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Land use as a sector for market mechanisms under Article 6 of the Paris Agreement

Final report

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Land use as a sector for market mechanisms under Article 6 of the Paris Agreement

Final report

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Abstract: Land use as a sector for market mechanisms under Article 6 of the Paris Agreement

The land-use sector plays a critical role for achieving the goals of the Paris Agreement to limit the increase of global average temperature to well below 2 °C and to achieve a balance between emissions by sources and removals by sinks in the second half of this century. This report discusses key environmental integrity challenges for using carbon market mechanisms to implement mitigation activities in the land-use sector. For carbon crediting mechanisms, the main challenges relate to the demonstration of **additionality** of mitigation activities, establishing **credible baselines**, addressing the risk of **leakage** from shifting of activities, the quantification of net carbon storage with **effective monitoring** systems, avoiding **double counting** both between nationally determined contributions and when integrating activities by different actors into a national accounting framework, and addressing the risk of **non-permanence** of stored carbon. Moreover, there is the need to establish **environmental and social** safeguards to minimise trade-offs and promote co-benefits. For cap-and-trade systems, addressing non-permanence is also a major challenge, next to the scope of emissions and removals to be included (e.g., land-based versus activity-based) and accounting questions (e.g., gross-net, net-net or accounting against a projected baseline).

The report evaluates how existing carbon market mechanisms address these challenges in practice and to what extent these approaches can mitigate environmental integrity risks. The analysis includes selected crediting mechanisms and two case studies of cap-and-trade systems (the EU LULUCF Regulation and the New Zealand Emissions Trading Scheme). Finally, the report synthesises key findings regarding the inclusion of the sector in carbon market mechanisms.

Kurzbeschreibung: Land use as a sector for market mechanisms under Article 6 of the Paris Agreement

Der Landnutzungssektor spielt eine entscheidende Rolle für das Erreichen der Ziele des Übereinkommens von Paris, den Anstieg der globalen Durchschnittstemperatur auf deutlich unter 2 °C zu begrenzen und ein Gleichgewicht zwischen Treibhausgasemissionen aus Quellen und der Aufnahme von Kohlenstoff durch Senken in der zweiten Hälfte dieses Jahrhunderts zu erreichen. Dieser Bericht erörtert die wichtigsten Herausforderungen für die Umweltintegrität bei der Nutzung von Kohlenstoffmarktmechanismen zur Umsetzung von Minderungsmaßnahmen im Landnutzungssektor. Bei Crediting-Mechanismen sind die größten Herausforderungen der Nachweis der **Zusätzlichkeit** der Minderungsaktivitäten, die Festlegung glaubwürdiger **Referenzszenarien** (baselines), die Bewältigung einer möglichen **Verlagerung von Emissionen oder Aktivitäten** (leakage), die Quantifizierung der Netto-Kohlenstoffspeicherung mit effektiven **Monitoring**systemen (monitoring), die Vermeidung von **Doppelzählungen** (double counting), sowohl in Hinblick auf NDCs als auch bei der Integration von Aktivitäten verschiedener Akteure in einen nationalen Anrechnungsrahmen, und die potenzielle **Nicht-Permanenz** (non-permanence) von gespeichertem Kohlenstoff. Darüber hinaus müssen **ökologische und soziale Schutzmaßnahmen** eingeführt werden, um Zielkonflikte zu minimieren und **Co-Benefits** zu fördern. Bei Cap-and-Trade-Systemen ist neben dem Umfang der zu berücksichtigenden Emissionen und der Kohlenstoffspeicherung (z. B. landbasiert versus aktivitätsbasiert) und den Fragen der Bilanzierung (z. B. brutto-netto, netto-netto oder Bilanzierung gegen eine projizierte Baseline) auch der Umgang mit einer möglichen Nicht-Permanenz eine große Herausforderung.

Der Bericht untersucht, wie bestehende Kohlenstoffmarktmechanismen diese Herausforderungen in der Praxis adressieren, und beurteilt, inwieweit diese Ansätze die Risiken für Umweltintegrität mindern können. Die Analyse umfasst ausgewählte Crediting-

Mechanismen und zwei Fallstudien von Cap-and-Trade-Systemen (EU-LULUCF-Verordnung und Neuseeländisches Emissionshandelssystem). Abschließend fasst der Bericht die wichtigsten Ergebnisse hinsichtlich der Einbeziehung des Sektors in Kohlenstoffmarktmechanismen zusammen.

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List of abbreviations

AAUs	Assigned Amount Units
ACR	American Carbon Registry
AFOLU	Agriculture, Forestry and Other Land Use
AR	Afforestation/Reforestation
ARB	California Air Resources Board
ART TREES	Architecture for REDD+ transactions/The REDD Environmental Excellency Standard
BAU	Business as Usual
CAR	Climate Action Reserve
CCER	Chinese Certified Emissions Reductions
CCP	Core Carbon Principles
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CH_4	Methane
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CO_2	Carbon dioxide
CO_2eq.	Carbon dioxide equivalent
COP	Conference of the Parties
EC	European Commission
ERF	Australia Emission Reduction Fund
ERUs	Emission Reduction Units
EU	European Union
EUC	Emissions Unit Criteria
ETS	Emissions Trading System
FCPF	Forest Carbon Partnership Facility
FMRL	Forest Management Reference Level
FRL	Forest Reference Level
GHG	Greenhouse gas
GS	Gold Standard Foundation
HWP	Harvested Wood Products
HZK	Humus-Zertifikate Kaindorf
ICAO	International Civil Aviation Organization
IFM	Improved forest management
ILUC	Indirect land-use change
IPCC	Intergovernmental Panel on Climate Change
ITMOs	Internationally Transferred Mitigation Outcomes

JCM	Joint Crediting Mechanism
JI	Joint Implementation
JNR	Verra‘s Jurisdictional and Nested REDD+
KP	Kyoto Protocol
lCER	Long-term Certified Emission Reduction
LULUCF	Land Use, Land-Use Change and Forestry
MA	Marrakesh Accords
MRV	Monitoring, Reporting, Verification
MS	European Union Member State
N_2O	Nitrous oxide
NDC	Nationally Determined Contributions (in Paris Agreement)
NFMS	National Forest Monitoring System
NZ	New Zealand
NZ ETS	New Zealand Emission Trading Scheme
NZU	New Zealand Unit
ODA	Official Development Assistance
OMGE	Overall mitigation in global emissions
PA	Paris Agreement
PFSI	Permanent Forest Sink Initiative
puro	Puro earth
PV	Plan vivo
REDD+	Avoiding deforestation or forest degradation, including reduced emissions from deforestation and degradation
REDD+ SES	REDD+ Social and Environmental Standards
RGGI	Regional Greenhouse Gas Initiative Offset Programme
RMUs	Removal Units
tCER	Temporary Certified Emission Reduction
TFS	California Tropical Forest Standard
UBA	Umweltbundesamt
UK PC	United Kingdom Peatland Code
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verra’s Verified Carbon Standard
WET	Wetland management
WCC	Woodland Carbon Code

Summary

The land-use sector plays a critical role in climate change mitigation strategies due to its ability to take up carbon dioxide (CO_2) from the atmosphere through natural processes and store it as carbon in different pools. The land-use sector can thus be both a source and a sink of greenhouse gas (GHG) emissions. Reducing emissions from the sector, in particular by avoiding deforestation, and enhancing its capacity to remove CO_2 from the atmosphere will be critical to achieve net zero emissions in the second half of this century, as agreed under the Paris Agreement.

To achieve these goals, policymakers pursue a variety of policy instruments. In recent years, carbon market approaches have been increasingly embraced as a means to incentivise emission reductions and removals from the land-use sector. There are different approaches that aim at reducing emissions or enhancing removals in the land-use sector, some of them can be referred to as referred to as 'nature-based solutions'. Using market or market-based approaches for the land-use sector raises, however, also particular challenges. This report discusses these challenges with a focus on environmental integrity risks and the new context of Article 6 of the Paris Agreement. In assessing these risks, the report looks at the land-use sector in the same way as at any other sector, as indeed many risks do not uniquely apply to land-use activities. The report addresses both crediting and cap-and-trade mechanisms and aims to identify key issues and challenges, as well as approaches to address them.

In this report, we define the land-use sector as what the Intergovernmental Panel on Climate Change (IPCC) refers to as Land Use, Land-Use Change and Forestry (LULUCF). This definition excludes agricultural activities, such as livestock management and fertiliser application, that are covered by the Agriculture sector and have been merged with the LULUCF sector in the IPCC's Agriculture, Forestry and Other Land Use (AFOLU) sector. The report focuses on forests and peatlands and differentiates four types of land-use activities: avoiding deforestation or forest degradation; afforestation and reforestation; improved forest management; and wetland management. We further define that 'environmental integrity' of mechanisms is ensured if aggregated global GHG emissions do not increase as a result of including an activity or action into a carbon market mechanism.

How is land use considered in international climate agreements?

Over the past decades, land-use activities have been considered in international climate agreements in various ways. In 1997, the **Kyoto Protocol** (KP) introduced GHG targets for GHG emission reductions and a cap-and-trade system for developed countries referred to in its Annex I. In Articles 3.3 and 3.4, the KP established rules for mandatory and voluntary accounting of land-use activities that result in direct anthropogenic emissions or removals. The Clean Development Mechanism (CDM) allowed developed countries to use emission reductions or removals generated from climate mitigation projects in developing countries to achieve their GHG emissions targets. Under Joint Implementation (JI), developed countries could implement climate mitigation projects and transfer the resulting emission reductions or removals to other developed countries. Under the CDM, only afforestation and reforestation projects were eligible, due to concerns over environmental integrity risks associated with crediting other LULUCF activities. Under JI, all types of LULUCF activities were eligible. Through its accounting rules the KP set the basis for several other international climate policies involving the land-use sector.

Adopted in 2013 under the Convention, the Warsaw Framework for **REDD+** (Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries)

provides for an international framework for performance-based payments for measurable and verifiable emission reductions or removals through concrete land-use measures in developing countries. Eligible activities include reducing forest conversion to other land use types, reducing forest degradation and improving forest management and afforestation. REDD+ is a national level approach that was developed for implementation in developing countries, also in response to the fact that avoided deforestation was not accepted as an activity under the CDM.

The 2015 **Paris Agreement** (PA) requires all countries to regularly communicate nationally determined contributions (NDCs) that set out their mitigation targets and actions. 102 countries included the land-use sector in various ways in their first NDCs, applying different approaches to formulate targets and to account for emissions and removals. Article 6 of the PA establishes a framework for Parties to engage in international carbon market mechanisms. Article 6.2 allows countries to use 'cooperative approaches' that involve the use of 'internationally transferred mitigation outcomes' (ITMOs) towards their NDCs. Article 6.4 establishes a new crediting mechanism that aims to contribute to the mitigation of GHG emissions and support sustainable development. This mechanism is commonly regarded as a successor to the CDM and JI. After six years of negotiations, the guidelines for cooperation under Article 6.2 and the rules, modalities and procedures for the Article 6.4 mechanism have been adopted at COP26 in Glasgow in November 2021. These may involve transfer of ITMOs from activities in the land-use sector, though there will be further considerations whether "emissions avoidance" and "conservation enhancements" will be eligible.

What are challenges for land-use activities in carbon crediting mechanisms?

The integration of land-use activities into international market mechanisms has been the subject of controversial discussion for decades. In practice, various governmental and non-governmental carbon crediting mechanisms have permitted the registration of land-use activities. So far, carbon credits from these activities have mainly been used in the voluntary market, i.e., by buyers who offset their emissions voluntarily in order to offer carbon neutral products or services, to achieve climate neutrality or net-zero targets, or to simply finance emission reductions elsewhere. Some governments also recognise carbon credits from land-use activities under national climate policies.

Based on a review of available literature, expert interviews, a workshop by UBA conducted in October 2020, and an evaluation of approaches employed by carbon crediting programmes, this report identifies and discusses key environmental integrity challenges for including different types of land-use activities in carbon crediting mechanisms. Key challenges include:

- **Demonstrating additionality**: Additionality is essential to ensure that carbon credits are backed by actual emission reductions or removals. Emission reductions or removals are only additional if they are caused by the incentives from carbon crediting revenues. If they also occur in the absence of the incentives from carbon credits, they are not additional. Non-additional emission reductions or removals undermine the effectiveness of crediting mechanisms. Robust additionality assessments are fundamental to any carbon crediting mechanism and for activities in any sector. Determining causality between a mitigation activity and emission reductions and removals in the land-use sector is particularly challenging, because national and sub-national policies strongly influence land-use decisions and land-use change is driven by multiple direct and indirect social and economic drivers.

- **Determining baselines**: A baseline represents the level of emissions or removals against which actual emissions or removals are compared to in order to determine the emission reductions or removals resulting from an activity. In practice, baselines can involve considerable uncertainty as they form counterfactual scenarios which cannot be observed or verified. To address uncertainty and preserve environmental integrity, many carbon crediting mechanisms require that baselines be established in a conservative manner (i.e., with a bias towards underestimation). The PA sets new conditions for establishing baselines. The NDC and policies needed to implement the NDC should be reflected in determining baseline levels, such that baselines for international carbon crediting are set at least at a level that is consistent with the NDC, or at more ambitious levels. Carbon crediting programmes use a variety of approaches for establishing baselines, including reference areas (for projects), (adjusted) historical averages (for projects and jurisdictions), historical trends (for projects and jurisdictions), and modelling (for jurisdictions). For afforestation and reforestation activities the uncertainty of the baseline is relatively low. For avoiding deforestation and forest degradation, improved forest management, and wetland conservation, the uncertainty of the baseline scenario remains a major environmental integrity risk that is difficult to address. This is because the baseline can be influenced by factors that are outside of the control of the mitigation activity, such as changes in demand for agricultural commodities or natural disturbances that may increasingly occur due to climate change.

- **Addressing or preventing leakage of emissions and removals**: If activities for reducing emissions or increasing removals in the land-use sector affect sources and sinks in other sectors or outside the target area, this is commonly referred to as leakage. Direct leakage, or primary leakage, occurs when an activity causes activities or agents to shift from one area to another. Indirect leakage, or secondary leakage, also occurs if land-use activities cause a reduction in product or service supply from the target area but occurs more indirectly, through market effects. Third, ecological leakage occurs when a land-use activity affects natural processes stretching out to surrounding ecosystems, e.g., by impacting the hydrological conditions and causing a tree dieback. Land-use related activities have variable risks of leakage. The risk of leakage depends partly on the type of activity (e.g., wetland restoration leading to ecological leakage) but even more on the activity design, scale and underlying drivers. Global leakage is particularly difficult to address. An ideal approach to addressing leakage includes identifying and mitigating leakage risks (e.g., by excluding activities with material risks of indirect leakage), monitoring and quantifying any remaining leakage during the activity's lifetime, and accounting for leakage by deducting leakage emissions in the calculation of total emission reductions and removals.

- **Monitoring of emission reductions and removals**: The monitoring, reporting and verification (MRV) required by crediting standards refers to the process of periodically quantifying the emission reductions or removals of an activity. The ability to accurately assess sources and sinks is important for ensuring environmental integrity of activities. Monitoring requirements are typically quite detailed for carbon crediting mechanisms and can include different means of validation, verification and documentation. Monitoring forms an important basis for robust accounting of any potential transfer of credits from land-use activities between different systems. This requires consistent methodological approaches to be applied. Currently, there are considerable inconsistencies between approaches applied under NDCs, for activities under the Warsaw Framework for REDD+ and carbon crediting mechanisms of voluntary markets.

- **Avoiding double counting**: Double counting occurs when a single emission reduction or removal is used more than once towards the achievement of mitigation targets or goals. It can occur in three main ways: double issuance of units, double use of units, and double claiming of emission reductions or removals. The variety of carbon crediting mechanisms, types of targets, and purposes for which carbon credits are used poses a significant challenge when it comes to preventing double counting, especially double claiming. Double counting is a particular risk for activities in the land-use sector, for two reasons: First, land ownership, land use and land management often lay in the hands of different stakeholders with overlapping rights. And second, some carbon crediting mechanisms pursue jurisdictional approaches which may overlap with crediting at the level of projects. Moreover, most carbon credits generated from activities in the land-use sector are used in the voluntary carbon market, potentially causing issues of double claiming with NDCs. Such double claiming can be avoided if (1) host countries account for the use of carbon credits by other entities under Article 6, through the application of 'corresponding adjustments'; if (2) only emission reductions and removals are credited that are outside of the scope of NDCs; or if (3) the buyers of the carbon credits do not claim the emission reductions or removals but make financial contributions that support the host country to achieve its NDC.
- **Addressing the risk of non-permanence:** Emission reductions or removals from mitigation activities in the land-use sector can be reversed if carbon stocks that are preserved or enhanced are lost through natural or human-induced disturbances at a later point in time. The risk depends on the susceptibility of the carbon reservoir to natural depletion processes, on the size and scale of the reservoir, and on how the mitigation activity affects human-caused drivers of carbon reservoir depletion. These aspects can considerably differ among different types of reservoirs and mitigation activities. For example, the non-permanence risk of an avoided deforestation project in a fire- and drought-prone area is higher than for a peatland restoration project with sufficient water supply. Crediting mechanisms have developed various approaches to address non-permanence risks in practice. This includes (1) measures to reduce non-permanence risks, such as requirements to design the mitigation activities in ways that reduce non-permanence risks; (2) monitoring and compensation for reversals (e.g., by establishing a 'pooled buffer reserve' in which a fraction of the carbon credits is set aside to compensate for reversals); (3) issuing temporary carbon credits which expire at some point and can be renewed if the carbon is still stored; and (4) discounting emission reductions and removals. Most carbon crediting programmes combine the first and second approach.
- **Considering safeguards and co-benefits**: Safeguards are essential to minimise potential social and environmental risks occurring when activities are being implemented under carbon crediting mechanisms. Safeguards are especially important for activities in the land-

use sector, where risks for other ecosystem services and social impacts (e.g., on rights of indigenous peoples) cannot be avoided altogether but need to be minimised. In practice, implementation of safeguards by carbon crediting programmes varies greatly. Minimum requirements relate to simply reporting on safeguards, while the strongest include grievance and redress mechanisms. Co-benefits of land-use activities are very context-specific and therefore hard to assess in a standardised manner.

What are challenges for land-use activities in cap-and-trade mechanisms?

Land-use activities have not only been introduced under carbon crediting mechanisms but also in some cap-and-trade systems, such as emissions trading systems (ETSs). The European Union (EU) has established a system for the land-use sector with similarities to a cap-and-trade system. New Zealand is the only ETS in which the land-use sector is included. This report reviews these two schemes.

The EU established a separate target for the land-use sector in the **EU LULUCF Regulation** and recently also included the full scope of emissions and removals from the land-use sector in its updated NDC. The EU LULUCF Regulation establishes a binding target for each EU Member State (MS) that the reported emissions from land use must be fully offset by an equivalent removal of CO_2 from the atmosphere through measures in this sector ('no-debit' rule). In its updated NDC submitted to the UNFCCC in December 2020, the EU communicated an economy-wide target of at least 55% greenhouse gas reductions by 2030 compared to 1990, without contributions from international carbon credits, but including the land-use sector. The EU LULUCF net sink is currently as high as it was in 1990 and expected to be reduced only slightly until implying that other sectors under the target would have to reduce their emissions only by about 53% compared to 1990 for meeting the overall -55% target. A separate net sink target was agreed aiming at a total of -310 Mt CO_2eq. to ensure an increase of efforts for expanding the EU's carbon sinks. However, due to non-permanence risks and volatility of GHG emissions from the land-use sector, the full-scope inclusion creates uncertainties that create challenges for quantifying and governing sectoral climate targets.

The LULUCF Regulation applies detailed rules for accounting for the land-use sector. For accounting of afforested land and deforested land a **gross-net accounting** approach is applied Total net removals or net emissions resulting from afforestation or deforestation during the accounting periods from 2021 to 2025 and 2026 to 2030 are fully taken into account. Instead, for accounting of managed cropland, managed grassland and managed wetland a **net-net accounting** approach is applied. For these categories net emissions or removals in the periods from 2021 to 2025 and from 2026 to 2030 are compared to average annual emissions and removals in a specific base period as an average of the years 2005 to 2009 reported by EU Member States. Also accounting of managed forest land is based on a comparison to a reference, the Forest Reference Level (FRL). The FRL forms the level of emissions and removals that would occur in managed forest land in the future based on the continuation of 'sustainable forest management practices' applied in the period 2000 to 2009. These rules aim to separate anthropogenic effects (e.g., caused by management changes) from natural growth effects in the forest (e.g., due to the age of forests). However, the EU LULUCF Regulation does not address environmental and social safeguards, such as maintaining and enhancing biodiversity. The proposal for a revision of the EU LULUCF Regulation and other EU policies presented in 2021 further considers options for incentivising agriculture and forestry activities to increase and store carbon sequestered. An option explored is the formation of a joint pillar consisting of the agriculture and LULUCF sectors (also referred to as the AFOLU sector), with a separate target.

This would imply full flexibility between the two sectors and is expected to deliver more cost-efficient mitigation options. However, there is also the risk of undermining environmental integrity by allowing offsetting non-CO_2 emissions from the agriculture sector by removals from the land-use sector, given non-permanence risks, considerable quantification uncertainties and reporting gaps in national GHG inventories in the LULUCF sector.

The **NZ ETS** covers several sectors. As of 2019, the forestry, waste, industry and energy sectors have obligations to report GHG emissions and surrender units, covering around 54% of New Zealand's emissions. It is the only scheme in the world that includes the forestry sector. The ETS rules applying to the forestry sector were designed to align with the requirements of the Kyoto Protocol and to help New Zealand meet its related obligations. Thus, forests are treated according to the year of their establishment and divided into two categories, with the Kyoto base year of 1990 as the cut-off date. NZ ETS participants have the obligation to report on the emissions resulting from their activities or on the removals of their activities. Deforestation of pre-1990 forest land requires landowners to surrender a respective number of units. Owners of post-1989 forest land can voluntarily opt into the NZ ETS and earn units for CO_2 removals. In its first NDC, NZ has broadly outlined the accounting methodologies it will apply for the LULUCF sector to assess achievement of its 2030 target under the Paris Agreement.

In the past, the NZ ETS has proven to be ineffective for reducing the country's emissions. This is partly because many key features, like the cap, were not implemented. The ETS was designed to function in the context of the Kyoto Protocol which resulted in an oversupply of units. The agriculture sector only carries reporting obligations in the NZ ETS. A set of amendments adopted in 2020 has the potential to improve the effectiveness of the ETS. Changes in the forestry sector aim to increase participation and incentivise improved management and afforestation. However, increased forestry carbon removals might in turn reduce pressure for decarbonising other sectors.

What are overall conclusions for using carbon market mechanisms for activities in the land-use sector?

Including land-use activities into carbon market mechanisms under the PA raises particular environmental integrity challenges. In considering the role of the sector, key questions are for which type and scale of activities environmental integrity risks are high, and, whether and how these risks can be appropriately addressed.

Fehler! Verweisquelle konnte nicht gefunden werden. provides an overview of the different environmental integrity risks and whether and how they can be addressed in the context of **crediting mechanisms**. Some environmental integrity risks uniquely apply to all land-use activities, while others differ substantially among different types of activities.

Table 1: Environmental integrity risks for different types of land-use activities and whether and how they can be addressed with current approaches

	Afforestation and reforestation	Reduced deforestation or forest degradation	Improved forest management	Wetland management
Mitigation type	Increasing carbon removals	Avoiding GHG emissions	Increasing carbon removals	Increasing carbon removals and/or reducing GHG emissions
Assessing additionality	Can be assessed	Difficult to assess	Difficult to assess	Wetland restoration: Can be assessed Wetland preservation: Difficult to assess
Addressing non-permanence	• Cannot be ensured - risks can only be mitigated; • Activities with high non-permanence risks should be excluded from crediting; • Appropriate activity design, responsibility of project owners to monitor and compensate for reversals over long time horizons, coupled with sufficiently capitalised and diversified pooled buffer reserves, are best suited to reduce reversal risks.			
Determining baselines	Can be determined, as uncertainty of future developments is limited	Difficult to determine as it involves considerable uncertainty about future developments		Wetland restoration: Can be determined Wetland preservation: Difficult to determine due to uncertainties
Addressing leakage	Depends on design of activity, e.g., status of land to be afforested	Depends on design of activity, e.g., deforestation drivers to be addressed	Depends on design of activity, e.g., forest products affected by activity	Depends on design of activity, e.g., alternative land uses considered
	• Increasing the boundaries of land-use activities from projects to jurisdictional scale can avoid direct leakage within the jurisdiction; • Lack of data regarding global leakage; • Activities causing global leakage should generally be excluded from crediting; • Cross-border leakage easier to assess, but needs to be incorporated in monitoring			
Effective monitoring and reporting	• Can effectively be done; • Biomass pools can be monitored with higher accuracy than soil carbon pools; • Global data and remote sensing can help to increase accuracy and consistency; • Consistency between lower level activities and national level reporting can be challenging.			
Avoiding double counting	• Can be avoided; • Provisions to ensure unique claims to carbon stored in the land are important; • ‘Nested’ accounting can avoid double issuance between jurisdictional approaches and crediting at project level.			
Considering safeguards and co-benefits	• Can in general be considered; • Risks and co-benefits are very context-specific: Land-use activities can pose particular risks but also considerable opportunities regarding adaptation, biodiversity protection, ecosystem restauration, sustainable development and human health.			

Source: Own compilation.

Among the environmental integrity risks applicable to all land-use-activities, perhaps the most important risk is **non-permanence**. In contrast to most other mitigation measures, the permanence of emission reductions or removals in the land-use sector cannot be ensured, and reversal risks can only be mitigated. If the goal is to stabilise GHG concentrations in the long-term, the degree to which measures in the land-use sector are used to enable continued GHG emissions from fossil fuels, which do not face any material non-permanence risks, becomes questionable. If land-use activities are pursued under crediting mechanisms, it is critical to appropriately manage reversal risks. First, carbon crediting programmes should refrain from crediting activities where reversal risks are high, such as for commercial plantations. Second, it is critical that the owners of the mitigation activity have incentives to reduce reversal risks. This can be best achieved by establishing requirements or incentives to appropriately design and maintain land-use activities and by requiring the activity owners to monitor and compensate for any reversals. Monitoring and compensation should be undertaken for sufficiently long time periods, such as 100 years, in order to provide incentives for robust activity design and to appropriately 'internalise' the cost of reversals. Sufficiently capitalised pooled buffer reserves or insurances should complement these approaches to address reversals caused by catastrophic events, changing climate conditions or situations where activity proponents are unable to compensate, e.g., due to bankruptcy.

