CarbonPool

Insuring the path to net zero

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The physics of climate change

Since 1900, Earth's average surface air temperature has increased by about 1 °C

The average concentration of atmospheric CO_2 has risen from 316 ppm[1] in 1959 to 411 ppm in 2019

Without abatement, an additional warming of 2.6 – 4.8 °C is expected during the 21st century

Source: National Academies of Sciences, https://nap.nationalacademies.org/resource/other/dels/net-zero-emissions-by-2050

(1) One ppm = one part per million; Measured at the Mauna Loa Observatory in Hawaii

The gigaton problem of climate change

Kyoto Protocol

Net-zero commitments go back to the Kyoto Protocol, which set binding emissions reduction targets for developed nations

Paris Agreement

International agreement between 190+ countries, limiting global warming to 1.5°C and leading to broader net-zero pledges

Goal: Global carbon neutrality by 2050

1997 **2015** **2050**

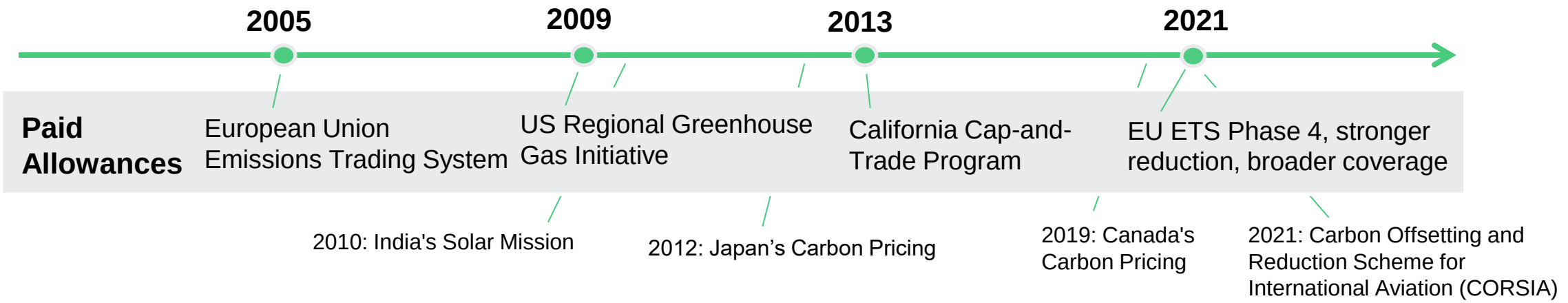
To keep global warming below 1.5°C, the world must **cut emissions by approximately 40-50 gigatons[1] of greenhouse gases[2] by 2050**. This requires all countries, collectively, to reduce greenhouse gas emissions and balance any remaining emissions with carbon removals.

(1) One gigaton equals one billion (10^9) metric tons. As comparison: Switzerland's current annual emissions are 40-45 million metric tons.

(2) Greenhouse gases are also denoted as carbon dioxide equivalent (CO_2e).

The collective solution for climate change

Countries have nationally determined contributions (NDCs)



Reduction "Achieving net zero emissions by 2050 will require nothing short of the complete transformation of the global energy system" – International Energy Agency https://www.iea.org/reports/net-zero-by-2050

