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For people and the environment

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Technical negative emissions: Is the Federal Government's climate policy target architecture *fit for purpose*?

A contribution to the discussion

Introduction

In the last three decades (1990-2019), global emissions have increased by more than 50 % to 59 Gt CO_2 equivalents $_{(eq)}$ therefore being at unprecedented levels now.[1] Thus, the imperative to achieve greenhouse gas (GHG) neutrality as quickly as possible is more urgent than ever. In order to achieve net zero GHG emissions in line with international and European climate targets, GHG emissions must be reduced as much as possible. Furthermore, GHG-intensive technologies and products must be replaced by GHG-neutral or GHG-poor ones. In addition to carbon dioxide, unavoidable, residual GHG emissions also include methane, nitrous oxide and F-gases. These must be offset by negative emissions on an ongoing basis to achieve GHG neutrality.

In the coalition agreement 2021-2025, the German government commits to technical negative emissions as a necessary complement to climate protection policy and announces a strategic process for dealing with residual emissions.[2,3] This positioning can be seen in line with the European and international climate protection policies, which also include activities on technical negative emissions. Such technical sinks include, for example, the capture of CO_2 from industrial processes or directly from the air and subsequent underground storage ("Carbon Capture and Storage", CCS or "Direct Air Carbon Capture and Storage", DACCS).

This change of course in climate policy, however, requires a readjustment of the climate target architecture in Germany. The Federal Climate Protection Act (Bundes-Klimaschutzgesetz), for example, sets sectoral GHG reduction targets to achieve GHG neutrality by 2045.

[1] Cf. IPCC (2022).
[2] Cf. SPD et al. (2021).
[3] Residual emissions are unavoidable remaining emissions, i.e. those that cannot be further minimised by reduction measures, e.g. methane from agricultural livestock.

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Residual emissions, which in previously published studies amount to between 36 and 74 Gt $CO_{2\text{-}eEq}$ depending on the assumed ambition level of the emission reduction path, are to be offset by means of negative emissions.[4] For this purpose, the Climate Protection Act sets a target corridor for the expansion of natural sinks. This corresponds to the assumed residual emissions of at least 40 million tonnes of $CO_{2\text{-}eq}$ in 2045. [5] *Natural sinks* include ecosystems, such as forests and peatlands, where emissions can be reduced and carbon sequestration maintained or even increased through sustainable agricultural and forestry land management. In the climate architecture, natural sinks, as well as emissions from land and biomass, are covered in the land use, land use change and forestry (LULUCF) sector.

Technical sinks, however, have not yet been included in the target architecture. This creates the danger that technical negative emissions and sectoral emission reduction targets are offset against each other. This issue manifests itself in scenarios in which, for example, CCS is assumed to reduce process emissions as early as 2030.[6] In this case, two risks result: First, GHG mitigation measures may be designed and implemented less ambitiously. An assumed use of CCS may lead to an improved GHG balance on paper, whereas "real" reduction measures, such as the optimisation of procedures and processes and the consistent use of waste heat, would be postponed. Second, such offsetting would have the consequence that neither sectoral reduction targets nor technical carbon sequestration (i.e. CCS, which is not yet part of national GHG inventories) could be transparently verified and tracked. Consequently, government mitigation and course correction measures would no longer be effective.

In Chapter 1, a new target architecture is proposed to limit these imponderables and disincentives for climate policy. Impulses for the design of this target architecture are given in Chapter 2. A summary is provided in Chapter 3.

[4] Cf. dena (2021), Luderer et al. (2021), Purr et al. (2019), Prognos et al. (2020), Prognos et al. (2021).
[5] Scenarios of the German Environment Agency (UBA) also show that with ambitious climate protection, natural sinks are able to compensate for the residual emissions. Cf. Purr et al. (2019).
[6] Cf. Prognos et al. (2021), dena (2021).

1 Proposal for a new climate target architecture

In the coalition agreement of December 2022, the German government introduces technical negative emission technologies into its climate protection policy. This inclusion regards exclusively offsetting residual emissions. From the perspective of the German Environment Agency this would require the expansion of the climate target architecture. In combination with the existing GHG emission reduction targets and the targets for natural sinks, this results in the following target triad:

1) Targets for sectoral GHG emission reduction

In accordance with the Climate Protection Act, GHG reduction targets are set for the energy, industry, buildings, waste, transport and agriculture sectors.[7] Until 2030, annual binding emission ceilings for these sectors, with the exception of the energy sector, are set in the Climate Protection Act. Cumulatively across all sectors, GHG emissions are to be reduced by at least 65 percent by 2030 and by at least 88 percent by 2040 compared to 1990. Worth mentioning in this context is a study by the German Environment Agency from September 2021, which shows how emissions could already be reduced by 70 percent by 2030 and by at least 90 percent by 2040.[8]

2) Targets for carbon sequestration in natural ecosystems (natural sinks)

The carbon sequestration by natural sinks recorded in the Climate Change Act in the LULUCF sector is to be achieved through sustainable agricultural and forestry land management, e.g. rewetting of peatlands and paludiculture. By 2030, at least 25 million t $CO_{2eq.}$, by 2040 at least 35 million t $CO_{2eq.}$ and by 2045 at least 40 million t $CO_{2eq.}$ are to be integrated in this way. The net $CO_{2eq.}$ integration in the LULUCF sector is thus always reported separately from the GHG reduction targets. For a net-zero balance in the target year 2045, offsetting can take place.

