C pathway. Heavy emitting industries may need to halve their emissions by 2030.	*"Shall not use carbon removals exceeding emissions levels indicated by broadly accepted sector pathways aligned with 1.5°C."* *"Nevertheless, members are highly encouraged to contribute to a liquid and well-regulated carbon removal certificate market before 2030 as such a market is important for accelerating decarbonisation."* Only incorporate removals with highly durable storage
NZAOA's role	Encourage investee companies to prioritize abatement. Invest capital into decarbonization technologies.	Invest capital in technologies and nature-based solutions that remove residual emissions. *"Shall not use carbon removals for their own sub-portfolio or sector target achievement before 2030."*

Source: Net Zero Asset Owners Alliance

Agenda

01 A primer on carbon removal

02 The importance of capital investment in nascent technologies

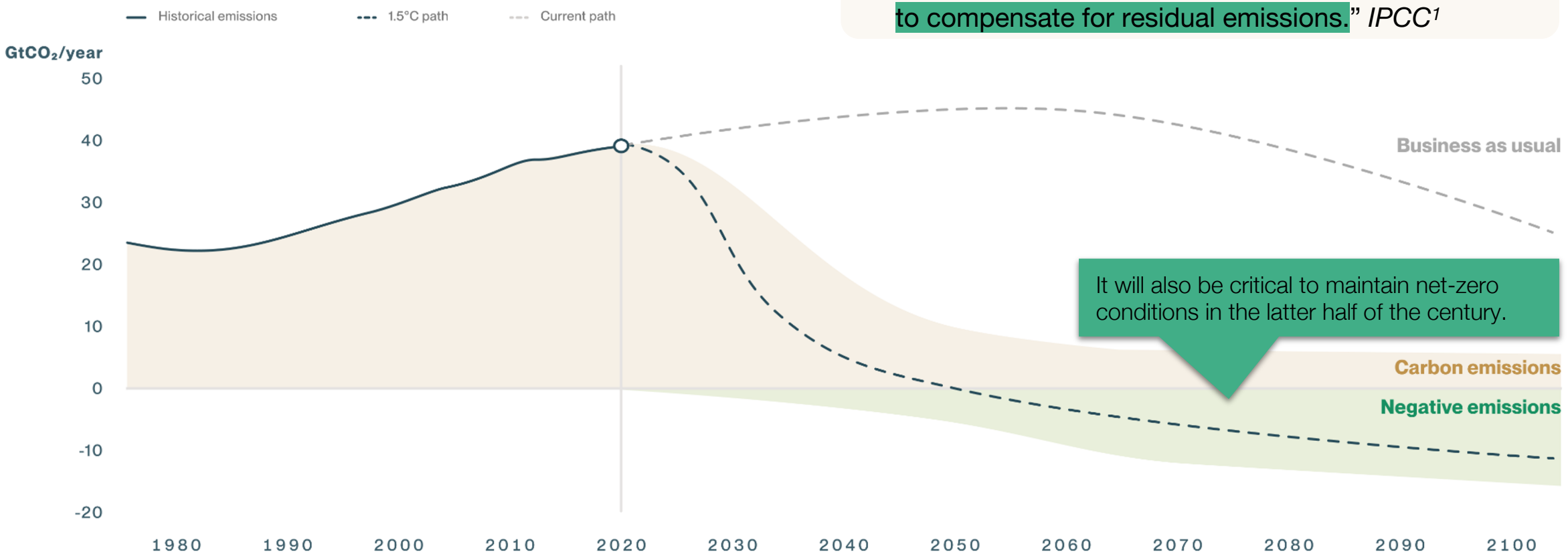
03 Broadly accepted sector-specific pathways

04 Conclusions

A primer on carbon removal

CO_2 removals alongside reductions are necessary for meeting climate goals

> Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide occur in the coming decades. All pathways project the use of carbon dioxide removal to compensate for residual emissions." *IPCC*[1]



(1) IPCC 6TH ASSESSMENT REPORT, 2021

There is a diversity of carbon removal technologies

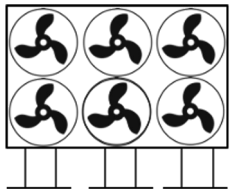
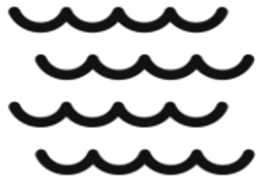
Nature-based solutions

Afforestation / Reforestation	Blue Carbon	Improved Forest Management	Peatland & Wetland Restoration	Soil Carbon
				