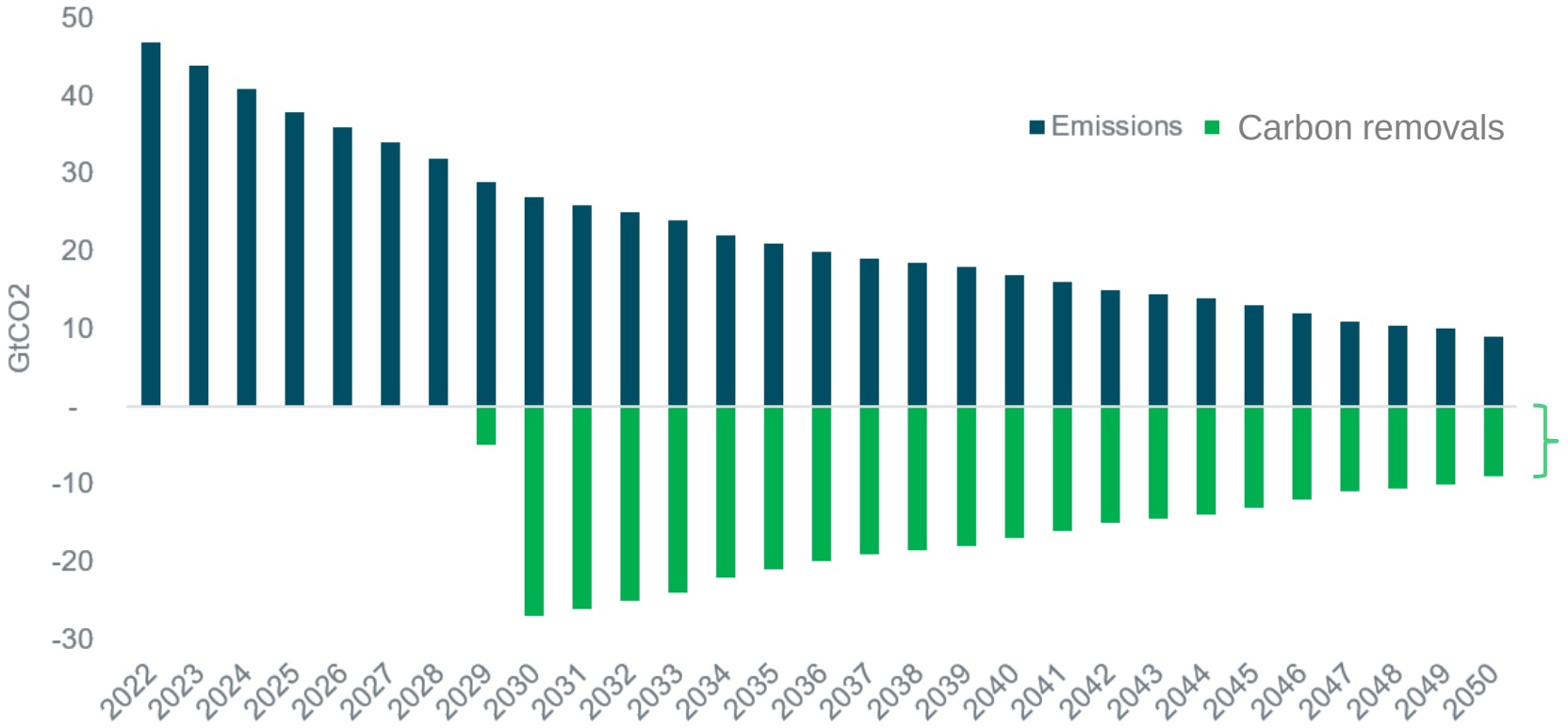
Removal Of already emitted CO_2e from the atmosphere

Avoidance Does not remove already emitted CO_2e

Offsetting Carbon Credits → Used to offset the remaining piece of emissions which cannot be further reduced

Global net zero needs removal of 10 GtCO2e/yr by 2050

Carbon offsets needed to balance expected emissions under all announced policies
(billion tons CO2e)



Source: Climate Action Tracker, IPCC, McKinsey, Mercator Research Institute

Need for Carbon Removals

If the goals for **climate and economic growth** are to be achieved, negative emissions technologies will likely need to play a large role in mitigating climate change by removing

~10 GtCO2e/yr by 2050

Microsoft's commitment:

"We've committed to be carbon negative by 2030. This means reducing our greenhouse gas emissions by more than half, removing the rest, and then removing the equivalent of our historical emissions by 2050."

Removal of CO_2e from the atmosphere

Type	Removal Method
Nature-based	Reforestation
	Afforestation
	Improved Forestry Management
	Soil Carbon Sequestration
	Blue Carbon
Technology-Based	Direct Air Capture (DAC)
	Carbon Mineralization
Hybrid	Biochar
	Bioenergy with Carbon Capture and Storage (BECCS)
	Enhanced Weathering

Certification and Verification

Registries providing certification and verification methodologies[1]:

- Verra
- Gold Standard
- American Carbon Registry (ACR)
- Plan Vivo
- Climate Action Reserve (CAR)
- Puro.earth
- Carbon Standards International
- …

Issuance of removal carbon credits

One removal carbon credit represents the **capture and storage** of one metric ton of CO_2-equivalent

Illustrative price examples:
$50 for an afforestation credit
$500 for a DAC credit

(1) Berkeley keeps a voluntary database of registry offsets: https://gspp.berkeley.edu/research-and-impact/centers/cepp/projects/berkeley-carbon-trading-project/offsets-database

The economics of climate change

15b tCO_2e

expected to be removed from the earth's atmosphere until 2050 by the ~11'000 projects registered today

Source: MSCI Carbon Markets

~$1.6 trillion

estimated annual spending on negative emissions worldwide up from the $36 bn already invested in 2012-2020[1], requiring massive sustained growth for decades

Source: Trove Research

~1'200

of the largest 2'000 publicly listed companies have a net zero commitment as of 2024, with many more expected to follow in the near future

Source: Net Zero Tracker

(1) Additionally, $18 bn were raised or committed between 1.2021-6.2023.