3) Targets for technical carbon sequestration (technical sinks) to offset unavoidable residual emissions

In order to prevent trade-offs and competition between technical sinks and emission reductions or the expansion of natural sinks, individual reporting is necessary. For this reason, technical sinks must be reported in a separate "category". In this way, ambitious measures and instruments for GHG mitigation or for the expansion of natural sinks can be formulated and implemented without technical removals lowering mitigation ambitions. The division of natural and technical sinks into two categories is also a prerequisite for establishing a transparent and reliable reporting and monitoring system.

In accordance with the coalition agreement, technical sinks should be seen as complementary to natural sinks. The possible future definition of a technical sink target has to be aligned with an ambitious development of the natural sink capacity. Thus, the target value for technical sinks can also be zero in the case of ambitious GHG reduction, ambitious measures for the expansion of natural sinks and minor impacts from climate change.

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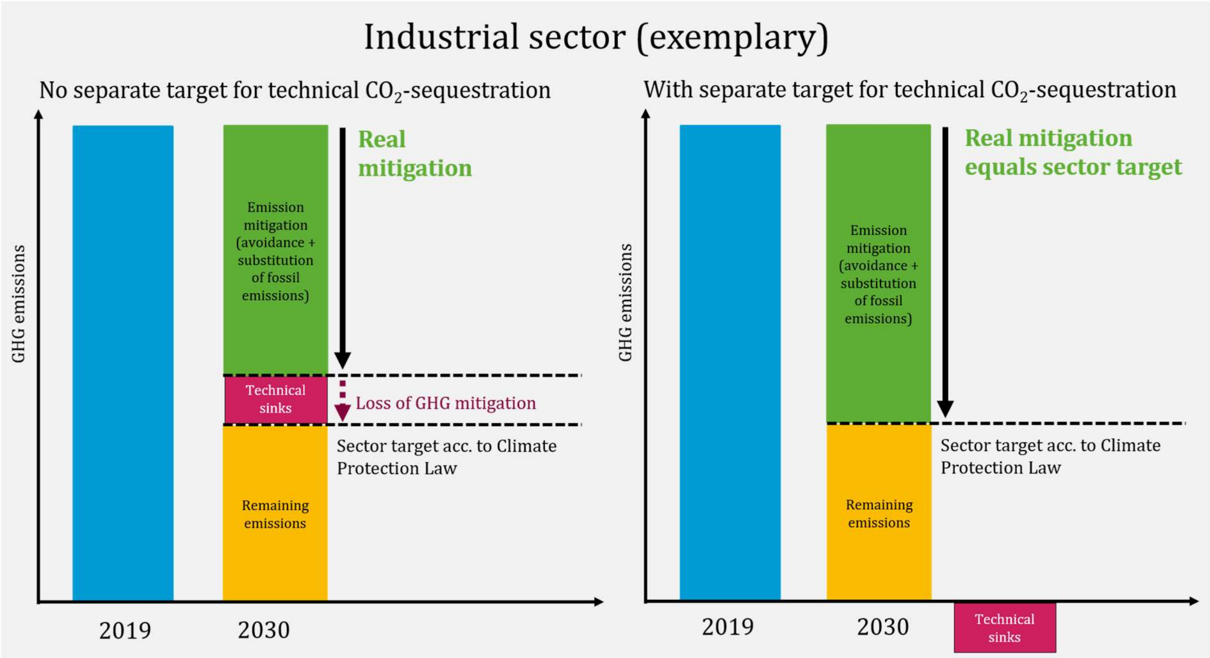
[7] Cf. KSG (2021).
[8] Cf. Purr et al. (2021).

Figure 1: Emission reduction through avoidance and substitution with and without a separate target for technical CO_2 removal using the example of the industrial sector



Source: own representation, German Environment Agency

Figure 1 shows at the example of the industry sector how a lacking separate target for technical CO_2 reduction affects the sectoral emission reduction. There is a risk that the actual emission reduction will be reduced by the assumed technical CO_2 reduction (see left graph). A separate target for the technical CO_2 reduction ensures that the sectoral targets can be achieved through emission reductions alone (see right graph).