Double counting of emission reductions and removals is another risk to all land-use activities as well as activities in other sectors. Two aspects are of particular importance to the land-use sector: potential competing claims to the carbon stored and the potential overlap of action at the jurisdictional and project level. These risks can be robustly addressed if carbon crediting programmes have provisions in place to ensure unique claims and pursue 'nested' accounting approaches to prevent double issuance of units due to overlap between crediting at jurisdictional and project level.

Some environmental integrity risks, in particular assessing **additionality**, establishing **baselines**, and preventing **leakage**, differ substantially among different types of activities:

- For **afforestation and reforestation activities**, additionality can be assessed with a reasonable degree of confidence, using the common tools applied for assessing additionality. Moreover, it can reliably be determined how much carbon has been absorbed. Leakage risks can be reasonably mitigated if the forest is established on abandoned land or if the project design ensures that no shift in services or products occurs.

- For **avoiding deforestation and forest degradation** activities, assessing additionality, establishing baselines and addressing leakage are major challenges that are difficult to resolve. Demonstrating additionality is difficult or even impossible, as observed changes in carbon stocks can be caused by multiple reasons, with the crediting mitigation activity being only one of them. Establishing a baseline scenario for the rate of future deforestation is associated with considerable uncertainties. And lastly, deforestation is strongly driven by demand for global agricultural commodities or services, which is beyond the control of activities and may induce leakage.

- For **improved forest management activities**, assessing additionality and establishing baselines are similarly challenging as for avoided deforestation as it requires approaches for accurate assessments that are data demanding and tend to lack transparency (e.g., Forest

Reference Levels). Whether leakage can be addressed depends on activity design, e.g., the type of products affected by the activity.

- For **wetland management** activities, the risks differ between wetland restoration and wetland preservation. While additionality is more easily assessed for wetland restoration, similarly to afforestation and reforestation, additionality of wetland preservation is difficult or impossible to prove. As for avoided deforestation, baselines for wetland preservation are associated with high uncertainties. Like for other activities, approaches for addressing leakage need to consider the activity design.

Given the diverging risks and possibilities to address them, policymakers should carefully consider which type of activities should be pursued under crediting approaches. Among the activities analysed in this report, avoiding deforestation and preserving wetlands pose the highest environmental integrity risks. This is especially true regarding GHG mitigation while the risk for biodiversity might be lower. In other sectors, similar activities, such as avoiding fuel switching, have been excluded from crediting due to similar uncertainties in making assumptions about future developments, such as international fuel prices, in assessing additionality and determining baselines. In the light of the concerns with regard to the quality of some carbon credits and the various efforts underway to enhance quality, a practical policy approach might be restricting crediting mechanisms to activities with high likelihood of additionality and thus baselines can be estimated with reasonable certainty – irrespective of the sector where the mitigation activities are implemented.

Cap-and-trade mechanisms avoid some of the challenges that carbon crediting approaches bring about. They do not require assessing counterfactual scenarios regarding the additionality and baselines of specific mitigation activities. They also avoid any leakage within the scope of the system. The main challenge of cap-and-trade mechanisms is establishing the cap sufficiently below business-as-usual emissions from the regulated entities. Initial over-allocation of allowances in ETSs has been a major challenge in nearly all established ETSs.

In principle, capping emissions from the land-use sector in line with overarching mitigation targets, such as under the EU LULUCF Regulation, can be a viable alternative to crediting approaches. If designed well, it could expose the sector to a carbon price and thereby create incentives for enhancing carbon stocks. This is particularly important for achieving net zero emissions over the next decades.

However, several aspects need careful consideration. First, non-permanence needs to be addressed. This means that a land type or activity type, once included, should remain included. It also means that accounting should encompass all years, and not only single target years, in order to ensure that all reversals are accounted for, regardless of when they occur. A second important challenge is that the land-use sector is currently a net sink in most countries. If under such circumstances the sector is included under a cap-and-trade mechanism that covers also other sectors, this implies that entities in the land-use sector could sell allowances to entities from other sectors, without enhancing any removals. This could undermine the overall mitigation achieved through the cap-and-trade system. Third, using allowances from potentially non-permanent emission reductions or removals from the land-use sector could incentivise more permanent emissions, such as from fossil fuel combustion. Such a development would undermine the long-term ability of the sector to store carbon, given that biosphere and oceans have limited capacity to absorb CO_2 and that biomass and soil carbon stocks are subject to natural disturbances under a changing climate.

Overall, the possible inclusion of land-use sector activities into carbon market mechanisms needs to follow a long-term perspective. This holds in particular for the transition phase towards net zero emissions, in which the pressure for permanent emission reductions shall not be reduced by the inclusion of the land-use sector in crediting or cap-and-trade systems. An early reliance on potentially non-permanent removals from the land-use sector for offsetting permanent fossil emissions bears the danger of a lock-in into emission levels too high for achieving the goals of the Paris Agreement. On the other hand, some activities need an early implementation as they only contribute with GHG emissions reductions or removals after several years.

Zusammenfassung

Der Landnutzungssektor spielt eine entscheidende Rolle für Strategien zur Eindämmung des Klimawandels, da er in der Lage ist, durch natürliche Prozesse Kohlenstoff in Form von CO_2 aus der Atmosphäre aufzunehmen und in verschiedenen Pools zu speichern. Der Landnutzungssektor kann somit sowohl eine Quelle als auch eine Senke für Treibhausgase (THG) sein. Die Verringerung der Emissionen aus diesem Sektor, insbesondere durch die Vermeidung von Entwaldung, und die Verbesserung seiner Fähigkeit, CO_2 aufzunehmen, werden entscheidend sein, um in der zweiten Hälfte dieses Jahrhunderts Netto-Null-Emissionen zu erreichen, wie im Pariser Übereinkommen vereinbart.

Um diese Ziele zu erreichen, verfolgen die politischen Entscheidenden eine Vielzahl von Instrumenten. In den letzten Jahren werden zunehmend Ansätze des Kohlenstoffmarktes als Mittel zur Schaffung von Anreizen für die Reduzierung von Emissionen und der Speicherung von Kohlenstoff im Landnutzungssektor eingesetzt. Es gibt verschiedenste Strategien und Ansätze zur Reduktion von Emissionen oder der Erhöhung der Speicherung von Kohlenstoff im Landnutzungssektor, einige von diesen werden auch als ‚naturbasierte Lösungen' bezeichnet. Der Einsatz von Kohlenstoffmarktkonzepten für den Landnutzungssektor bringt jedoch auch besondere Herausforderungen mit sich. Dieser Bericht erörtert diese Herausforderungen mit dem Schwerpunkt auf Risiken für die Umweltintegrität und dem neuen Kontext von Artikel 6 des Pariser Übereinkommens. Bei der Bewertung von Risiken betrachtet der Bericht den Landnutzungssektor auf die gleiche Weise wie jeden anderen Sektor, da viele Risiken in der Tat nicht nur für Landnutzungsaktivitäten gelten. Der Bericht befasst sich sowohl mit Crediting-Mechanismen als auch mit Cap-and-Trade-Mechanismen und zielt darauf ab, die wichtigsten Probleme und Herausforderungen sowie Ansätze zu deren Bewältigung zu ermitteln.

In diesem Bericht definieren wir den Landnutzungssektor als das, was der Zwischenstaatliche Ausschuss für Klimaänderungen (IPCC) als Landnutzung, Landnutzungsänderung und Forstwirtschaft (LULUCF) bezeichnet. Diese Definition schließt landwirtschaftliche Aktivitäten wie Viehhaltung und Düngemittelausbringung aus, die unter den Sektor Landwirtschaft fallen und mit dem LULUCF-Sektor im IPCC-Sektor Landwirtschaft, Wälder und andere Landnutzung (AFOLU) zusammengelegt wurden. Der Bericht konzentriert sich auf Wälder und Torfgebiete und unterscheidet prinzipiell vier Arten von Landnutzungsaktivitäten: Vermeidung von Entwaldung oder Waldschädigung, Aufforstung und Wiederaufforstung, verbesserte Waldbewirtschaftung und Bewirtschaftung von Feuchtgebieten. Wir definieren zudem, dass ‘ökologische Integrität‘ von Mechanismen gewährleistet ist, wenn die aggregierten globalen Treibhausgasemissionen infolge der Einbeziehung einer Aktivität oder Maßnahme in einen Kohlenstoffmarktmechanismus nicht ansteigen.

Wie wird die Landnutzung in internationalen Klimaabkommen berücksichtigt?

In den vergangenen Jahrzehnten wurden Landnutzungsaktivitäten in internationalen Klimaabkommen auf unterschiedliche Weise berücksichtigt. Mit dem **Kyoto-Protokoll** (KP) von 1997 wurden Treibhausgasreduktionsziele und ein Cap-and-Trade-System für Industrieländer (Anhang-I-Länder des Übereinkommens) eingeführt. In den Artikeln 3.3 und 3.4 des Kyoto-Protokolls wurden Regeln für die obligatorische und freiwillige Anrechnung von Landnutzungsaktivitäten festgelegt, die zu direkten anthropogenen Emissionen oder Kohlenstoffsenken führen. Der Mechanismus für umweltverträgliche Entwicklung (Clean Development Mechanism, CDM) ermöglichte es den Industrieländern, Emissionsreduktionen oder Kohlenstoffsenken aus Klimaschutzprojekten in Entwicklungsländern zu nutzen, um ihre Treibhausgasreduktionsziele zu erreichen. Im Rahmen der Gemeinsamen Projektdurchführung

(Joint Implementation, JI) konnten Industrieländer Klimaschutzprojekte durchführen und die daraus resultierenden Emissionsreduzierungen oder Senkenmaßnahmen auf andere Industrieländer übertragen. Im Rahmen des CDM waren nur Aufforstungs- und Wiederaufforstungsprojekte förderfähig, da Bedenken hinsichtlich der Risiken für die Umweltintegrität im Zusammenhang mit der Anrechnung anderer LULUCF-Aktivitäten bestanden. Im Rahmen von JI waren dagegen alle Arten von LULUCF-Aktivitäten förderfähig. Mit seinen Anrechnungsregeln bildete das KP die Grundlage für mehrere andere internationale Klimapolitiken, die den Landnutzungssektor betreffen.

Der 2013 im Rahmen des Übereinkommens verabschiedete Warschauer Rahmen für **REDD+** (Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries) sieht einen internationalen Rahmen für leistungsbezogene Zahlungen für messbare und überprüfbare Emissionsreduzierungen oder Kohlenstoffsenken durch konkrete Landnutzungsmaßnahmen in Entwicklungsländern vor. Zu den förderfähigen Maßnahmen gehören die Verringerung der Umwandlung von Wäldern in andere Landnutzungsformen, die Verringerung der Waldschädigung sowie die Verbesserung der Waldbewirtschaftung und Aufforstung. REDD+ ist ein Ansatz auf nationaler Ebene, der für die Umsetzung in Entwicklungsländern entwickelt wurde, auch als Reaktion auf die Tatsache, dass vermiedene Entwaldung nicht als Aktivität im Rahmen des CDM akzeptiert wurde.

Das **Übereinkommen** von **Paris** von 2015 verlangt von allen Ländern, dass sie regelmäßig ihre national festgelegten Beiträge (NDC) übermitteln, in denen sie ihre Minderungsziele und -maßnahmen darlegen. 102 Länder haben den Landnutzungssektor auf unterschiedliche Weise in ihre ersten NDCs einbezogen und dabei verschiedene Ansätze zur Formulierung von Zielen und zur Anrechnung von Emissionen und Kohlenstoffspeicherungen angewendet. Artikel 6 des Übereinkommens schafft einen Rahmen für die Beteiligung der Parteien an internationalen Kohlenstoffmarktmechanismen. Artikel 6.2 erlaubt es den Ländern, 'kooperative Ansätze' zu verwenden, die die Nutzung von 'international übertragenen Minderungsergebnissen' (ITMOs) für ihre NDCs beinhalten. Mit Artikel 6.4 wird ein neuer Anrechnungsmechanismus eingeführt, der zur Minderung von Treibhausgasemissionen und zur Förderung einer nachhaltigen Entwicklung beitragen soll. Dieser Mechanismus wird gemeinhin als Nachfolger des CDM und der JI angesehen. Nach sechsjährigen Verhandlungen wurden auf der 26. Vertragsstaatenkonferenz der Klimarahmenkonvention in Glasgow im November 2021 die Leitlinien für die Zusammenarbeit nach Artikel 6.2 und die Regeln, Modalitäten und Verfahren für den Mechanismus nach Artikel 6.4 abgeschlossen. Diese Entscheidungen ermöglichen es Ländern, ITMOs in Form von Gutschriften aus Aktivitäten im Landnutzungssektor zu übertragen. Allerdings wird es weitere Verhandlungen dazu geben, ob die „Vermeidung von Emissionen“ und „Erhöhung von Schutzmaßnahmen“ zugelassen sein werden.

Was sind die Herausforderungen für Landnutzungsaktivitäten im Rahmen von Crediting-Mechanismen?

Die Integration von Landnutzungsaktivitäten in internationale Marktmechanismen ist seit Jahrzehnten Gegenstand kontroverser Diskussionen. In der Praxis haben verschiedene staatliche und nichtstaatliche Mechanismen zur Anrechnung von Kohlenstoffsenken und vermiedenen Emissionen die Registrierung von Landnutzungsaktivitäten zugelassen. Bisher wurden Zertifikate oder Gutschriften aus diesen Aktivitäten hauptsächlich auf dem freiwilligen Markt verwendet, d. h. von Käufern, die ihre Emissionen freiwillig ausgleichen, um klimaneutrale Produkte oder Dienstleistungen anzubieten, um Klimaneutralität oder Netto-Null-Ziele zu erreichen oder einfach um Emissionsreduzierungen an anderer Stelle zu finanzieren. Einige

Regierungen erkennen auch Gutschriften aus Landnutzungsaktivitäten im Rahmen der nationalen Klimapolitik an.

Auf der Grundlage einer Überprüfung der verfügbaren Literatur, von Experteninterviews, eines vom UBA im Oktober 2020 durchgeführten Workshops und einer Bewertung von Ansätzen, die von Crediting-Programmen verwendet werden, identifiziert und diskutiert dieser Bericht die wichtigsten Herausforderungen für die Umweltintegrität bei der Einbeziehung verschiedener Arten von Landnutzungsaktivitäten in Crediting-Mechanismen. Zu den wichtigsten Herausforderungen gehören:

- **Nachweis der Zusätzlichkeit**: Die Zusätzlichkeit (additionality) ist von entscheidender Bedeutung, um sicherzustellen, dass die Gutschriften durch tatsächliche Emissionsminderungen oder Aufnahmen von CO_2 unterlegt sind. Emissionsminderungen oder die Aufnahme von CO_2 sind nur dann zusätzlich, wenn sie aufgrund der Anreize aus den Einnahmen aus Emissionsgutschriften umgesetzt werden. Wenn sie auch ohne die Anreize aus den Emissionsgutschriften stattfinden würden, sind sie nicht zusätzlich. Nicht zusätzliche Minderungen untergraben die Wirksamkeit von Crediting-Mechanismen. Eine solide Bewertung der Zusätzlichkeit ist daher für alle Crediting-Mechanismen und für Aktivitäten in allen Sektoren von grundlegender Bedeutung. Die Bewertung der Kausalität zwischen einer Minderungsmaßnahme und den Emissionsminderungen bzw. der Aufnahme von CO_2 ist im Landnutzungssektor eine besondere Herausforderung, da nationale und regionale Politiken Entscheidungen über die Landnutzung stark beeinflussen und Landnutzungsänderungen durch eine Vielzahl direkter und indirekter sozialer und wirtschaftlicher Faktoren beeinflusst werden.
- **Bestimmung von Referenzwerten**: Eine Referenz oder Basislinie (baseline) stellt das Niveau der Emissionen oder der Kohlenstoffspeicherung dar, mit dem die tatsächlichen Emissionen oder Speicherleistungen verglichen werden, um die aus einer Tätigkeit resultierenden Emissionsreduktionen oder die Steigerung von Senken zu bestimmen. In der Praxis können Referenzwerte mit erheblichen Unsicherheiten behaftet sein, da sie kontrafaktische Szenarien darstellen, die nicht beobachtet oder überprüft werden können. Um der Unsicherheit zu begegnen und die Umweltintegrität zu bewahren, verlangen viele Mechanismen zur Anrechnung von Kohlenstoffemissionen, dass Referenzwerte auf konservative Weise festgelegt werden (d. h. mit einer Tendenz zur Unterschätzung). Das Übereinkommen von Paris legt neue Bedingungen für die Festlegung von Referenzwerten fest. Der NDC und die zur Umsetzung des NDC erforderlichen Maßnahmen sollten sich in der Festlegung der Referenzwerte widerspiegeln, so dass die Basislinien für internationale Kohlenstoffgutschriften mindestens auf einem Niveau festgelegt werden, das mit dem NDC übereinstimmt, oder auf einem ehrgeizigeren Niveau. Programme zur Anrechnung von Kohlenstoffgutschriften verwenden eine Vielzahl von Ansätzen zur Festlegung von Referenzwerten, darunter Referenzgebiete (für Projekte), (angepasste) historische Durchschnittswerte (für Projekte und Länder), historische Trends (für Projekte und Länder) und Modellierung (für Länder). Bei Aufforstungs- und Wiederaufforstungsaktivitäten ist die Unsicherheit der Referenz relativ gering. Bei der Vermeidung von Entwaldung und Waldschädigung, verbesserter Waldbewirtschaftung und der Erhaltung von Feuchtgebieten bleibt die Unsicherheit der Referenz ein großes Risiko für die Umweltintegrität, das nur

schwer zu bewältigen ist. Dies liegt daran, dass die Referenz durch Faktoren beeinflusst werden kann, die außerhalb der Kontrolle der Minderungsmaßnahme liegen, wie z. B. Änderungen der Nachfrage nach landwirtschaftlichen Rohstoffen oder natürliche Störungen, die aufgrund des Klimawandels verstärkt auftreten können.

- **Berücksichtigung oder Verhinderung von Verlagerungen von Emissionen**: Wenn Aktivitäten zur Verringerung von Emissionen oder zur Erhöhung von CO_2-Speicherung im Landnutzungssektor sich auf Quellen und Senken in anderen Sektoren oder außerhalb des Zielgebiets auswirken, wird dies als Verlagerung (leakage) bezeichnet. Direkte oder primäre Verlagerungseffekte treten auf, wenn eine Aktivität eine Verschiebung von Aktivitäten von einem Gebiet in ein anderes bewirkt. Indirekte oder sekundäre Verlagerungseffekte treten ebenfalls auf, wenn Flächennutzungsaktivitäten zu einer Verringerung des Produkt- oder Dienstleistungsangebots aus dem Zielgebiet führen, z. B. indirekt durch Markteffekte. Drittens treten ökologische Verlagerungseffekte auf, wenn eine Flächennutzungstätigkeit natürliche Prozesse beeinflusst, die sich auf die umliegenden Ökosysteme ausdehnen, z. B. indem sie die hydrologischen Bedingungen beeinflussen und ein Baumsterben verursachen. Flächennutzungsbezogene Aktivitäten bergen unterschiedliche Risiken von Verlagerungseffekten. Das Risiko von Verlagerungseffekten hängt zum Teil von der Art der Tätigkeit ab (z. B. Wiederherstellung von Feuchtgebieten, die zu ökologischen Leckagen führt), aber noch mehr von der Gestaltung der Tätigkeit, dem Umfang und den zugrunde liegenden Faktoren. Globale Effekte sind besonders schwer zu adressieren. Ein idealer Ansatz für den Umgang mit diesen besteht darin, Risiken zu ermitteln und zu mindern (z. B. durch den Ausschluss von Aktivitäten, bei denen ein erhebliches Risiko indirekter Verlagerungseffekte besteht), etwaige verbleibende Effekte während der Lebensdauer der Aktivität zu überwachen und zu quantifizieren und Emissionen durch Verlagerungseffekte bei der Berechnung der Emissionsreduktionen konkret zu berücksichtigen und einzurechnen.

- **Überwachung von Emissionsreduktionen und Kohlenstoffspeicherung**: Die in den Anrechnungsstandards geforderte Überwachung, Berichterstattung und Überprüfung (MRV) zielt auf eine regelmäßige Quantifizierung der durch eine Aktivität erzielten Emissionsminderungen oder Kohlenstoffspeicherungen ab. Die Möglichkeit, Quellen und Senken genau zu erfassen, ist wichtig, um die Umweltintegrität von Aktivitäten zu gewährleisten. Die Überwachungsanforderungen sind in der Regel recht detailliert und können verschiedene Mittel zur Validierung, Überprüfung und Dokumentation umfassen. Die Überwachung bildet eine wichtige Grundlage für eine solide Buchführung über eine mögliche Übertragung von Gutschriften aus Landnutzungsaktivitäten zwischen verschiedenen Systemen. Dies erfordert die Anwendung einheitlicher methodischer Ansätze. Derzeit gibt es erhebliche Unstimmigkeiten zwischen den Ansätzen, die im Rahmen der NDCs, für Aktivitäten unter dem Warschauer Abkommen zur REDD+ und für Crediting-Mechanismen im freiwilligen Markt angewandt werden.

- **Vermeidung von Doppelzählungen**: Eine Doppelzählung liegt vor, wenn eine einzelne Emissionsverringerung oder erhöhte Kohlenstoffspeicherung mehr als einmal zur Erreichung von Minderungszielen oder -vorgaben verwendet wird. Dies kann auf drei Arten geschehen: doppelte Ausgabe von Einheiten, doppelte Verwendung von Einheiten und doppelte Geltendmachung von Emissionsminderungen oder erhöhter Kohlenstoffspeicherung. Die Vielfalt der Mechanismen für die Anrechnung von Emissionsgutschriften, die verschiedenen Arten von Zielen und Zwecken, für die Emissionsgutschriften verwendet werden, stellen eine große Herausforderung dar, wenn es darum geht, Doppelzählungen und insbesondere Doppelanrechnungen zu vermeiden. Die Doppelzählung ist aus zwei Gründen ein besonderes Risiko für Aktivitäten im Landnutzungssektor: Erstens liegen Landeigentum, Landnutzung und Landbewirtschaftung oft in den Händen verschiedener Akteure mit sich überschneidenden Rechten. Und zweitens verfolgen einige Mechanismen zur Anrechnung von Kohlenstoffgutschriften juristische Ansätze, die sich mit der Anrechnung auf Projektebene überschneiden können. Darüber hinaus werden die meisten Kohlenstoffgutschriften, die aus Aktivitäten im Landnutzungssektor stammen, auf dem freiwilligen Kohlenstoffmarkt verwendet, was zu Problemen bei der doppelten Anrechnung auf die NDCs führen kann. Eine solche doppelte Inanspruchnahme kann vermieden werden, wenn (1) die Gastgeberländer die Verwendung der Kohlenstoffgutschriften durch andere Einrichtungen gemäß Artikel 6 durch die Anwendung 'entsprechender Anpassungen' (corresponding adjustments) berücksichtigen, wenn (2) nur Emissionsreduktionen und Kohlenstoffspeicherungen gutgeschrieben werden, die nicht in den Geltungsbereich der NDC fallen, oder wenn (3) die Käufer der Kohlenstoffgutschriften die Emissionsreduktionen oder Kohlenstoffspeicherungen nicht in Anspruch nehmen, sondern finanzielle Beiträge leisten, die das Gastgeberland bei der Erreichung seines NDC unterstützen.

- **Umgang mit dem Risiko der Nicht-Dauerhaftigkeit**: Emissionsminderungen oder Kohlenstoffspeicherungen durch Minderungsmaßnahmen im Landnutzungssektor können rückgängig gemacht werden, wenn erhaltene oder verbesserte Kohlenstoffbestände zu einem späteren Zeitpunkt durch natürliche oder vom Menschen verursachte Störungen verloren gehen. Das Risiko hängt von der Anfälligkeit des Kohlenstoffspeichers für natürliche Abbauprozesse, von der Größe und dem Umfang des Speichers und davon ab, wie sich die Minderungsmaßnahmen auf die Treiber der Änderung von Kohlenstoffspeichern auswirken. Diese Aspekte können sich zwischen verschiedenen Arten von Speichern und Minderungsmaßnahmen erheblich unterscheiden. So ist beispielsweise das Risiko, dass ein Projekt zur Vermeidung von Abholzung in einem brand- und dürregefährdeten Gebiet nicht dauerhaft ist, höher als bei einem Projekt zur Wiederherstellung von Mooren. Im Rahmen von Anrechnungsmechanismen wurden verschiedene Ansätze entwickelt, um solche Risiken in der Praxis zu berücksichtigen. Dazu gehören (1) Maßnahmen zur Verringerung des Risikos, z. B. indem Minderungsmaßnahmen so zu gestalten sind, dass das Risiko der Nicht-Dauerhaftigkeit verringert wird; (2) Überwachung und Kompensation des Verlusts von Kohlenstoffspeichern (z. B. durch die Einrichtung einer ‚gepoolten Pufferreserve', in der ein Teil der Kohlenstoffgutschriften zur Kompensation von Verlusten zurückgestellt wird); (3) die Ausgabe von zeitlich begrenzten Kohlenstoffgutschriften, die zu einem bestimmten Zeitpunkt auslaufen und erneuert werden können, wenn der Kohlenstoff noch gespeichert ist; und (4) die Diskontierung von Emissionsreduktionen und Kohlenstoffspeicherungen. Die meisten Kohlenstoffgutschriftenprogramme kombinieren den ersten und zweiten Ansatz.

- **Berücksichtigung von Schutzmaßnahmen und Zusatznutzen**: Schutzmaßnahmen (safeguards) sind unerlässlich, um potenzielle soziale und ökologische Risiken zu minimieren, die bei der Durchführung von Maßnahmen im Rahmen von Emissionsgutschriften auftreten. Schutzmaßnahmen sind besonders wichtig für Aktivitäten im Landnutzungssektor, wo Risiken für andere Ökosystemleistungen nicht ganz vermieden werden können, aber minimiert werden müssen. In der Praxis ist die Umsetzung von Schutzmaßnahmen durch Emissionsgutschriftenprogramme sehr unterschiedlich. Die Mindestanforderungen beziehen sich lediglich auf die Berichterstattung über Schutzmaßnahmen, während die strengsten auch Beschwerde- und Rechtsbehelfsmechanismen umfassen. Zusatznutzen (co-benefits) von Landnutzungsaktivitäten sind sehr kontextspezifisch und daher schwer in einer standardisierten Weise zu bewerten.