Carbon sequestration projects face risks throughout their lifecycle that put large investments in jeopardy

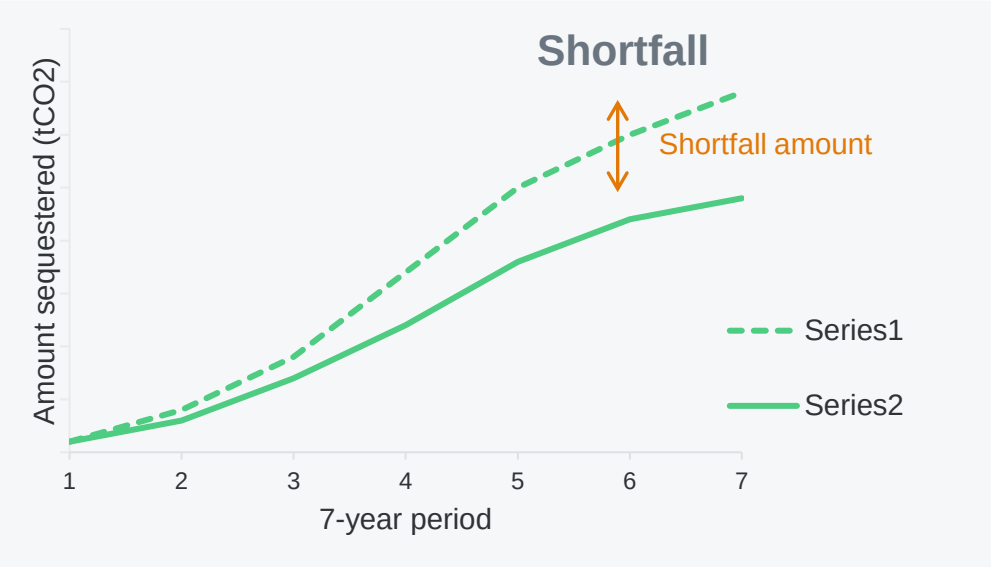
Natural risks

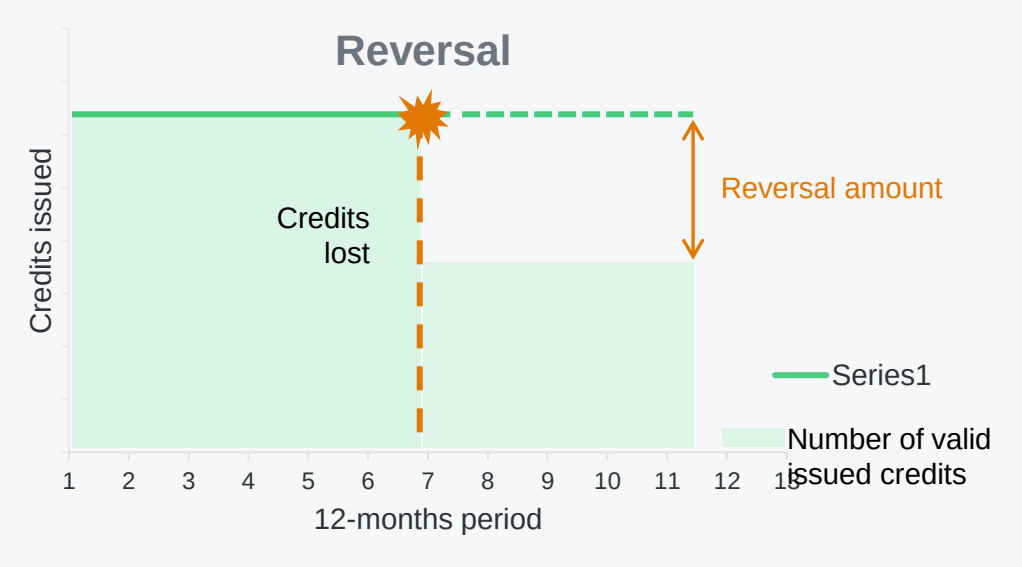
Engineering risks

Project management risk

Political risk

Regulatory risk



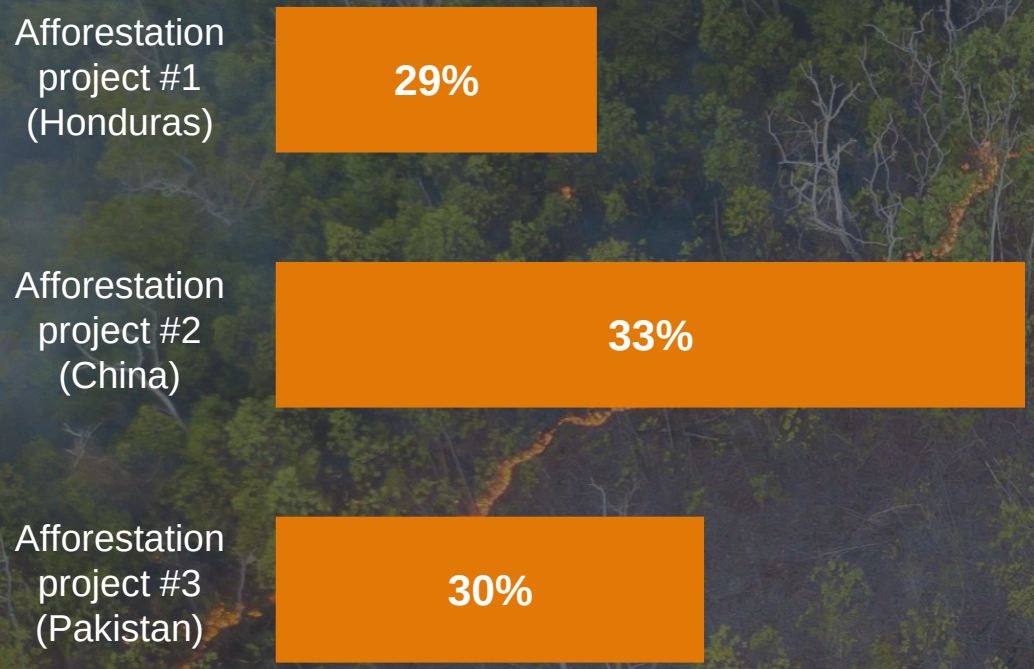


What we see: Even the best projects in a portfolio are at risk of under-deliveries and reversals

Pre-purchase due diligence can sort the good projects from the bad. **But that cannot stop a wildfire**.

CarbonPool actuarial results: 1 in 3 chance of under-delivery

% likelihood each year of shortfall above 10% loss



Case study: wildfires reverse all credits in Oregon project

Klamath East project area pre- and post-fire

May 2017 July 2023

From 2015-2021, the Klamath East IFM project in Oregon operated smoothly with no reports of major damage. In 2021, a large fire burned 40% of the project's total biomass and **destroyed all carbon credits the project generated—along with c. 20% of ACR's buffer pool**. Buyers from the project included Microsoft and BP.

Image source: Google Earth Pro

Insurance is vital in making carbon markets work

Corporates

Protection of net zero plan and multi-year investments into carbon removals as well as **protection against reputational and financial damage** due to future shortfalls

Carbon project developers

Improved sales and ability to attract capital for project development due to reliability of carbon delivery and quality provided by in-kind insurance addressing **key carbon removal buyer concern**

Asset managers

