Clearing the air?

Advice for principles and policy for governing carbon dioxide removal

Advisory report summary

WKR The Netherlands Scientific Climate Council

Summary

Deep, rapid and sustained reductions in emissions of greenhouse gases (GHGs) are essential to avoid the most severe climate impacts. But carbon dioxide removal (CDR) is required too.

The effects of climate change caused by human emissions of GHGs are becoming increasingly noticeable and severe. In the 2015 Paris Agreement, all countries agreed to limit global warming to well below 2°C, and to aim for 1.5°C. These temperature limits require rich countries, such as the member states of the European Union (including the Netherlands), to achieve net zero GHG emissions by 2050 at the latest. To this end, the parties to the European Climate Law have agreed to become 'climate neutral' by 2050, meaning they emit no more GHGs than are removed from the atmosphere. The Netherlands adopted this target in the 2019 Dutch Climate Act, which also states that the Netherlands will achieve 'negative emissions' after 2050 (in other words, that it will remove more GHGs from the air than it emits). CO_2 is the only GHG that can currently be removed from the atmosphere. This means that the Netherlands can only achieve its targets in the Climate Act with the help of CDR. This advice suggests principles and policies the Dutch government can adopt to steer the development of CDR.

Removing CO_2 from the atmosphere serves two purposes: it limits and reduces temperature overshoot, and it offsets residual emissions. GHG emissions can be brought to zero for many, but not all activities. Moreover, global emissions are not expected to fall fast enough to limit the rise in average global temperature to 1.5°C. It is therefore necessary to remove GHGs from the atmosphere, in addition to reducing emissions, for the following reasons:

- To lower the concentration of CO_2 in the atmosphere so that temperatures rise less rapidly or so that this rise could even be reversed. This could limit an overshoot of the 1.5°C target, and return the average global temperature rise to below 1.5°C by the end of the century.
- To achieve climate neutrality by offsetting GHG emissions that cannot be prevented, i.e. offsetting residual emissions.

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CDR involves deliberate activities to remove net CO_2 from the atmosphere and store it for an extended period of time. Examples of CDR methods include planting new forests, using wood as a building material, biomass conversion combined with CO_2 capture and storage in deep geological formations, direct capture of CO_2 from the air combined with geological storage, mineralisation (where CO_2 reacts with minerals to form rock or building materials), and agricultural practices that increase soil carbon content. We consider methods where the CO_2 is stored for at least a few centuries permanent CDR. These include geological storage in deep geological formations and mineralisation of CO_2. Methods such as afforestation, sequestration of CO_2 in agricultural soils or the use of biomaterials in construction capture CO_2 temporarily, probably only for decades, and come with the risk that the CO_2 will be released even earlier due to events such as forest fires or drought. This is considered temporary CDR. Carbon dioxide capture and storage (CCS) and carbon dioxide capture and utilisation (CCU) of fossil CO_2 emissions only reduce emissions, and so are not CDR methods.

CDR has limitations and risks, both for the individual technologies and for the climate system as a whole. Practically all existing CDR methods either use a lot of (renewable) energy, land, or both. As a result, many methods have only a limited potential. Some methods have unwanted side effects, such as a negative impact on nature, which could reduce public support for CDR. Methods for permanent CDR are not yet applied at the required scale, because they are not yet fully fledged, because they are too expensive, or for other reasons. This makes it uncertain whether CDR can be applied on a sufficiently large scale in practice.

If emitters rely too much on CDR and it fails to meet the expectations, future generations will be faced with even more climate change. Given the uncertainties and risks, there is a risk that CDR will not achieve the required capacity. Moreover, there is a real risk that emitters will delay reducing their emissions because they are counting on the CO_2 being removed from the atmosphere at a later stage, even if this CDR is still uncertain. This could mean that future generations will be confronted with even more extreme climate change. And even if these uncertainties and risks can be avoided, implementing CDR too late could lead to irreversible consequences for the climate system if temperatures continue to rise.

