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CDR policymaking: Insights from stakeholder engagement on DACCS

Carbon Dioxide Removal (CDR) has taken center stage in the climate policy community. Forming an increasingly prominent role in many countries' net-zero targets, many of these methods are, however, mired in controversy, especially Direct Air Carbon Capture and Storage (DACCS). Indeed, CDR generally and DACCS specifically are complex and uncertain topics, with an immense divergence of views and values on how to proceed (or not) with their implementation. Concerns abound about these technologies' mitigation potential and co-benefits, as well as fear they distract from emissions reduction priorities. As such, their nature and the concerns around them make them an important science-policy challenge within the climate policy landscape.

Critical to ameliorating concerns about CDR technologies and opening a path towards removals policymaking – one that is efficient, ethical and *implementable* – is stakeholder engagement.

KEY POINTS:

- When embarking on CDR legislative processes and policy developments – such as in the case of Germany's Carbon Management Strategy and Long-term Strategy of Negative Emissions – countries should include stakeholder deliberations each step of the way.
- DACCS deployment must not lead to mitigation deterrence. Governments must combine their support of DACCS deployment with ambitious emissions reductions targets and a fossil fuel phaseout.
- Timescale considerations should be reflected in DACCS policy design. Different policies that are adaptable over time are needed. These would account for changing requirements for the role of DACCS in the near and long term.
- CDR policy design should reflect considerations of tradeoffs. Governments should include detailed documentation of key tradeoffs that come along with different deployment pathways of CDR.

These processes have proven successful in gathering insightful information on general pereptions about CDR technologies; however, such deliberative policy learning for CDR policy design is still limited, particularly in Germany, which has had few engagements to date.

DACCS in particular has certain characteristics – such as its potential for large-scale CO_2 removal, flexibility in where it can be located geographically, a relatively low footprint regarding land and water (compared to other CDR methods), permanency of stored carbon and high certainty of measurement – that have attracted the sharp attention of policymakers, industries and academics. Implementation risks concern mainly the high demand in renewable energy and the (geological) storage of captured CO_2. This melange makes the technology especially ripe for stakeholder engagement.

In this policy brief we share recommendations for CDR and DACCS policy development derived from one of the few active stakeholder engagements in Germany on the topic. As a particularly controversial CDR method, DACCS is frequently debated in both expert circles and within broader society, discussions that have yet to arrive at how this technology should play a role in countries' climate policy mixes – if it should at all.

Legislators have an immense tool at their disposal as they decide whether and how to proceed with DACCS implementation. Co-creative, deliberative stakeholder engagement is crucial to ensuring scaling this technology will be legimitate, fair and effective. Responsible policy development requires the incorporation of stakeholder perspectives, and policymakers will have a clearer path forward towards implementing a highly polarizing technology in a way that minimizes polarization.

The recommendations presented in this policy brief were developed based on results from a two-day stakeholder engagement workshop that took place in Berlin from April 18-19, 2023 and a subsequent online survey. Participants were experts mainly engaged in European and German climate policy. More details available in Apergi et al., 2024.

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1. **When embarking on CDR legislative processes and policy developments – such as in the case of Germany's Carbon Management Strategy and Long-term Strategy of Negative Emissions – countries should include stakeholder deliberations during each step of the policy process**.

Stakeholder deliberation processes are critical to addressing "wicked problems" that bear a high value load without a clear concensus on a path forward, such as the implementation of CDR.

Stakeholder engagement allows policymakers to explore topic-specific contexts that influence the feasibility, desirability and acceptability of a given policy approach (Failing et al. 2007, Görg et al. 2010). **While high on the German policy agenda, there have been to date few engagements with stakeholders on CDR** (Boettcher et al., 2023).

An open, communicative process allows for an evolution of stakeholders' perceptions. Engagement can take many forms – from informative, one-way communication to an **iterative, "multi-way" process that empowers stakeholders and yields collaboration between those engaging and those being engaged.** The latter form of engagement **should be pursued with CDR and DACCS policymaking.** Indeed, oftentimes initial positions, even when rigid and black-and-white, can be nudged towards open disposition towards the issues at hand when engaged via different formats, such as small group discussions, silent individual deliberation and open face-to-face discussions during breaks.

Stakeholders who are interested, active and informed on the topic – seemingly already with a decided opinion – can be open for nuanced discussions around DACCS policymaking, especially when **discussing what is useful and desirable in which context. Such a focus can shift conversations on DACCS to avoid polarization.** When given the opportunity to elaborate on their value preferences in an imagined future, stakeholders will be able to express what they would need – what conditions would have to be met – in order to accept deployment of CDR and DACCS.

A deep dive into the concrete challenges but also possible policy measures to address them – working jointly on the details of development, deployment and policy measures – can enable a nuanced exchange.