Large carbon credit investors require insurance coverage to **protect very real downside and to attract institutional capital** with limited risk appetite (e.g., pension funds)

Microsoft alone has already contracted over 25 million tCO_2e of carbon removals, including credits to be delivered in the future

Source: Allied Offsets and press releases

In-kind carbon insurance is the only solution which can ensure that net zero goals are met

A unique in-kind insurance model

Risk assessment based on due diligence, remote sensing and proprietary risk model…

… **build matched balance sheet** of high-quality carbon removals …

… and secure policyholders' **net zero carbon outcomes**

World's first in-kind carbon insurance company.
Set to be regulated by Swiss insurance regulatory authority FINMA.

Why pay out in carbon credits?

Insulates both parties from **price and liquidity risks**

Guaranteed payout in carbon credits is the **only way to ensure that policyholders meet their net zero goals**

By investing millions of capital into a pool of replacement credits, **we are scaling the carbon market with the policyholders**

Take-aways

#1 Insurance is vital in making carbon markets work

#2 By paying claims in-kind with carbon removal credits, we are paying out in the true currency of the carbon market, which is not cash, but carbon

Unique challenges from carbon credit insurance

Cash does not make climate good – a cash indemnification cannot be converted into carbon dioxide removals due to their acute and perennial scarcity and associated enormous price volatility.