2 Realigning the climate target architecture: What needs to be done?

In order to realign the target architecture with a sustainable climate protection policy, the German Environment Agency emphasizes that the following minimum requirements must be met:

1. Premise of emission reduction

The highest priority is the reduction of GHG emissions. Whenever possible, emissions should be prevented from occurring in the first place or reduced through improved efficiency and sufficiency. Once these two reduction strategies have been exhausted, GHG-intensive activities, processes or products must be replaced by GHG-neutral or low-GHG alternatives. Only remaining emissions reduced to a technical minimum are to be offset by sinks to achieve GHG neutrality. The Climate Protection Act assumes residual emissions of 37.5 million t CO per $year_{2eq}$ from 2045 onwards. The upper limit has to be secured by appropriate instruments and measures on the path to 2045.[9] With the establishment of the LULUCF target, the performance of natural sinks, i.e. carbon sequestration in natural ecosystems, has to amount to at least 40 million t CO_{2eq} in 2045, so that a balance of the residual emissions would be achieved through natural sinks alone.

Regarding natural sinks, the premise of emission reduction is supported by the target architecture of the Climate Change Act. A target triad as proposed above would also make the application of technical sinks compatible with the premise of emission reductions

2. Integrated climate protection

Integrated climate protection can leverage synergies with other environmental goals and reduce trade-offs. In this respect, the preservation and expansion of natural sinks offer numerous advantages in addition to carbon sequestration, e.g. species protection, improvement of the microclimate (near the ground) and the water balance. With this land management practices which are harmful to the climate and biodiversity are reversed and synergies between climate protection and biodiversity can be harnessed. Adverse side effects, such as land use conflicts, reduction of albedo or disturbances of the microclimate, will be minimised. In contrast, focussing on technical sinks leads to lock-ins on fossil fuel pathways. In addition to the question of the reversibility of the carbon sequestration, which is also an issue with natural sinks, there are also negative consequences for other environmental media, e.g. influencing the pH value of groundwater and seawater. For these reasons, carbon sinks with the greatest possible co-benefits with other environmental objectives must always be prioritised. As previously highlighted, the level of a technical sink target can be "0" accordingly if the natural sink performance is sufficient.

[9] Cf. BT-Drs. 19/30230.

3. Reporting and monitoring system

Insufficient and non-permanence or reversibility of the carbon sequestration are among the key risks of both natural and technical sinks. The LULUCF sector, which includes natural sinks, is already covered in GHG inventories. However, some challenges still remain This includes for example the integration of natural ecosystem enhancement measures with higher granularity into the reporting and monitoring system. One of the benefits of this would be the more effective tracking and adaptation of measures. In contrast, technical processes for carbon sequestration in Germany have not yet been included in the GHG inventories. From the perspective of the German Environment Agency existing international reporting rules for CCS technology in accordance with the 2006 IPCC Guidelines for Emissions Reporting[10] need to be supplemented in many parts[11]. This would enable a transparent and reliable monitoring and reporting system for all process steps.

4. Transparency

The integration of technical sinks - pilot projects, market introduction and ramp-up - are associated with profound societal and economic changes. Whether, at what time and to what extent negative emission technologies are used to offset unavoidable has to be carefully considered. It is subject to socio-political decision processes whether the risks, uncertainties, costs and environmental and climate impacts outweigh the societal consequences of exceeding the 1.5-degree temperature limit. Transparent communication and continuous involvement of the public and relevant actors from politics, business, science and civil society are necessary to enable participation and buy-in.

[10] Cf. IPCC (2006).

[11] The new reporting tables under the Paris Agreement provide a way to record the recovery and recycling of emissions in the relevant source groups, but lack methods to consistently track GHGs.

3 Summary

With the German government emphasising the role of negative emission technologies for achieving GHG neutrality as of the coalition treaty of December 2022, it needs a reorientation of the climate policy architecture. This positioning is also necessary due to the activities on technical negative emissions in the European Union and in international climate policy. For these reasons, the German government should take a stand as soon as possible and adopt a sustainable and ambitious target architecture with a robust strategy for achieving and securing GHG neutrality. In order to continue to ensure and strengthen an ambitious climate protection policy, a separate recording of sectoral reduction targets, natural and technical sink targets have to be proposed. The target triad is as follows:

1. GHG reduction targets for the energy, industry, buildings, transport, agriculture, waste management and other sectors.

2. Targets for carbon sequestration in the LULUCF sector (natural sinks).

3. Targets for technical carbon sequestration to offset unavoidable, residual emissions (technical sinks).

In addition, the following minimum requirements are proposed for the realignment of the target architecture:

- According to the premise of emission reduction, residual emissions are only to be offset by sinks if emissions cannot be avoided or substituted.

- Integrated climate protection, i.e. the use of synergies with other environmental goals, must always be pursued. Technical sinks must always be aligned with the ambitious development of natural sink performance.

- A transparent and reliable monitoring and reporting system is a prerequisite for addressing the risk of non-permanence and reversibility of natural and technical sinks.

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