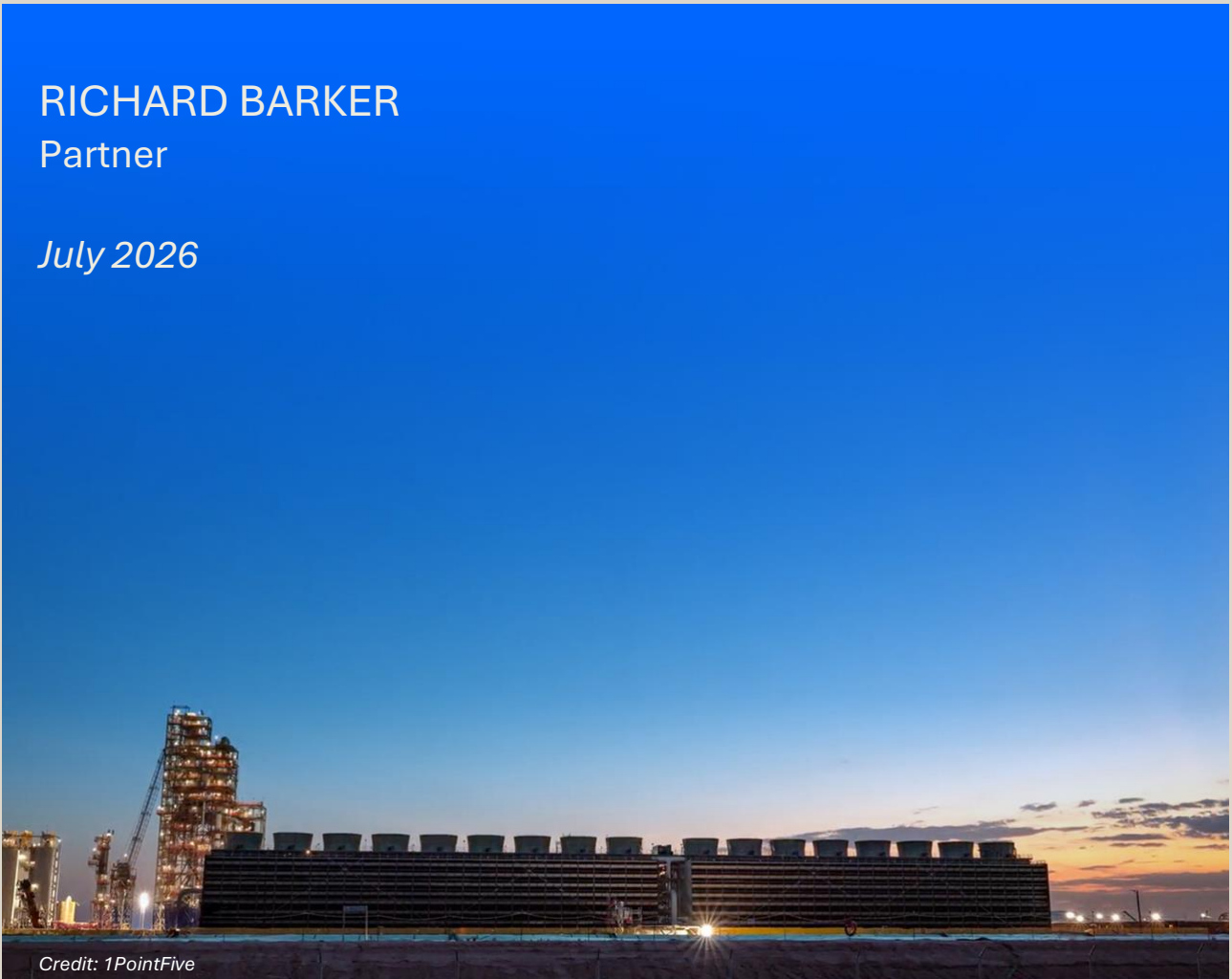


CARBON REMOVAL IS GRADUATING: IT IS THE NEXT MAJOR INSTITUTIONAL INVESTMENT OPPORTUNITY

*What the history of renewables tells us about the
investment case for carbon dioxide removal today*

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Credit: 1PointFive

01 Why is a future asset class hidden from view?

Anyone who works on the investment side of carbon dioxide removal (CDR), as I have for several years, can see a big investment opportunity in plain sight. It's so enormous that it's grown beyond the means of the sector's early investors, including the firm I co-lead, to realise.

Carbon removal is graduating. It has crossed a maturity threshold and now requires new classes of investors to fund and profit from its expansion.

The opportunity is unseen by almost all institutional investors. This is not because it's hidden but because carbon removal, unfortunately, tends to wrap even the smartest analysts in a fog. It's an extremely diverse and complex space. Even in an information-rich age there are few people who see the trendlines of a sector spanning earth systems, heavy industry, land use, carbon markets, state policy, and much in between.

There's another reason for low awareness: carbon removal as the category we know today did not exist even five years ago.

At no point in the past five years would I confidently say that carbon removal is a multi-billion-dollar investment opportunity for institutional investors. But it now is - for infrastructure, private equity, and other investor classes. Forces are coalescing from several directions to make the investment case for financing CDR's scale-up *and* seeing a superior return on investment. The factors include:

- **Long-term regulation-driven demand:** no matter what happens in any one market like the US, the trend globally is toward regulation, taxation and compliance-based systems that will incorporate carbon removal as a default mitigation option. This will propel demand in 2030-50. This month's guidance from the European Union is a case in point.
- **Shorter term voluntary demand:** although volumes are small relative to future projections, companies like Google and JPMorgan continue to voluntarily forward-buy carbon removal as part of their net zero planning and corporate risk management. This anchors demand over the next five years.
- **An uncorrelated investment profile:** returns from carbon removal will have a low correlation with other asset classes, in part because of the physical nature of CDR processes. Low correlation is attractive for asset allocators.
- **Internal diversification:** carbon removal is not one thing. It is a collection of very diverse technologies. Its internal diversification supports a portfolio approach that, in accordance with investment best practices, balances risk.
- **Technological maturity:** CDR technologies are increasingly out of the laboratory and proven in the field at pilot or early commercial scale. They are becoming technologically de-risked and primed for large-scale growth. This was not the case even two years ago.

