

Demand-Side Support for Scaling Carbon Dioxide Removal Policy Primer



Introduction

The carbon dioxide removal (CDR) sector is growing rapidly — eclipsing 11 million tonnes (Mts) in cumulative sales, with total investment of \$2.7 billion and an annual growth rate of over 250%.¹ However, even under the most ambitious scenarios for global reductions in greenhouse gas (GHG) emissions, meeting the goals of the Paris Agreement will require billions of tonnes of CDR annually by 2050.² Massively scaled demand for CDR will be needed to achieve this multi-gigatonne (Gt) annual delivery target. The voluntary carbon market (VCM), along with philanthropic support, has provided an invaluable catalyst for the early development and initial deployments of CDR, but current private sector

demand and funding support is not sufficient to sustain the annual growth rate needed to reach an interim delivery target of 100Mt by 2030 — potentially a \$20+ billion market — much less multi-Gt annual scale by mid-century.³

CDR will not achieve these required levels without significant additional policy intervention. We have seen promising initial steps in the United States (US) and European Union (EU), but dramatically increased policy innovation and implementation are

¹ CDR.fyi, August 2024.

² IPCC AR6 Synthesis Report p 50, 2023.

³ Ransohoff, *Red-Teaming the Next -5 Years of Carbon Removal*. February 2024.



needed, globally and at every level of government. A range of policy types is required to advance CDR, from establishment of fit-for-purpose permitting frameworks; to development of high-quality regulatory standards for monitoring, reporting, and verification (MRV); to supply-side funding support, and other incentives for research, development, demonstration, and deployment (RDD&D). A particular priority at the CDR market's current early stage is to advance policy that provides demand support for the full portfolio of CDR solutions we will need to meet our climate goals.⁴

Demand-side policy for CDR can come in the form of direct government procurement, tax credits, price supports, regulation of environmental claims, and ultimately government-mandated compliance markets.⁵ In addition to providing direct demand support, these policies can serve to establish

standards for high-quality CDR, and unlock additional VCM demand as well as new sources of private capital. Just as there is no “silver bullet” for meeting our CDR targets, we will need to advance and innovate on a range of policy interventions, with a “whole-of-government” approach across geographies, and at every level of government.

In this Policy Primer, a working group of Carbon Business Council member companies and partner organizations outline the rationale for implementing demand-support policy for CDR, explore a range of specific policy mechanisms, and provide a focused set of best practices for policymakers, advocates, and other CDR ecosystem actors to dramatically accelerate the global policy innovation, development, and implementation necessary to achieve multi-Gt annual scale CDR.

⁴ Carbon Business Council. *Defining CDR: Issue Brief*, April 2023.

⁵ Jacobs et. al. *Kickstart Markets for Clean Energy Technologies*. Bipartisan Policy Center, January 2024.





Why Implement Demand-Support Policy for CDR?

- **Economic development.** CDR has been widely forecast to grow to a trillion-dollar market by mid-century.⁶ CDR encompasses a range of approaches, at least some of which will be suited to virtually any geography. Lawrence Livermore National Lab's November 2023 Roads to Removal report (which covered only a subset of CDR methods) estimates that CDR can deliver over 440,000 long-term jobs in the US.⁷ Boston Consulting Group (BCG) has estimated that CDR can potentially create 190,000 jobs in Germany alone, and 670,000 across EU member nations by 2045.⁸ In addition to creating good jobs, CDR can grow national, state, and local tax bases. Given the clear and substantial economic benefits on offer, it is in governments' interest to incentivize the development, deployment, and scaling of high-quality CDR projects in their jurisdictions.
- **Climate mitigation.** The world's governments and global economy must reduce GHG emissions as rapidly and completely as possible. However there will remain certain "residual" emissions that cannot be eliminated in a climate-relevant time-frame, and the science is clear that CDR at multi-Gt annual scale is an "unavoidable" component of the climate mitigation necessary by mid-century to meet the goals of the Paris Agreement and limit warming to 1.5 or even 2°C.⁹ The world is not currently on track to reach this necessary scale — it is imperative that policymakers globally, and at every level of government, act now in order to leave future generations with a livable climate.¹⁰