Hybrid solutions

Biochar	Bioenergy with Carbon Capture & Storage
	

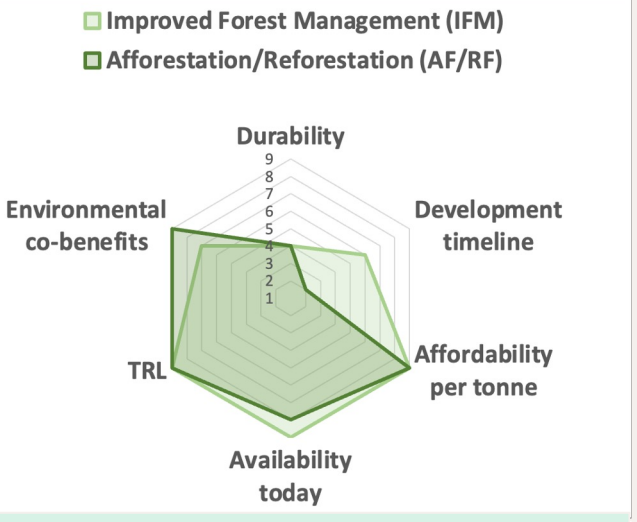
Engineered solutions

Carbon Mineralization	Direct Air Capture	Ocean Alkalinity Enhancement
		

Source: Images from Noun Project

Different technologies meet different priorities

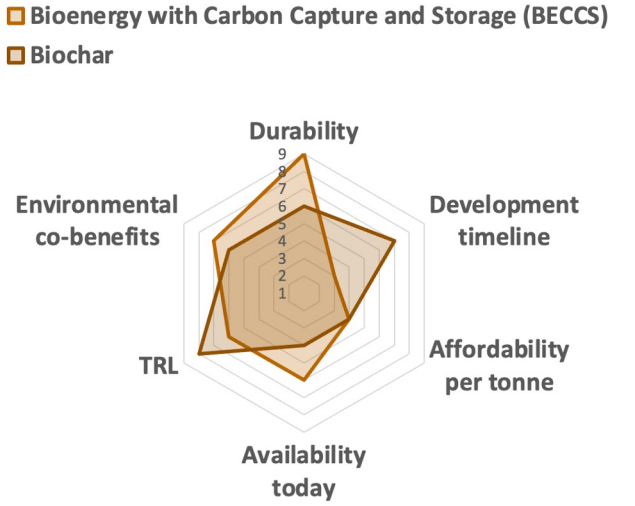
Nature-based



Strengths
- Low cost
- Ecosystem & community benefits
- High availability

Weaknesses
- Low durability
- Additionality issues

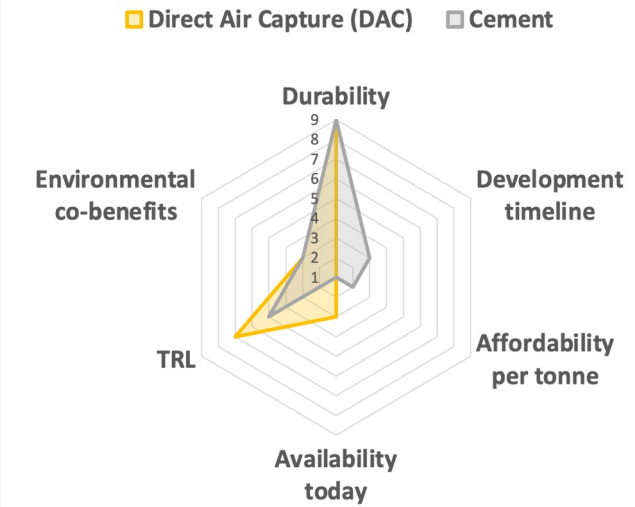
Hybrid



Strengths
- High durability
- Co-benefits

Weaknesses
- Biomass supply limitations and trade-offs
- Long project development time

Engineered



Strengths
- High durability
- High scalability

Weaknesses
- High cost
- Low availability
- Long project development time

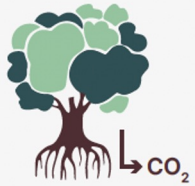
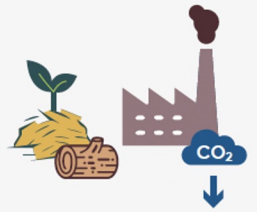
TRL = Technology Readiness Level, a scoring system for assessing the maturity of a particular technology.

Carbon can be stored in both biological and geological systems, with different implications for durability

AOA Shall encourage investees to only incorporate removals with highly durable storage

In this context, durability (or 'permanence') refers to the planned duration of carbon storage.