Was sind die Herausforderungen für Landnutzungsaktivitäten bei Cap-and-Trade-Mechanismen?

Landnutzungsaktivitäten wurden nicht nur im Rahmen von Crediting-Mechanismen eingeführt, sondern auch in einigen Cap-and-Trade-Systemen, wie etwa Emissionshandelssystemen (ETS). Die Europäische Union (EU) hat ein System für den Landnutzungssektor eingerichtet, das Ähnlichkeiten mit einem Cap-and-Trade-System aufweist. Neuseeland hat das einzige ETS, das den Landnutzungssektor einschließt. In diesem Bericht werden diese beiden Systeme näher betrachtet.

Die EU hat in der **EU-LULUCF-Verordnung** ein separates Ziel für den Landnutzungssektor festgelegt und vor kurzem auch den gesamten Umfang der Emissionen und Kohlenstoffspeicherungen durch den Landnutzungssektor in ihren aktualisierten NDC aufgenommen. Die LULUCF-Verordnung der EU legt für jeden EU-Mitgliedstaat (MS) das verbindliche Ziel fest, dass die berichteten Emissionen aus dem Landnutzungssektor vollständig durch eine gleichwertige Speicherung von CO_2 aus der Atmosphäre durch Maßnahmen in diesem Sektor ausgeglichen werden müssen (‚No-debit'-Regel). In ihrem aktualisierten NDC, das dem UNFCCC im Dezember 2020 vorgelegt wurde, hat die EU ein wirtschaftsweites Ziel von mindestens 55 % Treibhausgasreduzierung bis 2030 gegenüber 1990 verkündet, ohne Beiträge aus internationalen Kohlenstoffgutschriften, aber unter Einbeziehung des Landnutzungssektors. Die Nettosenke des LULUCF-Sektors in der EU ist derzeit so hoch wie sie in etwa im Jahr 1990 war, wird aber Projektionen zufolge geringfügig sinken. Dies bedeutet, dass die anderen unter das Ziel fallenden Sektoren ihre Emissionen im Vergleich zu 1990 nur um etwa 53 % reduzieren müssten, um das Gesamtziel von 55 % zu erreichen. Für das Jahr 2030 wurde zusätzlich ein separates Netto-Senken-Ziel vereinbart, das insgesamt -310 Mio. t CO_2eq. beträgt, um verstärkt Investitionen in den Ausbau der Kohlenstoffsenken in der EU anzuregen. Aufgrund des Risikos der Nichtdauerhaftigkeit und der Volatilität der THG-Emissionen aus dem Landnutzungssektor führt die Einbeziehung des gesamten Bereichs jedoch zu Unsicherheiten bei der quantitativen Bestimmung der sektoralen Klimaziele sowie zu Herausforderungen bei der Steuerung der Verpflichtungen der Mitgliedstaaten.

Die LULUCF-Verordnung wendet detaillierte Regeln für die Verrechnung des Landnutzungssektors an. Die Berücksichtigung von Kohlenstoffsenken aus aufgeforsteten und Emissionen aus entwaldeten Flächen erfolgt auf der Grundlage einer **Brutto-Netto-Anrechnung**. Das bedeutet, dass die gesamte Nettosenke oder die Nettoemissionen aus Aufforstung und Entwaldung, die in den Anrechnungszeiträumen 2021 bis 2025 und 2026 bis

2030 anfallen, berücksichtigt werden. Die Bilanzierung von bewirtschaftetem Ackerland, bewirtschaftetem Grünland und bewirtschafteten Feuchtgebieten basiert dagegen auf der **Netto-Netto- Anrechnung**. Das bedeutet, dass die Nettoemissionen oder die Kohlenstoffspeicherungen in den Zeiträumen von 2021 bis 2025 und von 2026 bis 2030 mit den durchschnittlichen jährlichen Emissionen und Speicherungen in einem Referenzzeitraum verglichen werden. Die Bilanzierung von bewirtschafteten Waldflächen basiert auf einer Anrechnung im Vergleich zu einem Waldreferenzniveau (FRL). Der FRL ist das kontrafaktische Niveau der Emissionen und Kohlenstoffspeicherungen, das auf bewirtschafteten Waldflächen in der Zukunft auftreten würde, wenn die Waldbewirtschaftung, wie sie im Zeitraum von 2000 bis 2009 dokumentiert wurde, fortgesetzt würde. Diese Regeln zielen darauf ab, anthropogene Effekte (z. B. verursacht durch Bewirtschaftungsänderungen) von natürlichen Wachstumseffekten im Wald (z. B. aufgrund des Alters der Wälder) zu trennen. Die EU-LULUCF-Verordnung geht jedoch nicht auf ökologische und soziale Schutzmaßnahmen ein, wie z. B. den Erhalt und die Förderung der biologischen Vielfalt. In einem Vorschlag zur Neufassung der EU-LULUCF-Verordnung und anderer EU-Politiken im Jahr 2021 wurden weitere Optionen für die Anreize zur Entwicklung und Umsetzung land- und forstwirtschaftlicher Maßnahmen zur Verringerung von Emissionen und Erhöhung von Kohlenstoffsenken geprüft. Eine Option sieht die Bildung einer gemeinsamen Säule, die aus den Sektoren Landwirtschaft und LULUCF (auch als AFOLU-Sektor bezeichnet) besteht, mit einem separaten Ziel. Dies würde volle Flexibilität zwischen den beiden Sektoren bedeuten und dürfte zu kosteneffizienteren Minderungsoptionen führen. Es besteht jedoch auch die Gefahr, dass die Umweltintegrität untergraben wird, wenn die Kompensation von Nicht-CO_2-Emissionen aus dem Landwirtschaftssektor durch den Abbau von Emissionen aus dem Landnutzungssektor zugelassen wird, da die Risiken der Nicht-Dauerhaftigkeit, der beträchtlichen Quantifizierungsunsicherheiten und der Berichtslücken in den nationalen Treibhausgasinventaren im LULUCF-Sektor weiter bestehen.

Das **neuseeländische Emissionshandelssystem (NZ-ETS)** erfasst alle wichtigen THG-Emissionsquellen in Neuseeland. Ab dem Jahr 2019 sind die Forstwirtschaft, die Abfallwirtschaft, die Industrie und der Energiesektor verpflichtet, THG-Emissionen zu berichten und Emissionsrechte stillzulegen, was etwa 54 % der neuseeländischen Emissionen abdeckt. Es ist das einzige System der Welt, das auch die Forstwirtschaft einschließt. Die für den Forstsektor geltenden ETS-Vorschriften wurden so konzipiert, dass sie mit den Anforderungen des Kyoto-Protokolls übereinstimmen und Neuseeland dabei helfen, seine entsprechenden Verpflichtungen zu erfüllen. So werden die Wälder nach dem Jahr ihres Entstehens behandelt und in zwei Kategorien unterteilt, wobei das Kyoto-Basisjahr 1990 als Stichtag gilt. Teilnehmende des neuseeländischen Emissionshandelssystems sind verpflichtet, über die aus ihren Aktivitäten resultierenden Emissionsminderungen bzw. Kohlenstoffspeicherungen zu berichten. Wurden Waldflächen vor 1990 umgewandelt, müssen Landbesitzende eine entsprechende Anzahl von Einheiten abgeben. Besitzer von Waldflächen, die nach 1989 abgeholzt wurden, können sich freiwillig für das neuseeländische Emissionshandelssystem (NZ ETS) entscheiden und Einheiten für Kohlenstoffspeicherungen erwerben. In seinem ersten NDC hat Neuseeland die Bilanzierungsmethoden, die es für den LULUCF-Sektor anwenden wird, um die Erreichung seines Ziels für 2030 im Rahmen des Pariser Abkommens zu bewerten, grob umrissen.

In der Vergangenheit hat sich das neuseeländische Emissionshandelssystem als relativ unwirksam erwiesen, um die Emissionen des Landes zu reduzieren. Dies liegt zum Teil daran, dass viele wichtige Merkmale, wie eine Obergrenze, nicht umgesetzt wurden. Das ETS wurde so konzipiert, dass es im Rahmen des Kyoto-Protokolls funktioniert, was zu einem Überangebot an Einheiten führte. Der Agrarsektor ist im neuseeländischen Emissionshandelssystem nur zur Berichterstattung verpflichtet. Eine Reihe von Änderungen, die 2020 verabschiedet wurden, können die Wirksamkeit des ETS verbessern. Die Änderungen im Forstsektor zielen darauf ab, die Beteiligung zu erhöhen und Anreize für eine bessere Bewirtschaftung und Aufforstung zu schaffen. Allerdings drohen leicht zu erzeugende Kohlenstoffspeicherungen durch Senken in der Forstwirtschaft den Druck zur Dekarbonisierung anderer Sektoren zu verringern.

Was sind die allgemeinen Schlussfolgerungen für die Nutzung von Crediting-Mechanismen für Aktivitäten im Landnutzungssektor?

Die Einbeziehung von Landnutzungsaktivitäten in die Crediting-Mechanismen im Rahmen des Übereinkommens von Paris bringt besondere Herausforderungen in Bezug auf die Umweltintegrität mit sich. Bei der Betrachtung der Rolle des Sektors stellt sich die Frage, für welche Art und Umfang von Aktivitäten die Risiken besonders hoch sind und ob und wie diese Risiken angemessen behandelt werden können.

Tabelle S1 gibt einen Überblick über die verschiedenen Umweltintegritätsrisiken und darüber, ob und wie sie im Rahmen von Crediting-Mechanismen behandelt werden können. Einige Umweltintegritätsrisiken gelten eindeutig für alle Landnutzungsaktivitäten, während sich andere zwischen den verschiedenen Arten von Aktivitäten erheblich unterscheiden.

Tabelle 1: Risiken für die Umweltintegrität bei verschiedenen Arten von Landnutzungsaktivitäten und die Frage, ob und wie sie mit den derzeitigen Konzepten angegangen werden können

	Aufforstung und Wiederbewaldung	Vermiedene Entwaldung und Waldschädigung	Verbesserte Waldbewirtschaftung	Bewirtschaftung von Feuchtgebieten
Art der Minderung	Erhöhung der Kohlenstoffspeicherung	Vermeidung von THG-Emissionen	Erhöhung der Kohlenstoffspeicherung	Erhöhung der Kohlenstoffspeicherung / Reduktion von THG-Emissionen
Zusätzlichkeit adressieren	Kann adressiert werden	Schwierig zu adressieren	Schwierig zu adressieren	Feuchtgebiet-wiederherstellung: Kann adressiert werden Feuchtgebiets-schutz: Schwierig zu adressieren
Risiko der Nicht-Dauerhaftigkeit adressieren	• Kann nicht gewährleistet werden - Risiken können nur gemildert werden; • Aktivitäten mit hohen Risiken der Nicht-Dauerhaftigkeit sollten von der Anrechnung ausgeschlossen werden; • Ein angemessenes Aktivitätsdesign, die Verantwortung der Projekteigner für die Überwachung und Kompensation von Umkehrungen über lange Zeithorizonte in Verbindung mit ausreichend kapitalisierten und diversifizierten gepoolten Pufferreserven sind am besten geeignet, um Umkehrungsrisiken zu verringern.			

<table>
<tr><th></th><th>Aufforstung und Wiederbewaldung</th><th>Vermiedene Entwaldung und Waldschädigung</th><th>Verbesserte Waldbewirtschaftung</th><th>Bewirtschaftung von Feuchtgebieten</th></tr>
<tr><td>Referenzwerte festlegen</td><td>Kann bestimmt werden, da die Unsicherheit alternativer Optionen begrenzt ist</td><td colspan="2">Schwierig zu bestimmen, da eine beträchtliche Unsicherheit hinsichtlich zukünftiger Entwicklungen besteht</td><td>Feuchtgebietwiederherstellung: Kann bestimmt werden
Feuchtgebietsschutz: Schwierig zu bestimmen aufgrund von Unsicherheiten</td></tr>
<tr><td rowspan="2">Verdrängungseffekte adressieren</td><td>Hängt von der Gestaltung der Aktivität ab, z. B. Status der aufzuforstenden Flächen</td><td>Hängt von der Gestaltung der Aktivität ab, z. B. zu behandelnde Ursachen der Entwaldung</td><td>Hängt von der Gestaltung der Aktivität ab, z. B. von der Aktivität betroffene forstwirtschaftliche Produkte</td><td>Hängt von der Gestaltung der Aktivität ab, z. B. Berücksichtigung alternativer Landnutzungen</td></tr>
<tr><td colspan="4">• Eine Ausweitung der Grenzen der Flächennutzungsaktivitäten von Projekten auf die Ebene der Gerichtsbarkeit kann eine direkte Verlagerung innerhalb der Gerichtsbarkeit verhindern;
• Besonders für globale Verlagerungseffekte fehlen Daten;
• Aktivitäten, die globale Verlagerungen verursachen, sollten generell von der Anrechnung ausgeschlossen werden.
• Regionalere Verlagerungseffekte über Grenzen sind leichter festzustellen aber müssen in Überwachungssysteme aufgenommen werden</td></tr>
<tr><td>Effektive Überwachung und Berichterstattung</td><td colspan="4">• Kann effektiv durchgeführt werden;
• Biomassepools können mit höherer Genauigkeit überwacht werden als Bodenkohlenstoffpools;
• Globale Daten und Fernerkundung können dazu beitragen, die Genauigkeit und Konsistenz zu erhöhen;
• Die Kohärenz zwischen Aktivitäten auf niedrigerer Ebene und der Berichterstattung auf nationaler Ebene kann eine Herausforderung sein.</td></tr>
<tr><td>Doppelzählungen verringern</td><td colspan="4">• Kann vermieden werden;
• Bestimmungen zur Gewährleistung eindeutiger Ansprüche auf den gespeicherten Kohlenstoff sind wichtig;
• Eine ‚verschachtelte‘ Anrechnung kann die doppelte Ausgabe von Zertifikaten auf Projektebene und die Anrechnung auf der Ebene der Gerichtsbarkeit vermeiden.</td></tr>
<tr><td>Schutzmaßnahmen und Zusatznutzen berücksichtigen</td><td colspan="4">• Kann im Allgemeinen berücksichtigt werden;
• Risiken und Zusatznutzen sind sehr kontextspezifisch: Landnutzungsaktivitäten können besondere Risiken, aber auch erhebliche Chancen in Bezug auf Anpassung, Schutz der biologischen Vielfalt und Wiederherstellung von Ökosystemen mit sich bringen.</td></tr>
</table>

Quelle: Eigene Darstellung.

Unter den Risiken für die Umweltintegrität, die für alle Landnutzungsaktivitäten gelten, ist das vielleicht wichtigste Risiko die **Nicht-Dauerhaftigkeit**. Im Gegensatz zu den meisten anderen Minderungsmaßnahmen kann die Dauerhaftigkeit von Emissionsminderungen oder Kohlenstoffspeicherungen im Landnutzungssektor nicht gewährleistet werden, sondern es können lediglich Verlustrisiken verringert werden. Wenn das Ziel darin besteht, die THG-Konzentrationen langfristig zu stabilisieren, ist es fraglich, inwieweit Maßnahmen im Landnutzungssektor dafür genutzt werden, um weiter die Nutzung fossiler Brennstoffe zu ermöglichen, bei denen keine wesentlichen Risiken der Nicht-Dauerhaftigkeit bestehen. Wenn Landnutzungsmaßnahmen im Rahmen von Anrechnungsmechanismen durchgeführt werden, ist es von entscheidender Bedeutung, die Umkehrrisiken angemessen zu kontrollieren. Erstens sollten Gutschriften nicht für Aktivitäten vergeben werden, bei denen ein hohes Umkehrrisiko besteht, wie z. B. bei kommerziellen Plantagen. Zweitens ist es von entscheidender Bedeutung, dass die Eigentümer der Minderungsmaßnahme Anreize haben, die Umkehrrisiken zu verringern. Dies lässt sich am besten dadurch erreichen, dass Anforderungen oder Anreize für eine angemessene Gestaltung und Instandhaltung der Landnutzungsaktivitäten geschaffen werden und dass die Eigentümer der Aktivitäten verpflichtet werden, etwaige Verluste zu überwachen und zu kompensieren. Die Überwachung und Entschädigung sollten über ausreichend lange Zeiträume, z. B. 100 Jahre, erfolgen, um Anreize für eine solide Planung der Tätigkeiten zu schaffen und die Kosten von Umkehrungen angemessen zu ‚internalisieren'. Ausreichend kapitalisierte gepoolte Pufferreserven oder Versicherungen sollten diese Ansätze ergänzen, um katastrophale Verluste oder Situationen zu bewältigen, in denen Akteure nicht in der Lage sind, Entschädigungen zu leisten, z. B. aufgrund von Konkurs.

Ein weiteres Risiko für alle Landnutzungsaktivitäten sowie für Aktivitäten in anderen Sektoren ist die **doppelte Anrechnung** von Emissionsreduktionen und Kohlenstoffspeicherung. Zwei Aspekte sind für den Landnutzungssektor von besonderer Bedeutung: potenzielle konkurrierende Ansprüche auf den gespeicherten Kohlenstoff und die mögliche Überschneidung von Maßnahmen auf der Ebene der Rechtsprechung und der Projekte. Diesen Risiken kann wirksam begegnet werden, wenn die Programme zur Kohlenstoffanrechnung über Bestimmungen verfügen, die eindeutige Ansprüche sicherstellen, und ‚verschachtelte' Anrechnungsansätze verfolgen, um die doppelte Ausgabe von Einheiten aufgrund von Überschneidungen zwischen der Anrechnung auf verschiedenen Ebenen zu verhindern.

Weitere Risiken für die Umweltintegrität, insbesondere die Bewertung der **Zusätzlichkeit**, die Festlegung von **Referenzwerten** und die Vermeidung von **Leckagen**, unterscheiden sich erheblich zwischen den verschiedenen Arten von Aktivitäten:

- Bei **Aufforstungs- und Wiederaufforstungsmaßnahmen** kann die Zusätzlichkeit mit einem angemessenen Maß an Sicherheit bewertet werden. Außerdem lässt sich zuverlässig feststellen, wie viel Kohlenstoff absorbiert wurde. Das Risiko von Verlagerungseffekten kann angemessen gemindert werden, wenn der Wald auf ungenutzten Flächen angelegt wird oder wenn das Projektkonzept sicherstellt, dass es zu keiner Verlagerung von Dienstleistungen oder Produkten kommt.
- Bei Maßnahmen zur **Vermeidung von Entwaldung und Waldschädigung** stellen die Bewertung der Zusätzlichkeit, die Festlegung von Ausgangswerten und die Vermeidung von Verlagerungen große Herausforderungen dar, die nur schwer zu bewältigen sind. Der Nachweis der Zusätzlichkeit ist schwierig oder sogar unmöglich, da die beobachteten Veränderungen der Kohlenstoffvorräte mehrere Ursachen haben können, von denen die getroffene Maßnahme nur eine ist. Die Festlegung eines Referenzszenarios für die künftige

Entwaldungsrate ist mit erheblichen Unsicherheiten behaftet. Und schließlich wird die Entwaldung stark von der Nachfrage nach globalen landwirtschaftlichen Gütern oder Dienstleistungen bestimmt, was sich der Kontrolle der Aktivitäten entzieht und zu Verdrängungseffekten führen kann.

- Bei Maßnahmen zur **Verbesserung der Waldbewirtschaftung** sind die Bewertung der Zusätzlichkeit und die Festlegung von Ausgangswerten ähnlich schwierig wie bei der vermiedenen Entwaldung, da sie Ansätze für genaue Bewertungen erfordern, die sehr datenintensiv und in der Regel wenig transparent sind (z. B. Waldreferenzniveaus). Ob Verdrängungseffekte berücksichtigt werden können, hängt von der Gestaltung der Aktivität ab, z. B. von der Art der von der Aktivität betroffenen Produkte.
- Bei der **Bewirtschaftung von Feuchtgebieten** unterscheiden sich die Risiken zwischen der Wiederherstellung von Feuchtgebieten und der Erhaltung von Feuchtgebieten. Während sich die Zusätzlichkeit bei der Wiederherstellung von Feuchtgebieten ähnlich wie bei der Aufforstung und Wiederaufforstung leichter beurteilen lässt, ist die Zusätzlichkeit bei der Erhaltung von Feuchtgebieten schwer oder gar nicht nachzuweisen. Wie bei der vermiedenen Entwaldung sind auch bei der Erhaltung von Feuchtgebieten die Ausgangswerte mit großen Unsicherheiten behaftet. Wie bei anderen Aktivitäten müssen auch hier die Ansätze zur Vermeidung von Verlagerungen die Gestaltung der Aktivitäten berücksichtigen.

In Anbetracht der unterschiedlichen Risiken und der Möglichkeiten, ihnen zu begegnen, sollten die politischen Entscheidenden sorgfältig abwägen, welche Art von Aktivitäten im Rahmen von Crediting-Mechanismen verfolgt werden sollten. Unter den in diesem Bericht analysierten Aktivitäten stellen die Vermeidung von Entwaldung und die Erhaltung von Feuchtgebieten die größten Risiken für die Umweltintegrität dar. In anderen Sektoren wurden ähnliche Aktivitäten, wie z. B. die Vermeidung der Umstellung auf andere Brennstoffe, von der Anrechnung ausgeschlossen, da bei der Bewertung von Zusätzlichkeit und der Festlegung von Referenzwerten ähnliche Unsicherheiten in Bezug auf Annahmen über zukünftige Entwicklungen, wie z. B. die internationalen Brennstoffpreise, bestehen. Angesichts der Bedenken hinsichtlich der Qualität einiger Emissionsrechte und der verschiedenen Bemühungen, die Qualität zu verbessern, könnte ein praktikabler Ansatz darin bestehen, Crediting-Mechanismen auf solche Aktivitäten zu beschränken, für die Zusätzlichkeit mit hoher Wahrscheinlichkeit gewährleistet werden kann und für die Referenzwerte mit angemessener Sicherheit geschätzt werden können - unabhängig vom Sektor, in dem die Minderungsmaßnahmen durchgeführt werden.

Durch **Cap-and-Trade-Mechanismen** werden einige der Herausforderungen vermieden, die mit dem Ansatz der Kohlenstoffgutschriften verbunden sind. Sie erfordern keine Bewertung kontrafaktischer Szenarien in Bezug auf die Zusätzlichkeit und Referenzwerte für Minderungsmaßnahmen. Sie vermeiden auch jegliche Verlagerung von Emissionen innerhalb des Systems. Die größte Herausforderung bei Cap-and-Trade-Mechanismen besteht darin, die Obergrenze ausreichend unter dem Emissionsniveau der regulierten Akteure festzulegen. Die anfänglich zu hohe Zuteilung von Zertifikaten im ETS ist in fast allen etablierten Systemen eine große Herausforderung.

Grundsätzlich kann die Begrenzung von Emissionen aus dem Landnutzungssektor in Cap-and-Trade-Systemen im Einklang mit übergreifenden Minderungszielen, wie z. B. im Rahmen der

LULUCF-Verordnung der EU, eine praktikable Alternative zu Crediting-Mechanismen sein. Sie kann dazu dienen, den Sektor einem Kohlenstoffpreis auszusetzen, und dadurch Anreize für die Erhöhung der Kohlenstoffvorräte schaffen. Dies ist besonders wichtig, um in den nächsten Jahrzehnten Netto-Null-Emissionen zu erreichen.

Mehrere Aspekte müssen jedoch sorgfältig geprüft werden. Erstens muss auch in diesen Systemen die Nicht-Dauerhaftigkeit berücksichtigt werden. Das bedeutet, dass eine einmal erfasste Fläche oder Aktivität auch weiterhin erfasst werden sollte. Es bedeutet auch, dass die Bilanzierung alle Jahre des Verpflichtungszeitraums und nicht nur ein einzelnes Zieljahr umfassen sollte, um sicherzustellen, dass mögliche Umkehrungen berücksichtigt werden, unabhängig davon, wann sie auftreten. Eine zweite wichtige Herausforderung besteht darin, dass der Landnutzungssektor derzeit in den meisten Ländern eine Nettosenke ist. Wenn der Sektor unter diesen Umständen in einen Cap-and-Trade-Mechanismus einbezogen wird, der auch andere Sektoren abdeckt, bedeutet dies, dass Akteure im Landnutzungssektor Zertifikate an Akteure aus anderen Sektoren verkaufen könnten, ohne dass diese stärkeren Anstrengungen zur Emissionsreduktion oder Senkenerhöhung unternehmen müssten. Dies könnte das Emissionsreduktionsziel des Cap-and-Trade-Systems untergraben. Drittens kann die Verwendung von Zertifikaten aus einer potenziell nicht dauerhaften Reduktion von Emissionen oder Kohlenstoffspeicherung den weiteren Ausstoß von deutlich dauerhafteren THGs, z. B. aus der Verbrennung fossiler Brennstoffe, erlauben. Damit würde vor allem die langfristige Fähigkeit des Sektors der CO_2-Speicherung untergraben, da Biosphäre und Ozeane nur über eine begrenzte Kapazität zur Aufnahme von CO_2 verfügen und Biomasse- und Bodenkohlenstoffbestände unter einem sich ändernden Klima natürlichen Störungen unterliegen.

Insgesamt muss die mögliche Einbeziehung von Aktivitäten des Landnutzungssektors in die Crediting-Mechanismen einer langfristigen Perspektive folgen. Dies gilt insbesondere für die Übergangsphase zu Netto-Null-Emissionen, in der der Druck für dauerhafte Emissionsreduktionen nicht durch die Einbeziehung des Landnutzungssektors verringert werden darf. Ein frühzeitiger Rückgriff auf potenziell nicht dauerhafte Emissionsminderungen aus dem Landnutzungssektor zur Kompensation dauerhafter fossiler Emissionen birgt die Gefahr, dass dadurch Emissionsniveaus festgelegt werden, die für die Erreichung der Ziele des Übereinkommens von Paris zu hoch sind.