As the European Union and its member states embark on a process to design a legislative landscape for CDR, stakeholder deliberations must be included throughout the policy process. **Approaching the 2050 net-zero future means removals will play a bigger and bigger role in governments' overall climate policy mix.** Informing this role and the political debates that will accompany it with co-creative and deliberative stakeholder engagement will be critical for choosing policies for CDR methods that are effective and *implementable.*

Policymakers should engage stakeholders as early as possible and in each subsequent portion of the legislative process. These engagements should be collaborative and empower the stakeholders to deliberate the issues at hand through a variety of formats.

This engagement will play an important role in how quickly DACCS can be implemented – when needed and without objection.

2. **DACCS deployment must not lead to mitigation deterrence. Governments must combine their support of DACCS deployment with ambitious emissions reductions targets and a fossil fuel phaseout.**

These mitigation efforts should focus on fast and large emissions reductions, and carbon removals should be treated only as a tool to compensate residual emissions that are kept at a demonstrable minimum (Stoefs, 2021).

The issue of **mitigation deterrence** refers to the danger that dependence on CDR technologies to address climate change can distract us from the urgent need to achieve substantial emissions reductions. CDR technologies, and DACCS especially, are often seen as presenting a technological solution to climate change that does not require societies to make any of the difficult compromises and transformations that aggressive emissions reductions require. Such expectations are, however, unfounded – there is no scientific evidence that indicates DACCS could be deployed at such a scale in the future to substitute the need for deep and fast emissions cuts (McLaren, 2020). **Even with widespread DACCS deployment, steep emissions reductions would still be necessary to achieve climate targets.**

The ways this danger manifests itself includes: lower mitigation reduction targets, less clear mitigation reduction targets and/or treating CDR and DACSS removals as perfect substitutes for emissions reductions.

In the European 55% reduction target, for example, there is no differentiation between emissions reductions and the level of carbon removals (Brad et al., 2023). In addition, in the Long-Term Strategies submitted to the United Nations Framework Convention on Climate Change (UNFCCC) one can observe that most countries estimate their residual emissions (hard-to-abate emissions that need to be covered with carbon removal) to be much higher than what is considered acceptable by the Intergovernmental Panel on Climate Change (IPCC) to stay within the 1.5ºC target (Buck et al., 2023). Moreover, there is no universal definition of what should qualify as "residual emissions" and how these should be estimated (Buck et al., 2023).

This lack of transparency can send the wrong signals to policymakers, investors and the public. That jeopardizes an effective response to climate policies as well as the public support of such policies. The absence of a clear definition also does not permit the discussion over residual emissions to become part of the UNFCCC negotiations despite them having a strong climate justice and mitigation component.

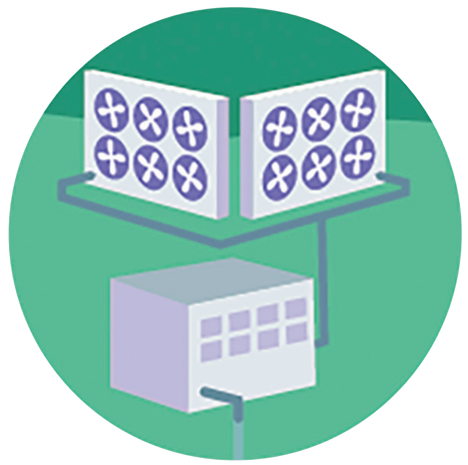
Overreliance on the unfounded technological promise of CDR can act as an excuse to delay fossil fuel decline which, according to both the IPCC and the International Energy Agency, will be essential to address climate change. In the case of DACCS this threat is further aggravated by the fact that the fossil fuel sector is pursuing the use of DACCS technology for enhanced oil recovery, often with government support (Deprez, 2023). Finally, the energy requirements for large-scale DACCS deployment compete directly with energy requirements for mitigation actions (e.g. replace conventional fossil fuels with renewables) which can also lead to mitigation deterrence.

To address the risk of mitigation deterrence, policymakers need to maintain **strict emissions reduction targets** despite the pressure to weaken them. Importantly, removals should **not be treated as equivalent** to emissions reductions when determining mitigation targets. On the contrary, clear targets should be specified separately for cutting emissions and for compensation with removals, potentially with different timelines and separated supporting policies (Brad at el., 2023). The two should be treated as complements, not substitutes.