Illustrative and highly-simplified:

	NATURAL CLIMATE SOLUTIONS		HYBRID / BIOMASS WITH CARBON REMOVAL STORAGE		ENGINEERED SOLUTIONS
Carbon project type					
	'RESTORE'	'MANAGE'	BIOCHAR	BECCS	DACCS
Carbon storage system	Biological (i.e., land based)			Geological (i.e., underground)	
Durability of storage	*10-100s of years*			*>1000s of years*	

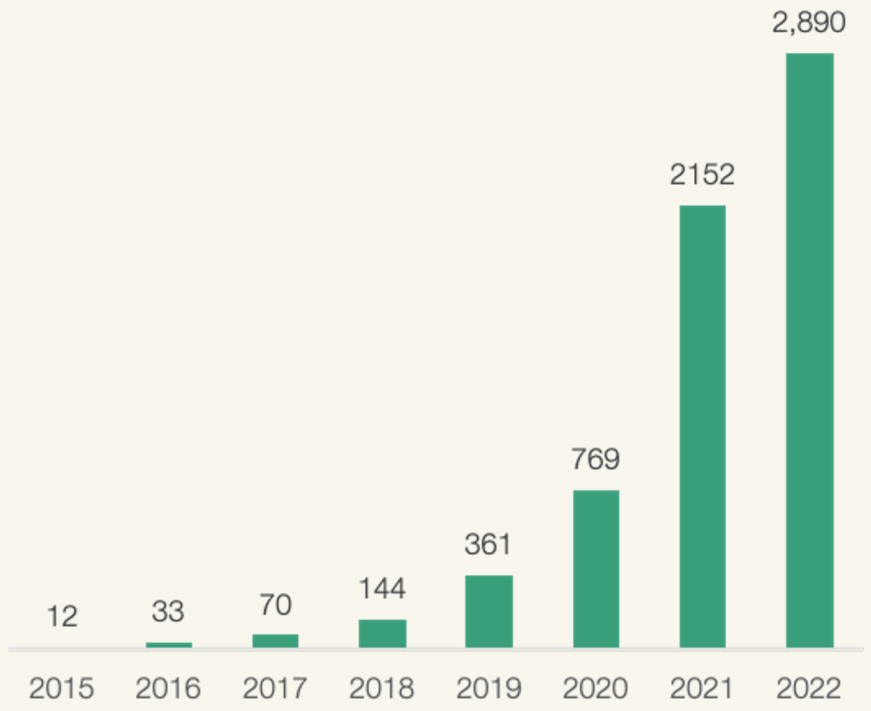
Source: Carbon Direct; Energy Transitions Commission (2022)

AOA members are encouraged to invest capital in technologies and nature-based solutions that remove residual emissions

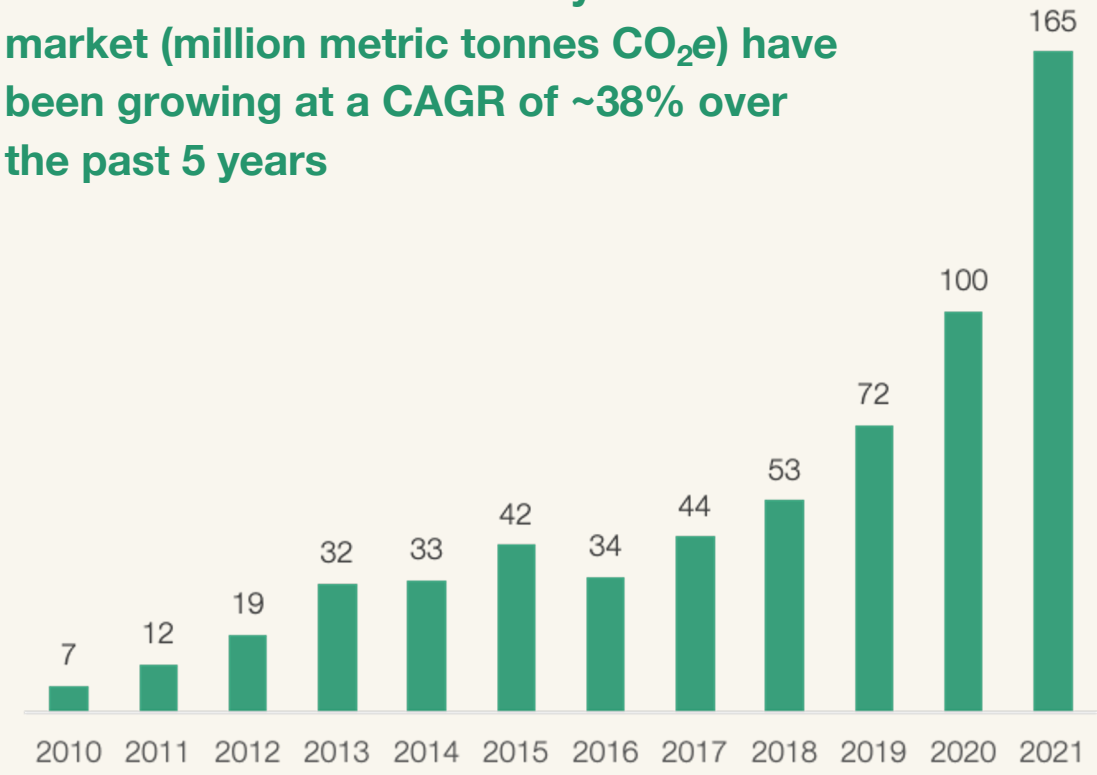
As the market matures, volumes must align around quality and accelerate to gigaton scale

Regulatory and voluntary market tailwinds are driving that transition.

