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Six roadblocks to net zero — and how to get around them

Overcoming these obstacles in carbon markets can speed up decarbonization.

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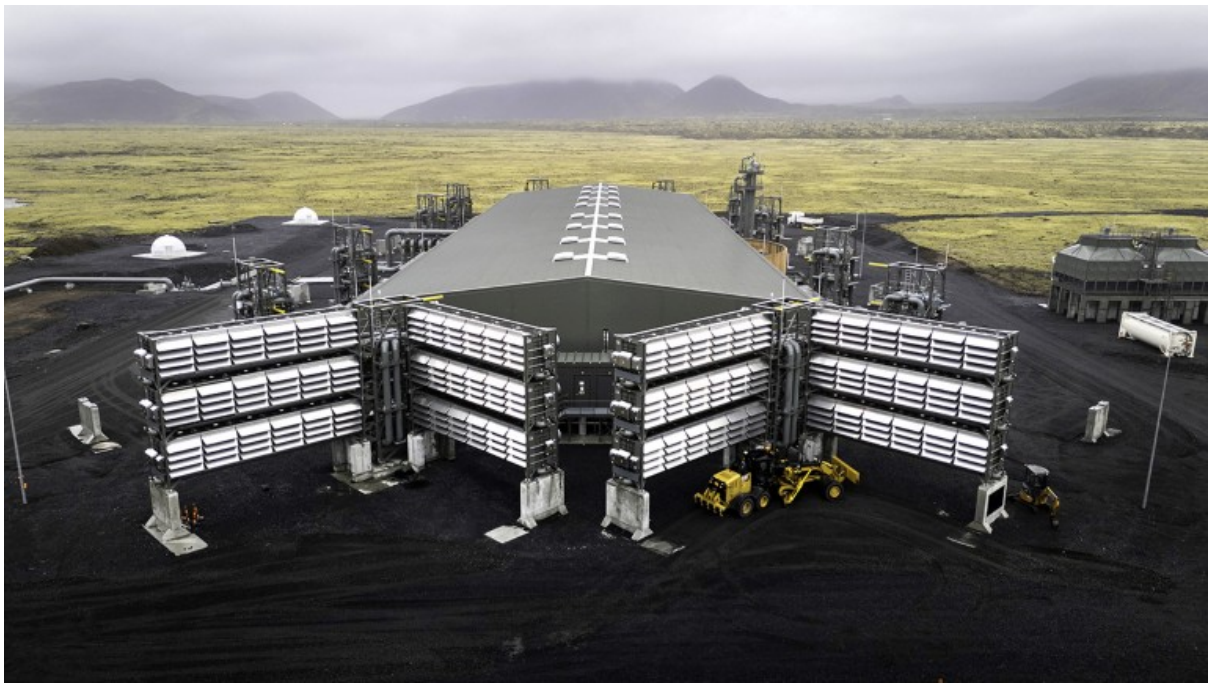

The Mammoth carbon-removal plant near Reykjavik uses geothermal energy to extract carbon dioxide from the air and store it in bedrock. Credit: John Moore/ Getty

Net zero. This simple accounting term represents humanity's greatest challenge — and opportunity — to stabilize Earth's climate. The goal, timeline and metric for success seem clear: by 2050, each tonne of carbon emitted must be matched by a tonne removed. But achieving this is easier said than done.

Since the dawn of the Industrial Revolution, the world has built up more than 250 years of momentum in a carbon-emitting economic and technological paradigm. Now, under the terms of the 2015 Paris climate agreement, it has just 25 years — or a few business cycles — to replace the carbon-dependent parts with net-zero components.

Will AI accelerate or delay the race to net-zero emissions?

The journey requires unprecedented coordination, innovation, investment and speed to avoid the catastrophic consequences of failure — including increasingly severe natural disasters, from rapidly rising sea levels and floods to heatwaves and wildfires. We, the authors, understand the potential and pitfalls, having spent more than 20 years between us developing the strategies, programmes, products and policies that achieving net zero demands.

We have deployed and influenced more than US$1 billion in investments and purchases related to carbon reduction and removal, and have been on the front lines of driving large-scale voluntary decarbonization in the corporate sector. Previously, we served as principal architects of Microsoft's carbon-negative commitment. Now, one of us (E.W.) is a net-zero strategy consultant, and the other (L.J.) is a private-equity executive working to deliver a net-zero investment portfolio.