Definitions

Table 2: Definition of relevant terms used in the report

Term	Definition and comment
Afforestation/reforestation (AR)	A land-use activity that converts non-forest land into forest land. This includes tree planting and revegetation of areas without trees or low tree cover.
Additionality	Additionality refers to emission reductions and removals that occur because of the existence of the crediting system. Emissions reductions and removals achieved through specific activities are also referred to as attributability.
Allowance	An emissions unit issued under a cap-and-trade mechanism that entitles the holder to emit one metric tonne of CO_2 (or its equivalent).
Auditor	An independent third-party entity that assesses: a) conformity of new project applications with requirements of a carbon crediting mechanism. This process is also referred to as 'validation'. b) conformity of carbon credit issuing with all requirements of a carbon crediting mechanism. This process is also referred to as 'verification'.
Avoiding deforestation or forest degradation (REDD)	A land-use activity that reduces emissions by avoiding deforestation or forest degradation.
Baseline	Benchmark of emissions or removals against which emission reductions or enhanced removals can be measured. In the land-use sector, sometimes the term reference level is used instead of baselines.
Cap-and-trade mechanism	A mechanism that establishes an emissions cap for a set of defined entities, issues allowances corresponding to the emissions cap, and allows entities to trade the allowances. An example is an emissions trading system, such as the EU Emissions Trading System.
Carbon credit	An emissions unit issued by a carbon crediting mechanism. It represents an emission reduction removal of one metric tonne of CO_2 (or its equivalent). Carbon credits are issued, tracked, and cancelled by means of a registry.
Carbon crediting mechanism	An organisation registering land-use activities and issuing carbon credits for achieved emission reductions or removals. Credits may be used in the voluntary market for voluntary offsetting, in compliance markets for meeting obligations, and as a vehicle to disburse results-based finance.
Carbon market mechanism	A mechanism that provides for the issuance and transfer of emissions units. This includes cap-and-trade mechanisms and carbon crediting mechanisms.
Double counting	Double counting occurs when a single emission reduction or removal is used more than once towards the achievement of mitigation targets or goals.
Emissions unit	An electronic unit denominated as one metric tonne of CO_2 (or its equivalent) that is issued by a carbon market mechanism to a registry. Emissions units can include carbon credits or allowances.
Environmental integrity	Concept for assessing mitigation activities and carbon market mechanisms to ensure that aggregated global GHG emissions do not increase as a result of an activity or implementation of activities or mechanisms.
Improved forest management (IFM)	A land-use activity that enhances removals or reduces emissions from forest land. This includes silvicultural measures, reduced management intensity and reduced impact logging.

Term	Definition and comment
Jurisdictional approach	A land-use activity implemented at the scale of a jurisdiction. The jurisdiction may be at the national level, including an entire country, or at a sub-national administrative level.
Land-use activity	A climate mitigation activity implemented in the land-use sector. This report recognises four types of activities: avoiding deforestation or forest degradation (REDD), afforestation/reforestation (AR), improved forest management (IFM), and wetland management (WET). Activities may be carried out at different scales, including projects, programmes, and jurisdictional approaches.
Land-use sector	This comprises what the Intergovernmental Panel on Climate Change (IPCC) refers to as Land Use, Land-Use Change and Forestry (LULUCF). This definition excludes agricultural activities, such as livestock management and fertiliser application, which are covered by the agriculture sector and have been merged with the LULUCF sector in the IPCC's Agriculture, Forestry and Other Land Use (AFOLU) sector.
Leakage	An increase in emissions that is occurring outside the boundaries of the credited activity. Leakage can be caused by the direct shift in the supply of products or services (direct leakage) or caused by the implementation of an activity in one area indirectly creating incentives for changes in activities in other areas (indirect leakage). Leakage is differentiated from spillover effects that occur on other areas not related to the target of the activity (e.g., emission reduction activity leading to increased biodiversity or improved water retention). Like leakage, spillover effects can be positive or negative.
Nature-based solutions	Defined by IUCN[1] as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits".
Non-permanence	Refers to the risk of emissions reductions or removals being reversed.
Project	A land-use activity implemented on a confined area within a jurisdiction.
Safeguards	Requirements and procedures of carbon crediting mechanisms aimed at avoiding and reducing their potential negative impacts.
Validation	Assessment of whether a land-use activity conforms with all requirements of a carbon crediting mechanism.
Verification	Assessment of whether a request for issuing carbon credits from a land-use activity conforms with all requirements of a carbon crediting mechanism.
Wetland management (WET)	A land-use activity that establishes new wetlands or enhances removals or avoids emissions from existing wetlands. This includes rewetting of organic soils, wetland restoration and wetland conservation.

Source: own compilation.

[1] https://www.iucn.org/theme/nature-based-solutions

1 An overview of the land-use sector and the role of market mechanisms

1.1 Background and aim of the report

The goal of the Paris Agreement (PA) is to limit the increase of global average temperature to well below 2 °C. This requires halting the increase of the concentration of greenhouse gases in the atmosphere and achieving a balance between emissions by sources and removals by sinks. Due to its ability to store carbon through natural processes, the land-use sector plays a critical role in climate change mitigation strategies. Land-use mitigation activities that provide further ecosystem services beyond mitigating climate change have recently also been referred to 'nature-based solutions' (NbS). It is important to stress that NbS need to be differentiated from land-use mitigation activities in general, as NbS can also address other societal challenges and have further requirements, including social and environmental safeguards and a net benefit for biodiversity (Reise et al. 2022).

However, the sector's contribution substantially depends on the long-term net balance of carbon removals through natural sinks and greenhouse gas (GHG) emissions from sources through land management and land conversion. Globally, the land-use sector is currently a carbon sink, taking up about 6 $GtCO_2eq$. per year. This net sink is the result of about 6 $GtCO_2eq$. of emissions from land-use change, mainly deforestation, and an uptake of about 12 $GtCO_2eq$. through ecosystems, mainly forests and grasslands (Friedlingstein et al. 2020). However, climate change and other drivers pose risks that this natural net sink may be reduced in the future (Seidl und Rammer 2017; Seidl et al. 2017).

All Parties to the PA have committed to contribute to achieving its goal and to regularly pledge mitigation contributions in their Nationally Determined Contributions (NDCs). Additionally, many non-state actors have also pledged voluntary contributions to help achieve the goals of the PA. Parties may use international carbon market mechanisms to achieve their NDCs. Article 6.2 of the PA establishes a framework for Parties to engage in 'cooperative approaches' that involve the use of 'internationally transferred mitigation outcomes' (ITMOs) towards NDCs, and Article 6.4 establishes a new crediting mechanism to contribute to the mitigation of GHG emissions and support sustainable development (Article 6.4 mechanism). In addition, many carbon market approaches are being implemented by governments and non-state-actors. These can be used for various purposes, including for international cooperation under Article 6, as national climate policies to achieve NDCs, or as voluntary action to reduce emissions. This report considers various carbon market approaches but with a focus on their potential use under Article 6 of the Paris Agreement.

Including land-use sector activities into carbon market mechanisms under the PA raises particular challenges. These are especially related to the demonstration of **additionality** of mitigation activities, establishing **credible baselines**, addressing the risk of **leakage** from shifting of activities, quantifying net carbon storage with **effective monitoring** systems, avoiding **double counting** both between NDCs and when integrating activities by different actors into an international accounting framework, and addressing the potential **non-permanence** of stored carbon. Moreover, the land-use sector forms the basis for multiple ecosystem services and is therefore subject to different, often opposing policy regimes. Key considerations to find the necessary political support for the integration of the land-use sector are therefore establishing environmental and social **safeguards** to minimise trade-offs and considering **co-benefits** in decision making.

In order to determine the contribution of the land-use sector to the achievement of NDCs, emissions and removals must be quantified and accounted using comparable and consistent approaches. The **reporting** of emissions and removals from the land-use sector is based on internationally agreed rules for national GHG inventories and aims at documenting the level and development of GHG emissions and removals over time. The main basis is the 2006 IPCC Guidelines for National GHG Inventories (IPCC 2006). These have recently been amended by the so-called '2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories' adopted in 2019 (IPCC 2019). However, so far, only the 2006 IPCC Guidelines must be used within the framework of the Paris Agreement.

Accounting of GHG emissions and removals, in contrast to reporting, relates setting a GHG mitigation target and tracking the achievement of it (Böttcher et al. 2019). For most sectors, this is relatively straight-forward, by comparing the actual observed emissions with the target level. Accounting rules for the land-use sector are more complex. Accounting in the land-use sector involves a variety of elements, that involves historic but also projected references against which targets are compared. Moreover, also decisions on the scope of accounting matter, i.e., the question what activities, reporting categories and emission sources or sinks are included in the target. The first accounting rules for the land-use sector were developed under the Kyoto Protocol for industrialised countries. Since 2005, the REDD+ framework was developed to remunerate developing countries through results-based payments for forest conservation and the creation of carbon sinks. More recently the EU has imposed advanced rules for its Member States (MS) with the LULUCF Regulation (2018/841).

Moreover, numerous approaches for accounting and quantification for the land-use sector have been developed under carbon market regimes. This includes carbon crediting mechanisms that partially serve compliance and voluntary markets and that have been established under multilateral, bilateral, domestic or non-governmental regimes, such as the Clean Development Mechanism (CDM) under the Kyoto Protocol, or emissions trading systems (ETSs), such as the New Zealand Emissions Trading Scheme (NZ ETS).

Under the PA, Article 13 establishes an 'enhanced transparency framework' to report GHG emissions and removals and to track progress towards the implementation and achievement of NDCs. This framework has been operationalised through the adoption of the 'Modalities, procedures and guidelines for the transparency framework for action and support' (MPGs) at COP24 in Katowice (decision 18/CMA.1). The MPGs provide an overarching accounting concept, including the land-use sector. Important elements for accounting for the land-use sector are also included in decision 4/CMA.1, which lists information that countries should include in their NDCs in order to provide clarity and provides guidelines for how countries should account for their NDCs.

This report discusses the role of the land-use sector in carbon market mechanisms, in particular under the Paris Agreement's Article 6. The inclusion of land-use activities in carbon market approaches has been discussed controversially for more than two decades. The main debate relates to whether and how the particular challenges of the sector can be appropriately addressed in order to preserve environmental integrity. However, there have also been concerns about social and environmental impacts of land-use activities, in particular in relation to indigenous peoples and local communities, and whether 'cheap' carbon credits from the land-use sector may 'flood' the market. Some authors have also questioned whether emission reductions from the land-use sector should be used at all to offset emissions from fossil fuel combustion (Mackey et al. 2013) or called for different targets and accounting regimes for the land-use sector and other sectors, or for emissions and removals. Recently, this debate has gained new momentum, as demand for voluntary offsetting is growing and NbS, which can be focused on climate change mitigation as well, are playing an increasingly prominent role. Lastly, the role of the land-use sector becomes more important, as more and more countries, companies and institutions are pledging to achieve net-zero targets and envisage that removals from the land-use sector should play a pivotal role in achieving these targets.

This report aims to contribute to this debate by assessing whether and how key environmental integrity challenges for including the land-use sector in carbon market approaches can be addressed. In this way, the report aims to build a better understanding of the challenges of integrating the land-use sector into international climate policy. Towards this end, the report evaluates how existing carbon market mechanisms address these challenges in practice and assesses to what extent these approaches can mitigate environmental integrity risks. The report addresses both **crediting** mechanisms and **cap-and-trade mechanisms**, such as ETS. Based on the analysis, the report synthesises key findings regarding the inclusion of the land-use sector in carbon market mechanisms.

In this report we define the land-use sector as what the IPCC refers to as Land Use, Land-Use Change and Forestry (LULUCF). This definition excludes agricultural activities, such as livestock management and fertiliser application, that are covered by the Agriculture sector and have been merged with the LULUCF sector in the IPCC's Agriculture, Forestry and Other Land Use (AFOLU) sector. The report focuses on forests and peatlands regarding the examples chosen and considers activities related to avoiding deforestation or forest degradation, afforestation and reforestation, improved forest management and wetland management. We further define that 'environmental integrity' is ensured if aggregated global GHG emissions do not increase as a result of an activity or action.

1.2 Land use in international agreements

1.2.1 Kyoto Protocol

The rules for the land-use sector under the Kyoto Protocol (KP) defined for the first time what part of the reported emissions and removals should be taken into account in achieving climate targets and what rules had to be followed in accounting for these emissions or removals. In its Articles 3.3 and 3.4, the Kyoto Protocol distinguished between mandatory and voluntary accounting of land-use activities that result in direct anthropogenic emissions or removals. While initially only afforestation, reforestation and deforestation were obligatory to be accounted for and forest management as well as arable and grassland activities could voluntarily be accounted for (first commitment period 2008-2012), obligatory accounting of activities was extended to forest management in the second commitment period (2013-2020). In addition, rules were created that allowed countries to voluntarily account for activities related to wetland drainage and rewetting.

The KP established a cap-and-trade system for developed countries (Annex I countries to the Convention) that imposed national caps on GHG emissions for countries that had ratified the Protocol by assigning a corresponding number of tradable allowances (Assigned Amount Units, AAUs, allowing to emit 1 t CO_2eq.). Countries could carry over unused AAUs into the next commitment period, subject to certain restrictions. Other types of tradable units were carbon credits, including certified emission reductions (CERs) generated under the Clean Development Mechanism (CDM) for emission reductions or removals in developing countries and emission reduction units (ERUs) generated under Joint Implementation (JI) for emission reductions or removals in developed countries. For net removals resulting from land use, land-use change and forestry activities in developed countries, removal units (RMUs) were issued and could also be traded.

The Marrakesh Accords (MA, UNFCCC 2002, see Box 1 below) formed a set of principles for accounting for the LULUCF sector into national targets under the Kyoto Protocol. These principles partly aimed at establishing safeguards to protect the environment. They also formed the basis for more elaborated accounting rules developed and applied in the first and second commitment period of the Kyoto Protocol.

Principle h) of the MA requires that accounted amounts need to be human-induced and **additional**. This principle was operationalised by establishing a cap on the number of RMUs that countries could generate from forest management activities in the first commitment period and accounting against a Forest Management Reference Level (FMRL) in the second commitment period. Accounting against the FMRL was an attempt to factor out the contribution of influences beyond direct human control (such as climate effects) or occurring indirectly (such as the legacy effect of age-classes in forests). The approach allows to make recent changes in forest management practices beyond a **baseline** visible in inventories and thus forms a technical solution for factoring out past practice effects was required by the Marrakesh Accords (Böttcher et al. 2008). However, FMRLs under the KP were criticised for including policy assumptions on future harvest levels which bears the risk of inflating baselines (Grassi et al. 2018). This is because the FMRL estimates submitted by countries underwent a technical assessment by the UNFCCC but reviewed in detail as for example national GHG inventories.

Box 1: Principles of the Marrakesh Accords (UNFCCC 2002)

The principles in the Marrakesh Accords responded to concerns that the use of LULUCF RMUs should not undermine environmental integrity of the Kyoto Protocol. They should '*govern the treatment of land use, land-use change and forestry activities*' in the following way :

a) "*That the treatment of these activities be based on sound science;*

b) That consistent methodologies be used over time for the estimation and reporting of these activities;

c) That the aim stated in Article 3, paragraph 1 of the Kyoto Protocol (the emission reduction target of 5% relative to 1990) not be changed by accounting for land use, land-use change and forestry activities;

d) That the mere presence of carbon stocks be excluded from accounting;

e) That the implementation of LULUCF activities contributes to the conservation of biodiversity and sustainable use of natural resources;

f) That accounting for land use, land-use change and forestry does not imply a transfer of commitments to a future commitment period;

g) That reversal of any removal due to LULUCF activities be accounted for at the appropriate point in time;

h) That accounting excludes removals resulting from: (i) elevated carbon dioxide concentrations above their pre-industrial level; (ii) indirect nitrogen deposition; and (iii) the dynamic effects of age structure resulting from activities and practices before the reference year."

The accounting rules under the KP did not set a strong focus on additional mitigation (Böttcher und Graichen 2016). This is especially true for emissions and removals from afforestation accounted for on a gross-net basis. All areas afforested or reforested since 1990 were practically included. This implied that countries could issue a large number of RMUs. However, activities that took place way before the implementation of climate policies related to the UNFCCC process were explicitly excluded from accounting (Böttcher und Graichen 2016).

Accounting at an appropriate point in time, as required by principle g), was meant to limit the risk of **non-permanence** and unbalanced accounting over time, where RMUs might be issued but carbon released later may not be accounted for, e.g., because the emissions are excluded as they are considered to be natural disturbances. Under the KP second commitment period, parties had the option to apply special rules for treating emissions from natural disturbances such as fires and storms in the case of extreme events (Böttcher und Graichen 2016). Subsequent removals from lands subject to this natural disturbances provision have to be excluded from accounting (IPCC 2013a). Excluding natural disturbance emissions from accounting bears the risk that RMUs issued for removals before a disturbance event increase overall emissions if they are not replaced with other units.

Other principles of the MA addressed **safeguards and co-benefits** such as principle e) that requires that the implementation of LULUCF activities contributes to the conservation of biodiversity and the sustainable use of natural resources. Accounting rules can potentially be in conflict with this principle, if, e.g., biomass harvest for bioenergy negatively affecting biodiversity is being 'hidden' in the FMRL for forest management accounting (McKechnie et al. 2014).

Principle b) requires that consistent methodologies be used over time for the estimation and reporting of GHG emissions and removals. A transparent, accurate, consistent and comparable **monitoring** of emissions and removals from LULUCF is key for establishing baselines, identifying potentials, accounting and planning and tracking progress of mitigation measures. An important basis for monitoring form the IPCC Guidelines (IPCC 2006). These guidelines introduce basic concepts, such as the definition of anthropogenic emissions and removals and gases to be reported, but also delineate sectors, land-use categories and carbon pools for the compilation of national GHG inventories. They also offer basic methods for estimating activity data (i.e. often area information) and emissions and removals per unit of activity. These methods are meant to put every single country in the position of providing a basic GHG inventory of emissions and removals at the so-called Tier 1 level. The method makes use of available national or international statistics in combination with default values provided for specific climatic, site or management conditions. The IPCC Guidelines follow the principle of conservativeness (Grassi et al. 2008): if completeness or accuracy of estimates cannot be achieved, the reported data should not overestimate removals, nor underestimate emissions. An example is the rule under the KP that foresaw that a country may choose not to account for a certain pool if transparent and verifiable information is provided that the pool is not a source (Böttcher und Reise 2020).

As the Kyoto Protocol's cap-and-trade system covered only developed countries, global **leakage** effects were likely to occur. In fact, the embodied carbon imports from countries without commitments under the Kyoto Protocol to countries with commitments increased prior to the start of the first commitment period by around 8% and the emission intensity of these imports by about 3% between 2004 and 2007 (Aichele and Felbermayr 2015). Hartl (2019) found that leakage effects were about 4% of traded CO_2 emissions between countries with and without commitments between 2002 and 2009. Another risk for leakage constituted the narrow scope of the KP on land-use activities that must be accounted for. This could have resulted in the displacement of activities related to land use within one country from activities that are mandatory for accounting to activities that are voluntary for accounting. Moreover, the activity-based approach of the KP (as opposed to 'land-based' accounting), did not cover necessarily all managed land in a country. This narrow definition of activities aimed at limiting the inclusion of large amounts of gross removals, e.g., from existing forests.

Under the CDM, only afforestation and reforestation projects were eligible, due to concerns over environmental integrity risks associated with crediting of LULUCF activities. The risk of non-permanence was addressed by issuing credits that were only temporarily valid and needed to be replaced by permanent Kyoto units (see section 2.4). Under JI, all types of LULUCF activities were eligible. Non-permanence was addressed within the Kyoto regime, as countries had to report any reversals as part of the their national GHG inventories and would, in principle, thereby account for any reversals.

Trading of AAU, ERU, CERs and RMUs could bear the risk of **double counting**. This risk was addressed by specifying which types of units could be used to meet commitments as well as the modalities for their issuance, transfer and use (Schneider et al. 2014b). The KP required countries to establish national registries that were internationally reviewed. Transactions had to be authorised by an International Transaction Log managed by the UNFCCC secretariat. CERs under the CDM were issued under the governance of the CDM Executive Board. Double counting with commitments under the Kyoto Protocol was prevented by only accounting for emission reductions or removals that occur in developing countries. **Double issuance** of CERs for a specific emission reduction was prevented through a number of methodological safeguards, e.g., by allowing only one type of entity to claim emission reductions (Schneider et al. 2014b). ERUs from Joint Implementation were directly converted from AAUs or RMUs in host countries, thus reducing the host country's allowable amounts of emissions.

1.2.2 REDD+

The Warsaw Framework for REDD+ (Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries[2]) provides for an international framework for results-based payments for measurable and verifiable emission reductions or removals (measured in t CO_2eq.) through concrete measures in developing countries. Eligible activities include reducing forest conversion to other land uses, reducing forest degradation and improving forest management and afforestation. REDD+ is a national level approach that was developed for implementation in developing countries, also in response to the fact that avoided deforestation was not accepted as an activity under the CDM.

To date, substantial investments have been made to enhance institutional capacities of countries to fulfil REDD+ requirements and implement actions under REDD+ readiness. In accordance with the requirements of this framework, developing countries have established national plans and monitoring structures or are in the process of doing so. Between 2008 and 2015, direct and indirect payments for REDD+ activities totalled approximately EUR 19.4 billion (Olesen et al. 2018)[3].

Before the adoption of the Warsaw Framework, there was considerable debate whether REDD+ should be a results-based payment system without transfer of results or a crediting mechanism, in which seller and buyer exchange credits corresponding to avoided GHG from deforestation. Before negotiations on REDD+ under the UNFCCC concluded, projects to reduce deforestation were implemented as so-called demonstration activities. In parallel, projects under the

[2] All REDD+ related UNFCCC COP decisions: 2/CP.13, 4/CP.15, 1/CP.16, 2/CP.17, 12/CP.17, 1/CP.18, 9/CP.19, 10/CP.19, 11/CP.19, 12/CP.19, 13/CP.19, 14/CP.19, 15/CP.19, 16/CP,21, 17/CP.21, 18/CP.21
[3] See also UNFCCC REDD+ info hub at https://redd.unfccc.int/info-hub.html

voluntary carbon market were implemented. This has led to a situation where, depending on the implementing actor, REDD+ is considered as one or the other.

To date, REDD+ is increasingly targeted towards drivers of deforestation and forest degradation and thus promoting overall sustainable development (Bastos Lima et al. 2017). The effectiveness of REDD+ depends on technical, biophysical and socio-economic factors, as with all mitigation measures in the land-use sector. An important factor is how drivers of land-use change develop in the implementing country. Monitoring capacities for demonstrating progress in the achievement of objectives, governance and the effectiveness of law enforcement in a country are also important prerequisites for successful implementation.

In the context of the negotiations that led to adopting the REDD+ framework under the UNFCCC[4], the development of credible baseline systems, monitoring, leakage, safeguards and co-benefits were key contentious issues on how to govern access to results-based payments and ensure environmental integrity. They were solved in the following way:

- Reference levels: countries are required to develop national reference levels which form the basis against which results-based payments are made. Sub-national reference levels are considered an interim solution. There is no prescribed methodology for establishing reference levels, but historical data must be taken into account. Reference levels undergo a technical assessment but are ultimately established by countries and not internationally approved.
- Monitoring: countries are required to develop national monitoring systems, subnational monitoring and reporting is an interim measure. Parties are encouraged to use the latest IPCC guidelines for estimating GHG emissions and removals.
- Safeguards: countries implementing REDD+ activities are requested to promote and support seven social and environmental safeguards. Actions to reduce the displacement of emissions (leakage) and to address the risk of reversal (non-permanence) are two safeguards. Countries are further required to put systems in place for providing transparent and consistent information on how they promote and support each safeguard (see chapter 2.8 for more information).
- Leakage: those countries that started with the implementation at a sub-national level were required to monitor and report leakage at the national level and to address it.
- Non-permanence: other than through a referral as a safeguard, REDD+ guidance does not consider non-permanence, but standards implementing projects addressed permanence to ensure the quality of their credits.
- Co-benefits: from the start of the negotiations it was recognised that REDD+ activities can deliver co-benefits, for example for biodiversity, but no guidance was adopted in this regard. Article 5 of the Paris Agreement reaffirmed the importance of incentivising non-carbon benefits.

[4] See the Warsaw Framework for REDD+, https://unfccc.int/topics/land-use/resources/warsaw-framework-for-redd-plus

In this report we use REDD+ only when we refer to the activities implemented in accordance with the UNFCCC requirements of the Warsaw Framework for REDD+, which does not entail the transfer of emission reductions or removals between Parties, but establishes a framework for results-based payments. However, readers need to be aware that the term 'REDD+' is also used in the context of voluntary carbon markets, which does entail a transfer of emission reductions or removals between entities.

1.2.3 Paris Agreement

With the adoption of the Paris Agreement (PA), the ultimate objective of the UNFCCC '*to achieve the stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'* has been translated into a numerical temperature goal (Gao et al. 2017). With Article 2.1 of the PA countries agreed "*to hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels*", recognising that that this would significantly reduce the risks and impacts of climate change. With Article 4 of the PA, countries further established a link between the temperature goal and more specific mitigation aims that can be regarded as what Parties 'acknowledge as necessary to reach this goal' (Rajamani und Werksman 2018). This includes inter alia the aim to '*reach global peaking of GHG emissions as soon as possible and to undertake rapid reductions thereafter […] so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHG emissions in the second half of this century'*. This aim emphasizes more strongly the role that the land-use sector will have in achieving the PA's objectives. It stresses that anthropogenic GHG emissions need to be reduced to close to zero and any remaining emissions would need to be balanced by an equivalent amount of GHG removals, through the enhancement of sinks (Levin et al. 2015). Many countries, including key major emitters, have already translated this provision of the PA into national legislation, strategies and plans by adopting climate neutrality or net-zero targets that specify the time frame by when they want to conclude the required socio-economic transition of their economies towards net zero.[5]

The PA in its Article 5 includes an explicit call on all Parties '*to take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases, including forests*'. The further provisions of Article 5 integrate the REDD+ framework established through the UNFCCC and related COP decisions into the PA (Climate Focus 2015).