Avoiding emissions is more effective and reduces climate risks with more certainty than CDR. However, both are necessary, so we must be cautious not to trade one off against the other. Any GHG emissions that will have been avoided, will not contribute to climate change. Most emission reduction measures, such as energy conservation or solar

power, have fewer negative side effects than most CDR methods. A balance will have to be struck between the rapid scale-up of new or existing CDR methods and continuing emission reductions. CDR policies should not detract from efforts to reduce emissions, or in any case as little as possible.

Recommendation
The Council recommends making maximum efforts to reduce emissions. This will limit the dependence on CDR to achieve climate neutrality. The Council also recommends that CDR be deployed primarily to limit and reduce a potential temperature overshoot.

Government intervention is needed to deploy CDR methods at the required scale. CDR is a public good: everyone benefits from it, and not just the party who carries it out. Companies are currently unable to monetise the benefits of CDR, leading to a lack of investment in the development and scaling up of permanent CDR methods. Government policy is needed to ensure demand for CDR is created so that it can be scaled up in time. Subsequently, national and European policy is required to ensure that CDR is widely and responsibly implemented.

Recommendation
The Council advises the Dutch government to pursue CDR policy, in conjunction with European policy.

To ensure that emissions are reduced as much as possible, it is prudent to limit the amount of CDR that can be used to counterbalance residual emissions. CDR should be deployed as little as possible to counterbalance residual emissions. Over-commitment to CDR could result in emitters failing to reduce avoidable emissions. To maintain the incentive for emissions reductions, it will help to establish the amount of allowable residual emissions in 2050. This will also determine the maximum amount of CDR that can be deployed for counterbalancing emissions. Such limits could be imposed at the European, national and sectoral levels. The limit could be reviewed on a regular basis and revised (if necessary) based on new developments, for instance if new societal or technological opportunities for emission reductions emerge.

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Recommendation
The Council recommends setting limits to the use of CDR for counterbalancing residual emissions at the European, national and sectoral levels.

Only permanent CDR is suitable for counterbalancing fossil CO_2 and other GHGs that remain in the atmosphere for a long time. The global carbon cycle can be divided into a short cycle, for example plants absorbing CO_2 and indirectly re-emitting it, and a long cycle, such as carbon in fossil fuels that was sequestered millions of years ago. Human activities, such as the use of fossil fuels or the felling of old-growth forests, mix carbon from the long cycle with that of the short cycle. This CO_2 then stays in the atmosphere for a long time, causing global warming. Preventing the mixing of carbon from the short and long cycles therefore helps to mitigate climate risks. In addition, a very long storage duration is important for some other greenhouse gases, such as nitrous oxide or fluorinated compounds, which remain in the atmosphere for centuries or even millennia. Offsetting these greenhouse gases requires a proportional amount of permanent CO_2 removal.

Recommendation
The Council recommends deploying only permanent CDR to offset fossil GHG emissions and emissions of GHGs that remain in the atmosphere for a long time.

Policies are required to scale up permanent CDR methods in particular and develop a market for them. Unlike temporary CDR methods, permanent CDR is not yet widely applied. This is why policies are necessary to scale up permanent CDR and develop the market for these methods.

Recommendation
The Council recommends focusing Dutch CDR policy on permanent methods.

Despite its limited contribution to the climate targets, there are good reasons to stimulate temporary CDR as part of other policies, such as those directed at nature restoration or sustainable forestry and agriculture. Methods for temporary CDR (such as afforestation, reforestation and sequestration of CO_2 in agricultural soils) are often

more developed and cheaper than permanent methods. However, temporary methods have only a limited potential in the Netherlands. Policies that promote temporary CDR in agriculture and forestry could have negative impacts on other policy areas, such as food production, biodiversity and land use. Policies aimed at sustainable construction, sustainable agriculture, nature restoration and the prevention of soil subsidence could on the other hand have positive side effects.

Recommendation
The Council recommends encouraging temporary CDR in the Netherlands, but only as part of other policies.