Although we have a deep conviction that net zero can work, we know it has issues. A premature desire for perfection, overly precise guidelines for implementation, insufficient flexibility in carbon accounting, unhelpful constraints on collaboration and a disproportionate focus on the actions of others all combine to slow down the net-zero transformation just when it needs to speed up. Here, we describe the barriers and suggest ways to overcome them.

Obstacles to market growth

For net zero to work, the world must design markets in which every product or service, everywhere, prices in the cost of removing carbon dioxide and other greenhouse gases from the atmosphere or replacing them with an alternative that emits little or no carbon. Regulation will play a crucial part. But adoption at scale will happen only when removals and low-carbon alternatives are cheaper in price, superior in performance, or both, relative to higher carbon incumbents.

Reduction and removal technologies are still in their infancy. Sustainable aviation fuel, green hydrogen and steel, low-carbon concrete and technologies that capture CO2 from the air are expected to be part of a future net-zero economy. But today, they are too scarce and expensive to enable stakeholders to build anything more than theoretical plans around them.

Long-term cost-efficiencies and supply will emerge only through large investments in a host of approaches, allowing the markets to determine winners and losers. This was a clear lesson from decades of advances in solar and wind energy, whichultimately saw the costs of these renewables plummet by more than 70%.

To meet net-zero goals, global investments in the clean-energy and carbon-removal sectors, and their supporting infrastructure, must exceed $4 trillion annually by 20301. But we are concerned that current carbon-market expectations are inadvertently making it harder — not easier — to deploy the climate capital needed to build robust carbon markets.

Despite widespread agreement on the need for net zero, few binding requirements compel individuals or organizations to act in support of climate goals. This creates a carbon catch-22: governments are hesitant to impose regulations without clear price signals from markets, while markets struggle to deliver price clarity without regulatory guidance.

As a result, achieving net zero globally must rely heavily on early movers — organizations that pursue net-zero outcomes voluntarily. But, so far, there are too few of these, and they aren't moving quickly enough. In part, that is because the net-zero landscape is dominated by prescriptive rules that are difficult to implement, often creating confusion instead of clarity.

These roadblocks must be removed. Here we identify six remedies.

Pursue progress over perfection

Organizations need flexibility if they are going to commit to innovation. For example, in the early days of renewable energy, corporate buyers purchased renewable energy credits to meet their 100% renewable electricity goals that would not meet quality standards today. But they got the ball rolling: buyers invested,

learnt and iterated. Procurement of ‘unbundled’ renewable-energy certificates was replaced by more sophisticated ways of buying and selling energy, such as through contracts to match hourly energy consumption.

A carbon-transport ship in Norway takes waste carbon dioxide from industrial processes to a storage facility near Bergen.Credit: Carina Johansen/Bloomberg via Getty

Similarly, today’s corporate leaders are advancing energy projects on a voluntary basis, from nuclear to geothermal. Their energy prices are high now, but will come down if buyers and suppliers are given room to improve the technologies. In other words, setting an ambitious but achievable goal and sticking with it, while continuously improving its execution, should be a core principle for reaching net zero.

Yet, rigid and complex standards introduced too soon are discouraging companies from innovating. For example, last year, the Science Based Target Initiative (SBTi) removed nearly 240 companies — representing more than $4 trillion in market capitalization — from its Corporate Net Zero Standard, because of their inability to meet its stringent criteria[2]. This highly publicized action led to frustration from the affected companies, some of which stated they were unaware that the deadline for meeting these criteria was approaching.

Delisting or penalizing companies for ‘missing’ arbitrary net-zero milestones should be avoided. SBTi’s working groups should recommend that flexibility and iteration

are core pillars of its forthcoming revision to the Corporate Net Zero Standard (see go.nature.com/428ukzq).

Prioritize direct over indirect emissions

The Greenhouse Gas Protocol, a partnership between businesses, governments and other organizations that has set global standards for measuring emissions, has established three 'scopes' for voluntary reporting of emissions by corporations. Scope 1 includes an organization's direct emissions (such as those from a steel producer's coal-powered kiln). Scope 2 reflects those associated with consuming electricity, as well as heating and cooling. Scope 3 emissions represent all those embodied in an organization's supply chain and product-delivery networks. Thus, Scope 2 and Scope 3 emissions help companies to understand the wider carbon implications of their operations. But, if every company reduced their Scope 1 emissions to zero, then every other company's Scope 2 and Scope 3 emissions would also disappear.