In this paper I will make the case for carbon removal as an emerging institutional asset class. Although the discussion is useful for orientating corporates, project developers and financial intermediaries, the paper is focused on the opportunity for institutional investors.

I won't discuss the *non-financial benefits* of removing carbon dioxide pollution from the atmosphere, nor why this is such an important application of a range of modern technologies. The environmental and societal benefits of CDR motivate me and my colleagues at Counteract. It's time, however, to make a purely investment-based argument for CDR. Scaling it will be an enormous infrastructural effort. That will require large-scale capital - which is attracted to returns on investment rather than appeals to do the right thing.

“It's time to make a purely investment-based argument for CDR.”

The low correlation of carbon removal with other asset classes

Investors should note, first, that carbon removal shows unmistakable signs of being a new and strongly uncorrelated asset class when compared to asset classes such as global equities or traditional listed infrastructure.

This matters because asset allocators analyse the correlation between asset classes to identify investments that move independently of one another. This enables them to build portfolios that reduce volatility without sacrificing expected returns - the basis of modern portfolio theory.

CDR's correlation is shown in the data table below. The data are indicative, not empirical, since there is no 10-year return profile for CDR as a traded asset class. It is based on our own structural analysis of what drives volatility in CDR projects: long-term offtakes, carbon pricing, input cost dynamics and infra-style physical risk and structuring.

- Listed real estate moves closely with global equities with a correlation of 0.73.
- Non-agricultural commodities like oil and gas partially track global equities with a correlation of 0.40.
- Carbon removal stands apart for having the lowest or near-lowest correlation to every other asset class other than carbon credits (to which it is linked). It resembles some types of agriculture commodities: always needed regardless of prevailing market conditions, even if it follows its own supply and demand dynamics.

Correlation matrix: major asset classes including CDR

Approx 2014-2024 monthly returns

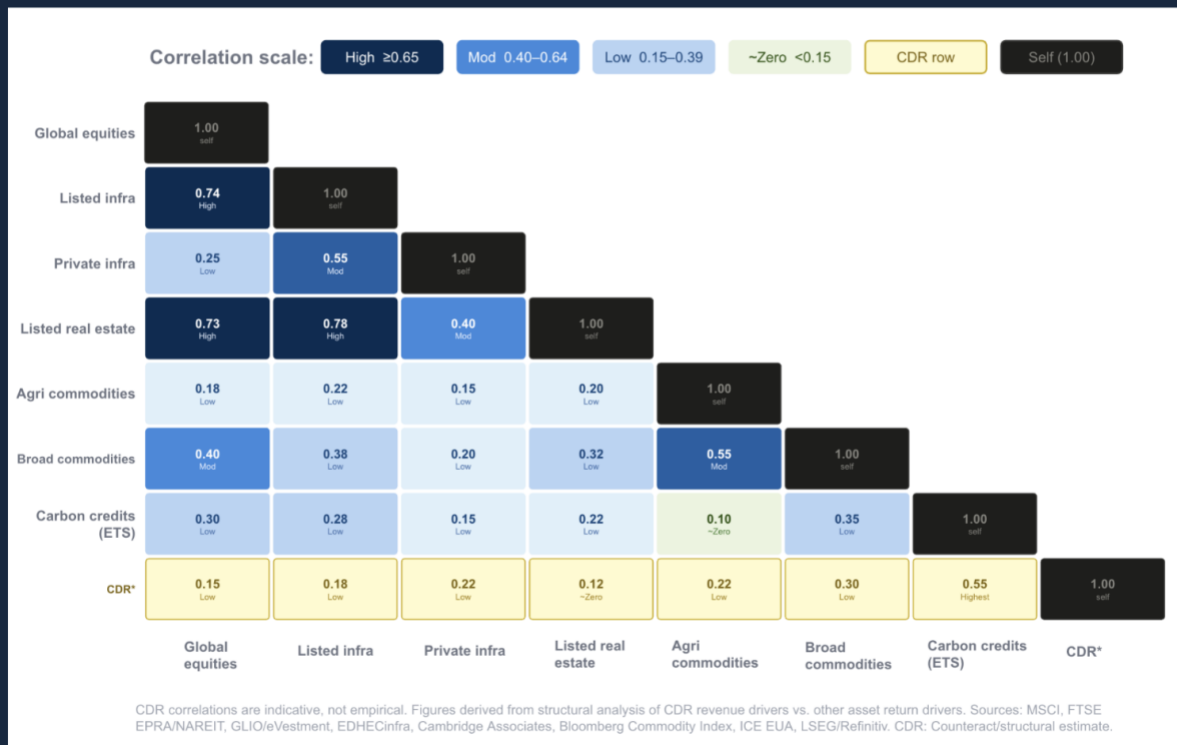


Figure 1. CDR has notably low correlation with other, more established asset classes. **Source:** Counteract research combining in-house data with external sources including MSCI, Cambridge Associates, Bloomberg Commodity index.

If low correlation is partly a result of permanent demand, then regulation is likely to firm this trend. As laws mandate CDR purchases by the 2030s, carbon removal credits and products will be more in demand no matter the macroeconomic situation.

Regulatory convergence, rising demand, and limited supply

This month the European Commission confirmed that it will integrate millions of carbon removal credits in its Emissions Trading System (ETS) in the 2030s starting with direct air capture (DAC) and biomass-based carbon capture and storage. This is a watershed moment for a market that has long expected regulation to drive demand – and the EU to lead among global regulators.

The EU, however, is just one of many jurisdictions moving towards compliance-based carbon markets that seek to integrate carbon removal credits.