6 Mannon et. al. Carbon Removals: How to Scale a New Gigaton Industry. McKinsey Sustainability, December 2023.

7 New Analysis Outlines National Opportunities to Remove CO₂ at Gigaton Scale. LLNL, December 2023.

8 Herhold et. al. Carbon Dioxide Removal: Europe and Germany's Role in Catalyzing a Trillion Dollar Industry. June 2024

9 Buck et. al. Why Residual Emissions Matter Right Now. Nature Climate Change, March 2023.

10 Smith et. al. State of CDR 2nd Edition, 2024.

- **Co-benefits.** In addition to the substantial direct economic benefits on offer, many CDR approaches can potentially deliver significant agricultural, ecosystem, social, and economic co-benefits. In April 2024, Carbon Business Council published an [Enhanced Weathering Policy Primer](#) that highlights the agricultural co-benefits that farmer-focused deployment of this promising CDR pathway can offer. A number of marine CDR (mCDR) approaches can reduce ocean acidification locally, to the benefit of coastal ecosystems and commercial aquaculture.¹¹ Local governments in the western US are supporting biomass carbon removal and storage (BiCRS) projects in order to mitigate the risk of catastrophic wildfire.¹² Bioenergy with carbon capture and storage (BECCS) produces 24/7 dispatchable renewable energy, and creates demand for the development of carbon dioxide storage and transport infrastructure.¹³ Direct air capture (DAC) can serve as an anchor customer and demand pull mechanism for clean electricity to help scale the deployment of new renewable power generation.¹⁴

One key attribute of demand-support policy is the opportunity to consider factors beyond price — including the co-benefits enumerated here, as well as jobs and union jobs creation, and benefits to disadvantaged communities — in order to ensure safe, responsible, and equitable deployment of these essential climate solutions. In addition to the primary climate and economic benefits offered by CDR, governments that enact policies to scale the deployment of CDR can create significant co-benefits for their citizens as well.

- **Market shaping.** The CDR sector is young, but highly dynamic and growing quickly.¹⁵ Regulatory frameworks, industry best practices, and market

mechanisms are being developed as the field advances, and governments that move first to implement demand-side and other supportive policies will establish clear climate leadership and have an outsized influence on shaping the future of CDR. Carbon Business Council’s March 2023 [Monitoring, Reporting, and Verification \(MRV\) Issue Brief](#) outlines the central importance of rigorous, science-based verification standards to the future success of CDR. Both the US and EU have placed strong emphasis on MRV in their CDR policy to date, and it will be essential for policymakers globally to maintain this focus on quality. Similarly, governments that enact demand-support and other CDR policy have the opportunity to center equity and justice in their legislative frameworks, ensuring that the benefits of CDR deployment are equitably distributed, with a focus on delivering benefits to historically disadvantaged communities. The CDR sector will be strongest if it is broadly based across geographies, with a portfolio of approaches scaled to their full potential. Proactive policy development and deployment that is strongly informed by science can shape the future of CDR to help make this vision a reality.

Demand-Support Policy Opportunities

- **Procurement.** Direct government [procurement](#) has been a key driver for the rapid scaling — and dramatic reduction in cost — of renewable energy deployment globally.¹⁶ In the US, federal procurement has served to accelerate innovation and bridge the gap between RDD&D to commercialization in sectors from computing to pharmaceuticals.¹⁷ Emergent “buy clean” policies

11 [Marine Carbon Dioxide Removal Issue Brief](#). Carbon Business Council, January 2024.

12 [Velev. 4 Corners Carbon Coalition Announces Grants for Using Biomass to Remove Carbon](#). Carbon Herald, January 2024.

13 [Denholm, et. al. Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035](#). NREL, 2022.

14 [Van der Jagt et. al. Understanding the Role and Design Space of Demand Sinks in Low-Carbon Power Systems](#). Energy and Climate Change, April 2024.

15 [cdr.fyi](#)

16 [Sustainable Public Procurement](#), UNEP.

17 [Bowman et. al. Procurement as a Catalyzing Federal Instrument for Carbon Dioxide Removal](#). Clearpath, 2024.

for low-carbon concrete, “green steel,” and other decarbonization initiatives show similar promise to provide strong market signals to support the early scaling of these critically important technologies.

The first operating national CDR procurement program is underway in the US, where the Department of Energy (DOE) CDR Purchase Pilot Prize launched in November 2023, with \$35 million in funding from the 2021 Infrastructure Investment and Jobs Act (the “Bipartisan Infrastructure Law”) to purchase CDR from up to ten projects. In parallel to the Prize, DOE is running a Voluntary CDR Purchasing Challenge in an effort to magnify these federal investments by spurring increased levels of voluntary CDR purchases from the private sector. In March 2024, Congress passed a FY2024 budget with new funding of up to \$20 million to continue the Prize.