There are various policy instruments that could be deployed to implement and scale up permanent CDR. There is a voluntary carbon market where CDR certificates are traded. However, the current voluntary market will not be able to achieve the required scale and quality of CDR. First, it is not sufficiently clear whether the voluntary market will lead to long-term, sustainable and truly additional CDR. The voluntary market is geared towards offsetting fossil emissions with relatively cheap, temporary CDR. Second, the voluntary market is likely to remain small, because the incentives for companies to invest in CDR are limited and fragile. There are various other ways in which the government can stimulate the demand for CDR, for example by procuring CDR certificates, obliging emitters to carry out CDR, or including CDR in an emissions trading scheme. A key prerequisite for the deployment of these instruments is a reliable certification system for CDR. European certification policy to this end is already at an advanced stage.

It is in the Netherlands' interest to ensure that sustainable methods for permanent CDR become widely available as soon as possible. As a rich country with both high current and historical per capita emissions, the Netherlands must contribute to reducing a temperature overshoot. The Netherlands also has an interest in counterbalancing what will likely be 'hard-to-abate' residual emissions, for example from some parts of the agriculture sector, the industry and aviation. The Dutch government should therefore adopt targeted policies to stimulate the implementation of various methods of permanent CDR. To meet the climate targets, this would need to be well underway before 2035. An obligation that would only apply to Dutch emitters would create an uneven European playing field. Targeted procurement of CDR certificates is currently a suitable instrument, as it can be introduced relatively quickly, does not come at the expense of emission reductions, and does not disadvantage Dutch emitters.

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Recommendation
The Council recommends launching a Dutch government-led procurement programme for permanent CDR to gain experience with various methods of CDR in the Netherlands in the runup to 2035.

It is important that, in addition to Dutch policies, European CDR policies also get off the ground quickly. As a member state with a relatively large need for permanent CDR, it is important for the Netherlands that European CDR policies are implemented. With European-level policies, more CDR options will become available, which will reduce the costs. Such policies can also prevent carbon leakage and create a level playing field for emitters. It is therefore in the Netherlands' interest for Europe to quickly reach sound agreements. The Netherlands can influence this by leading the way in the development of a European strategy for creating demand for CDR.

Recommendation
The Council advises the Dutch government to initiate cooperation with other member states to explore possible European policy instruments for creating demand for CDR and encourage their introduction.

Any potential inclusion of CDR in Europe's Emissions Trading Scheme (ETS) should be subject to stringent conditions. Delaying the moment of integration will reduce the risks of trade-offs between CDR and emissions reductions. Under the current policy, fossil CO_2 emissions covered by the ETS will need to fall to zero between 2040 and 2045. For some strategic or economically important activities, however, achieving zero CO_2 emissions will be almost impossible in that timeframe. The remaining emissions would require offsetting within the ETS to reach net zero. However, including CDR in the ETS too early could reduce the incentive for emissions reductions. To prevent this from happening, CDR should only be deployed in the ETS under strict conditions: only if it concerns permanent CDR (because the emissions regulated by the ETS consist entirely of fossil emissions), and only if there really is no other means, for example because the ETS no longer functions properly because there are only limited opportunities for emission reductions. Moreover, if CDR certificates are introduced in the ETS by the government, the European Union will have more opportunities to regulate the deployment of CDR in the ETS.

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Recommendation
The Council recommends to exclude CDR from the ETS as long as possible, to maintain the incentive for emission reductions for as long as possible. The Council further recommends that, should CDR become part of the ETS, only the government be authorised to introduce CDR certificates in the market.

To avoid shifting the costs of CDR to future generations, it is reasonable to ask current emitters to help pay for future CDR. Permanent CDR that is achieved today, and is not used to offset emissions, will help to limit temperature overshoot. However, there is currently little permanent CDR capacity available. It is therefore not possible to oblige current emitters to remove all their remaining CO_2 emissions from the atmosphere. Most of the costs of CDR therefore risk to be shifted to future generations, who are not themselves responsible for the emissions. To avoid the situation where future generations bear a disproportionate burden of CDR, provisions should be taken today to ensure that current emitters contribute to future CDR. There are several ways to do this, such as a CDR fund or extra investments to reduce emissions. More research is needed to determine the best route.

Recommendation
The Council advises the government to ensure that emitters start contributing from now on to the future costs of limiting and reducing a temperature overshoot, and to design and implement instruments to this end.

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