- The state of California has announced plans to add CDR to its ETS by 2030.
- Japan's GX-ETS, which recently entered its mandatory phase, favours CDR over other credit types.

- The UK plans to integrate CDR (which it calls Greenhouse Gas Removals or GGR) in its ETS by 2030. “We are aiming to integrate GGRs in the UK ETS as soon as practicable to provide a long-term demand signal for removals,” according to this month’s statements from the Department for Energy Security and Net Zero.
- CORSIA, the offsetting scheme for the airline industry, will enter its mandatory phase in 2027. Demand has been accelerating this year. Select types of removals credits are allowed and traded in the scheme.

Countries and whole industries (e.g. CORSIA) are moving at different speeds toward carbon-market-based mechanisms to reach net zero. They are working through timelines and technicalities of how, not if, they integrate CDR in these mechanisms. Many governments prefer carbon *removal* to carbon *reduction* credits, because one removes legacy emissions and the other simply reduces the rate of their increase.

CDR’s integration with emissions trading and pricing schemes globally

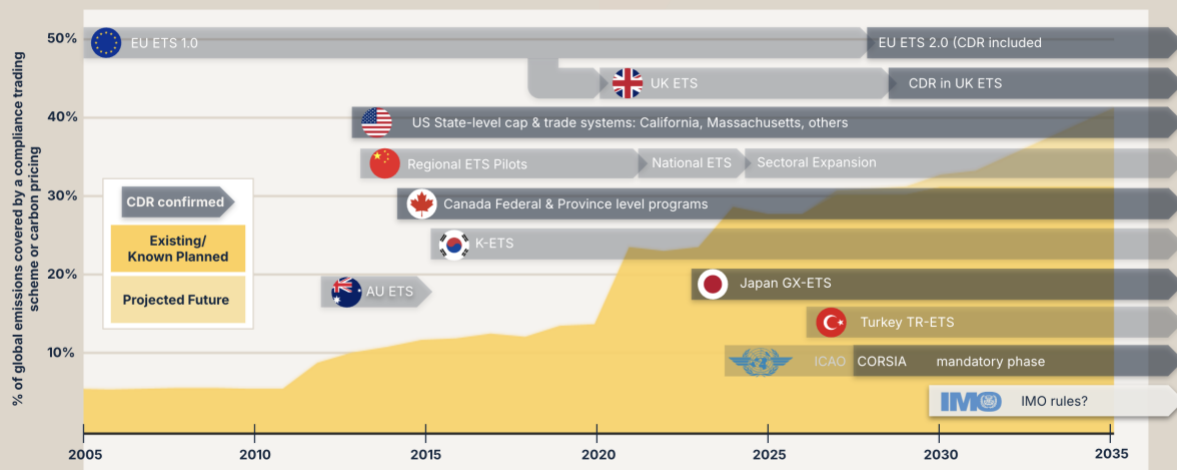


Figure 2. Carbon pricing and carbon emissions trading schemes will cover over 30% of global emissions by 2030. These schemes have increased since 2015 and are now moving from voluntary to mandatory, supporting demand for CDR credits which are a preferred, premium offsetting category. **Source:** World Bank State and Trends of Carbon Pricing Dashboard, Counteract analysis

Voluntary offsetting frameworks will push demand higher. In its recently updated corporate net zero standard the Science Based Targets Initiative (SBTi), the largest climate action framework for corporates, now recognises a place for carbon removal in corporate climate strategies. It will require CDR credit purchases to address unabated, ongoing emissions from 2035.

As demand continues to build, CDR’s supply gap will become increasingly clear. Carbon removal is underdeveloped relative to future needs, as the latest [State of Carbon Dioxide Removal report](#) shows graphically. Many of the most promising CDR approaches – those that are the most verifiable and likely to store CO₂ for 1,000+ years – are also the least developed today. These approaches will create opportunities for investors.

No returns without risks

Though promising, investing in carbon removal carries risks. The correlation data above is compelling but not complete. Global regulation is moving in the right direction, but its future direction (and timing) cannot be precisely predicted in an age of turbulence.

We are looking at solid data points, in other words, but we must factor in the risk at the project level or the sector level. It reminds me of the outlook for wind, solar, biomethane, and other renewable energy investments in the early 2000s. I've spent most of my career across both spaces. The similarities between renewables 20 years ago and CDR today gives me even more confidence in the investment case for CDR in the near future.

02 What 20 years of investments in renewables tell us about carbon dioxide removal

There's a point in any emerging sector when pressure for capital replaces pressure for further technology development. Technologies continue to improve and sometimes show flaws that require attention. But they are generally investable and can be built out in "commercial" projects. AI in the years leading up to the release of ChatGPT is a good example.

Wind and solar energy technology began to cross this threshold around 2005. The scale at which solar farms are now built in China was unimaginable then. Costs were high, engineering and infrastructural connectivity issues were complex, regulatory support was encouraging but uncertain, and established energy technologies were cheaper and much more reliable.

Still, investors betting on the transition knew that *technologically* the PV-based solar energy systems of the day were sound enough to scale with sufficient capital and that *specific* investment opportunities existed to justify mobilising capital. These investors moved during a period of high complexity, high risk, but high returns on investment: the hard-but-rewarding phase that now defines the CDR opportunity.

“Investors moved during a period of high complexity, high risk, but high returns on investment: the hard-but-rewarding phase that now defines the CDR opportunity.”

The graph below shows how early-stage renewables investors such as Brookfield Renewable Partners, Foresight Group, and Macquarie captured absolute project returns of 12-18% and began establishing renewable-energy investment franchises. These yields are now unavailable in wind and solar precisely because the fields have matured.