Article 4 of the PA establishes the obligation for Parties to account for the anthropogenic emissions and removals corresponding to their NDCs and to '*promote environmental integrity, transparency, accuracy, completeness, comparability and consistency*' in doing so. Parties are also required to ensure the avoidance of double counting. More detailed accounting guidance was adopted by the CMA in 2018 (Annex II of decision 4/CMA.1). The basic requirements are that Parties must follow IPCC methodologies and apply common metrics, ensure their approach is methodologically consistent, include all significant carbon pools and categories of anthropogenic emissions and removals or provide an explanation for excluding them. The IPCC methodologies include further specifications relevant for the LULUCF sector, namely that Parties must provide information on the approach they use to address emissions and removals from natural disturbances on managed lands, which IPCC approach is used to estimate emissions and removals from harvested wood products and information on how they address the effects of

[5] For an up-to-date list of countries with net zero targets see the following overview at Climate Change News which is updated continuously https://www.climatechangenews.com/2019/06/14/countries-net-zero-climate-goal/

age-class structure of forests. Actual accounting, where emissions and removals are counted to assess the progress made in the implementation of the NDC, takes place when Parties prepare biennial transparency reports.

Under the PA, 102 countries included the land-use sector in various ways in their first NDCs (Herold et al. 2018). High uncertainties regarding the quantitative contribution of the land-use sector and political uncertainties regarding the rules under the PA led 31 states to exclude the land-use sector from their first NDCs. Nine states indicated that they would decide on the inclusion of this sector in their NDCs at a later stage (including the EU), often arguing that improved monitoring data are needed before a decision can be made on the sector's contribution to the national target (Herold et al. 2018).

Countries that included the land-use sector under the PA took different approaches: 76 countries presented an economy-wide mitigation target that included also the land-use sector. Of the countries including LULUCF 37 countries did that through an absolute reduction target for the sector. Instead, 39 countries set targets compared to a business-as-usual scenario. 21 countries formulated a separate target for the land-use sector (Herold et al. 2018). The 'bottom-up character' of the NDCs, where countries were free to choose approaches, scope and documentation, caused large differences in type of land uses included, method of baseline setting and other accounting rules applied (e.g., whether or not accounting for natural disturbances or harvested wood products).

For reducing emissions from the land-use sector or increasing its capacities as a sink, Parties may also use approaches for voluntary cooperation in the implementation of their Nationally Determined Contributions (NDCs) that are defined under Article 6 of the PA. Article 6.2 establishes a framework for countries to engage in international carbon market mechanisms. It allows countries to pursue cooperative approaches that involve the use of internationally transferred mitigation outcomes (ITMOs) towards their NDCs. Moreover, Article 6.4 establishes a new crediting mechanism that aims to contribute to the mitigation of GHG emissions and support sustainable development (the Article 6.4 mechanism). This mechanism is commonly regarded as a successor of the CDM and JI. After six years of negotiations, the guidelines for cooperation under Article 6.2 and the rules, modalities and procedures for the Article 6.4 mechanism have been adopted at COP26 in Glasgow in November 2021.

The Paris Agreement establishes new principles and requirements for the engagement of countries in international carbon market mechanisms. These include:

- Enhancing ambition, meaning that the engagement in Article 6 should enable countries to pursue more mitigation action and adopt more ambitious NDCs. This could be achieved in various ways, including by applying more ambitious baselines when setting the reference levels, shortening the crediting periods, or discounting a fraction of the emission reductions or credits issued.

- Overall mitigation in global emissions (OMGE), which means that a fraction of the emission reductions achieved should neither be used by the host country nor by the buyer country to achieve their NDCs but be a benefit for the atmosphere (Schneider and Warnecke 2019; Wang-Helmreich et al. 2019).

- Robust accounting and avoiding double counting, meaning that the same emission reduction or removal should not be used more than once to achieve NDCs (Schneider et al. 2019a; Schneider et al. 2015). This is a key new challenge as under the PA all Parties are required to communicate mitigation targets or actions as part of their NDCs (in contrast to the KP, see above).

- Double counting can take the forms of double issuance, double use and double claiming. In the context of NDCs double claiming is a particular concern; it means that both the host country – by reporting lower emission levels – and the entity using the carbon market unit – by counting the unit– claim the associated mitigation outcomes to achieve their mitigation target or goal. Article 6 of the Paris Agreement addresses double counting through a form of double-entry bookkeeping, referred to as 'corresponding adjustments'. The country transferring ITMOs makes an addition to its emissions level, and the country acquiring ITMOs makes a subtraction. Both countries prepare an emissions balance in which the country's target level is compared with its emissions, adjusted for any international transfers of ITMOs (Schneider et al. 2019a).
- Further principles transpire from the provisions of the Paris Agreement, the decisions on Article 6 or concepts that have been already defined and applied under the UNFCCC or the KP. These include the following:
- While the provisions in Article 6 do not directly make reference to **additionality**, the Article 6 decisions adopted at COP26 stipulate that additionality must be met for activities both under Article 6.2 and the Article 6.4 mechanism. This means that reductions that occur anyway (e.g., due to a change in demand for wood products) will not be eligible for transfer under Article 6.
- The decisions on Article 6 stipulate that **baselines** should be set in a conservative manner, below BAU projections, take into account all existing policies and address uncertainties in quantification and potential leakage. For the Article 6.4 mechanism, the decision stipulate similar requirements and specifies different approaches for establishing baselines, including best available technologies, ambitious benchmarks, or historical emissions that are adjusted downwards. Moreover, any mechanism methodology should adhere to a range of principles and provisions, including raising ambition, alignment with the NDCs, and equitable sharing of mitigation benefits.
- If using Article 6.2, the decisions require Parties to take into account any potential **leakage**. For the Article 6.4 mechanism, the decision requires that mitigation activities minimize the risk of leakage and adjust for any remaining leakage in the calculation of emission reductions or removals.
- Similarly, both decisions require to minimise the risk of **non-permanence** of emission reductions across several NDC implementation periods and, where reversals occur, ensure that these are addressed in full.
- The decision on the Article 6.4 mechanism requires the application of robust, social and environmental safeguards. How this will be operationalised by the Supervisory Body is still unclear. For Article 6.2, the need for safeguards will be further considered. Article 6.1, however, stipulates that any voluntary cooperation in the implementation of the NDCs must

promote sustainable development. This mirrors the PA's overall recognition that the response to the climate crisis must take place in the context of sustainable development (see Article 2.1). For the Article 6.4 mechanism the objective of sustainable development is directly reflected in its name (mechanism to contribute to the mitigation of GHG emissions and support sustainable development) and decision on the Article 6.4 mechanism include requirements that activities should contribute to achieving sustainable development.

- With regard to the eligibility of land use-related activities in Article 6, a key requirement in the is that Parties participating in Article 6 provide clarity on their NDC targets. This should include information on how the LULUCF sector is addressed in the NDC, including what activities and pools are covered and how the sector is accounted for. Moreover, there is continued consideration of whether "emissions avoidance" and, in the case of the Article 6.4 mechanism, "conservation enhancements" will be eligible activities.

2 Land use in carbon crediting mechanisms

2.1 Introduction

The integration of land-use activities into international market mechanisms has been the subject of controversial discussion for decades. Proponents of integration argue, among other things, that there is considerable low-cost potential in this sector, that land-use activities can bring particularly high levels of sustainable development and other benefits, and that additional funding is urgently and promptly needed, especially to halt further deforestation. Critics of inclusion fear in particular that the environmental integrity of credits in this sector is harder to ensure, that there are greater risks of negative impacts on people or the environment, and that there could be a large supply of credits at very low prices, which could delay climate action and innovation in other sectors. There are also broader concerns that compensating fossil fuel emissions with land-use activities enables more carbon from stable geological reservoirs being transferred to instable pools as formed by the biosphere, which can be more easily subject to natural disturbances and other forms of reversals.

This report focuses on the environmental integrity risks. The main risks to environmental integrity are uncertainty of **baselines**, the risk of a lack of **additionality**, risks of **leakage** (increasing emissions or reducing sinks elsewhere), **non-permanence** (reversals of emission reductions or removals), uncertainty in **monitoring** emission reductions or removals, **double counting** of emission reductions or removals, and the challenge of ensuring **environmental and social safeguards.** These risks can differ significantly between different types of mitigation activities.

Under the Kyoto Protocol, the compromise was found that only afforestation and reforestation projects are allowed under the CDM, whereas there were no restrictions for JI. In practice, however, only a few forest projects were implemented under the CDM. A major reason for this is that the Kyoto Protocol provides for a liability of the buyer countries to compensate for any non-permanence: the credits either have a limited validity (temporary certified emission reductions, tCERs) or have to be replaced by the buyer country in case of non-permanence (long-term certified emission reductions, lCERs). Furthermore, the EU, as the largest buyer of CDM credits, has excluded the use of credits from afforestation and reforestation projects in the EU ETS.

In the negotiations on Article 6 of the Paris Agreement, Parties hold also different views on this matter. The divergence of views resulted in a lack of any provisions for the land-use sector: neither Article 6 of the Paris Agreement nor the decisions on rules for Article 6 include a specific reference to the LULUCF sector. The decisions include, however, references to addressing non-permanence, which can be interpreted such that activities with non-permanence risks are eligible under Article 6, as long as non-permanence risks are appropriately addressed. Moreover, there is ongoing consideration of whether "emissions avoidance" and, in the case of the Article 6.4 mechanism, "conservation enhancements" will be eligible activities.

Similarly, the issue was controversial in the negotiations on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) adopted under the International Civil Aviation Organization (ICAO). The potential supply of credits from the land-use sector plays a particularly important role in the discussion. Ultimately, the scheme's emissions unit criteria (EUC) allow the use of credits from the land-use sector (ICAO 2019).

Beyond these multilateral approaches, various governmental and non-governmental carbon crediting mechanisms have permitted the registration of land-use activities. The market leader with the largest share of forest projects is Verra, which permits both projects under its Verified

Carbon Standard (VCS) and sectoral approaches under its Jurisdictional and Nested REDD+ (JNR). The latter includes embedding projects in sectoral approaches.

In addition, some carbon crediting mechanisms have also specialised in the land-use sector (e.g., 'Plan Vivo', 'UK Woodland Carbon Code', 'Moor futures'). With the Forest Carbon Partnership Facility (FCPF), the World Bank has launched its own programme for the use of market approaches in the forest sector and the BioCarbon Fund for the wider land-use sector. In addition, there are some national or regional programmes for the purchase of credits that include the land-use sector.

The non-governmental carbon crediting mechanisms have so far mainly been used in the voluntary market, i.e. by buyers which offset their emissions voluntarily, offer carbon neutral products or services, achieve climate neutrality or net-zero targets, or simply finance emission reductions elsewhere. Some governments also recognise these standards under national climate policies. In Colombia, for example, companies can use credits from certain standards to meet a CO_2 tax. In addition, several of these standards have been approved under CORSIA.

2.2 Method for assessing environmental integrity risks of land use in crediting systems

The number of carbon crediting mechanisms has continuously been increasing over time. There is a now a large number of different carbon crediting mechanisms that issue credits from a large variety of land-use activities. The development of different standards resulted also in a diversity of approaches to ensure environmental integrity and address the identified challenges of land-use crediting.

This report analyses how environmental integrity challenges are dealt with by carbon crediting mechanisms. It is based on a literature review, interviews with experts, an evaluation and comparison of approaches pursued by carbon crediting mechanisms, and feedback sought through a workshop carried out in October 2020 in which preliminary findings were discussed. The analysis focuses on selected types of activities including:

- Afforestation/reforestation (AR), i.e. tree planting and revegetation of areas without trees or low tree cover;
- Avoiding deforestation or forest degradation (REDD), i.e. reduced emissions from deforestation and degradation;
- Improved forest management (IFM), i.e. silvicultural measures, reduced management intensity and reduced impact logging;
- Wetland management (WET), i.e. rewetting of organic soils, wetland restoration and wetland conservation.

A subset of standards was selected to allow for an in-depth review and analysis of approaches applied by different systems. The selection aimed to cover a variety of approaches and facilitate a categorisation of differences.

For the selection, we first identified standards that include land-use activities by a literature and internet search, as well as interviews with experts in the field. The identified crediting standards are heterogenous in nature and pursue different aims and approaches. While some serve mainly compliance markets, others target voluntary offsetting. There are also differences in the scope of operation. While some operate domestically, others involve the international transfer of carbon credits. Also, with regard to the geographical coverage, differences exist. Some mechanisms target emission reductions or removals at jurisdictional level while others target only small-scale projects, involving individual farmers or local communities.

From the identified standards, a subset of standards was selected for further investigation, based on the following criteria:

- Type of activities covered by the standards (e.g., afforestation/reforestation, improved forest management, avoided deforestation and degradation, wetland management);
- Geographical applicability of the standards (to one country/region, to multiple countries);
- Scale of activities addressed by the standards (project, jurisdictional);
- Type of market that the standards serve (voluntary, compliance markets).

Based on the above criteria, 16 standards were chosen for evaluation. These include: American Carbon Registry (ACR), Architecture for REDD+ transactions/The REDD Environmental Excellency Standard (ART TREES), Australia Emission Reduction Fund (ERF), California Tropical Forest Standard (TFS), Clean Development Mechanism Afforestation/Reforestation (CDM AR), Climate Action Reserve (CAR), Gold Standard Foundation (GS), Humus-Zertifikate Kaindorf (HZK), Joint Crediting Mechanism (JCM), Plan Vivo (PV), Puro earth (puro), RGGI Offset Programme (RGGI), UK Peatland Code (UK PC), Verra‘s Jurisdictional and Nested REDD+ (JNR), Verra’s Verified Carbon Standard (VCS), and Woodland Carbon Code (WCC). Moreover, the provisions for carbon capture and storage under the CDM (CCS CDM) were evaluated, as they include interesting elements that could also be applied in the land-use sector.

The report evaluates the following environmental integrity aspects:

- Assessing additionality (section 2.3);
- Determining baselines (section 2.4);
- Addressing or preventing leakage of emissions and removals (section 2.5);
- Monitoring of emission reductions and removals (section 2.6);
- Avoiding double counting (section 2.7);
- Addressing the risk of non-permanence (section 2.8);
- Considering safeguards and co-benefits (section 2.9).

The analysis puts a particular focus on evaluating approaches to address non-permanence. For this aspect, all standards are assessed systematically. With regard to the evaluation of other environmental integrity aspects, the study draws on these standards by providing examples of interesting elements but does not systematically evaluate and compare all selected standards.

For each of the environmental integrity aspects, first, a **general definition** of the issue is formulated, and relevant environmental integrity risks are identified. Subsequently, approaches and methodologies applied by the standards **in practice** are discussed. Where relevant, this includes a differentiation by **types of activities** as these differ in terms of requirements to effectively address risks for environmental integrity and the methods applied. Finally, remaining

challenges and opportunities are identified, including gaps that have not been addressed by standards.

2.3 Assessing additionality

2.3.1 Definition and relevant aspects

Emission reductions or removals are additional if they occur because of the incentives created by carbon credit revenues. Additionality is thus about causality: emission reductions or removals are only additional if they are caused by the incentives from carbon crediting revenues. If they also occurred in the absence of the incentives from the carbon credits, they would not be additional (Schneider 2009a; Gillenwater 2012).

Determining the additionality of an activity is not the same as determining how many emissions reductions or removals result from the implementation of a project (Gillenwater 2012). However, the two issues are related and often considered together, because they determine whether and how carbon credits should be issued.

If credits from non-additional emission reductions or removals were used to offset GHG emissions, this would undermine environmental integrity and increase GHG emissions to the atmosphere (Broekhoff et al. 2019). Additionality is thus essential to ensure that carbon credits are backed by actual emission reductions or removals (Michaelowa et al. 2019a; Gillenwater 2012). A lack of additionality also undermines the cost effectiveness of using carbon crediting mechanisms.

Carbon crediting mechanisms are thus only effective if they establish procedures or tests to ensure that credited activities have a high likelihood of additionality. Robust additionality assessments are thus fundamental to any carbon crediting mechanism. Without it, carbon crediting is an unviable policy option (Gillenwater 2012).

Two fundamental challenges arise with determining additionality:

- Assessing additionality is inherently uncertain. It requires understanding what would have happened in the absence of carbon credit revenues. However, it is not possible to observe or measure this counterfactual scenario (Fischer 2005; Gillenwater 2012). Rather, it can only be construed based on assumptions about future developments such as international fuel prices or agricultural commodities.
- Assessing additionality requires information on a mitigation activity's financial feasibility and possible barriers for its implementation. This information is, however, not known to carbon crediting mechanisms. Under project-specific additionality tests, the owners of the activity provide this information. Project owners, however, have an incentive to provide information that biases a decision in their favour of the project being considered additional. Whether the provided information is accurate can be difficult to judge for auditors and the carbon crediting programme. This information asymmetry makes assessing additionality difficult in practice (Fischer 2005; Schneider et al. 2018).

In practice, the uncertainty in assessing additionality varies between different types of mitigation activities. Some activities do not generate revenues or cost savings beyond carbon credit revenue. These activities are very likely to be additional, as long as they are not implemented as a result of policies or regulations. Many mitigation activities, however, generate benefits beyond carbon credits. For these activities it can be difficult to assess whether the other benefits are sufficient to proceed with the activity or whether, in addition, the incentives from carbon credit revenues are decisive for making the activity viable.

For activities in the land-use sector, assessing additionality is associated with further specific challenges:

- Land-use change, or land-use practices, are often driven by multiple direct and indirect human drivers (Schneider et al. 2018). Agricultural expansion, infrastructure development and wood extraction are frequent causes for deforestation and forest degradation, but how these will develop, is in turn influenced by changes in underlying causes such as population growth, market developments, technological developments and policy changes (Geist und Lambin 2002). This creates considerable uncertainty how land use would develop in the absence of the carbon credit revenues, in particular for activities that avoid deforestation or forest degradation.
- Land use is considerably influenced by policy decisions at the national or subnational level, for example regarding land ownership, enforcement of environmental laws or economic development. However, the additionality or future adoption of policies is impossible to assess in practice. Policy decisions and the implementation of laws are often motivated by several policy objectives. In many cases, reducing GHG emissions or enhancing removals is only one of several motivations. Moreover, their adoption and implementation depend on political priorities, public awareness and the power of different stakeholders, which may change over time.

These factors make it difficult to demonstrate a causality between specific mitigation activities (i.e. the policy intervention) and observed changes of carbon stocks on land compared to a baseline. Whether the observed changes in land-use are attributable to the specific measures implemented under a carbon crediting mechanism, or whether they occur as a result of other changes, can be difficult or impossible to assess. In other words: the quantified emission reductions or removals may be difficult to attribute to the land use activities implemented under a carbon crediting mechanism. However, causality and attributing emissions reductions or removals to specific activities eligible for crediting is an important aspect of additionality under crediting mechanisms (Schneider et al. 2018; Gillenwater 2012).

Lastly, the Paris Agreement changes the context for assessing additionality. Countries may need to adopt new mitigation policies to achieve their NDCs. One could thus argue that measures are only additional if they are not implemented as a result of existing or new policies needed to achieve NDCs. This is further complicated, as NDCs are regularly updated with the view to enhancing ambition. An activity that is additional under current NDCs may thus no longer be additional if the ambition of the NDC is enhanced. For crediting under Article 6 of the Paris Agreement, one could also argue that the need to have robust activity-specific additionality tests in place may depend on the ambition of the NDC. If the NDC is ambitious, countries would have own incentives to only authorise activities for international transfer that they deem truly additional. Moreover, countries may need to compensate for the transfer of non-additional emission reductions by reducing emissions in other sectors (Michaelowa et al. 2019a; Schneider et al. 2017).

2.3.2 Demonstrating additionality in practice

Additionality is the central quality criterion for ensuring the quality of carbon credits. Three approaches to assess additionality can be identified in existing carbon crediting mechanisms:

1. Activity-specific, stepwise additionality assessments;
2. Standardised additionality assessments;
3. Additionality assessment through comparison to a jurisdictional baseline.

Many carbon crediting programmes also combine elements from the first two approaches.

2.3.2.1 Activity-specific, stepwise additionality assessments

Some carbon crediting programmes assess additionality individually for each proposed activity. Usually, this involves a stepwise test that aims to exclude activities that are unlikely to be additional. Often, this test is also used to determine the most likely alternative scenario to the project, which is then considered to be the baseline scenario. This type of test was first introduced under the CDM. The main three activity-specific elements are:

- **Identification of alternative scenarios and regulatory analysis:** This includes the identification of alternative scenarios to the mitigation activity that are consistent with legal and regulatory requirements and would deliver comparable results. It is important that one of these scenarios includes the situation that the mitigation activity would be carried out without the revenue from the crediting programme.
- **Investment analysis**: The investment analysis serves to assess the financial viability of a proposed mitigation activity without carbon credit revenues. If the investment analysis shows that the mitigation activity is the financially most feasible option without carbon credit revenues, then the activity is not additional. Three different types of financial tests can be used for carrying out investment analyses. Projects that do not generate revenue other than carbon credits are considered automatically additional. Other projects can either use an 'investment comparison analysis' which compares the financial feasibility of different alternative investments, or a 'benchmark analysis' which compares the project with a financial hurdle rate.
- **Barrier analysis:** Some mitigation activities may not be implemented even though they are economically viable. This is because they can face barriers for their implementation, such as institutional, social, technological or other constraints. The barrier analysis is used to assess whether mitigation activities face such barriers and whether the access to carbon credit revenues can overcome these barriers (e.g., because it provides access to another technology).

For afforestation and reforestation projects, the CDM uses the ‘Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities‘.[6] This tool includes the steps described above, with additional specific considerations for the land-use sector. The continuation of pre-project land use is a mandatory alternative land-use scenario to

[6] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf

be considered. Potentially relevant barriers relate to land tenure, ownership, inheritance and property rights.

The VCS has also adopted a separate tool for the demonstration and assessment of additionality for AFOLU project activities (VCS 2012). It includes the same analysis steps as under the CDM. After identifying credible alternative land-use scenarios, project developers are required to identify the baseline scenario using the specific baseline methodology. Then an investment analysis and/or barrier analysis are carried out, followed by a common practice analysis.

Other examples are the Woodland Carbon Code and UK Peatland Code (WCC 2020a). They also use the above-mentioned steps to assess additionality of projects. Passing a 'legal requirements test' and a 'contribution of carbon finance test' are mandatory. The latter requires projects to demonstrate that 'the income from the sale of carbon units' equals at least 15% of planting and establishment costs in the first ten years of the project. No other costs are considered. The use of a pre-established spreadsheet is required to pass this and the following test. The third step is an investment test, where project developers must demonstrate that carbon finance contributes to the financial viability of the project. The fourth step is a barrier analysis. Projects are considered additional if income generated through carbon is necessary to overcome other barriers. These include cultural barriers, unfavourable ecological conditions, institutional barriers, prevailing practices and ownership issues. Projects are required to provide 'documentary evidence' of the barriers, for example through statistics, market data, surveys, and describe how the project helped to overcome them. Projects are considered additional if they pass either the third or the fourth test.

2.3.2.2 Standardised additionality assessments

To avoid reliance on 'subjective judgments' and address the problems with information asymmetries, many carbon crediting programmes have introduced standardised additionality tests as an alternative to activity-specific tests. These tests aim to use more objective information for assessing additionality (Broekhoff 2007). They are often designed as 'eligibility criteria' which define which type of mitigation activities are eligible for crediting under a programme. Further potential advantages of a standardised approach include reduced transaction costs and more transparency in the verification and approval process (Broekhoff 2007). A disadvantage of a standardised approach is that is has to be conservative and regularly updated, to respond to changing conditions around specific activities (Schneider et al. 2019b). Ultimately, standardised approaches transfer the responsibility for assessing additionality from the project owner to the carbon crediting mechanism.

In assessing additionality for types of activities - rather than individual activities - many carbon crediting programmes use the same type of consideration as for activity-specific additionality tests, such as the typical financial attractiveness of the type of activity. Some carbon crediting mechanisms also use other standardised tests, in particular:

- **Market penetration tests:** Some carbon crediting mechanisms assess to what degree the mitigation activities are already being implemented. If the market penetration is low, the mitigation activity may be considered as automatically additional (e.g., as under the 'first-of-its-kind' approach under the CDM) or the project may not be considered additional if the market penetration surpasses a certain threshold (e.g., as under the 'common practice' test under the CDM).
- **Performance benchmarks:** Some carbon crediting programmes only qualify mitigation activities as additional if they meet certain performance benchmarks, such as an emissions

intensity per production. Such performance benchmarks aim to make sure that only advanced - and thus costly and less viable - technologies qualify.

In practice, many carbon crediting programmes combine project-specific and standardised tests. The Climate Action Reserve, for example, uses a legal requirement test and performance standards. For improved forest management and avoided conversion projects, the legal requirement test involves the project owners signing an 'Attestation of Voluntary Implementation form' where they indicate that the project is not legally required and was not legally required at the start of the project date (Climate Action Reserve 2019). A legal requirement can arise from any federal, state or local law, a statute, a rule or an ordinance. The GHG reductions or removals of an additional project must go beyond and above of any required by law. As for the performance standards, improved forest management projects are automatically considered additional. For avoided deforestation projects, project owners must demonstrate that the project area is suitable for conversion and that the value of the alternative land use for the project area is at least 40% higher than for the forest. This evidence is provided by means of a real estate appraisal that conforms to certain minimum standards. For the VCS, demonstration of regulatory surplus is the first step for determining the additionality of improved forest management activities, and the second is a performance benchmark (VCS 2020a).

2.3.2.3 Additionality assessment through comparison to a jurisdictional baseline

In the land-use sector, jurisdictional approaches are pursued as an alternative to crediting at the level of individual projects. Under jurisdictional approaches, the emissions in an entire jurisdiction are compared to a baseline emissions level for that jurisdiction. Jurisdictional approaches allow combining multiple measures and policy interventions to reduce emissions. They can be considered as a form of 'policy crediting'. Under jurisdictional approaches, additionality is commonly assumed as automatically achieved if the emissions are reduced below the jurisdictional baseline.

This approach is, for example, used by Verra in its 'Jurisdictional Nested REDD+' (JNR) standard, first introduced in 2012. Jurisdictional approaches under JNR are government-led and the jurisdiction can be national or sub-national (VCS 2021). The JNR allows jurisdictions to cover geographical areas until 'the second administrative level below the national level'. Commitments by the jurisdiction to reduce GHG emissions and increase removals by sinks must be included in the baseline and baselines established under the UNFCCC take precedent. As of 2021, there are no JNR activities listed in the Verra Registry. ART TREES uses a similar approach and 'only emissions achieved below a conservative historical baseline will be eligible for crediting" (ART 2020).