For most companies, Scope 3 captures most of their emissions. Accounting for these has helped to drive a cascade of decarbonization commitments, such as identifying, addressing or replacing high-carbon producers. That is good.

Why we still don't know the mounting health risks of climate change

But a disproportionate focus on reporting Scope 3 emissions — including by the SBTi, the CDP (an international non-profit organization dedicated to collecting

information on corporate sustainability efforts) and jurisdictions such as the United States and the European Union — has arguably distracted many companies from doing the hard work at home. In 2022, only 7% of consumer companies were on track to meet their targets for value-chain decarbonization, and only 18% were on track with their direct-emissions targets (see go.nature.com/43ystkc). Companies could make more progress on Scope 1 if they were able to simplify and focus their attention.

First, requiring companies to commit to reductions they have little or no control over, and then penalizing them for failing to make progress, discourages them from engaging. Indeed, in a 2024 survey by the SBTi, Scope 3 difficulties were the biggest complaint from companies working on climate issues, mentioned by 54% of firms[2].

Second, a focus on Scope 3 introduces extreme uncertainty into reporting of carbon emissions. The most common way to derive Scope 3 emissions is to multiply how much is spent on certain broad categories, such as 'marketing', by a numerical factor approximating national or global emissions for that activity. This simplistic approach misses both the accuracy and precision that reporting bodies desire.

And third, Scope 3 emissions can potentially divert focus away from Scope 1 and 2 emissions for a reason of efficiency: if most of an organization's emissions are indirect, why focus first on the minority that are direct?

The fix is simple. SBTi, CDP, regulators and other parties should create a tiered system that prioritizes target setting and reporting for Scope 1 and 2 over that for Scope 3. Companies should be making progress on decarbonizing their Scope 1 and 2 emissions before they are expected to tackle the more difficult Scope 3.

Focus on demand over delivery

Corporate demand has had an outsized role in developing renewable-energy markets. Starting in the 2010s, companies were motivated to make purchases because they received credit for doing so under the Greenhouse Gas Protocol. But the protocol's accounting practices contain an inconsistency. Under its 'location-based' and 'market-based' accounting rules, companies can get credit for Scope 2 carbon reductions from the electricity they consume by purchasing renewable energy that is never physically delivered to them. But there is no mechanism to do that for Scope 1 or 3.

Engineers work on an electrical panel at Octavia Carbon, a carbon-capture plant near Nairobi.Credit: The Washington Post/Getty

The protocol now needs to be expanded to allow for such claims across all emissions classes. It is more important that solutions are contracted and paid for than specifying where and to whom they are delivered. For instance, being able to track the delivery of sustainable aviation fuel to a buyer in a specific seat on a particular aeroplane is less important than ensuring that an equivalent amount of fuel was delivered into the broader aviation network.

Allowing companies to claim credit for these purchases would incentivize them to invest. To build trust, descriptions of the projects funded or financed can help others to assess the value of any company's carbon reduction and removal purchases.

Allow flexibility between emissions reduction and removal

As the Intergovernmental Panel on Climate Change has emphasized, limiting the worst harms of global warming requires both reduction of emissions and large-scale carbon removal. In the context of global net zero, how much reduction is needed versus how much removal is an open question, and well-intentioned but premature mandates hold back innovation.

For example, SBTi's Corporate Net Zero Standard requires a company's decarbonization commitment to include a pledge to reduce their emissions by 90%

or more before relying on carbon-removal technologies to counterbalance the remaining 10%. This requirement is too strict, and too early.

By analogy, in the renewable-energy sector, early markets were unconstrained by requirements for specific amounts of solar, wind or hydropower. Instead, technologies competed, and winners emerged for different uses in different places. A market-driven approach allowed the most effective solutions to materialize naturally over time.

Applying a similar do-and-learn principle to reduction and removal will be important for discovering the most cost-efficient and scientifically sound ratio of one to the other. The SBTi should relax its required percentages and work with sectors to determine what works best for each business case, according to the technologies available.

Some might worry this would allow companies to avoid carbon-reduction efforts and rely solely on carbon removal alone to achieve net zero. In practice, there would probably be a spectrum of corporate activities, with some relying heavily on reduction, some on removal and most on a combination of the two that meets their individual needs and preferred price point. The SBTi and regulators could negotiate different reduction recommendations by sector. Companies should transparently report the details of any carbon-removal purchases they use.