Wind & solar: target unlevered project returns 2005-2020

Shaded bands = interpolated uncertainty range
Markers = anchored source data points

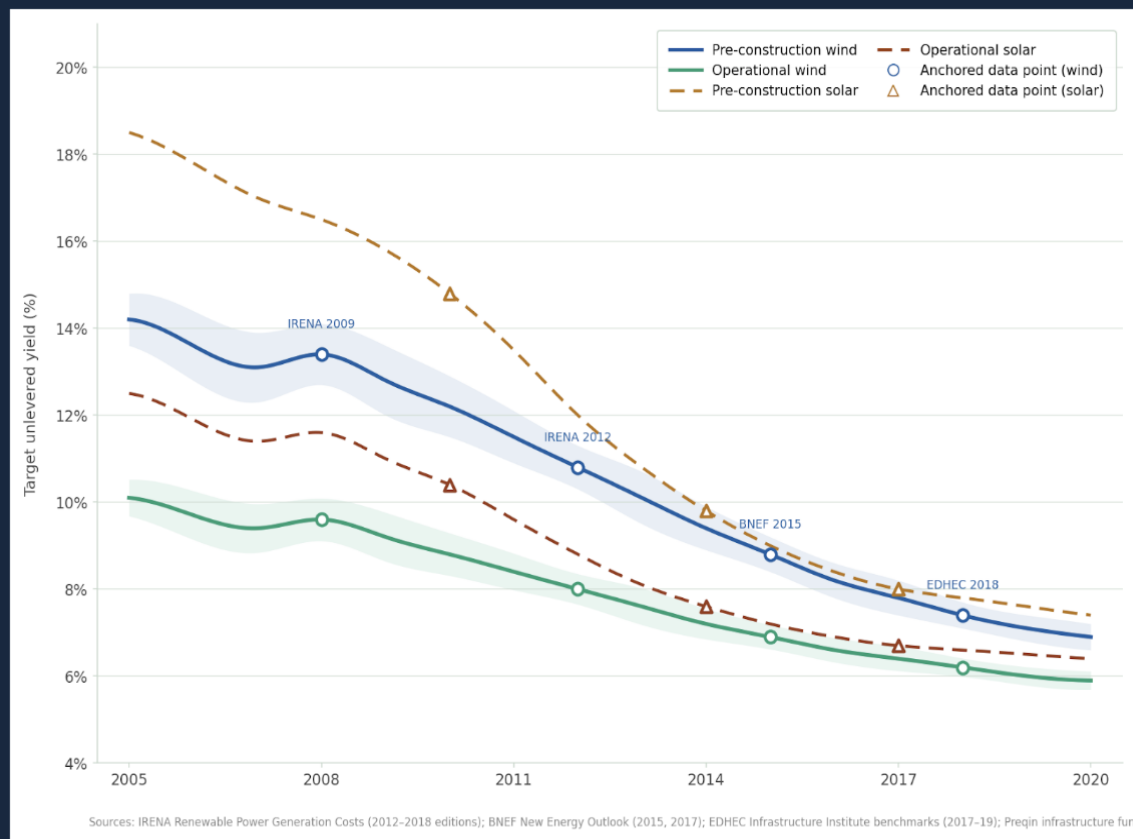


Figure 3. Market returns for solar and wind projects compressed over 15 years for both pre-construction investments and operational investments. **Source:** IRENA, EDHEC, BNEF, Prequin, others.

Investors in early *operational* solar and wind projects could expect circa 10-13% unlevered project returns, though these returns compressed to around 6% by 2020. Those willing to take on more risk and invest in the *pre-construction* stage saw higher early returns: over 18% for pre-construction solar projects in 2005.

The construction risk premium was around 350-450 basis points in 2005-2008 for a wind project (See Figure 4). It was often higher for solar projects.

CDR construction risk premia today are, by our estimations, similar to wind and solar construction risk premia circa 2005. Pre-construction assets across the CDR spectrum command a 300-600bps premium over operational CDR assets. This premium will compress as more projects are built, track records solidify, lender familiarity grows, and measurement and verification frameworks continue to improve.

Wind & solar construction risk premium: Yield spread 2005-2020

Bars = wind spread with uncertainty range. Dashed line = solar spread central trend.
Markers = anchored source data