2.3.3 Challenges and opportunities

The ability to assess additionality, and the level of uncertainty associated with the assessment, differs considerably between different types of mitigation activities. Similarly, the likelihood that an activity is additional depends considerably on the type of activity (Cames et al. 2017; Trexler 2019; Schneider 2009b). This also holds with regard to the land-use activities considered in this report:

- For **afforestation and reforestation** activities, the common tools to assess additionality can be applied. Afforestation and reforestation activities are unlikely to be additional if the projects also generate income from harvesting of biomass. Plantations are often financially viable on their own and the incentive to establish them does not stem from carbon credit revenue. If the primary focus of afforestation and reforestation is the restoration of an ecosystem and the generation of woody or other products is not foreseen, then these activities are more likely to be additional, however, natural regeneration processes also need to be considered.

- **Avoiding deforestation and forest degradation** is generally more effective at the jurisdictional level, as policies and their implementation are usually the decisive factor for developments in land use. However, assessing the additionality of policies is difficult if not impossible. A further challenge is that future deforestation can depend on various factors, such as demand for global agricultural commodities, with the measures undertaken as part of a credited activity being only one of these factors. It is thus difficult to establish a causality between observed changes in deforestation rates and specific mitigation activities being implemented on the ground. This holds in particular where countries have included measures to reduce deforestation and forest degradation in its NDC, as it is then likely to introduce or strengthen policies to support this goal.
- For **improved forest management** activities, additionality is also difficult to demonstrate**.** Improved forest management practices can generate revenues other than from carbon credits and are already being implemented in many countries without carbon market incentives. The assessment of additionality is associated with a high degree of uncertainty, especially because information asymmetry may play a significant role.
- **Avoiding wetland conversion or degradation and wetland management** is more effective at the jurisdictional level. As for avoiding deforestation, however, additionality is very difficult if not impossible to assess. It also depends on the specific context of the jurisdiction where the activity takes place.
- **Wetland restoration** activities are likely to be additional if they do not generate revenue other than from carbon credits and if they are not incentivised through other policies and regulations. The common tools for assessing additionality can be applied here.

In conclusion, ensuring additionality is a major, and unresolvable, challenge for some land-use activities, in particular avoiding deforestation and forest degradation, avoiding wetland conversion, improved forest management and wetland management. This holds in particular because it seems difficult, if not impossible, to establish a causality between the mitigation activities pursued and the observed results in terms of emission reductions and removals. This also applies to jurisdictional approaches. Similar challenges are also observed in other sectors. Under the CDM, for example, methodologies for avoiding the switch of fuels were proposed several times but rejected due to the uncertainties associated with how fuel use would develop in the future in the absence of incentives from carbon credits.

By contrast, additionality can be reasonably assessed for some other land-use activities, in particular afforestation and reforestation as well as wetland restoration. The likelihood of additionality of these activities depends considerably on whether they generate financial benefits other than from carbon credits.

The Paris Agreement brings further challenges for assessing additionality which, however, are not specific to the land-use sector. It requires assessing which activities will be implemented due to policies to achieve the NDC. This comes with several practical challenges, related to the updating of NDCs, translating the NDC into a sector-specific baseline, and determining whether the ambition level of an NDC will lead to actual mitigation action (Spalding-Fecher et al. 2017; Michaelowa et al. 2019a). New regulations, programmes and policies that countries may implement to reduce land-based emissions or improve land-based carbon sinks will over time also limit the scope for voluntary action (VCS 2020b).

2.4 Determining baselines

2.4.1 Definition and relevant aspects

In the context of carbon crediting mechanisms, a baseline represents the level of emissions or removals against which actual emissions or removals are compared to in order to determine the emission reductions or removals resulting from an activity. The term 'baseline' is used to describe both an underlying *scenario* (e.g., continued deforestation at historical levels) and the associated *emissions or removals level* (e.g., the emissions resulting from continued deforestation at historical levels). In some instances, baselines are also used for demonstrating additionality. In the land-use sector, standards often consider additionality as automatically demonstrated if the baseline is above the observed emissions under the activity.

In the land-use sector, sometimes the term 'reference level' is used instead of 'baselines', for example under the Warsaw framework for REDD+ (see section 1.2.2) as well as in the EU LULUCF regulation (see section 3.2). Both terms are used for the same purpose: as the emissions or removals level against which credits are issued or results-based payments are made. In this section, only the term 'baseline' is used, as this term is more common in carbon crediting mechanisms.

2.4.1.1 Uncertainty and conservativeness

In many existing carbon crediting mechanisms, the baseline aims to represent the most likely scenario that would occur in the absence of the proposed activity, often also referred to as 'business-as-usual' (BAU) scenario. If this scenario was known, and the associated emissions and removals levels could be accurately quantified, then the resulting emission reductions or removals would be neither underestimated nor overestimated.

In practice, baselines can involve considerable uncertainty as they form counterfactual scenarios which cannot be observed or verified. There are two types of uncertainty to be considered for establishing baselines:

1. Uncertainty as to which scenario is likely to occur in the future (e.g., how will deforestation rates develop over time), and
2. Uncertainty in the underlying data (e.g., how much carbon is stored in the land).

Uncertainty of baselines varies considerably between different types of activities and country situations. For some activities, such as avoiding deforestation, the uncertainty of the baseline can be significantly larger than the envisaged emission reductions – an issue that has also been classified as a 'signal-to-noise' problem (Schneider et al. 2014a). For other activities, such as afforestation, uncertainty is relatively low.

To address uncertainty and preserve environmental integrity, many carbon crediting mechanisms require that baselines be established in a conservative manner. This means that baseline emissions or removals should be determined with a bias towards underestimation rather than overestimation. The larger the uncertainty is, the larger should be the bias towards underestimating baseline emissions or removals. The principle of conservativeness can thus result in choosing a baseline scenario that represents lower emissions or larger removals than the most likely scenario and/or in adjusting the emission or removal levels associated with a certain baseline scenario. Another way of achieving conservativeness is excluding emission sources or carbon pools that are unlikely to be a net sink or issuing credits only for a shorter period than the period over which the activity will result in emission reductions or removals.

2.4.1.2 New context of the Paris Agreement

The Paris Agreement changes the context for establishing baselines, for two main reasons. First, all countries need to communicate NDCs. To avoid the risk that countries 'over-sell' emission reductions or removals, baselines should at least represent an emissions or removals level that is consistent with the implementation of the NDC. This is particularly relevant for countries that have sectoral targets and plan to implement sectoral approaches for crediting, such as jurisdictional REDD+ approaches.

Second, Article 6 of the Paris Agreement requires that the engagement in international carbon market mechanisms should enhance ambition. This is commonly understood as an international transfer of emission reductions or removals to enable countries to set more ambitious climate targets. The possibility to use Article 6 could help buyer countries to adopt more ambitious NDCs. However, there is a widespread understanding that the principle of enhancing ambition should also help the seller countries to increase their ambition. This can be achieved by establishing crediting baselines that are below the most likely BAU emissions or removals. If baselines are set in this way, then part of the emission reductions or removals achieved through the activity would not be credited and internationally transferred and could thus be counted by the host country to achieve its own NDC. This may allow the country to adopt a more ambitious NDC target in the future or to achieve a conditional NDC.

In summary, while the most likely scenario in the absence of an activity – i.e. the BAU emissions or removals – have historically been a starting point for setting baselines, the principle of conservativeness, the consideration of NDC targets, and the principle of enhancing ambition imply that baselines need to be set at more ambitious levels in order to achieve the objectives set out under the Paris Agreement. The degree to which baselines may be set below BAU emissions, and the methods used for establishing baselines, are important policy choices in this context.

2.4.1.3 Updating of baselines

Under crediting mechanisms, the baseline emissions or removal levels are often determined ex-post but the baseline scenario and the methodological approaches to determine the baseline emissions and removals are determined ex-ante with the approval of the activity. In the case of land-use activities, baseline emissions or removals are often established prior to implementation of the activity but can be subject to revision, e.g., to reflect changes in methodology and to ensure methodological consistency between determining baseline emissions or removals and actual emissions or removals during the crediting period. Most carbon crediting mechanisms also require regular updating of baselines, in particular at the renewal of crediting periods.

2.4.2 Determining baselines in practice

The determination of baselines needs to consider the scale of activities to be credited. Activities can be implemented at the level of jurisdictions – such as an entire country or federal, state or administrative region – or be constrained to the boundaries of a particular project. Moreover, different types of land-use activities may require different methodological approaches to determine the baseline which may involve different degrees of complexity.

Carbon crediting programmes use a variety of approaches for establishing baselines in the land-use sector. In general, the following four main approaches can be differentiated (see Figure 1):

1. Reference areas (used for projects);
2. (Adjusted) historical average (used for projects and jurisdictions);
3. Historical trend (used for projects and jurisdictions); and
4. Modelling (used for jurisdictions).

Independent of how baselines are derived, they always represent a future emissions and removals level. Baselines are thus projections that anticipate a future development of land-use change, e.g., by interpreting drivers of past trends or making assumptions on a BAU development. The approaches differ in which scenario is assumed to occur in the future and what data basis is used to estimate the emissions or removals level associated with the baseline scenario.

2.4.2.1 Reference area

A reference area is an area with similar conditions as the area where a credited activity takes place but where the activity will not be implemented. It can be used for comparing the development on the two sites. The emission reductions or removals are determined ex-post, based on a comparison of the credited site with the reference area.

Under the VCS and Plan Vivo, for example, baseline emissions from deforestation and degradation in the project area can be estimated using estimates from a reference region that is similar to the project area. The suitability of the selected reference area should be ensured by selection criteria and recommended approaches. The reference area should be geographically larger than the project intervention area and should include the project intervention area e.g., applying buffering around the area where activities take place assuming similar conditions in the surrounding area. The reference region must also be representative of the future trajectory of the activity area in absence of the project activity and be truly unbiased regarding, e.g., natural, geopolitical, or watershed boundaries, access and drivers of land-use change. It often also needs to comply with a minimum size (e.g., VCS V0006 (2014a) 2.1 sets it to 250 000 ha or at least the size of the project area).

The approach of using reference areas can be used for projects but cannot be applied to jurisdictional approaches. It may also be more suitable for small-scale activities where it can be assumed that the most plausible baseline scenario is the continuation of a land use causing no changes in carbon stocks. In practice, approaches involving reference areas could be difficult to implement as sufficiently similar areas often do not exist.

2.4.2.2 (Adjusted) historical average

Under this approach, it is assumed that the historical situation – and the associated emissions or removal level – will continue in the future. The baseline emissions or removals are estimated using a historical reference period, mostly by determining the average emissions or removal level over a defined period which is often five years. A variation of this approach consists in allowing for adjustments to historical averages to reflect national circumstances (e.g., state of development, equity aspects).

This baseline approach is often applied for estimating baselines for avoiding deforestation and forest degradation, and for establishing Forest Reference Levels (FRLs) under the Warsaw framework for REDD+. Huettner et al. (2009) identify three different data sources that may be used in retrospective baseline setting. First, based on historical relative deforestation rates derived from gross forest cover data, e.g., provided by FAO, a rather simple baseline estimate can be produced. A more advanced approach uses historical relative deforestation rates based on globally consistent satellite imagery of forest cover, e.g., as offered by Global Forest Watch. The third approach employs advanced spatial data for distinguishing different strata, e.g., intact forest, non-intact forest and non-forest land (Mollicone et al. 2007). The related area changes of subsequent satellite images within a period determine the relative rate of deforestation and forest degradation. Such an approach establishes a national and globally consistent baseline of changes in forest cover. Sloan and Pelletier (2012) concluded that, with the exception of countries with significant changes in carbon stocks and rather uniform forest-carbon density, baselines based on spatial data are of limited value due to lower accuracy and considerable lack of transparency as drivers of land-use change may remain undetected. However, remote sensing technologies have significantly advanced in recent years, offering opportunities for much more detailed differentiation of changes in forest cover and carbon stocks (Jha et al. 2021), especially when combining land-use change and biomass maps (Sy et al. 2019).

The ART TREES establishes baselines, referred to as 'Crediting Level', only based on average historical emissions. To reflect uncertainty in underlying data, it requires that the Crediting Level is reduced if uncertainty exceeds 15%. VCS JNR is another example applying historical baselines, although not exclusively. VCS JNR also allows establishing jurisdictional reference levels with increasing emission trends if justifiable by national circumstances, such as in the case of high forest low deforestation countries (VERRA 2020). Historic data can become invalid for baseline setting if it is too far from the crediting period. This requires periodical updates of baselines. The ART TREES standard demands an update every five years, requiring also that an updated baseline may not be higher than the previous level.

Baselines based on average historic emissions are a simple approach. They assume that the future development will be the same as in the past. This may be reasonable for afforestation or reforestation activities or rewetting of organic soils (assuming additionality of the activity is proven separately). For other activities, in particular avoiding deforestation and forest degradation, wetland conservation, or improved forest management, there is considerable uncertainty of what the likely future development will be and whether and how the credited activity will impact these developments. For these activities, baselines based on historical emissions could lead to either under-crediting (e.g., for 'high forest cover, low deforestation' countries) or to over-crediting (e.g., for countries or regions where the rate of deforestation decreases over time). As a consequence of historical variations in emissions and removal levels, the choice of the reference period can have considerable influence on the baseline level (Mertz et al. 2018). For improved forest management activities, historical baselines applying average values are also problematic due to natural and indirect human-induced effects, such as age-class shifting (Böttcher et al. 2008).

2.4.2.3 Historical trend

This approach is a variant of an (adjusted) historical average approach and can be applied for projects or jurisdictions for which a trend in historical data can be observed. This trend could be an increasing rate of deforestation, e.g., as often observed in countries with emerging economies but deficits in governance, or a decreasing rate, e.g., in countries where economic shifts reduce deforestation pressure over time. The approach builds on the assumption that such trends will continue in the future.

The baseline emissions or removals are estimated using a historical reference period, mostly by determining the trend in change of emissions or removal levels over this period. The trend is than extrapolated as an (e.g., linear) trajectory to the future, with the slope of the average historic development. VCS, for example, allows for the use of baselines extrapolating historical trends.

2.4.2.4 Modelling

More advanced methods than trend extrapolation for establishing projected baselines are scenario analyses involving more or less complex projection models. These can involve specific drivers, future policies and planned activities, like infrastructure projects, agricultural production but also changes in conservation policies. This makes such baselines not only complex but also less transparent which poses risks for inflated baselines. Given the range of possible baselines, it is impossible to clearly assess which would be the most appropriate scenario as there are no standard criteria for what to include in modelled baselines.

Baselines using modelling are inevitable for activities related to forest management. They enable to exclude past practice and other indirect human-induced effects from accounting (Böttcher et al. 2008). This is important to limit crediting to only those changes in carbon stock changes that are directly caused by management changes. A managed forest might constitute a net carbon sink without management changes, simply due to its age class structure. The CAR Forest Project Protocol baselines include assumptions about forest growth and harvest and assumptions regarding the extent of harvest operations under BAU conditions to be verified. It requires modelling of the baseline carbon stock development over a 100-year period to be averaged and adjusted for trends (e.g., to address legal constraints for increasing carbon stocks).

Baselines based on models can quickly be outdated as drivers and underlying data might change. Regular updates are therefore important. The renewal of crediting periods varies considerably between carbon crediting programmes. The VCS baseline for avoided deforestation activities, for example, must be revised every 10 years. For baselines based on models, the reassessment of baselines should capture changes in the drivers and behaviour of agents that cause the change in land use and changes in carbon stocks.

2.4.3 Challenges and opportunities

Robust baselines are critical for the environmental integrity of carbon credits. If baseline emissions are overestimated, both environmental integrity and economic effectiveness are undermined. If they are underestimated, harm to the environment might be limited but revenues from carbon credits might be lower and the activity may be less financially viable - though this depends on the elasticity of carbon credit demand.

Establishing baselines is a particular challenge for mitigation activities in the land-use sector, mainly due to the comparably high uncertainty of baselines in this sector and - to a lesser extent - due to the limitations in data availability. Here, we discuss three main issues identified in the evaluation of existing approaches of carbon crediting programmes: the uncertainty in baseline scenarios, uncertainty of data in estimating carbon stocks, and alignment with the requirements of the Paris Agreement.

2.4.3.1 Uncertainty in establishing baseline scenarios

The uncertainty in establishing baseline scenarios differs considerably between different types of land-use activities (e.g., afforestation and reforestation versus avoiding deforestation) and the scale at which activities are implemented (e.g., projects versus jurisdictional approaches).

For **afforestation and reforestation** activities, the continuation of the current situation is a plausible scenario, as long as additionality of the activity is given. In some instances, some natural revegetation may occur. Overall, the uncertainty of the baseline is relatively low.

Similar considerations hold for the **rewetting of organic soils** or **wetland restoration**, noting though that in this case the uncertainties regarding the actual amount of carbon lost from soils is considerably larger. This uncertainty can, however, be addressed by determining the actual carbon stored in a rather conservative manner.

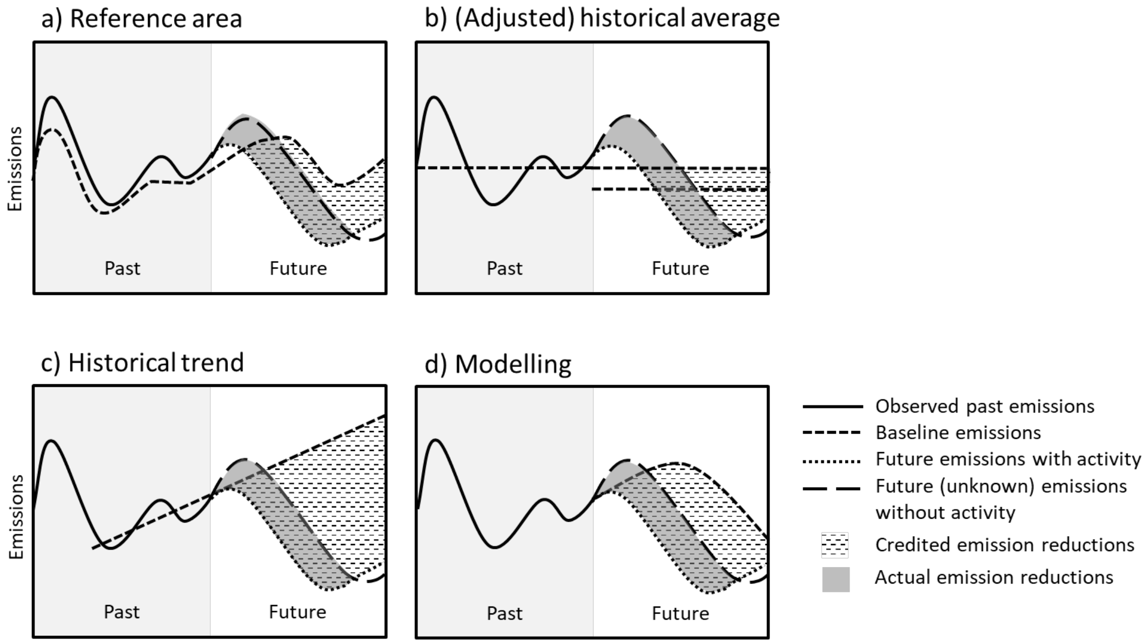
For activities **avoiding deforestation and forest degradation** and **wetland conservation**, the uncertainty of the baseline scenario is a major environmental integrity risk. This is because deforestation and forest degradation can vary considerably over time and are driven by multiple factors which are difficult or impossible to predict. This includes demand and prices for agricultural commodities, the impact of future climate change, or changes in political priorities as for example observed in Brazil (Heilmayr et al. 2020). This raises the question to what degree emission reductions, as determined against a hypothetical baseline, are attributable to the mitigation activity or attributable to other factors that may be beyond the control of the entities implementing the mitigation measures. Attributability of the credited emission reductions to the mitigation measure is, however, a key requirement and prerequisite for ensuring additionality and environmental integrity (Gillenwater 2012).

Uncertainty in baselines is common in carbon crediting mechanisms for many types of mitigation activities, however, for avoiding deforestation activities existing challenges are most prevalent. It can be managed by choosing baselines conservatively, but only as long as the uncertainty of baselines is small in relation to the mitigation outcomes from the credited activity - an issue that has sometimes been referred to as 'signal-to-noise' issue (Cames et al. 2016; Spalding-Fecher et al. 2012). The signal-to-noise challenge can apply to different mitigation activities and sectors. For renewable power generation, for example, the uncertainty of the grid emission factor is considerable. For instance, if the uncertainty range lies between 0.5 and 1.0 t CO_2eq. per MWh electricity, using a value of 0.5 t CO_2eq. per MWh would be a rather conservative approach. This approach would still allow crediting a renewable power plant that does not cause any emissions. The plant may receive fewer credits than with the actual - but unknown - grid emission factor but environmental integrity would be ensured, despite the uncertainty in the baseline. This would, however, not hold for an activity that installs a new fossil-fuel based power plant with an emissions intensity of 0.6 t CO_2eq. per MWh. In this case, it would not be known whether using this baseline actually leads to over-crediting or under-crediting; the impact of the mitigation activity could lie within the uncertainty range. In the case of avoiding deforestation, this same issue would occur if, for example, the uncertainty of a baseline lies between 100,000 and 200,000 ha of land that is deforested per year, and the credited activity reduces deforestation by 30,000 ha per year.

Under existing carbon crediting mechanisms, many baseline and monitoring methodologies and several mitigation measures have been rejected due to this matter. Under the CDM, for example, this includes capacity building measures, large hydro dams due to uncertainty over methane emissions, avoided fuel switch due to over uncertainty of future fuel prices, among others.

In our assessment, this challenge also applies to many activities avoiding deforestation or forest degradation. This is further illustrated in Figure 1 for a mitigation activity that reduces deforestation. In the figure, the historical emissions from the area fluctuate considerably over time (continuous lines). Without the implementation of the mitigation activity, these fluctuations are assumed to continue in similar patterns in the future (lines with long dashes). Once the credited mitigation activity is implemented, this future development can, however, no longer be observed - it is counterfactual. The mitigation activity reduces the emissions to some extent. Here it is assumed that it will result in a relatively constant absolute emission reduction, and thus a relatively constant deviation of emissions from the unknown future emissions level that would occur without the mitigation activity. The true - but unknown - emission reductions are illustrated through the grey area.

Figure 1: Illustration of implications of different baseline approaches for a hypothetical activity that reduces deforestation



Panel a) applies a reference area approach that compares two areas with similar conditions, panel b) includes two alternative baselines, a historical average extrapolated from the past and a (downward) adjusted baseline considering specific circumstances, panel c) applies a historical trend projection, and panel d) a projection based on a simulation model.
Source: own compilation

Approaches applying a reference area fail to ensure attributability of activities when there is high variability in the observed emissions between the areas (case a), Figure 1). Other approaches could lead to significant over-crediting (see case c) if a historic trend is projected that brakes after the baseline period. Modelling approaches can be able to better capture changes in drivers but need to anticipate their trends accurately (see case d). Due to the significant variations in historical emissions and the large uncertainty about their future development, even conservative choices in establishing crediting baselines may not ensure that emission reductions are not over-credited.

Therefore, in our assessment, the current baseline approaches employed by carbon crediting mechanisms for avoiding deforestation activities do not address this challenge appropriately and involve considerable risks of over-crediting emission reductions. Given that many methodologies and mitigation activities with similar issues have been rejected under existing carbon crediting mechanisms such as avoided fuel switch[7], this raises the question whether avoiding deforestation and forest degradation should be eligible for crediting at all.

If policymakers wish to deem this activity eligible, we identify here, drawing on the wealth of experience with crediting mitigation activities in other sectors, three approaches that could be further explored to reduce environmental integrity risks:

- **Limiting crediting to activities that fully halt deforestation or forest degradation, combined with baselines set at the lower end of the uncertainty range:** This approach

[7] https://www.oecd.org/env/cc/34008610.pdf

would aim to preserve integrity by ensuring that emissions under the credited activity are lower than the uncertainty band of the baseline emissions. If credits are only issued under the condition that the mitigation activity fully and continuously halts deforestation and if the baseline is chosen towards the lower band of the uncertainty range, emission reductions would not be over-estimated. In implementing this approach, the uncertainty of the baseline level could be estimated in various ways, such as by using Monte-Carlo-analysis to model the implications of different factors or drivers or by using historical data in different regions over longer time periods. This approach may work appropriately for smaller-scale activities, the crediting of which raises other challenges such as leakage (see section 2.5) but may not work for jurisdictional approaches for which it may be difficult to fully halt deforestation.

- **Reference areas:** The use of reference areas could, in some instances, be a viable alternative for establishing baselines (see section 2.4.2.1). However, this option hinges on the availability of data from a significantly large number of truly comparable reference areas with similar characteristics. It is also only an option for activities implemented at project scale.

- **Crediting the impact of specific activities, rather than the existence of carbon stocks:** Under the CDM and other carbon crediting mechanisms, the signal-to-noise challenge was often addressed by choosing a narrow boundary and determining the emission reductions from specific activities, rather than from aggregated results.[8] For example, an activity that works with local farmers to increase the amount of services provided by their land, thereby reducing the pressure to make new land available through deforestation, could determine the emission reductions based on the amount of enhanced services provided by the land, rather than based on the amount of carbon stocks existing on the land. This is a common approach in methodological standards for other sectors. In other words: the current approaches used by carbon crediting mechanisms for avoiding deforestation or forest degradation determine results at a high level of aggregation (total carbon stocks on the land) and assume a baseline at this same level of aggregation, while the activity is implemented in an environment where carbon stocks are affected by multiple drivers, which may only partially be addressed by a mitigation activity.

Modelling could, in principle, be a further alternative but raises other issues. Models may be capable of incorporating more influencing factors, for example by adjusting the baseline ex-post based on parameters that are beyond the control of the activity owners and that impact deforestation levels, such as global agricultural commodity prices. However, such models also involve uncertainty, increase complexity and may be less transparent. It is therefore not recommended as a suitable approach.