Challenge #1

Modelling of the full carbon balance sheet, composed of carbon credits assets and carbon credits liabilities, and converting that into a fiat-currency equivalent for the purposes of taxation, valuation and solvency

Challenge #2

The 1-year horizon view, which is usually the focus of traditional insurance solvency, needs to be replaced with a **multi-period approach**[1], i.e., a view where risks are explicitly modelled across longer time periods

Challenge #3

Carbon as a balance sheet unit does not have the same time fungibility as fiat-currency units. As a result, **carbon liquidity across the term structure** becomes a critical element to model

(1) For an introduction to the multi-period approach, see, e.g., Albrecher & Dacorogna, 'Allocating Capital to Time: (…)', 2024.

Climate change in risk modelling

Climate change has a **direct impact on the outcome** of many of the projects currently generating carbon credits, with hazards such as, e.g., fire, flooding, and windstorms being driven by climate changes.

Guideline #1

It is important to **include climate change when modelling the risks** associated with CO_2e sequestration projects, including the associated trends across time.

Guideline #2

Given the world-wide positioning of the projects, CarbonPool is also pioneering **global internally consistent climate modelling** across the comprehensive balance sheet, as opposed to independent localized hazards.

Risks & opportunities from changes in regulations and policies

The carbon market is currently bifurcated into a largely unregulated voluntary carbon market and regulated compliance markets imposed by governments.

Increasing demand for carbon credits

As demand for carbon credits increases, both as corporates' net zero claims come due and as credits are integrated into compliance schemes, it is likely that the market will experience significant supply constraints.

Buyers should thus plan ahead to secure the supply they need to meet their net zero targets.

Integration into compliance schemes

It is our view that, in the coming years, we will see the integration of carbon removal credits into compliance markets and increasing regulation of the voluntary carbon market.

This is occurring, for example, with the EU's proposed Carbon Removal and Carbon Farming (CRCF) framework.

Carbon credit insurance and the economics of climate change

There are less than half a dozen MGAs and carriers that offer any capacity, and aside from the ongoing license application of CarbonPool, not a single one with a carbon balance sheet-based approach.

Need for carbon credit insurance

The limited offers in the market are all for specific investment sums insured against specific perils, primarily invalidation. For 2023, there was over $10bn spent on carbon projects that was completely uninsured, with that sum growing at 25% to 60% per year since 2016.

We anticipate carbon credit insurance to grow extremely fast to catch up to these large and rapidly growing investment levels.

Need for converging definitions

For insurance to play its most efficient role, it will require globally converging definitions of carbon credits, in order to get the full capital fungibility across the globe.

Optimizing on local only schemes will simply add cost.

The actuarial profession and future trends

Insurance helps manage risk and encourage investment.

Insurable risks

Our experience over the past 3 years is that risks in the fast-growing carbon credit world are largely insurable – they are measurable, accidental damage happens and the insurance cost is affordable.

Understandable risks

Many of these carbon credits are based on the natural world, and although we have no “claims” history, the scientific understanding of these risks is strong, and the impact of changing climate is foreseeable in the short insurable term.

Actuarial profession

As the actuarial profession adapts to using forward looking science-based models, it can help keep the insurance balance sheets robust and able to take on carbon risks.

Take-aways

#3 The carbon credit insurance industry is set for rapid growth as the urgency to address risks tied to net-zero commitments intensifies.

#4 Securing the resulting carbon balance sheets requires indemnification in carbon credits, not cash, and actuaries will play an important role in modelling the resulting carbon assets and carbon liabilities.

Beat Krauer (l.), CarbonPool's CUO, and Modou Thiam (r.), Head of ALLCOT Senegal, planting mangroves at ALLCOT's Senegal restoration project, Sep. 2024

Thank you for your participation

If you have questions or comments, you can contact me at pedro@carbonpool.earth

About CarbonPool: World-first carbon insurance company that pays policyholders' claims in carbon removal credits

Who we are

In-kind carbon insurer founded by former senior Allianz and AXA executives

Team includes top forestry, climate, and weather experts

Why we exist

To secure our clients' carbon investments and ensure they meet their net zero goals

What we do

Provide in-kind insurance against the largest risks facing carbon credit buyers, including credit under-deliveries and reversals