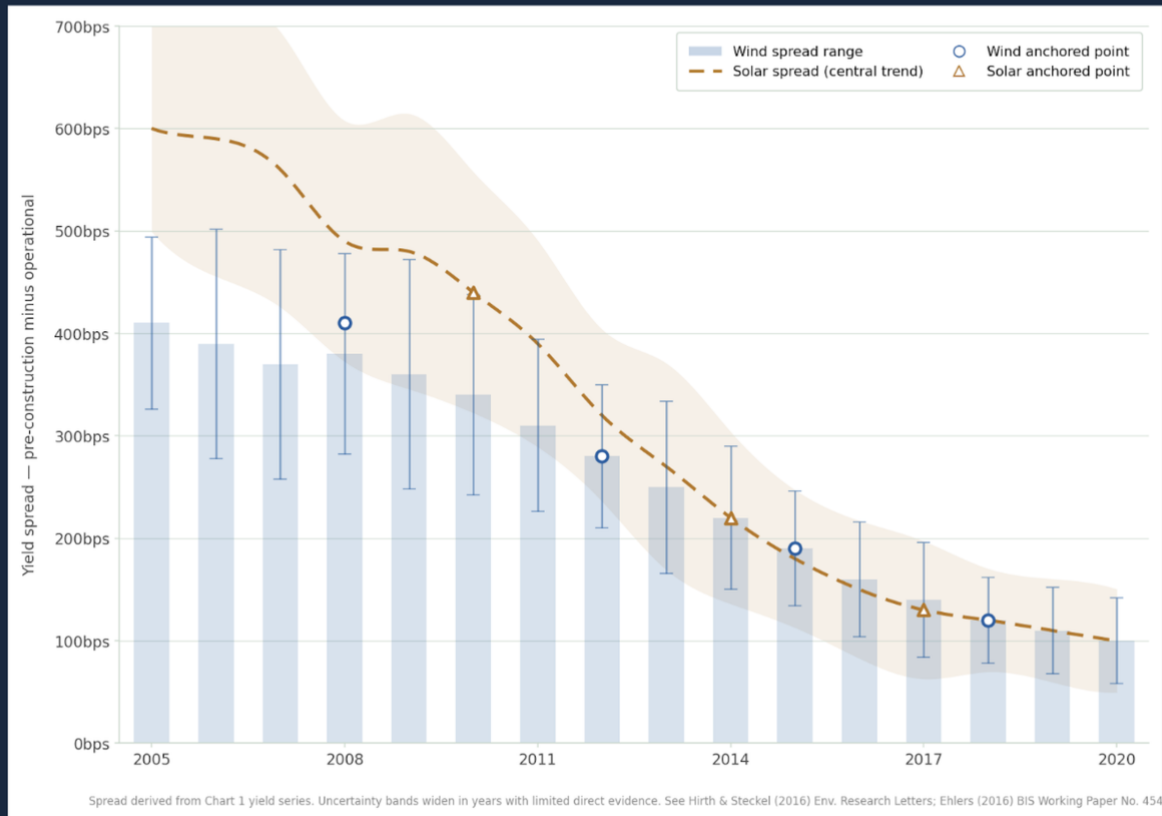


Figure 4. Even when accounting for uncertainty ranges, yields in wind and solar projects clearly trended downward in the decade after 2005. **Source:** Hirsch & Steckel, Ehlers, others.

This suggests that investors in CDR today can expect a similar *double return* that early renewables investors enjoyed: a high absolute yield, plus portfolio upside from yield curve compression as the assets re-rate. It's not often that opportunities like this arise for time-limited early entry and long-term returns.

“Investors can expect a similar double return that early renewables investors enjoyed: a high absolute yield, plus portfolio upside from yield curve compression as the assets re-rate.”

Is CDR so similar?

The question is then how close an analogy we can draw between the renewables landscape in 2005, the CDR landscape today, and the window of opportunity.

Global renewables investment, 2000-2025

Wind, solar, other renewables

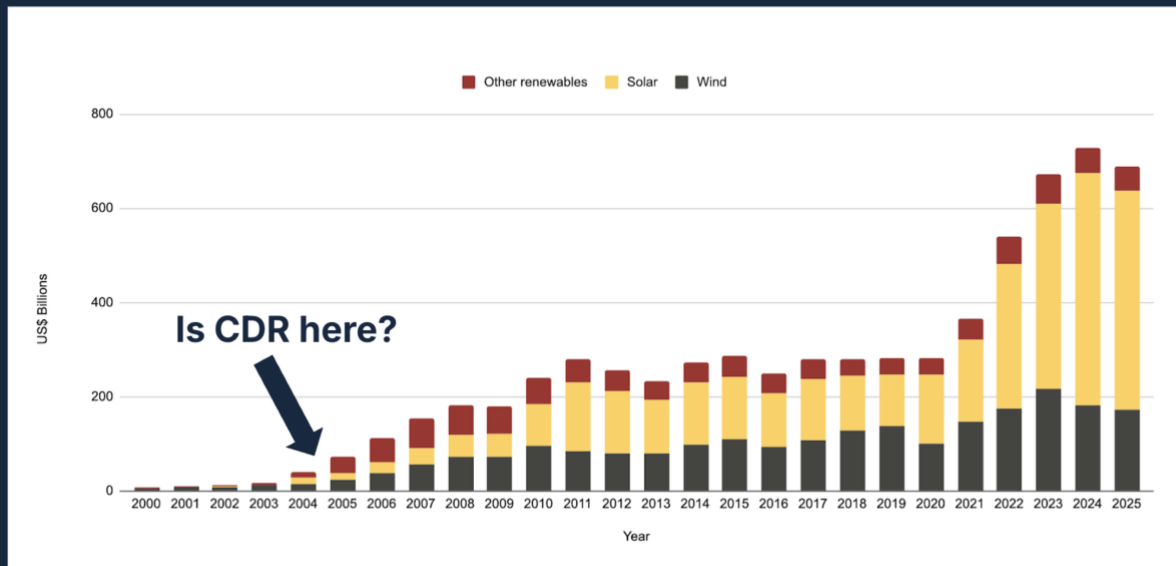


Figure 5. Early movers in renewables circa 2005 built their franchises ahead of successive waves of later investors who encountered a sector with lower risks but also lower returns. **Source:** Counteract.

The comparison is fitting when we consider how *unlike* wind and solar projects were in 2005 (and even now), yet how investor returns followed a similar trajectory. Indeed their trajectory represented similar trends, albeit with different features, across a larger, more diverse renewables sector.

As investable asset classes, renewable energy and carbon removal are both incredibly diverse. The components of these “asset classes” are so different that they are in fact different industries. But they are a class nonetheless, because the components share important attributes. Carbon removal methods share the same goal — removing tonnes of CO₂ — even if they have little else in common. Wind, solar, geothermal and hydroelectric align only by generating non-fossil-based energy.

Despite its internal differences CDR now, like renewable energy then, shares important *commercial* commonalities. Companies across the asset class show that they:

- are crossing thresholds of technological readiness
- need large allocations of capital to scale and lower unit costs
- can tap expertise in adjacent industries (oil and gas, engineering, manufacturing, and finance) to accelerate the scaleup
- offer integration benefits for corporates

Comparing one asset class to another, CDR stands out for being *even more diverse* than renewable energy. To put this in perspective, consider how a large infrastructure investment could manifest across different, real-life carbon removal methods:

- **Biochar:** building large-scale pyrolysis plants, securing biomass feedstock sources, and securing access to adjacent farmland and forestry in South Asia.
- **Enhanced rock weathering:** establishing farmer co-operatives to apply minerals to farmland and monitoring carbon and agricultural yields in Brazil.
- **Direct air capture:** Building 10 DAC machines, each the size of a large house, with aggregate capacity to suck 10,000 tonnes of atmospheric CO₂ out of the air per year.
- **Wastewater alkalinity enhancement:** Mixing reactive minerals in 100 wastewater treatment plants across the US and measuring the impact on water purity and carbon removal.
- **Afforestation:** planting and monitoring the growth of mangrove forests along 50km of threatened coastline.
- **BECCS:** repurposing a coal-fired power plant to run on renewable biomass and capture and store the CO₂ emitted

What does such diversity “do” for investors? It provides options, and it creates an internal hedge by allowing for more than one winning bet.