Public procurement of CDR is advancing in other countries as well. In April 2024, Canada made CDR eligible for a portion of its CAD\$135 million Low-Carbon Fuel Procurement Program. In Europe, Sweden is in the process of enacting an ambitious 36 billion SEK (\$3.2 billion) procurement scheme for BECCS that will employ an innovative reverse auction mechanism to make annual purchases of CDR from 2026-2046, at increasing volume and declining price.

While these programs are modest in scope relative to the challenge of multi-Gt annual scale CDR by mid-century, they offer an important start. Proposed legislation in the US such as the bipartisan Carbon Removal and Emissions Storage Technologies Act of 2023 (CREST Act) (S.1576), and the federal Carbon Dioxide Removal Leadership Act (CDRLA) (H.R. 7054 / S.3615) represent compelling policy opportunities to scale CDR procurement. Looking further into the future, the Energy Futures Initiative’s CO₂-Secure is an ambitious proposal to create a National Carbon Removal Authority that would fund and operate federal CDR procurement on a sustained basis to

deliver the immense scale required for the US to achieve net-zero greenhouse gas emissions in the coming decades.

- **Tax credits.** Tax policy represents another important policy lever to support demand for CDR. In the US this has been exemplified to date by the Section 45Q Tax Credit for Carbon Sequestration — a production tax credit which was substantially increased and extended by the 2022 Inflation Reduction Act (IRA). The IRA further added beneficial “direct pay” and transferability attributes for the tax credit. The expanded 45Q has provided up to \$180/t of price support for DAC, and \$85/t for BECCS — however the credit is not currently avail to other forms of CDR. The science and techno-economics are clear that no single pathway can deliver multi-Gt scale CDR by mid-century. The need is great for an expanded, method-neutral tax credit that is applicable to the full range of CDR approaches necessary to meet Paris Agreement targets, including BiCRS, mCDR, and mineralization in addition to BECCS and DAC.¹⁸

- **Price support.** Governments can employ a range of policy mechanisms to provide price subsidies and support that will scale demand for CDR. In April 2024, the Danish government selected the first tender of three projects for its DKK2.6 billion (\$370 million) Negative Emissions by CO₂ Capture and Storage (NECCS) subsidy fund, investing ~45% of the fund (DKK1.14 billion, or \$166 million) to deliver 160,000 tonnes of CDR annually from 2026-2032. In exchange for the subsidy, Denmark will be able to count these CDR credits against its Nationally Determined Contribution (NDC) to meet Paris Agreement goals, and the companies supplying the credits will be able to recoup the balance of their value via sales to the VCM.

Other examples of policy mechanisms that can provide price support for CDR include the Luxembourg Negative Emissions Tariff (L-TEN), which is based on the German feed-in-tariffs that

18 Assim et. al. Scaling to the Skies: Policy Design Options for a New CDR Tax Credit. Third Way, October 2023.



helped successfully scale solar.¹⁹ L-TEN provides project developers with performance-based ex-post direct payments in exchange for verified CDR. (L-TEN also supports utilization, but at a lower rate than durable CDR.) Contract-for-difference is a policy mechanism, being advanced for example in the United Kingdom (UK), where the government guarantees a price to project developers that can help make projects bankable.²⁰ When the market price falls below the guaranteed level, the government makes up the difference; and when the price exceeds the guarantee the developer pays the government the surplus amount.²¹

- **Compliance markets.** Another important demand-support policy mechanism is the creation of government-mandated compliance markets where emitters are required by law to neutralize their residual GHG emissions with high-integrity CDR. While such a compliance market currently seems politically challenging at the federal level in the US, a CDR compliance market in Europe is likely to be inaugurated in conjunction with the initiation in 2031 of Phase 5 of the EU Emissions Trading Scheme (ETS) — whether as part of the

ETS, or a parallel negative emissions trading system.²² If implemented in a net-zero-aligned fashion, where only high-integrity carbon removals are permitted to compensate for GHG emissions, this will provide a massive source of new demand for CDR.

It is critical, however, that we do not wait for 2030 to act, nor can we rely solely on Europe for the advancement of such a vital policy mechanism. Happily, there are green shoots in this regard in several other jurisdictions globally. In April 2024, Japan announced that it would start including CDR in its GX-ETS — currently a voluntary trading scheme but one which represents the foundation for a future compliance market in the world's fourth largest economy.²³ In May 2024, the UK opened a request for information regarding how best to incorporate CDR into its national ETS, which could happen as early as 2028. Finally, California's SB 308 legislation proposes to establish binding CDR targets (alongside the state's pioneering Cap and Trade Program) to ensure the successful attainment of net zero by 2045.