Including removals in the **voluntary carbon markets** can support the early deployment of DACCS technologies e.g. in the development of monitoring reporting and verification (MRV) technologies and practices (Brad et al., 2023). However, the introduction of removals in the carbon markets should be done with care (e.g. with restricted or separate integration) as their unlimited use could lead to the offsetting of viable emission reductions in addition to residual emissions (Brad et al., 2023). Separate policies incentivizing DACCS (e.g. government supported research and development (R&D), subsidies and tax incentives) are preferable. Such policies should **also support the design of strict MRV and accounting of removals.** Independent monitoring and clearly defined liabilities for potential leakage are essential to ensure the permanence of carbon storage. Importantly, any policy support should **be combined with a fossil fuel phaseout,** and efforts to replace fossil fuels with sustainable energy sources should continue undeterred. At the same time, excess renewable energy capacities need to be built up to power energy-intensive direct air capture facilities.

Definitions of residual emissions must be unambiguous, and internationally standardized and accepted, clarifying both what constitutes residual emissions and how these should be calculated. Governments and policymakers need to play a strong role here, as do interdisciplinary research initiatives funded and coordinated via government programmes. Researchers can conduct analysis to determine the specific sectors and activities that will not be possible (technically or economically) to abate and provide insights into how difficult sectors could further decarbonize. International initiatives should also be put in place to promote the availability of data to enable analysis and country comparisons. Importantly, researchers can inform and give scientific rigour to the process of designing clear criteria by which residual emissions should be determined. Defining such criteria should involve stakeholder engagements, as well as negotiations and agreements at the international level via dynamic processes with frequent revisions to reflect technological progress (Buck et al. 2023).

Finally, policymakers should provide clarity about what actually counts as carbon removal (Sekera et al., 2020). For DACCS to count as carbon removal, CO_2 needs to be permanently stored and not used in other activities. Moreover, the removed CO_2 should exceed the CO_2 emitted via the capture and storage process. Value-chains involving enhanced oil recovery activities for example, cannot be considered as carbon removal and should not receive any government support.



Infographic depicting DACCS technology

3. Timescale considerations should be reflected in DACCS policy design.

Different policies that are adaptable over time are needed. These would account for changing requirements for DACCS scale-up in the near and long term.

At the moment DACCS deployment is low. There currently exist only very few small-scale pilots that store the captured carbon permanently and do not use it for commercial reasons (Sekera et al., 2020). The high cost and energy requirements are among the main barriers for large-scale DACCS deployment.

The current costs per ton of carbon removed range between $100 and $600 (with upper estimates reaching up to $1000) (Meckling et al., 2021). Removing 1 Gt of CO_2 via DACCS is estimated to require the total electricity generated in the United States for one year (Meckling et al., 2021). Moreover, for DACCS to be considered a tool to address climate change it needs to rely on renewable energy. This high energy intensity places the deployment of DACCS in direct competition with development (e.g. universal access to electrification) and mitigation priorities (replacing fossil fuels with renewables for electrification) (Deprez, 2023).

Other barriers to large-scale deployment of DACCS include the mismatch between locations with good geological storage capacity and places with good renewable energy sources, along with a number of environmental risks associated with the storing of CO_2 (such as leakages, water pollution and earthquakes) (Sekera et al., 2020).

Although there is no market demand for captured and permanently stored CO_2, technological innovations and economies of scale could bring costs down ($150-$200 per ton over the next 5-10 years) and bring about efficiency improvements (Lebling et al., 2022). This would mean a larger DACCS deployment in the long run. Moreover, the development of a robust MRV system can help detect environmental hazards early and ensure the permanence of storage (Stoefs, 2021). Although DACCS does not present a viable technological solution to address climate change in the near term (and it could be the case that it will not do so in the long term either), **policy support and incentivization today is important for the technology to be given the opportunity to play a meaningful role in the fight against climate change in the future.** Policy design should be dynamic to adapt to technological developments and new requirements for DACCS development.

Policymaking efforts today **should include a strong focus on support for applied research, pilot projects and demonstration plants for DACCS.** It is important to support the design of a large number of small scale pilot projects to allow for learning and positive spillover effects (Boyd et al., 2024). In addition, competition between many small scale actors will also help reduce costs (Lebling et al., 2022). Planning should ensure that DACCS pilot facilities are located in places with good storage capacity. Overall, continued research on DACCS technologies will determine if they are realistic options as well as their exact role in addressing climate change (e.g. as stopgap technologies vs permanent solutions) and the timescale for their deployment (Buck et al., 2023).

Policy incentives like **subsidies, tax incentives and loans** will be indispensable in the first phase to achieve DACCS innovation and to scale-up. **Public procurement of DACCS** credits and reverse auctions are also suggested tools to fund DACCS programs in the near term. One way this government support can be financed is through revenues from emissions trading and carbon pricing (Brad et al., 2023). Support from development banks will also be important to address issues of high financing costs (Fulton, 2023). Whereas the voluntary carbon market can also support DACCS deployment, this support is marginal in the near term.

Government support should also target the development of an enabling infrastructure, including the development of transport and storage solutions along with the design of an MRV system (Boyd et al., 2024). These should, therefore, also be the focus both research initiatives and pilots.