Number of companies with a Science-Based Target (SBT) is surging



Retirements on the voluntary carbon market (million metric tonnes CO_2e) have been growing at a CAGR of ~38% over the past 5 years



Organizational engagement in the voluntary carbon market comes from a variety of funding pools

Sustainability budgets

Mainstream sustainability funds procuring carbon offsets against their emissions

shopify

$70/t
average spend

Business line budgets

Connecting carbon credit purchases to **business line integrations** and products

And/or

Funding purchases through an **internal carbon tax**

Swiss Re

$100/t
carbon tax

Investment funds

Working through **corporate investment funds** to secure project level investment

CARBON STREAMING

$25M+
investments

Philanthropy

Collaborating with **corporate foundations** to provide grant funding to support carbon programs

stripe

>$1.4M
R&D Grants[1]

Typically focused on procurement - ***AOA protocol encourages members to push these actions to their portfolio companies.***

Investing for financial return and/or credit streams - ***AOA protocol allows for this now***

Contributions to R&D or carbon programs (no procurement included)

1. In most cases, accompanied with small purchases of offset removals Source: Public disclosures, earning statements, sustainability reports

There are two major classes of credits available today

Not all carbon credits are created equal. Removal carbon credits are generally more capable of demonstrating carbon goals

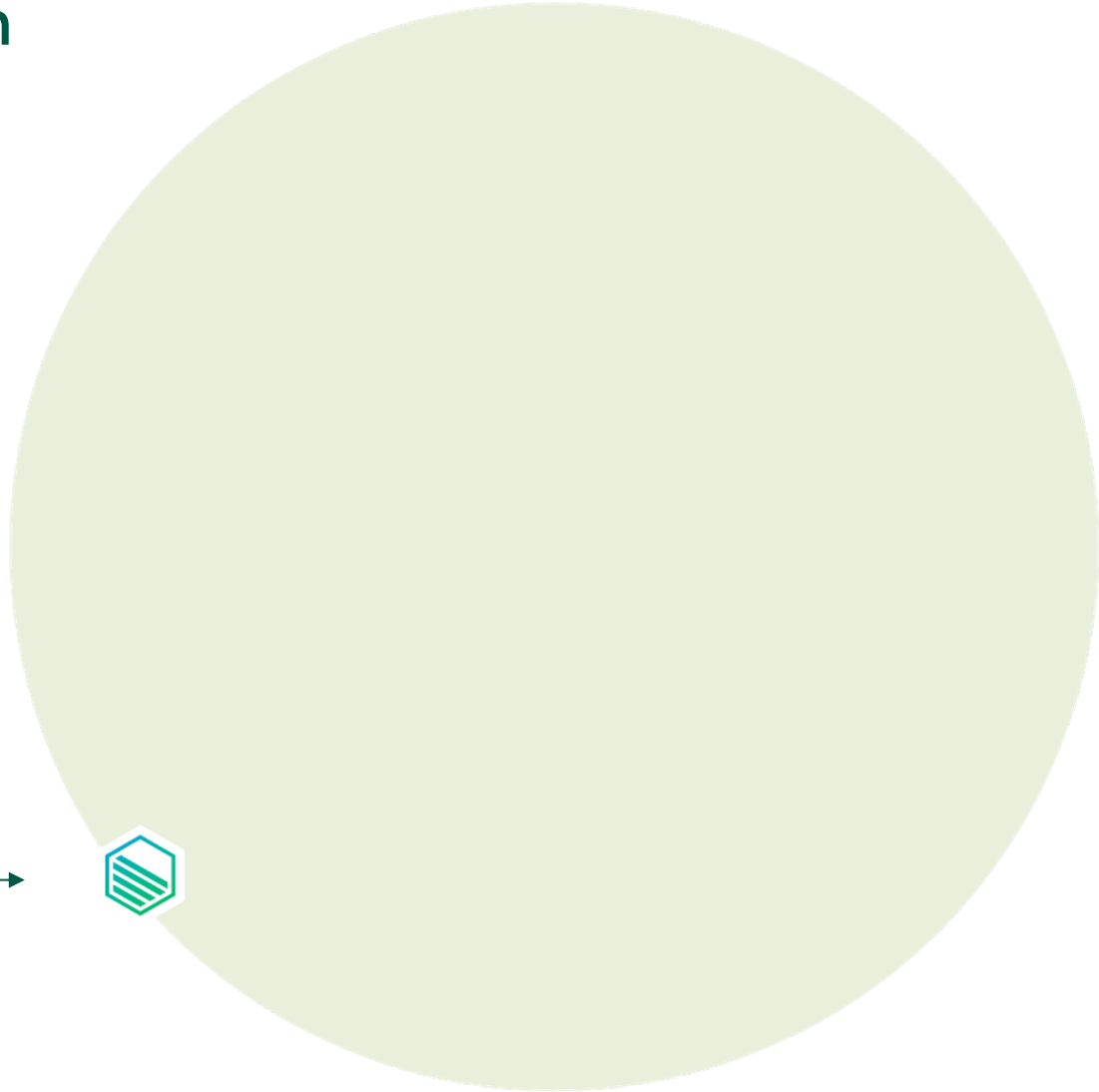
Credit type	CO_2 Storage Potential	Example Project	Advantages	Risks	Market Availability
Avoidance/ reductions Additionality is generally difficult to demonstrate and carbon projects are difficult to monitor.	**Renewable Energy Reduction Credits** *No Storage*	Renewable energy	Socio-economic benefits to vulnerable & marginalized populations. Cheap.	Very high risk of non-additionality/ inflated baselines.	Abundant
	Nature-based Avoided Deforestation Credits *Storage of 10s of years*	REDD+ (reducing emissions from deforestation and forest degradation)	Avoided deforestation is a highly impactful climate outcome if successful, and extremely critical.	Frequent baseline/ additionality failure as this is highly difficulty to assess and projects are difficult to maintain. MRV ** requires further research	Abundant
Removals. *Durability and additionality are easier to prove but many solutions are not as mature*	**Nature-based Removals Credits** *Storage of 10s - 100s of years*	Afforestation / reforestation	High technical readiness. Co-benefits for nature and communities. Easier to demonstrate additionality of carbon dioxide removal.	Durability considerations because of the higher risk of reversal, therefore must be monitored. Some additionality & baseline questions. MRV ** requires further research.	Predominant form of removals credits available today, primarily from the afforestation and forestry sectors.
	Engineered & Hybrid Removal Credits *Storage of 100s - 1000s years*	Direct air capture	High durability/ permanence, Easy to demonstrate carbon additionality. Supporting innovative climate tech.	High cost, less clear co-benefits. Risk of use of unsustainable biomass feedstocks or non-renewable power. Low TRL*.	Mostly ex-ante (projected availability of future credits)