Early renewables investors (I was one) had to look at a broad and largely unformed space to determine where they wanted to invest: geographically, sectorally, and at different levels of risk and tech-readiness. In many cases they didn’t know at first. They developed portfolios around multiple early-stage renewables projects and over time decided where to focus future efforts.

The point is: there were more options than wind or solar to fit a “renewables investment” thesis. Far more, each with their own attributes. High IRRs were achieved in select renewables investments *beyond* wind and solar. The investors who eventually realised high returns had leaned into the sector’s diversity in its early stages and studied where they wanted to enter. The more they learnt, the better able they were to build franchises with above-market performance.

Counteract entered CDR at its embryonic stage in 2020 with this theory of first-mover advantage in mind. Five years later, our first fund has performed well in seed-stage venture capital terms. The sector is now primed for larger-scale institutional capital to be first movers in CDR’s scale-up phase.

“Diversity provides options, and it creates an internal hedge by allowing for more than one winning bet.”

03 More diversity, more risk?

Diversity in an emerging asset class, then, means more risk and more opportunity. We have experienced this at Counteract: the risks of betting on individual companies or pathways that fail to deliver; also the portfolio-theory evidence of multiple investments moving in the direction of superior returns.

How does diversity — or put another way, the options for diversification — show up in carbon removal? For once it's not an exaggeration to say it boggles the mind. It is multidimensional and needs some visual aids to comprehend.

The excellent chart below, from the third edition of *The State of Carbon Dioxide Removal*, illustrates 16 CDR methods. Each varies by **technological readiness**, **duration** of removal (100 to 10,000+ years), **capture process** (geochemical or biological), and **newness**: “novel” CDR methods like direct air capture get media attention, but most CDR still happens through “conventional” methods like forestry.

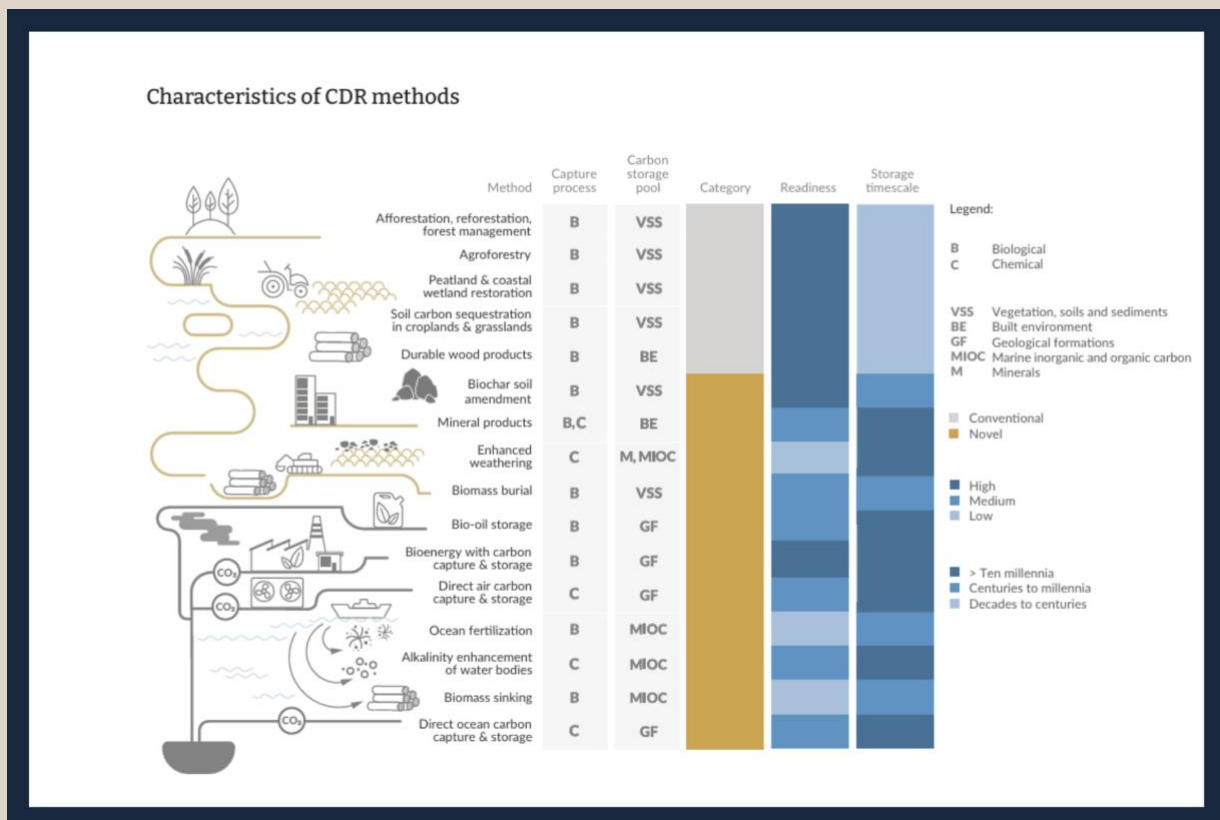


Figure 6. CDR methods, also called “pathways,” are extremely diverse in terms of capture process and technological readiness. **Source:** *The State of Carbon Dioxide*, Third Edition (June 2026).