19 Nemet. How Solar Energy Became Cheap. Routledge, 2019.

20 Greenhouse Gas Removals (GGR): Business Model. UK Department for Energy Security and Net Zero, December 2023.

21 Lockwood. Designing Carbon Contracts for Difference. February 2024.

22 Tamme. How to Include Carbon Removals in the EU ETS. October 2023.

23 Japan's GX-ETS to Accept International Removal Voluntary Credits for Compliance Obligations. S&P Global, April 2024.

- Environmental claims.** Given that most current demand for CDR is voluntary, steps taken by the world's governments to increase the rigor underpinning, or provide regulatory frameworks for, corporations' environmental claims can help drive demand for CDR, both via purchases of CDR credits on the VCM and insetting. In the EU, the current deliberations about the proposed Green Claims Directive are high-stakes in terms of determining whether European corporations will have any requirement to purchase high-integrity CDR credits to neutralize residual emissions on their path to net zero.²⁴ In the US, while efforts by the Securities and Exchange Commission (SEC) to establish climate disclosure rules at the national level have been paused by litigation, impactful legislation remains possible at the state level. California's AB1305 became law in late 2023, creating a regulatory framework around voluntary corporate claims for companies seeking to do business in the world's fifth largest economy. Environmental claims policy, regulation, and legislation offers an indirect but powerful tool for CDR demand-side support.

Demand-Support Policy Best Practices

- Enact tech-neutral policy.** Wherever possible, demand-support policy for CDR should be tech-neutral, and establish core criteria for what constitutes high-quality CDR. (These criteria are outlined in Carbon Business Council's March 2023 Defining Carbon Removal Issue Brief.) The emerging CDR sector recognizes that no single removal pathway has the capacity to achieve multi-Gt annual scale by mid-century. To reach this objective will require a full portfolio of solutions, across a range of BiCRS, DAC, mCDR,

and mineralization-based approaches, as well as potentially yet to be developed approaches. Governments globally should seek to enact policy that is reflective of this fact, and that lets the market and innovation compete to deliver the best climate outcomes. By way of positive example, the May 2024 announcement of the 24 semifinalists for the US DOE CDR Purchase Pilot Prize included representatives from each of the four primary CDR pathways. However, much work remains to be done. In the EU, the Carbon Removal and Carbon Farming Certification (CRCF, formerly the Carbon Removal Certification Framework), which will serve as a vital foundation for future EU CDR policy, currently addresses only a small number of selected CDR pathways.²⁵ It will be critical to expand the CRCF over the coming years to accommodate a more complete portfolio of CDR methods. In the US an important next step will be for Congress to introduce and pass an expanded, tech-neutral production tax credit for high-quality CDR. Internationally, continued vigilance and advocacy will be needed to ensure that the Paris Agreement's Article 6.4 mechanism be enacted in a tech-neutral fashion.²⁶

- Consider local context.** When developing demand-support policy for CDR, policymakers and advocates should be highly cognizant of political, social, legislative, geographical, and historical contexts. Different policy approaches will lend themselves best to certain contexts.²⁷ While a compliance policy might seem challenging (at least for the moment) at the US federal level, it represents a much more promising option in jurisdictions with existing emissions trading systems, such as the EU, UK, or California. Feed-in-tariffs and contract-for-difference mechanisms have greater precedent in the EU than in the US. Jurisdictions with an existing net-zero target — or CDR roadmap — can

24 Green Claims: Urgent Call from 53 Companies and Organizations Supporting Clear Rules for Supporting Investment in Permanent Carbon Removals. May 2023.

25 EU Carbon Removal Certification Framework, Carbon Gap Policy Tracker, 2024.

26 Meeting the Goals of the Paris Agreement: An Open Letter from 100+ Carbon Removal Experts. Carbon Business Council, April 2023.

27 Neidl, On Hooks and Windows. Rethinking Removals, February 2024.

potentially offer increased impetus and an existing framework for demand-support and other CDR policy. Politically, economic policy rationales could resonate more strongly in certain jurisdictions than climate benefit or environmental justice — and vice versa. With careful consideration of local context, some form of CDR policy is achievable in virtually every jurisdiction. Politics is the “art of the possible,” and given our collective urgency to act on climate, it is essential that policymakers and advocates remain both opportunistic and pragmatic.