*TRL = Technological readiness level, a scoring system for assessing the maturity of a particular technology. ** MRV = Monitoring, Reporting and Verification

Framework adapted from: https://3degreesinc.com/services/carbon-credits/

Not all credits on the voluntary carbon market are equal

The market is transitioning towards increased removal supply, but the market is constrained



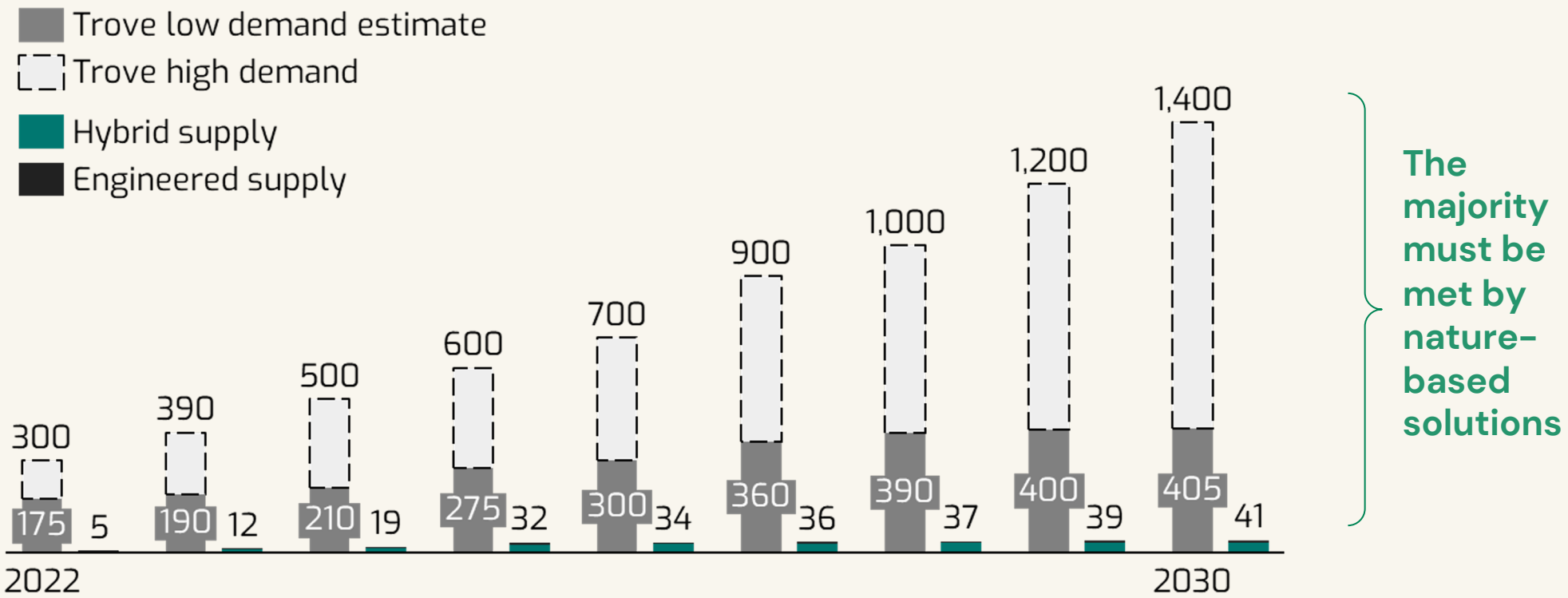
ONLY 6%

of credits in the voluntary carbon market are pure removals*

*The other 94% of credits often rely on difficult-to-verify counterfactual scenarios.