For **improved forest management** activities, it is crucial to reflect age-class related effects of future changes of emissions and removals to attribute activities adequately to emission reductions or increased removals. With sufficient data on age-class distribution and forest

[8] Under the CDM, for example, a project developer originally proposed to determine the methane leakage from a natural gas pipeline by measuring the inlet and outlet flow of the gas pipeline. As this measurement uncertainty is larger than the likely level of the leaks, the proposed methodology was not deemed appropriate, and instead each individual leak (or a sample of leaks) are measured using appropriate measurement devices.

structure, the projection of forest dynamics does not need to involve complex models, especially for short- to medium-term projections up to 20 years. Instead, simple matrix-model approaches can be used that project the historically observed transition of area between forest age-classes and types.

In the case of **jurisdictional approaches**, similar considerations hold as for avoiding deforestation and forest degradation, as discussed above. The baseline can involve a very high degree of uncertainty. This makes it questionable whether a reliable and conservative baseline can be identified, in the light of uncertainties about future political priorities. When implementing jurisdictional approaches, nested baselines can be used for sub-jurisdictional crediting within a nested accounting framework (see section 2.7). The draft updated VCS JNR nested approach (VERRA 2020) demands demonstration on how the development of the jurisdictional reference level is consistent with the development at a higher level, e.g., as recorded in the National Forest Monitoring System (NFMS). Most important for nested approaches is consistency with a country's NDC that can be considered as forming the national level baseline. In total, baselines should exceed the NDC ambition both to guarantee overall emission reductions and to be regarded as additional effort.

2.4.3.2 Uncertainty in data

Uncertainty in data on carbon stocks on land is another practical challenge. Compared with the uncertainty in baseline scenarios this matter can be addressed more easily, by adjusting uncertainties through conservative assumptions and approaches (Grassi et al. 2008). This means that when accuracy of estimates cannot be achieved, baseline emissions should include a bias towards underestimating baseline emissions or overestimating removals.

In establishing baselines, it would also be useful to use transparent and consistent data sources for historic emissions (e.g., from global forest observation systems). Towards this end, Obersteiner et al. (2009) suggest establishing an 'International Emission Reference Scenario Coordination Centre' (IERSCC). The IERSCC would act as a global clearing house for harmonised data to be used in implementing baseline methodologies (Obersteiner et al. 2009). Global data is readily available for assessing land-use changes consistently with high time resolution and high accuracy, e.g., from Global Forest Watch. However, such data need to be accepted and trusted by stakeholders. They also cannot fully substitute for sound national data that is needed for transparent and adequate baseline setting.

2.4.3.3 Alignment with the requirements of the Paris Agreement

The Paris Agreement sets new conditions for establishing baselines. These provisions have not yet been adopted by carbon crediting mechanisms, which often still aim to establish baselines at the level of BAU emissions. Next to using more ambitious baselines, below BAU, it will be important to ensure consistency of baselines with NDCs. This means that policies to implement the NDC should be reflected in assessing baseline levels. For jurisdictional approaches, the overall baseline for the jurisdiction would need to correspond at least to the ambition level of the NDC. As many NDCs include targets for the land-use sector, these targets could be used as a starting point. If the country intends to use international carbon crediting approaches to achieve its NDC, it will need to ensure that it only transfers part of the emission reductions or removals. This would be enabled if the baseline is set at a more ambitious level than the NDC.

2.5 Addressing leakage

2.5.1 Definition and relevant aspects

Activities for reducing emissions or increasing removals in the land-use sector can affect emissions and removals in other sectors or outside the target area. Such effects are commonly referred to as leakage. The Intergovernmental Panel on Climate Change(IPCC) defines leakage as `*the indirect impact that a targeted land use [...] activity in a certain place at a certain time has on carbon storage at another place or time*' (IPCC 2000). Such displacements can be caused by activities implemented at different scales, including projects, programmes, or jurisdictional approaches. While displacement within the system boundaries is usually reflected in the activity's monitored emissions, leakage is a displacement happening **outside** the boundaries of the activity (Henders und Ostwald 2012). Leakage can have different causes and implications. Box 2 presents definitions of different concepts around leakage that need to be distinguished.

Box 2: Definitions around leakage

Displacement: Geographical shifts in the supply of products or services from one area to another as a result of the implementation of a land-use activity. Displacement occurs when the implementation of an activity (given that the demand is stable or increasing) reduces the supply of products or services provided by the land in comparison to the situation where the activity had not been implemented.

Leakage: An increase in emissions that occurs outside the boundaries of the credited activity.

Direct/primary leakage: Leakage effects caused by the direct shift in the supply of products or services from one area to another through the implementation of an activity, such as the displacement of grazing land for cows to another area (activity shifting).

Indirect/secondary leakage: Leakage effects caused by the implementation of an activity in one area indirectly creating incentives for changes in activities in other areas. Indirect effects are usually caused by the reduction in supply of products or services leading to a shift in markets, such as increased crop production in other areas due to a reduction of crop production on the targeted land area (market effects).

Ecological leakage: Leakage effects caused by the implementation of an activity in one area affecting natural processes stretching out to surrounding ecosystems outside an activity's boundary leading to emissions, e.g., if organic soils in an area are rewetted affecting the hydrological properties of ecosystems outside the area causing tree dieback.

ILUC: Indirect land-use change can be a consequence of displacement effects, e.g., triggered by demand for products or services (not directly a land-use activity or policy), where the previous production is displaced to other areas if the demand for the previously cultivated products or services remains.

Rebound effect: Increase in the total use of products or services as a result of lower prices for the products or services. This can occur if an activity results in efficiency increases or otherwise contributes to lowering the product or service prices. Rebound effects can cause additional leakage.

Substitution effect: Exchange of one product or service with another product or service that has the same functionality. It forms the basis of why displacement and leakage happen.

Spillover effect: Impact of an activity on other areas that is not related to the target of the activity (e.g., emission reduction activity leading to increased biodiversity or improved water retention). Like leakage, spillover effects can be positive or negative.

A prerequisite for displacement to happen is that products or services inside and outside the geographical area of the activity are homogeneous or similar in function, so that there can be substitution between them. If the degree of substitution is high, there is a high possibility of displacement and thus potential leakage (Pan et al. 2020). Schwarze et al. (2002) describe different mechanisms of leakage that can be used for a classification of leakage types, such as activity shifting, market effects and ecological leakage (Figure 2, Box 2). It must be noted that the definition of leakage of mitigation activities is usually constrained to leakage of emissions, the thematic target of the activity. However, displacement might lead to impacts on other thematic areas. Mitigation activities can have impacts on biodiversity, employment, and other aspects. Such impacts are also referred to as spillover (Box 2). Different types of leakage are usually also more or less relevant for different types of land-use activities.

Direct leakage, or primary leakage, occurs often at a local and national scale. It occurs when an activity reduces the supply of products or services in comparison to the situation where the activity had not been implemented and causes activities or agents to shift from one area to another. Especially activities that avoid deforestation or degradation bear the risk of direct leakage because they aim at reducing activities such as agriculture or logging that can rather easily be relocated by the agents. Reforestation and afforestation activities can also cause previous activities in the land to shift location. Thus, primary leakage relates to situations where the supply of a product or service is displaced by the activity, pointing also to a flawed design of such activities (Aukland et al. 2003).

Indirect leakage, or secondary leakage, also occurs if land-use activities cause a reduction in product or service supply from the target area but occur more indirectly through market effects. These effects are typically triggered by conservation activities avoiding the expansion of commercial agricultural production or afforestation of productive agricultural crop- and grasslands. The risk of secondary leakage, as well as primary leakage, is smaller if activities involve abandoned land. Compared to primary leakage, secondary leakage is most likely to occur on a national and international scale.

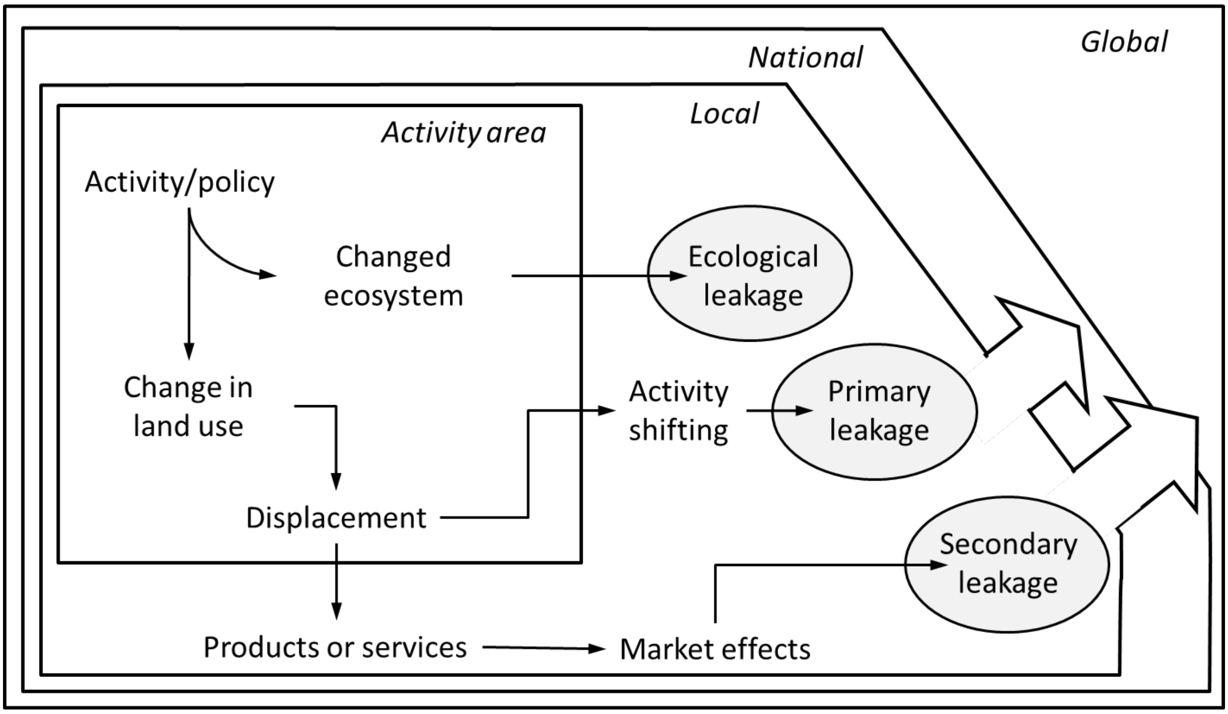
Displacement can also be caused by additional supply of goods and services, e.g., generated by AR activities, leading to a reduction in prices and subsequently an increase in demand (Aukland et al. 2003). Such rebound effects can be a further source of leakage (see Box 2). Life-cycle effects (Schwarze et al. 2002) describe the effect of mitigation activities increasing emissions in upstream or downstream activities of the activity. They might cause emissions not directly related to land use but to other sectors, such as increased emissions from tourism activities started around the new area protected from deforestation.

A special type of leakage is ecological leakage that refers to natural processes inside an activity's boundary that lead to emissions in surrounding ecosystems. They are typically associated with wetland activities that affect hydrological properties of ecosystems (Schwarze et al. 2002).

Leakage is not per se restricted to specific activity types (ecological leakage caused by wetland management activities as an exception). Direct leakage can be associated with any activity that changes the level of supply of products or services from the affected areas. For afforestation activities on unused land such effects are often rather small or can also be positive. Overall, leakage is more determined by the land use prior to the activity, the properties of products and services from affected areas, and characteristics of markets.

Global leakage risks might be lower if all countries had effective policies in place for halting deforestation. This is not yet the case. Not all countries have included the land-use sector in their NDC, and those who have included the sector do not necessarily have effective policies in place and do not necessarily include all land-use categories or carbon pools. But even in a complete and fully covered reporting system, leakage could still occur. It is thus essential to identify and quantify leakage effects, to attribute them to specific activities and parties and ensure overall environmental integrity.

Figure 2: Leakage types and mechanisms related to mitigation activities or policies.



Source: own compilation based on Schwarze et al. 2002

2.5.2 Addressing leakage in practice

An ideal approach to addressing leakage includes identifying and mitigating leakage risks, monitoring and quantifying any remaining leakage during the activity's lifetime, and accounting for leakage by deducting leakage emissions in the calculation of total emission reductions and removals (Chagas et al. 2020).

2.5.2.1 Identifying and mitigating leakage risks

Identifying and categorising leakage are important prerequisites for mitigating, monitoring and quantifying leakage of land use-related carbon crediting activities. Leakage risk can already be mitigated through the appropriate design of mitigation activities. Measures for increasing the efficiency of production and services from the land affected or providing alternative sustainable livelihoods can prevent the displacement of those when activities are implemented. However, whether such measures can successfully prevent leakage, depends on sufficient participation and acceptance by stakeholders, resolved land tenure issues and effective governance.

For example, the CDM methodologies for afforestation of land used for agriculture and pasture require procedures to demonstrate that leakage from activity displacement due to displacement of pre-project grazing activities does not occur. This can be done by providing evidence that there are sufficient areas where the land is used below its sustainable capacity in the vicinity to the area where the activity takes place and within the same market area. This can ensure that no stocked areas will need to be converted to grazing land or to cropland in the course of displacement.

Another example is the Plan Vivo methodology applied to the project 'Conservation of miombo woodland in Mozambique' that addresses leakage by implementing activities to reduce the pressures on forests. These measures include agroforestry and improved crop management measures to increase crop yields and reduce encroachment into surrounding areas for agricultural land and establishing sustainable woodlots to provide products such as fuelwood or poles that may no longer be available from within the protected area.

Leakage risk can also be reduced by appropriately setting system boundaries for crediting, i.e. including all relevant activities, pools and gases in order for activities to be eligible for crediting (Schneider et al. 2018). This would limit crediting to projects or jurisdictions that take full account of all processes related to planned land-use activities for increasing sinks or reducing emissions. However, secondary leakage might not be fully addressed through improved system boundaries, as demand may come from beyond those boundaries, especially if international markets are involved. Still, applying a landscape management approach can help to identify pressures that are behind displacement processes and remove or reduce these pressures, thereby minimising potential leakage.

Ecological leakage is usually addressed through activity design. It can be avoided by ensuring that the leakage effect caused by ecosystem connectivity is reduced (e.g., through preventing a significant alteration of mean annual water table depths in surrounding areas or a buffer zone within the activity boundary as applied by VCS (2015)).

Excluding specific activities with high leakage risk is also an effective way of reducing the risk. Avoided deforestation activities were excluded from the CDM, also due to the high leakage risk associated with crediting of such activities.

2.5.2.2 Measuring direct leakage

Over the last decade, different ways to detect and measure leakage effects have been developed and tested. Henders and Ostwald (2012) provide an overview of direct and indirect methods. Direct measurements are often applied to assess primary leakage effects, e.g., by establishing a reference area around an activity where activities are likely to be displaced to. This can be done with the help of remote sensing or ground measurements of forest area, biomass and carbon stocks. But also interviews and surveys can provide information on displaced activities and their magnitude. Most carbon crediting mechanisms account for direct leakage by using such methods.

Direct measurements can also be applied for estimating ecological leakage, which is usually addressed for wetland management activities (e.g., VCS and WCC), e.g., through water level gauges or vegetation assessments. Another approach for measuring leakage is leakage belt monitoring. It measures and quantifies shifts of activity in areas where these are likely to occur and compares increases or losses of carbon stocks to a baseline for the area. Such an approach is, for example, applied by the VCS and the ACR. Monitoring belts need to be sufficiently large and their determination can be challenging. It requires a good understanding of local and regional economic structures and markets, and the potential mobility of agents to make leakage belts an effective monitoring approach. New satellite monitoring techniques may improve monitoring, but attribution of drivers to land-use changes observed remains uncertain.

2.5.2.3 Assessing secondary leakage

Secondary leakage is impossible to be measured directly and is therefore typically assessed using economic market models that determine the likely changes in prices and shifts of market equilibria. Such models require sufficient information about market conditions but can also be considered as black boxes if assumptions are not transparently presented. Simpler methods involve default factors to discount the achieved emission reductions in order to account for market effects without directly quantifying them. Leakage of land use-related activities can only be comprehensively addressed if leakage approaches are combined that cover primary and secondary leakage effects (Henders und Ostwald 2012).

Under the VCS, for example, for most activities relevant leakage from the jurisdiction needs to be determined, including direct, indirect and ecological leakage. Verra's JNR (2014b) requires the determination and accounting of indirect leakage if activities affect the production of relevant global commodities that are linked to international markets. This can be done using a default approach that includes 'Global Commodity Leakage Values' which have been derived based on literature and differentiate between Brazil, Indonesia, Democratic Republic of the Congo, and all other countries.

Assessing jurisdictional market leakage requires estimating the baseline amount of production for each relevant global commodity within the jurisdiction. More advanced methods, as applied by the JNR, include an 'effective area approach' and a 'production approach'. The effective area is defined as the difference between the area of production observed within the jurisdiction and the area required to maintain the projected baseline levels of production. The production approach evaluates only whether, and to what extent, an area has experienced a net decline in the amount of global commodity production as a result of an activity. Such approaches require detailed information on the decrease in production occurring as a result of the land-use activity and share of deforestation attributable to different drivers.

The ACR requires addressing activity shifting, either by quantifying actual emissions that result for leakage or by applying a verifiable default value to be determined by project proponents (American Carbon Registry 2019). Similarly, market leakage must be accounted for if activities cause a quantifiable, statistically significant decrease in the supply of goods. If such leakage occurs, peer-reviewed studies on market leakage rates can be used to quantify the effects.

For afforestation activities on degraded or abandoned land, where market leakage effects are expected to be small or positive, neither ACR nor VCS require assessing market leakage. The ART TREES standard encourages to address leakage through activity design. For leakage effects that cannot be avoided, it requires to discount up to 20% to the estimated emission reductions based on the percentage of national forest area included in the geographical boundary of the jurisdictional approach, ranging from > 90% coverage where no leakage risk is assumed to < 25% where leakage risk is assumed to be high.

An important finding by Henders and Ostwald (2012) is a lack of methods that address international leakage. Therefore, many standards do not require to address this form of leakage. Scientific modelling tools exist to provide a quantification of global leakage. Since data requirements and model complexity are high, practicability for an application to a specific project is limited. However, such tools can be used to provide more elaborated and product-specific default values, potentially regionally differentiated as presented for indirect land-use effects of biofuel products by Valin et al. (2015).

2.5.3 Challenges and opportunities

Leakage effects occur due to the fact that areas outside the boundary of the land-use activity exist where emissions caused by displacements remain undetected. Therefore, increasing the boundaries of land-use activities from projects to jurisdictional scale can help incorporating direct leakage emissions. While a national or jurisdictional scale does not completely eliminate displacement effects, any leakage is automatically accounted for when quantifying emission reductions.

Appropriate methods for identifying, quantifying and controlling leakage are key for ensuring environmental integrity of land-use activities and policies (Henders und Ostwald 2012). While direct leakage can be addressed by adequate activity design, the risks of market and international leakage are more difficult to address (Chagas et al. 2020).

Direct leakage can be interpreted as emissions not anticipated in the baseline that includes only emissions within the boundaries of an activity. Consequently, leakage identification should also be linked with an understanding of the activity design, including baseline estimation (Aukland et al. 2003). If the main elements determining leakage are properly identified and understood at the onset of an activity, a large extent of the potential primary leakage may be prevented if addressed in an early phase. This can include a critical assessment of characteristics of products and services by areas affected through activities and options for their substitution.

Appropriately categorising leakage based on types of activities and addressing leakage by applying default values is a challenge but a way to address leakage in a differentiated approach. Land use-related activities have variable risks of leakage. The risk of leakage depends partly on the type of activity (e.g., wetland restoration leading to ecological leakage) but even more on the activity design, scale and underlying drivers. Community activities that improve forest management rather than eliminate forest harvest in general have a lower risk for activity-shifting leakage. In contrast, avoided deforestation activities that have highly mobile agents can have high risks of leakage (Chagas et al. 2020). There is the risk that default leakage approaches for any type of activity ignore such differences and cause more leakage by poor activity design or implementation, or both. Therefore, a standardised approach to leakage seems not to be useful (UBA 2019).

Leakage caused by mitigation activities refers only to emissions occurring due to displacement. However, there can also be non-GHG impacts, e.g., impacts on biodiversity, employment or health. Such spillover effects are an important aspect of leakage which is not fully addressed in the common use of the term. Spillover as well as ecological leakage effects need to be considered to address displacement effects of activities and policies more comprehensively.

UBA (2019) recommend a differentiated approach to addressing leakage. First, they identify standardised no-leakage assumptions for activities where leakage effects are known to be rather limited to mitigate the risk. For such activities simple default leakage accounting methods would still be adequate but reduce efforts of leakage determination and monitoring. This applies to activities that are to be implemented on abandoned land with no ongoing agricultural use and for cases where the displaced activity is banned on land potentially affected by leakage. If land use can continue at a similar level of service or production (e.g., reed or hay harvesting; subsistence harvesting) leakage effects can also be small. This applies more often to afforestation and reforestation activities than activities avoiding GHG emissions that are usually caused by economic activities on the targeted area that need to be reduced or ceased for achieving reductions in GHG emissions. Another option related to activity design is compensation for expected leakage outside the activity area but under the monitoring system of the activity.

Other types of activities with more complex displacement effects would need to apply activity-specific assessments to identify and quantify leakage. To quantify market leakage, economic models can be applied. However, they require sufficient data for calibration and rely on assumptions and can therefore be considered as 'black boxes'. Activities with inherently high leakage risks that cannot be adequately quantified or mitigated (international leakage), should generally be excluded from crediting.

To conclude, adequate leakage consideration is very important for ensuring environmental integrity. To minimise risks as much as possible, the following hierarchy should be followed:

1. **Identify** possible leakage risks related to land-use activities, including not only emission leakage but also ecological leakage and potential spillover effects where relevant;
2. **Exclude activities** with material risks of global leakage;
3. **Mitigate** leakage risks to the extent possible through careful design of activities, e.g., implementation on abandoned land, introduction of buffer zones;
4. **Quantify** leakage appropriately using case-specific quantification methods, if default factors are applied, they need to be differentiated as much as possible (e.g., by type of activity/products affected etc.);
5. **Include** leakage transparently in determining total emission reductions or removals.

2.6 Effective monitoring

2.6.1 Definition and relevant aspects

The monitoring, reporting and verification (MRV) required by crediting standards refers to the process of periodically quantifying the emission reductions or removals of an activity. The process involves predefined methods for monitoring, usually specified in baseline and monitoring methodologies and the regular preparation of monitoring reports in which emission reductions or removals are quantified for specific periods. Monitoring reports are usually independently verified.

The ability to accurately measure emissions and removals is important for ensuring environmental integrity of activities. Complexity of natural processes and insufficient data can be a major challenge for MRV of land use-based carbon crediting at project and jurisdictional level. A commonly faced challenge is the question of how to cope with a lack of data. **Effective monitoring** requires **transparency** of methods, **accuracy** of estimates, **completeness**, **consistency,** and **comparability** of data across time, space, and activities. To achieve that, spatially or temporarily overlapping datasets need to be combined using consistent approaches and definitions to correctly assess dynamics over time and across the landscape. An important prerequisite for the implementation of nested approaches is the scalability of emission reduction estimates, consistently from local to national levels.

Estimation of emissions and removals for baselines and during the crediting period requires accurate data on carbon stocks and/or stock changes per ha and area information. The first can be provided by methods like, e.g., forest inventories based on field sampling, the latter on statistics and/or remote sensing information. Models can also be used to assess carbon stock changes caused by activities through comparison of alternative scenarios, especially for estimating emissions at larger geographical scales. The advantage of modelling approaches is that the degree of complexity covered is larger compared to simpler methods. This can help to better assess leakage and other implications of activities. However, their application can reduce the transparency of estimates, reduce access (because of limited capacity to understand underlying assumptions) and increase uncertainty.

Effective monitoring with sufficient accuracy needs to account for different types of activities, pools to be covered, country situations, and environmental and geographical conditions. While biomass carbon stock changes of afforestation/reforestation activities on large uniform areas can be effectively monitored using remote sensing information on forest cover and limited data from field surveys, the monitoring of carbon stock changes in agricultural soils or increases/decreases of biomass in dense forests require considerably more efforts. Stratification of the area where the activity takes place into homogeneous units, e.g., using remote sensing information, can increase precision of estimates and reduce cost of monitoring by reducing variance within each stratum.

2.6.2 Effective monitoring in practice

Monitoring requirements are typically quite detailed for carbon crediting mechanisms and can include different means of validation, verification, and documentation. These include monitoring plans that describe how areas are being monitored at the start, during and at the end of an activity and monitoring reports that document progress over time. Monitoring elements include further geographic coordinates of the boundary of activities and any stratification inside the boundary.

Some standards manage uncertainty of estimates by defining a minimum level of acceptable uncertainty. For example, the VCS requires estimates of not more than ±20-30% uncertainty based on a 90-95% confidence level. ACR requires a precision level for biomass estimation of ±10% of the mean at a 90% confidence level which is also applicable to CDM AR activities. Under the CAR, each applicable pool or combination of pools must meet the minimum precision threshold of ±20% at the 90% interval. While biomass assessment methods can manage to meet such levels of uncertainty, the range for other pools such as soil carbon can be much larger. Uncertainty levels above these thresholds may be accepted but require a reduction in credited emission reductions or removals following the conservativeness principle.

An important difference between standards is the time over which monitoring needs to be guaranteed and the frequency of required reporting. For example, CAR requires annual monitoring of carbon stocks to provide assurance that GHG reductions or removals achieved by a project have not been reversed. Monitoring is required for a period of 100 years following the final issuance credits. The standard considers activities to be automatically terminated if data are not reported and verified at the required intervals.

VCS JNR requires monitoring and verification to be conducted at least every five years, from the activity start date or end of the last monitoring period. MoorFutures requires to make the first submission of monitoring reports 3-5 years after the start of the activity and thereafter every 10 years.

Monitoring is also crucial for documenting if biophysical or socio-economic conditions for activities change over time. In the VCS and ACR, for example, such changes must be part of the monitoring report and this will be assessed at verification. A full re-validation might be required in cases where conditions have changed considerably.

Consistency between lower- and higher-level monitoring is important in the case of jurisdictional approaches. Under VCS JNR, monitoring results from higher levels may be used by lower levels where there is an overlap in activities and boundaries. Where possible, the higher-level jurisdiction may adopt monitoring results from lower-level jurisdictions and projects for relevant areas.