As technologies become more viable in the long term, a number of additional private sector incentives could partially replace government support. These include carbon pricing and the integration of DACCS into the carbon markets (Boyd et al., 2024). The latter, however, should be done with care to avoid mitigation deterrence as previously outlined.

R&D funding support for DACCS remains within a limited number of countries including the United States, Australia, Canada, Japan, the United Kingdom, Norway and a number of EU countries. This includes initiatives targeting the development of CO_2 storage capacity. The primary funds available to support research for carbon removal and DACCS at the European level include the **Innovation Fund** and **Horizon Europe.** There is a need to ensure that a specific DACCS focus is included in these funds and that the funding ambition for R&D is increased as well as initiated in countries currently without support (Breitschopf et al., 2023).

4. CDR policy design should reflect considerations of tradeoffs.

Governments should include detailed documentation of key tradeoffs that come along with different deployment pathways of CDR.

Tradeoffs between climate mitigation efficiency and other targets should be tackled proactively in CDR policymaking, and their documentation should be transparent and made available to access.

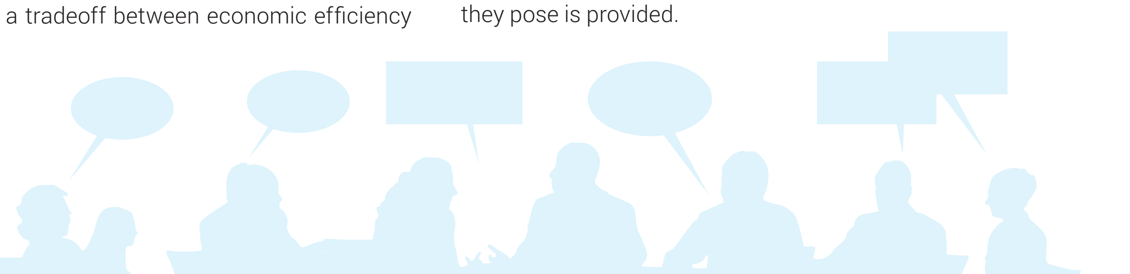
No singular policy measure exists to deal with the challenges deriving from the complexity of DACCS and other CDR methods. Indeed, each CDR deployment pathway poses a range of tradeoffs.

Potential tradeoffs exist, among others, between fair processes and climate effectiveness, between economic performance, ecological effectiveness and social justice, etc. One such example likely to emerge among governments' considerations could be developed countries choosing to invest in storage in developing countries, which would present a tradeoff between economic efficiency and equity.

Policymakers will inherently skew towards one end or the other of these perceived tradeoffs depending on how they take into account other relevant considerations such as the timeline. This is inevitable. This inevitability does not, however, mean policymakers can overlook elaborating on the choices made surrounding these tradeoffs.

Indeed, deliberating with stakeholders on tradeoffs is a very important aspect of DACCS stakeholder engagement. **Policymakers should ensure these tradeoffs are considered by a variety of experts across a range of fields and sectors, including civil society representatives, during their engagement efforts.** This should be done in the early stages of such engagement, and policymakers should ensure stakeholders are informed of existing mechanisms available to address these tradeoffs (e.g. compensation mechanisms).

Deliberations around DACCS tradeoffs should be documented in a transparent and accessible way and made accessible publicly once a policy pathway with DACCS has been chosen. This could take various forms, such as a supporting document in a legislative annex. Public trust in the legislative process would increase with knowledge that different tradeoffs were considered and a clear justification for the legislative choices made and the tradeoffs they pose is provided.



CONCLUSION

Stakeholder engagement will play a critical role in the EU, providing countries like Germany with tools to incorporate CDR and DACCS into their climate policy strategies in a way that is effective, ethical and – above all – *implementable*. This engagement should start early and accompany each step of the legislative process, as this will lead policymakers to gain a greater and more nuanced understanding of how and under what circumstances these technologies can and should play a role in their policy mix. Moving towards implementation, governments should ensure DACCS deployment will not deter mitigation efforts and, as such, is accompanied by measures such as a fossil fuel phaseout. With DACCS' highly controversial and potentially polarizing nature, trust in the policymaking process will be crucial to its acceptance, and as such it should transparently convey considerations of issues such as timescale and tradeoffs.

About CDR-PoEt (2021 - 2025)

Carbon Dioxide Removals – Policies and Ethics (CDR-PoEt) examines the ethical and equity implications of policy instruments for CDR, based on interdisciplinary research and stakeholder deliberations. The project specifically evaluates the feasibility ('what can we do from an economic, socio-cultural, and institutional perspective?') and the desirability ('what do we want to do?') of CDR policies and methods in their specific contexts, providing a foundation for developing policy recommendations at local, national and international levels.

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