To meet climate targets, the market will need to maintain rapid growth across nature-based, hybrid and engineered supply

Future supply and demand for high quality credits (MT)[1]



1 Trove analysis of carbon credit demand. Supply analysis based on public announcements of investments, forward procurements, and purchasing

Given their profile as a pure expense, the price of credits in today's market is generally set by costs rather than value

Risk assessment: low | med | high

Vertical	Credit price today ($/t)	Anticipated directional price change by 2030	Operational*	Reputational
AF/RF	20-45	We expect nature-based removals prices to rise as demand for quality removals increases faster than available supply		
IFM	15-30			
Biochar	35-60	We expect engineered removals prices to fall as scale and tech development drives down costs		
BECCS	100-250			
DAC	120-300			

Cost drivers of production:

- CAPEX for facilities (where relevant)
- Feedstock, energy, materials, etc.,
- Vertical-specific MRV requirements
- Financing & sales and marketing

Price pressure upwards:

- Supply constraint for quality
- Charismatic credits / potential narrative alignment
- Additional certifications
- Required return for financing

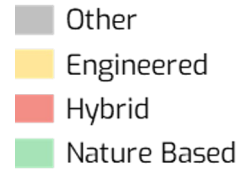
Note: the list here does not represent an exhaustive list of project types, rather this is a representative profile

AF/RF = Afforestation/ Reforestation
IFM = Improved forest management
BECCS = Bioenergy with carbon capture & storage
DAC = Direct air capture

**Operational risk includes risk of credit delivery as well as risk that a project's infrastructure requirements will compromise implementation*

Organizational carbon removal strategies typically reflect organizational values

Leaders vary in their procurement approaches, but all have a 'blended' portfolio



Buyer	Annual tCO_{2e}*	Category Mix (tCO_{2e})	Selected project types included
Microsoft	1.5 million	99.4% / 0.1% / 0.5%	• Afforestation/reforestation (AF/RF), improved forest management (IFM), soils, biochar/ bio-oil, direct air capture (DAC), built mineralization, blue carbon
shopify	0.1 million	74.5% / 3.7% / 16.1% / 5.7%	• AF/RF, soils, biochar/ bio-oil, DAC, built mineralization
stripe	0.015 million	16.6% / 83.4%	• Biochar/bio-oil, DAC, enhanced weathering, mineralization, macroalgae

Proportional volumes represent total carbon credit removal tonnes purchased

Source: Microsoft, Stripe, cdr.fyi. *Approximate based on representative year, e.g., 2022.

AOA members encourage their investees to *"...not use carbon removals exceeding emissions levels indicated by broadly accepted sector pathways aligned with 1.5°C."*

Aligning with broadly accepted sector pathways

There are a range of sector-specific pathways and target-setting frameworks. AOA's guidance is broadly inclusive to enable investees to find additive value with a framework of their choice, or to work solely with AOA's guiding principles

SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

iea

MISSION POSSIBLE PARTNERSHIP

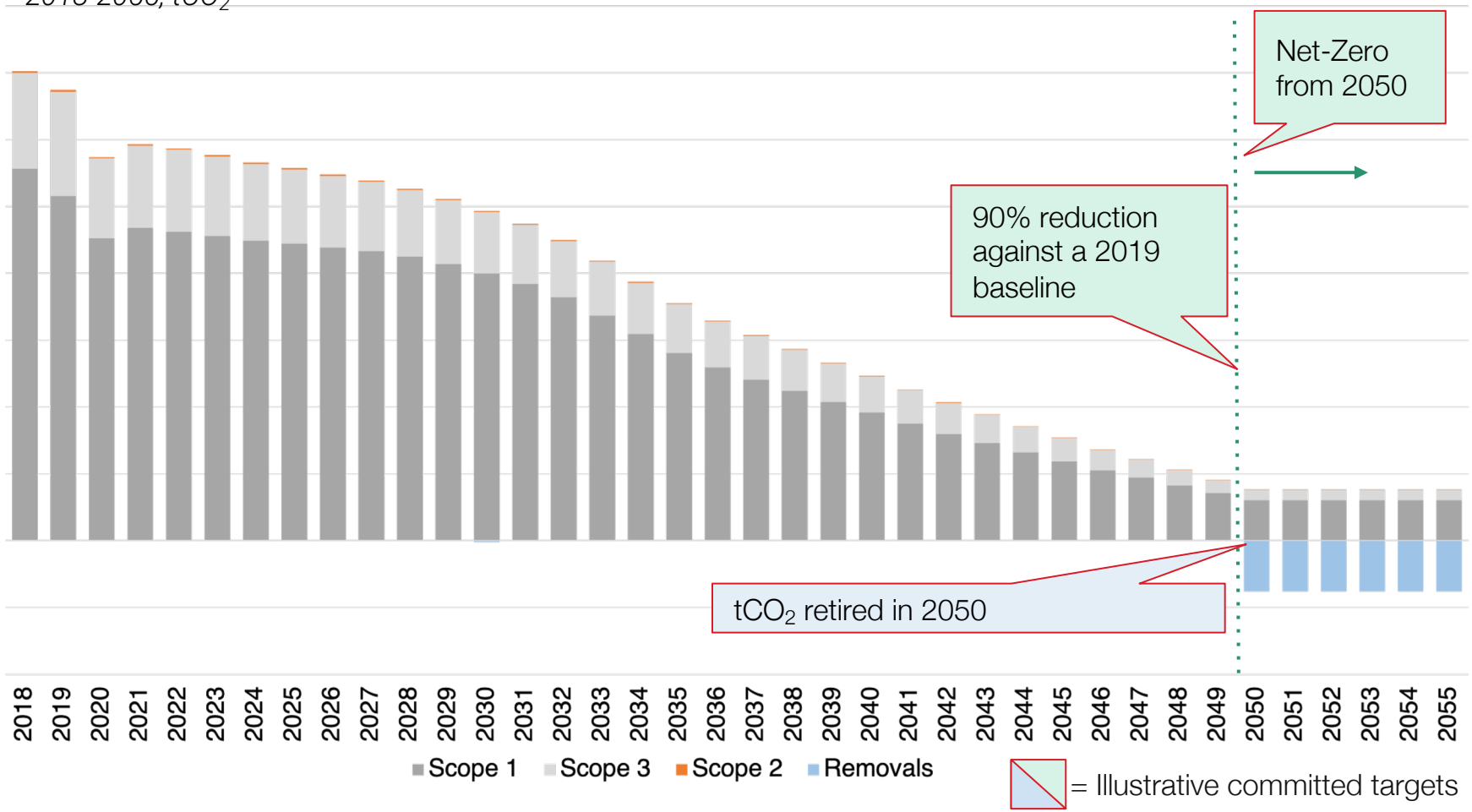
NGFS

Central Banks and Supervisors Network for Greening the Financial System

Source: Carbon Direct; Energy Transitions Commission (2022)

Under SBTi, removals don't necessarily come into play until Net Zero target in 2050

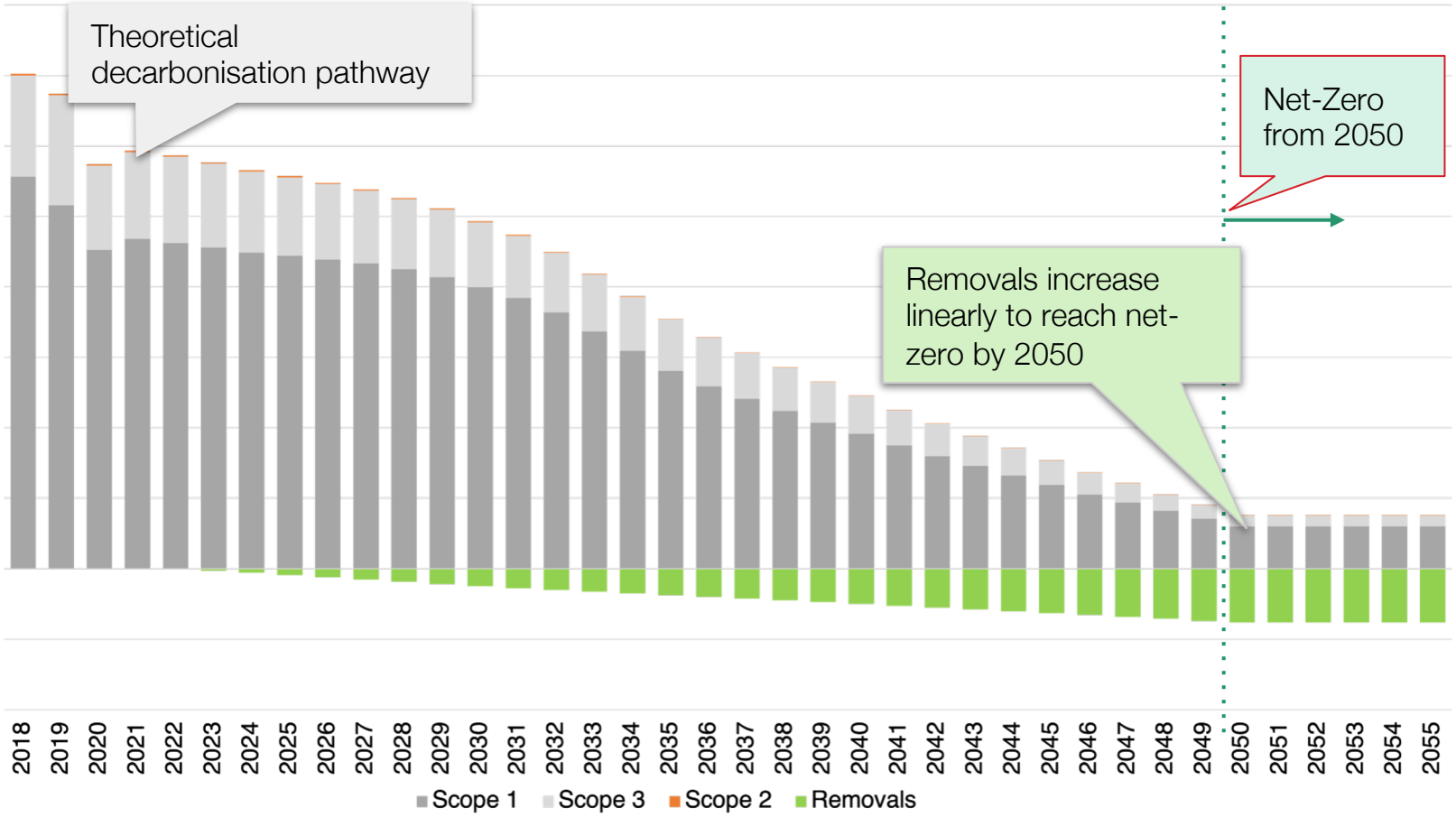
Illustrative targeted decarbonisation trajectory,
2018-2055, tCO_2