These classifications are just the beginning. We use other filters for assessing opportunities in the space:

- **Core economic drivers:** how the rate of sequestering carbon, which follows scientific fundamentals, together with the project's capex and opex profile drives the project's financial profile. (Our team built a tool to map this – available on web.)
- **Scale:** the different sizes or stages of projects and how that affects the appropriate financing instruments and structures.
- **Operational risk and revenue certainty:** the trade-offs in accepting higher risk but potentially higher returns for projects (or entire methods) that are less technologically ready (TRL) or have less-developed Measurement, Reporting, and Verification (MRV) protocols.
- **Strategic value-adds and revenue-stacking:** Assessing the relative value of multiple revenue streams. Carbon credit revenue is just one potential source of value. Biochar, for example, captures atmospheric CO₂ in a stable form (underpinning high-value carbon credits) but can also fertilise nutrient-poor farmland and strengthen building materials. Stacking the revenue potential of benefits and “co-benefits” is one of the most important investment considerations.

The landscape is complex. Navigating it requires learning — or a knowledgeable guide.

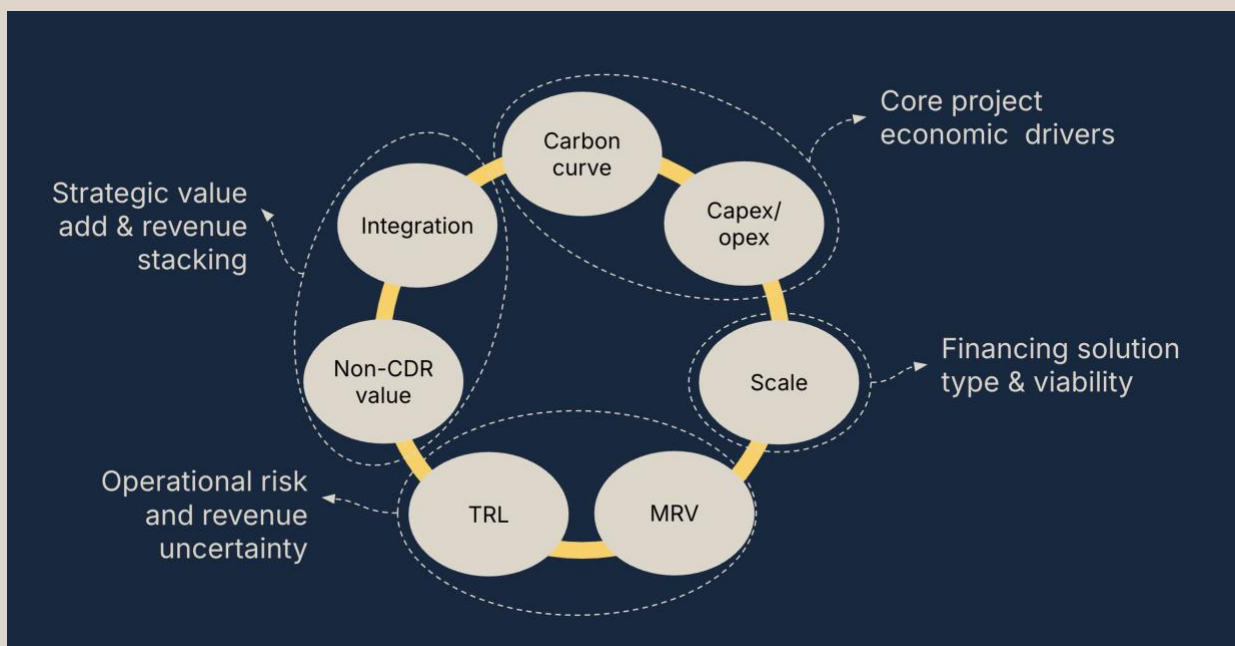


Figure 7. Investment filters for CDR projects beyond their geophysical method and capture process. **Source:** Counteract.

Less risky than meets the eye: select projects are derisked by corporate offtakes

While risk increases with diversity and complexity in any emerging sector, some of the best carbon removal projects are *financially derisked* — for now — in a way that few outside investors appreciate. Offtake deals are a key reason.

Buyers like Microsoft, Google, Airbus and the blue-chip consortium behind Frontier have signed long-term, high-priced, ambitious supply deals with carbon removal developers across the 16 methods illustrated above.

These buyers are motivated to meet their net zero targets with the help of carbon removal. But that is just the floor of their commitment. They want to be sector architects, creating the enabling infrastructure for CDR (and climate mitigation) in the way that they created whole platforms or industries and thus earned their place in the Fortune 500.

The often-explicit aim of these offtakes is to make CDR “bankable.” Companies want to send a message to investors that long-term demand is secure if capacity is built out.

As much as there is handwringing about too few buyers dominating the CDR market, the size of these offtake deals is a crucial structural support. It is roughly equivalent to dozens of big corporations stepping up in the early days of the solar industry, signing future power-purchase agreements representing 25x the installed capacity of solar energy at the time, and collectively saying: “We’ll buy this from you if you can build it for us.”

“These prices prop up rates of return over the short to medium term, underpinning 12-18% IRRs.”

Rigorously diligenced, these deals can act as a proxy for quality for new investors. Corporate buying teams, often aided by scientists at organisations like Carbon Direct, have selected the very top tier of developers and projects across the ecosystem.

The best part for investors today, though, relates to contracted pricing levels and their impact on project IRR. Corporate offtakers have committed to prices in the voluntary market that are *significantly higher* than the projected long-run prices in future, compliance-based markets: \$500 per tonne today versus a long-run estimated price of \$100-150 per tonne, for example.

These prices prop up rates of return over the short to medium term, underpinning 12-18% IRRs in projects we have modelled. They are temporary and artificial, reflecting visionary early buyers who can afford to pay a premium. Costs and prices will inevitably descend their curves as these early investments catalyse increased efficiency, scale economics, and expanded supply — especially as governments mandate carbon removal buying.

The window of opportunity is narrow. Investors willing to finance projects with secure offtake contracts signed between 2024-2028 will, most likely, lock in the highest IRRs for the next decade.