Promote adoption over additionality

Before carbon removal became popular, leading companies relied mainly on avoided emissions 'offsets' to zero out their remaining emissions. These offsets were obtained by paying a third party that was emitting carbon into the atmosphere to stop. These 'avoided' emissions could then be credited as reductions under the Greenhouse Gas Protocol.

Proving that the third party stopped emitting only because of that financing — also known as 'additionality' — became an important criterion in assessing whether an offset could count. For instance, a corporation paying to help finance the closure of coal plants and replace them with renewable energy would not get credit from these bodies if the coal company was going to shut down anyway because of economic or policy considerations. Bodies exist to certify and register valid offsets, including the US-based non-profit organizations American Carbon Registry, Verra and Climate Action Reserve, and the Swiss non-profit Gold Standard.

Researchers are testing how much carbon can be stored in seagrasses off the coast of Turkey.Credit: Lokman Ilhan/Anadolu via Getty

This additionality precedent has now been widely adopted for carbon-removal markets, and is included in the Oxford Principles for Net Zero Aligned Carbon Offsetting, for example (see go.nature.com/4jgtojw). This sounds good in theory, but doing so in strictly the same way as avoided emissions offsets is counterproductive. Payments for the cessation of an activity differ from payments to produce a product — it is often much harder to validate a payment for cessation, for instance. Requiring the same hurdle for carbon removal limits the total market and slows adoption.

Instead, carbon-removal purchases should borrow from the Scope 2 practices of the Greenhouse Gas Protocol, which differentiate 'offset' emissions reductions from those related to 'usage' associated with electricity generation. Industry certification and standards bodies, such as the Integrity Council for the Voluntary Carbon Market, should provide more tailored guidance on additionality measurements around carbon removal versus avoided emissions offsets, and account for the market implications of their recommendations.

Support collaboration over competition

Because net-zero technologies are often the first of their kind, many of them are expensive. This can make it hard for a corporation to buy them in large quantities, which reduces demand and slows down the cost-efficiency improvements that can be delivered through high-volume production. Collaboration across corporate

sustainability teams on net-zero purchases can help to rectify this, turning relatively small individual purchases into large, pooled ones.

How scientists can drive climate action: celebrate nature and promote hope

For example, the Clean Energy Buyers Association in Washington DC allows corporations to share their best practices and combine their influence to drive investments. Similar collective efforts are emerging for sectors such as green steel and sustainable aviation fuel. The First Movers Coalition, a global partnership of companies launched in 2021 at the COP26 climate meeting in Glasgow, UK, focuses on using the combined scale of their decarbonization investments to motivate markets. Other organizations, such as Frontier and Symbiosis — coalitions of companies across different sectors that have signed up to advanced market commitment for carbon removal — also represent a step in the right direction by pooling purchasing demand.

But this work is sometimes slowed down by legal concerns about competition law, which limits the ability of organizations to aggregate their purchasing power and accelerate the supply of climate solutions through increased demand. Governments can help by issuing clear guidance.

For example, in 2023, the UK Competition and Markets Authority issued guidelines on ‘green agreements’ that spell out when cross-sectoral collaboration can happen, while maintaining the positive benefits of market competition[3]. The European Commission has followed suit, encouraging companies to approach it for guidance

on such sustainability agreements[4]. These precedents can serve as models for other countries and jurisdictions seeking to balance the benefits of collaboration and competition appropriately during the net-zero transition.

Moving forward

Allowing some organizations to stumble in their net-zero journey is not the biggest error the world can make. The biggest error would be to build a system that discourages companies from doing anything at all. These six remedies are intended to avoid that, making it practical for as many organizations as possible to engage voluntarily with a net-zero transformation.

Corporations and civil society both have a part to play. Both should demand, and provide, transparency in their efforts. Companies should move ahead quickly by doing, showing and continuously improving their work. And organizations such as the SBTi, the Greenhouse Gas Protocol, the Integrity Council for the Voluntary Carbon Market and others should provide guardrails that allow the flexibility this transition requires.

Achieving net zero is not about having perfect solutions from the beginning. It is about making progress as quickly as possible by allowing markets to drive rapid iterations of investments and innovations. That is how, collectively, we will make net zero work.

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