- **Advance policy at every level of government.** Policymakers and advocates should seek to advance demand-support policy for CDR globally and at every level of government. By virtue of their greater scale, federal policies will ultimately be most impactful, but those legislative processes can be slow and politically uncertain. At the CDR sector’s current early stage of development, a much larger number of policy “shots on goal” is needed, across a broad range of geographic and jurisdictional contexts. In the US, states offer a significant opportunity in this regard to innovate on and scale CDR demand-support policy.²⁸ In addition to California’s landmark SB 308, the Massachusetts CDR Leadership Act (S.2096) represents a tremendous opportunity to implement a tech-neutral CDR procurement program at the state level. Such legislation can be impactful in itself, but potentially even more important as precedent — which can then spread to other jurisdictions, both subnational and eventually national. Local governments can meaningfully engage as well — in the western US, for example, the 4 Corners Carbon Coalition has established a buying group of local governments that has just completed its second round of procurement awards. Internationally, sustained multilateral engagement will be critical, e.g. with the UNFCCC’s Article 6.4 deliberations.

- **Set standards and shape markets.** As outlined previously, there exists a tremendous opportunity for demand-support policy to establish standards and shape markets for high-integrity CDR. Policymakers can leverage procurement, compliance markets, and other policy mechanisms to enshrine high-quality MRV as an essential component to delivery verification and CDR credit generation. Procurement policies in particular afford the opportunity to center equity and justice in the responsible deployment of CDR, and many of the policy mechanisms discussed here can explicitly factor co-benefits such as jobs creation, ecosystem services, and agricultural co-benefits. It is imperative that policymakers consider these standards-setting and market-shaping opportunities from the ground up when formulating demand-support policy for CDR. Finally, while it is understandable for first-of-a-kind procurement programs to require projects to be implemented in the relevant jurisdictional boundary, in order to capture the economic development benefits locally, CDR markets must ultimately be global and interoperable. Additionally, demand support will be critical for efforts to scale the responsible deployment of CDR in the Global South, where the promise of enhanced weathering and certain other CDR approaches is particularly strong.²⁹ In the long term, policymakers should seek to implement demand-support policy for CDR without geographic restrictions.

- **Unlock and scale private-sector capital.** The most effective demand-support policies for CDR will be those that leverage public investment to de-risk, unlock, and scale private capital. Achieving the goals of the Paris Agreement — including, certainly, mid-century multi-Gt annual CDR targets — will require extensive public-private collaboration, and a massive global mobilization of both government and industry. While compliance

²⁸ Burns and Bryce. States Can Be Laboratories for Climate Policy. The Hill, March 2022.

²⁹ Boudinot et. al. Enhanced Rock Weathering in the Global South: Exploring Opportunities for Enhanced Agricultural Productivity and Carbon Dioxide Drawdown. Precision Development, January 2023.

markets are the ultimate manifestation of this goal, in the immediate term the US DOE's innovative efforts to scale its investment in the CDR Purchase Pilot Prize with the parallel Voluntary CDR Purchase Challenge provide an excellent example of how demand-support policy can drive public-private partnership.

Conclusion

Achieving CDR at multi-Gt annual scale by mid-century will require massive policy intervention. As we keep the long-term target in clear sight, we must continue to advance CDR this decade towards interim 2030 targets and beyond — both to build a robust portfolio of effective, safe, and economical CDR approaches that can appropriately be scaled in the 2030s and 2040s, as well as to continue to increase scientific and operational learning, and move as many CDR approaches down the cost curve as possible. This will not be possible without the implementation of a robust portfolio of demand-support policy across geographies and at every level of government.

Globally interoperable government-mandated compliance markets will be needed to scale the CDR market to Gt annual scale and beyond. While such compliance markets have the potential to be implemented in certain jurisdictions (such as EU, UK, and California) by early next decade, reaching this goal in the US and elsewhere globally may take longer. A June 2024 Boston Consulting Group report estimates that compliance policies can generate up to 2.5Gt per year in global demand for durable CDR by 2050 — an impressive total, but one that falls short of many mid-century annual CDR targets.³⁰ To achieve Paris Agreement goals will require a broad portfolio of demand-support policy in the coming decades, likely including direct procurement at significant scale, to supplement compliance mechanisms. Policymakers and advocates should seek opportunistically and pragmatically to continue to advance the portfolio of demand-support policies for CDR outlined in this Primer, to catalyze public-private partnership, and to innovate on additional novel policy mechanisms not contemplated here.

³⁰ Mistry et. al. Scaling CDR: Demand Drivers for Durable Carbon Removal. Boston Consulting Group, June 2024.

Credits

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