“Investors willing to finance projects with secure offtake contracts signed between 2024-28 will most likely lock in the highest IRRs for the next decade.”

05 Conclusion: invest today or wait and see?

Carbon removal is emerging as the next major institutional investment opportunity. It is a long-term investment theme with a short-term opening for high returns. If Counteract had several hundred million dollars to invest into 10-20 CDR projects (like Frontier, which recently announced a \$915m advance market commitment with the backing of Anthropic), we would. But CDR is our comfort zone.

Should an institutional investor just wait and see how the space shakes out?

They could, though they would risk missing high IRRs that are undiscovered only because the space is uncomfortably complex. They would also lose out on less tangible benefits: strategic positioning, knowledge, and preferential deal access that come from entering an emerging market early.

The tradeoffs are outlined below:

EARLY-MOVER OPPORTUNITY	WAITING UNTIL 2030+
• Exceptional ROIs from selected opportunities at pre-construction & early-operational stages. • Proprietary deal flow from relationships built during formative years. • Knowledge about CDR’s method-specific technology sets, monitoring tools, risks, and offtake opportunities – knowledge that becomes real expertise • Optionality over future CDR offtake supply and financing. • Franchise value as an established sector specialist.	• Lower project returns as asset class matures. • Competition from generalist funds becoming comfortable with CDR. • Limited proprietary deal flow: many relationships between developers and financiers already established. • Starting with no accumulated track record in managing risk. • Limited optionality on CDR offtakes and financing upside.

Who should invest?

The following investor types should not wait until the 2030s:

- **Private equity:** specialists in energy, manufacturing, infrastructure or other sectors that have hard assets and are influenced by policy.
- **Infrastructure:** Infra funds comfortable with the “Value-Add” and “Opportunistic” end of the spectrum – and interested in ticket sizes of \$20m+.
- **State-backed energy or strategic assets funds:** funds that seek sector-leading IRRs but also have long-term mandates to drive decarbonisation or help meet net zero targets.
- **Development finance:** funds focused on the Global South and interested in projects that deliver Sustainable Development Goals *alongside* good returns.

Though not targeted in this investment thesis, we do believe that there are niche investment opportunities in CDR for three further groups:

- **Banks:** bank finance has a role, but it will only work in niche CDR projects where asset-style finance is viable. Banks are relevant as part of blended financing solutions that include the financial institutions named above.
- **Industrial companies:** The financial and strategic benefits of integrating CDR with existing industrial operations - for example by acquiring IP from startups and building it out - is very compelling (see Counteract blog). But there are different IRR considerations and a different fact set for industrial-corporate investors.
- **Venture capital:** VC still has a role to play in building early-stage CDR companies. But like a parent watching children grow, we can see that CDR’s best opportunities are graduating beyond VC ticket sizes.

Where and how to invest?

Picking projects and structuring investments to suit those projects is a prerequisite for realising the early-mover advantage. This is not easy to do. It requires expertise and knowledge across a space even more diverse than renewable energy. Institutions need to either build this capability by assigning investment managers and analysts to the area – or buy it in.

Of the few generalisations we can make about how to invest, the most important one is: **take a portfolio approach**, even if it’s a small and targeted portfolio of just a few investments. Do not restrict yourself to one project just because it seemingly reduces complexity or aligns with your investment area. There are too many project-specific risks at this stage of the cycle.

Portfolio investing spreads the risks, drives knowledge, and increases the upside not only in theory but in practice with CDR. Spectacular opportunities emerge from pathways of carbon removal that you might dismiss in your first analysis.

“Institutional investors in carbon removal need guides.”

An evolving role for Counteract

Institutional investors in carbon removal need guides. We believe that Counteract is one of the best qualified guides, even if my three partners and I are still considering how best to structure relationships with institutional capital. We have looked at over 1,000 companies and invested in 27 carbon removal-related companies to date.

Our thinking about a new partnership structure comes from a conviction that the opportunity is better than ever, though capital structures need to evolve to realise it. As carbon removal matures, we can see the opportunities that are likely to perform better than others. Not only that: these opportunities need capital allocation now for market-beating returns to materialise later.

We are planning to create, along with like-minded investment partners, a vehicle that will finance a portfolio of select CDR projects. It will balance manageable risk with strong returns and the optionality upside of being an early mover.

As part of our broader mission to achieve catalytic impact for carbon removal, we also want to share our experience with investors who can help grow CDR. We welcome the chance to talk to institutions interested in exploring the opportunity.

One final thought

Carbon removal’s ultimate benefit is, of course, not financial. Removing excess carbon dioxide from the atmosphere helps make the planet more liveable. This is the reason CDR has a place in every climate mitigation model through 2050. I could discuss how financial returns are a “co-benefit” of successfully scaling CDR. But this is a separate narrative and one that has been argued convincingly by others.

About Counteract

Founded in 2020, Counteract was the first dedicated carbon removal investment company. Its mission is to catalyse the development of 5 billion tonnes of carbon removal by 2050.

To date the team has diligenced over 1,000 early-stage companies and made 27 investments at pre-seed, seed, and series A stages.

Counteract One, its first fund, is now nearing full deployment. The fund has consistently tracked strong above-average returns (both IRR and TVPI) compared to recent VC capital performance benchmarks (Carta).

The firm was founded by Andrew Shebbeare, Matt Isaacs, Andy Bonsall, and Richard Barker: a multidisciplinary team of entrepreneurs with technical, commercial, and financial backgrounds. The partners focus on specific areas of a CDR ecosystem spanning “engineered” carbon removal, “nature-based” carbon removal, and many areas in between. This has allowed depth and rigour in a Counteract One portfolio that is purposely diverse by method and geography — reflecting the opportunities in the CDR market as a whole.

Counteract is networked with off-takers, policymakers and other investors in CDR. It has also developed partnerships with academia, research groups, and advocacy groups internationally. This, together with its own focused research, puts Counteract at the epicentre of the emerging CDR ecosystem.

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