Source: Carbon Direct

AOA's framework allows for a 'market commitment' trajectory that can set a clear signal for 2050 compliance and builds credible supply

Illustrative Carbon Removal Milestone Targets, *2018-2055, tCO_2*



Source: Carbon Direct

AOA can play the role of “market maker”

AOA can unblock challenges facing procurement today

Invest capital in technologies and nature-based solutions that remove residual emissions.

1. **Expanding access to quality** - both in the ex-post (i.e., existing credits) and in forward purchases
   a. Few high quality projects are currently available
   b. Demand for quality credits is scaling rapidly

2. **Drive quality in the market**
   a. Quality transactions and development are both highly technical
   b. Transactions require both breadth and depth of expertise (across 15 project types/technologies)

3. **Maturing market structures**
   a. Suppliers have limited access to finance
   b. Development is often predicated on early buyer participation

4. **Be a part of building a new market**
   a. Nature-based solutions are steadily increasing in price due to the overall scarcity of supply
   b. 2030 corporate climate targets are expected to accelerate that trend

KEY DEFINITIONS

CO_2e: the term ‘carbon dioxide equivalent’ represents the impact of any greenhouse gas in relation to the amount of CO_2 emissions with the same global warming potential.

Ex-ante: based on a forecast rather than in a real result. For carbon credits, it refers to the amount of credits that are issued for the expected lifetime of a project, which can be purchased in advance.

Ex-post: based on a real result rather than a forecast. For carbon credits, it refers to credits issued from emissions reduction or removals that have already been realized, and that come from projects that have received strong monitoring and verification.

Nature-based: type of CO_2e removal that uses naturally-occurring processes to remove CO_2e from the atmosphere. An example is reforestation or other forms of ecosystem restoration.

Engineered: type of CO_2e removal that uses technological solutions to remove the carbon from the atmosphere. An example is direct air capture, a technology that uses chemicals to capture CO_2 from air.

Hybrid: type of CO_2e removal that combines both nature-based and engineered solutions. An example is bioenergy with carbon capture and storage (BECCS). Biomass is formed by carbon naturally-locked by photosynthetic processes. CO_2 is released when this biomass is utilized as an energy source, and is captured and stored through technological processes. Another term for this is BiCRS: Biomass with Carbon Removal and Storage.

Spot purchase (of credits): refers to the purchase of ex-post credits from existing projects on the market.

Forward purchase agreement: refers to contracting a set percentage of ex-ante credits from an existing (usually early-stage) project on the market.

Co-development (of credits): refers to co-financing and co-designing a new project on the voluntary market.

Milestones: refers to targets set by an organization to scale its commitment to CO_2e removal.

Removals credits: refers to credits that certify the action of taking one tonne CO_2e emissions out from the atmosphere/oceans and placing it in durable storage. This is currently done through many different processes, for example via nature-based solutions such as afforestation and/or reforestation (AF/RF), or engineered solutions such as direct air capture (DAC).

Reduction and/or avoidance credits: refers to credits that certify the action of avoiding one tonne CO_2e emissions from being emitted into the atmosphere. This is currently accomplished via avoided deforestation projects or renewable energy projects which reduce the overall use of fossil fuels.