2.6.3 Challenges and opportunities

Monitoring forms a crucial element of carbon crediting as it is the main tool for tracking progress of an activity but often also a prerequisite for demonstrating additionality, determining adequate baselines, identifying, and compensating reversals, measuring, and addressing leakage, and identifying and tracking co-benefits.

With an increase in availability of global data with high resolution and accuracy, there are opportunities for including global data for monitoring and verification of carbon crediting at project and jurisdictional level. Such data, like provided by Global Forest Watch[9] or readily available tools for analysing spatial data like OpenForis[10] or moja-global[11], can be used for validation and stratification but also third-party verification of land-use activities at different scales.

Monitoring forms also an important basis for robust accounting of any potential transfer of credits from land use between different systems. This requires consistent methodological approaches to be applied. There are important inconsistencies between approaches to accounting applied under NDCs, for activities accounted under the Warsaw Framework for REDD+ and carbon crediting mechanisms.

Compared to crediting mechanisms, under the Warsaw Framework for REDD+, countries have substantial flexibility regarding the activities, carbon pools and periods to include. There can also be a discrepancy between activity-based reporting and accounting under REDD+ and carbon crediting and land-based reporting applying specific land-use categories in GHG inventories under UNFCCC. To increase consistency, any credits to be transferred need to correspond to emissions and removals included in national emission inventories and be included under a country's NDC.

If emission reductions from land-use activities are not consistent with national GHG inventories, the host countries may not be able to use achieved emission reductions or removals for achieving their NDC targets. An international transfer of emission reductions or removals that are not reflected in national GHG inventories could even imply that countries need to compensate for such transfers by reducing domestic emissions further (Schneider et al. 2018).

2.7 Avoiding double counting

2.7.1 Definition and relevant aspects

Double counting occurs when a single emission reduction or removal is used more than once towards the achievement of mitigation targets or goals (Fearnehough et al. 2020; Schneider et al. 2019a). If occurring on a large scale, double counting has the potential to lead to higher global emissions, ultimately undermining the achievement of climate targets or goals.

The Paris Agreement requires Parties to avoid double counting when accounting for NDCs and when using cooperative approaches under Article 6. Avoiding double counting is of special relevance in the context of carbon market mechanisms and if multiple mechanisms operate simultaneously, which is possible under Article 6 of the Paris Agreement.

Double counting can occur at different levels. In the context of the Paris Agreement, double counting can occur if two Parties use the same mitigation outcome to achieve their NDCs. Double counting can also occur with respect to other climate targets or goals, including with respect to

[9] https://www.globalforestwatch.org/
[10] http://www.openforis.org
[11] https://moja.global/

the goal of carbon-neutral growth under CORSIA, voluntary mitigation targets by non-state actors, and domestic climate targets or emissions trading schemes and voluntary mitigation targets or CORSIA.

Double counting is a particular risk for activities in the land-use sector because land ownership, land use and land management often lay in the hands of different stakeholders with overlapping rights. This can lead to a situation where it is not straightforward for an entity to demonstrate that its actions lead to an emission reduction or removal and claim its right to it (Schneider et al. 2018). For example, an indigenous community and a developer of an improved forest management project may both claim the rights to an emission reduction occurring on indigenous land and register under different standards, leading to a double issuance of credits. Additionally, there may also be a difference between customary rights to land ownership and harvest rights of indigenous peoples and local communities and statutory law on land ownership (Streck und Unger 2016).

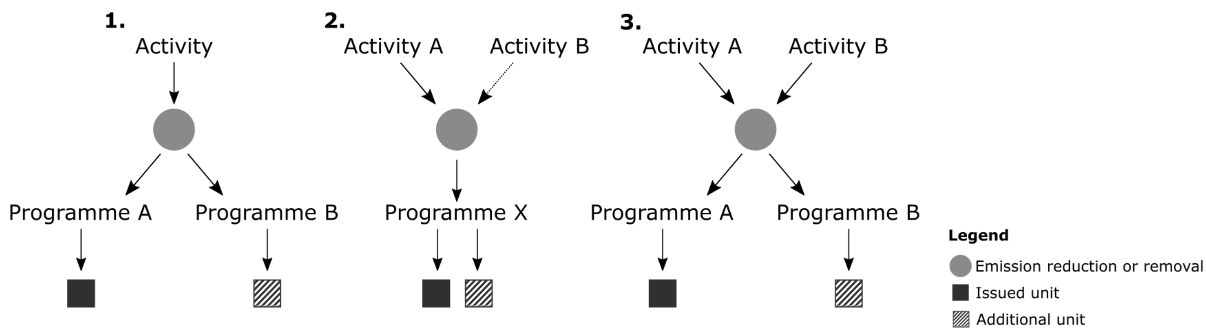
Another reason why double counting is a particular risk in the land-use sector is because actions to address emissions from land use may take place at both jurisdictional level (national or subnational) and at project level within that jurisdiction. Thus, project owners and jurisdictions could claim the same emission reductions or removals. A prominent example is double counting between national efforts to reduce deforestation and projects to reduce deforestation either on indigenous land or in a protected area. 'Nested accounting' (Pedroni et al. 2009) has been proposed as an approach to prevent this risk.

Double counting can occur in three main forms (Prag et al. 2013; Fearnehough et al. 2020; Schneider et al. 2015): Double issuance of units, double use of units, and double claiming of emission reductions or removals.

2.7.1.1 Double issuance of units

Double issuance occurs when two units are issued for a single emission reduction or removal. This can happen directly, when one project issues two units for the same emission reduction, either under the same or under two different crediting programmes. Another way it could happen is indirectly, when the same emission reduction or removal is used to issue units by entities that have an overlapping claim on it (see Figure 3). An example for indirect double issuance is if two separate projects issue units for reducing deforestation in the same geographic area. One could do so by strengthening institutional capacities to prevent illegal logging and the other one by providing clean cookstoves that reduce the demand for fuelwood. This type of double issuance typically occurs when projects include emissions sources outside of their covered area into the calculation of their emission reductions and removals.

Figure 3: Illustration of ways how double issuance may occur

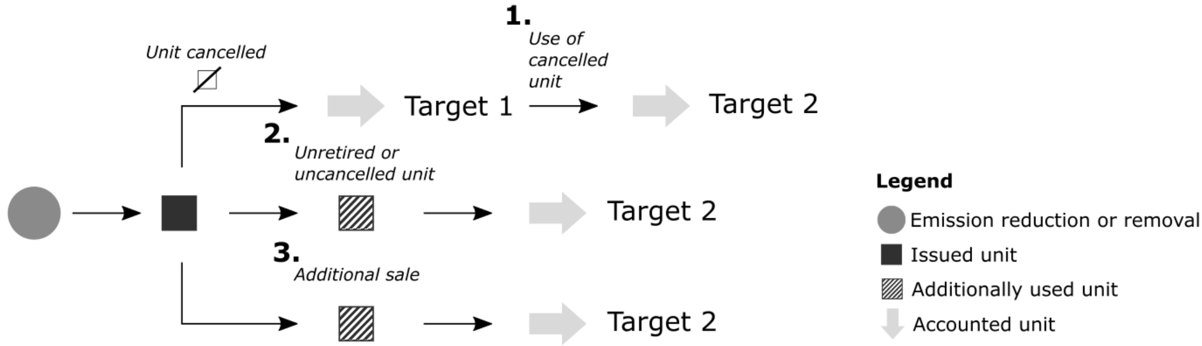


Source: own compilation

2.7.1.2 Double use of units

Double use occurs if an issued unit is used twice by buyers to achieve mitigation pledges. This can be the case if either the same buyer uses the same unit twice (e.g., by not cancelling the unit the first time), the same unit is used by two different buyers (also often referred to as double selling), or if a carbon credit is only cancelled once but the cancellation is claimed twice to achieve climate targets or goals (see Figure 4).

Figure 4: Illustration of ways how double use of units may occur



Source: own compilation. An additional case of double use would occur if the same unit was used towards the same target. This case is not depicted here.

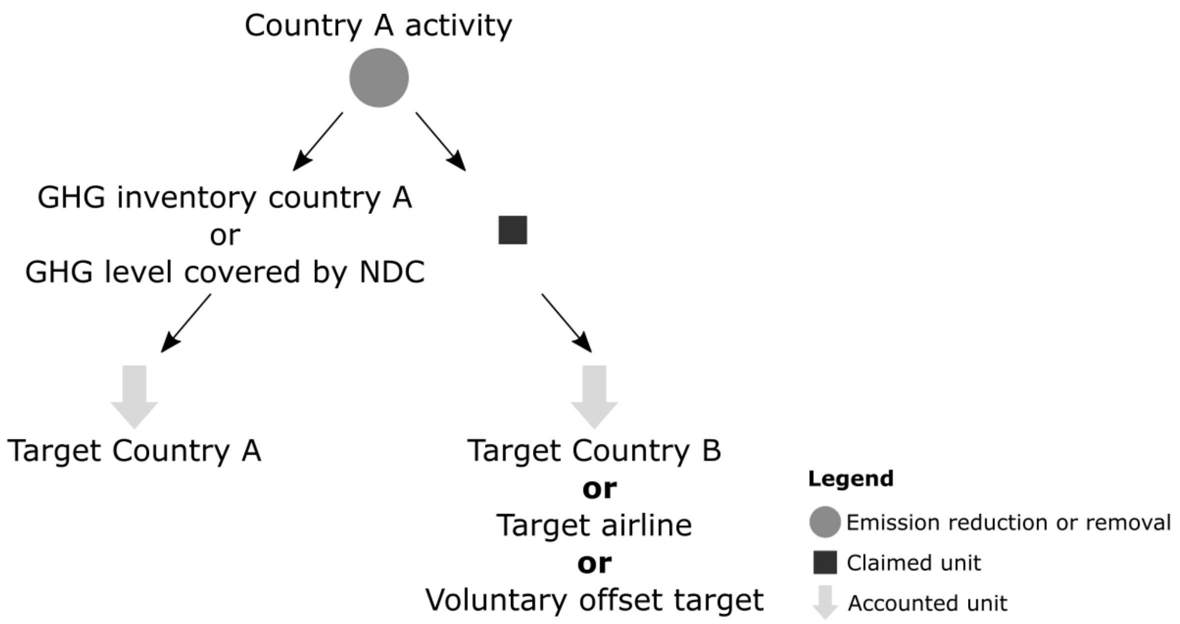
2.7.1.3 Double claiming of emission reductions and removals

Double claiming can occur with domestic mitigation targets and with international mitigation targets. An example of a domestic target is the obligation for EU Members States under the EU LULUCF Regulation to prevent any net emissions from the LULUCF sector (Regulation (EU) 2018/841, see chapter 3.2). Double claiming would occur if removals from an afforestation project were accounted by the member state to achieve its obligations under the EU LULUCF regulation and at the same time issued as a carbon credit and used by a third party to achieve a goal or target.

Double claiming with an international mitigation target occurs if an emission reduction or removal is both reflected in a country's indicator for achieving its target and used to generate a credit that is used by another entity or country, without the host country accounting for the transferred emission reductions when demonstrating achievement of the target. In the case of NDCs the indicator usually is the level of emissions covered by the NDC.

The defining feature of double claiming is that the underlying emission reduction or removal is reflected in a country's GHG inventory (or another entity's emissions report, such as an entity reporting its emissions under an ETS) and additionally used to generate carbon credits that are used by another country or third party, usually to offset their own emissions (Figure 5).

Figure 5: Illustration of how double claiming of emission reductions or removals occurs



Source: own compilation

2.7.2 Avoiding double counting in practice

2.7.2.1 Avoiding double issuance

Double issuance can occur in two ways: either directly because the same activity is registered twice under different carbon crediting mechanisms or because there is an indirect overlap between two activities.

Double issuance can be avoided with the following measures (ClimateWorks Foundation; Meridian Institute; Stockholm Environment Institute 2019; Schneider et al. 2015):

- Exclusion of projects that are already registered under another carbon crediting mechanism, or cancellation of carbon credits issued for emission reduction or removal under one mechanism before reissuing carbon credits under another mechanism and procedures to verify this before issuance takes place. This requires procedures to check for any double registration and clearly tagging emission reductions or removals that have been cancelled for the purpose of being reissued under another programme. Auditors could also be required to check that emissions reductions or removals are not used under another programme before the issuance of units.
- Establishing procedures or requirements to ensure that project owners have the rights to the emission reduction or removal before issuance of credits. This is especially relevant for projects in the land-use sector, where there may be overlapping claims on right to land ownership or to use the land, concurrent efforts at the jurisdictional and project level or differences in customary and statutory law.
- Requesting legal attestations from project owners that they will not engage in practices that lead to double issuance.

- Exclusion of projects that consider emission sources outside of their project scope to calculate their emissions and removals (indirect emissions and removals). This can be implemented by defining allowed project types in a way that prevents overlaps in emission reduction claims between different project types.

For example, the ACR explicitly allows projects to register under the ACR and 'other voluntary or compliance GHG programs or registries' but only if project developers disclose additional registrations and both carbon crediting mechanisms approve this, and if the same emission reduction, as defined by vintage and the project boundary, is only registered under one programme. The ACR requires the public cancellation of an emission reduction before re-issuance. Moreover, auditors must confirm for each reporting period that a project does not report the same emission reductions under another programme.[12] Similarly, the VCS also allows project registration under multiple GHG programmes and the conversion of credits issued under other programmes to units issued under the VCS. The procedure for this conversion includes an official notification for the cancellation of units under the other programme.

The UK Woodland Carbon Code and Peatland Code require that projects exclusively register under the UK Land Carbon Registry, which records all transactions with 'woodland carbon units' and 'peatland carbon units' based in the UK, thus preventing double issuance (2020b).

ART TREES requires proof of ownership of the emission reduction or removal upon registration and an 'annual attestation of ownership and use' before issuance.

2.7.2.2 Avoiding double use

The most important measure to prevent double use is the operation of a publicly accessible registry, which allows clear identification of each carbon credit by means of unique serial numbers. Unique serial numbers assigned when credits are issued allow the tracking of unit transfers and retirements/cancellations. Another essential function of a registry is providing an overview of the ownership of credits. This is generally achieved by assigning participants accounts for their credits. Registries are also important tools to prevent double issuance.

To prevent double use, it is also important that carbon crediting mechanisms require that the purpose for the retirement/cancellation of a credit is publicly disclosed and recorded. Publicly indicating the purpose can prevent that a credit is cancelled once but ultimately used towards more than one target. The public disclosure of the cancellation purpose should include the relevant target or goal that is achieved as well as capturing the calendar year of the target fulfilled by the retirement/cancellation (e.g., 'offsetting the emissions of company X for all of its operations in the year Y').

Carbon crediting mechanisms also have other requirements, obligations, or procedures in place to prevent double use by account holders. Account holders in the 'ART Registry' enter a 'legal Terms of Use agreement, which prohibits double selling and that ownership of the credits is transferred off-registry' (ART 2020). The ACR also uses a legal terms of use agreement, with similar provisions.

2.7.2.3 Avoiding double claiming

In the context of the Paris Agreement, double claiming between NDCs will be addressed with the so-called 'corresponding adjustment'. This means that Parties will adjust the reported emission levels according to the sales (addition) and purchases (subtraction) of emissions reductions and

[12] https://americancarbonregistry.org/carbon-accounting/standards-methodologies/acr-validation-and-verification-standard-1/acr-vv-standard_v1-1_may-31-2018.pdf

removals. Corresponding adjustment must be applied for the transfer of ITMOs under Article 6.2, including emission reductions are generated under the Article 6.4 mechanism if the host country authorizes them for use under Article 6.

The decisions also foresee that Parties can authorise the use of ITMOs for mitigation purposes that do not relate to NDCs, which could for example include the use under CORSIA or in the voluntary carbon market (referred to as "other international mitigation purposes"). Once host countries have authorised emission reductions or removals as ITMOs, they must apply corresponding adjustments upon their transfer, irrespective of the purpose of the transfer.

These provisions prevent double claiming between countries' NDCs and mitigation targets outside of the Paris Agreement, e.g., if ITMOs are used under CORSIA or in the voluntary market. Effectively implementing this approach also requires rules and regulations at the level of carbon crediting mechanisms and arrangements by countries to keep oversight of emission reductions or removals that are sold to buyers outside of their jurisdiction. This requires, for example, earmarking carbon credits that are backed by host country authorisations and thus qualify for use under CORSIA.

Preventing double claiming with domestic targets or ETSs requires similar provisions to ensure that the emission reductions issued as credits are no longer claimed by the jurisdiction or under the ETS. For example, under Joint Implementation, some EU member states established provisions for cancelling ETS allowances if emission reduction units (ERUs) were issued for reductions that occurred within the scope of the EU ETS. Some carbon crediting mechanisms also have procedures in place that forbid the issuance of carbon credits that overlap with ETS or they require that a respective amount of allowances be cancelled.

Most carbon crediting mechanisms have not yet established procedures to facilitate the avoidance of double claiming with NDCs, but several are in the process of establishing respective provisions. Key elements for such provisions are, for example, summarised in voluntary guidelines developed by a number of carbon market organisations and non-governmental organisations (ClimateWorks Foundation; Meridian Institute; Stockholm Environment Institute 2019).

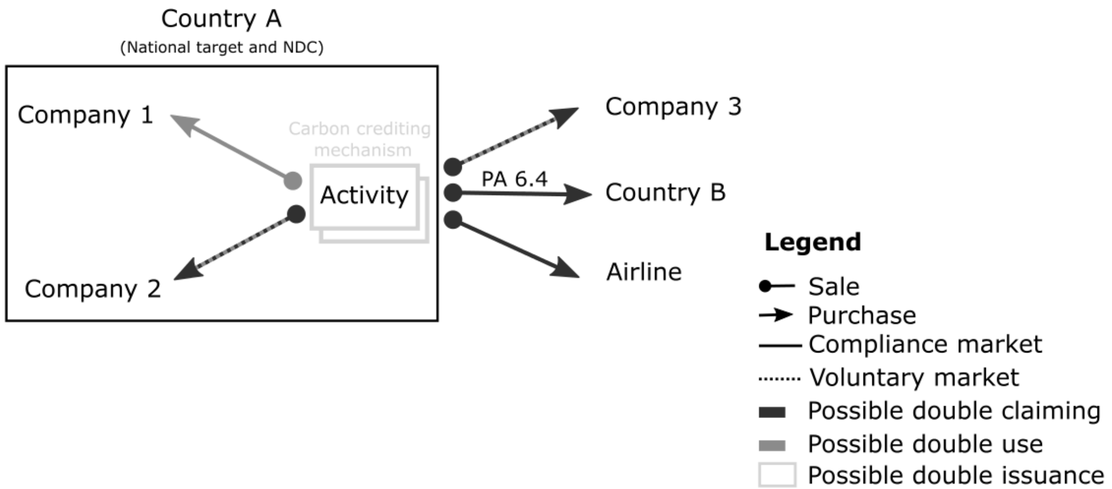
Some general procedures to avoid double claiming at the level of the carbon crediting mechanisms are, for example, laid out by the ACR (2018). It requires credit owners to report on sales for use towards a Party's NDC and to provide host country acknowledgment. The ACR will communicate information on credit transactions made towards fulfilment of NDCs or CORSIA obligations to the UFNCCC focal points of the project host country and the buyer country. The ACR will also publish relevant information on transfers on its registry, including the acknowledgement of transfers by the UNFCCC focal points to facilitate corresponding adjustments. Ultimately, ACR states that it aims to facilitate corresponding adjustments and will 'adhere to any future requirements' stemming from the UNFCCC or CORSIA. These provisions cannot fully prevent double claiming but are a first step towards establishing more elaborated procedures to avoid double claiming. Several other standards, such as the Gold Standard Foundation and Verra, are in the process of developing rules to offer carbon credits for which double claiming is prevented.

2.7.3 Challenges and opportunities

The variety of carbon crediting mechanisms, types of targets, and purposes for which carbon credits are used poses a significant challenge when it comes to preventing double counting, especially double claiming. Figure 6 depicts the different ways how double counting may occur from the perspective of a single project that is implemented in a country with an NDC and a domestic mitigation target, and that may sell carbon credits to different buyers, including voluntary market buyers as well as domestic and international compliance markets. As described in the preceding sections, carbon crediting mechanisms have several procedures in place that help to prevent double issuance and double use. Registries and uniquely assigned serial numbers are key prerequisites to prevent all forms of double counting. Double issuance requires robust oversight and checks, as well as coordination between different carbon crediting programmes. The main challenge is avoiding double claiming of emission reductions and removals with NDCs.

Currently, most of the carbon credits generated from activities in the land-use sector are used in the voluntary carbon market. Some stakeholders see the voluntary market as a key contribution to climate change and intend to scale it significantly over the next decade (Taskforce on scaling voluntary carbon markets 2021), mainly through land-use activities. In this context, a controversial debate is whether double claiming with NDCs constitutes a significant environmental integrity risk and how such risks should be addressed. Some stakeholders argue that this risk is not material. However, aggregated emissions may increase or may not be reduced under various scenarios, depending on how different actors respond to a reduction in emissions resulting from the purchase of carbon credits (Fearnehough et al. 2020).

Figure 6: Illustration of credit transactions and potential for double counting



Source: own compilation. The transfer of ITMOs under Art 6.2 of the Paris Agreement is not depicted here, given the requirement for corresponding adjustments by Parties.

Three options are currently discussed to reduce the risk of double claiming between a country's NDC and carbon credit buyers (Fearnehough et al. 2020; Gold Standard 2018).

1) Host countries apply corresponding adjustments for credits sold in the voluntary market. This option implies that voluntary markets operate under the rules of the Paris Agreement. By carrying out a corresponding adjustment, host countries would waive their claim on the emission reduction and removal, leaving the claim with the buyer. This option requires robust institutional arrangements by the host country for oversight and approval of voluntary market activities as well as for authorising ITMOs and reporting and accounting for ITMOs used in the voluntary market. Project owners would need to seek host country approval before they can issue credits that are backed by corresponding adjustments. A disadvantage of this approach is that it may create additional transaction costs and raise

corruption risks around project approval. Also, it faces opposition from some proponents of the voluntary market, that argue that double claiming does not constitute a material risk.

2) Carbon crediting mechanisms only credit emission reductions and removals that are outside of the scope of NDCs. This option also leaves the claim of the emission reduction or removal with the credit buyer (Schneider et al. 2020; Spalding-Fecher 2017). Most of the NDCs include the land-use sector, which would rule out this option. Moreover, it can be difficult for countries to identify whether an emission reduction or removal is achieved outside or inside of their NDCs' scope. This option could also create disincentives for countries to expand the scope of their NDCs and to move towards economy-wide targets, as encouraged under the Paris Agreement.

3) Elimination of the notion that carbon credits can be used to 'offset' emissions from the credit buyer and to achieve carbon or climate neutrality. In this option the claim to the emission reduction or removal remains with the host country. Buyers could still claim that they have contributed financially to scaling up climate action in the host country, but it would not serve their own climate targets. This option provides the advantage for host countries that they can use the achieved emission reductions to achieve their own NDCs. This may be attractive as they often lack financial means to implement activities in the land-use sector. On the other hand, it is unclear whether corporate buyers who have made climate neutrality pledges would be willing not to claim the associated emission reductions.

Another consideration of the land-use sector is that project level and jurisdictional approaches may overlap. Nesting projects from the voluntary market into the national or sub-national (jurisdictional) effort has been proposed as a solution for this. If projects are embedded in jurisdictional approaches, this avoids double issuance and may also help preserve environmental integrity. However, countries would need to carefully consider which projects they approve for nesting, as these emission reductions could no longer be claimed under the jurisdictional approach for crediting.

A final important consideration around claims in the land-use sector is that landowners or customary users of the land, e.g., indigenous peoples and local communities where project activities take place, will also have a claim on emission reductions and removals and will want to benefit from the credit revenue. Preventing conflicts in this regard can require benefit sharing arrangements by countries and/or requirements at the level of project standards.

2.8 Addressing non-permanence

2.8.1 Definition and relevant aspects

There is an inherent risk of land use-related mitigation being reversed, as carbon stocks that are preserved or enhanced could be lost through natural or human-induced disturbances at a later point in time. Reversals are associated with carbon pools. The susceptibility of a specific carbon reservoir for reversal depends on the underlying processes how carbon is stored, and in which form it is fixed, as well as the natural and human-induced drivers underlying potential losses at a later stage. Since biomass pools naturally have relatively high turnover rates, carbon from these pools can be released faster than from soil carbon pools.

Figure 7 illustrates how reversals may occur for mitigation activities that enhance carbon stocks (panel A) or that reduce the loss of carbon stocks (panel B) and how emission reductions or removals relate to changes in carbon stocks.

Addressing non-permanence is important for the environmental integrity of a crediting mechanism. If in an initial time period credits are issued on the basis of observed net mitigation that is subsequently reversed, the mechanism will have effectively over-issued credits, potentially leading to a net increase in global emissions (Schneider and La Hoz Theuer 2019).

The concept of non-permanence is similar but different to the concept of leakage. As discussed above, leakage is considered a response of an activity by a shift of products or services from an area through displacement occurring close in time to the activity's implementation. Reversals, by contrast, can occur within or outside the geographical boundaries of a mitigation activity. They can also happen at a much later point in time and are not necessarily caused by the mitigation activity but can occur incidentally – because carbon stored in a reservoir may be affected by unrelated drivers or disturbances (e.g., wildfires, climate change impacts).

The risk for a mitigation activity being reversed thus firstly depends on the susceptibility to natural depletion processes that differs among different types of reservoirs. Carbon stored in fossil fuel reservoirs is highly stable and not exposed to material natural disturbance risk. For CO_2 that is captured and stored in geological reservoirs, natural leakage risk is small, though not zero (Deng et al. 2017). By contrast, biospheric reservoirs, such as forests or wetlands, can be subject to natural disturbances like fire, disease, drought, or windstorms. Susceptibility differs also among different carbon pools within the land-use sector, e.g., between living and dead biomass and soil and litter or different categories of harvested wood products.

Susceptibility to human-caused depletion also differs among reservoirs. Forests and wetlands may be susceptible to different types of human-caused depletion, such as from demand for wood, or for land needed for subsistence, agricultural production, or development. Similarly, fossil fuel reserves may be used in the future. By contrast, CO_2 stored in geologic reservoirs faces little to no human-caused demand pressure (either for the CO_2 itself or for the reservoir space).

The size and scale of carbon reservoirs affected by a mitigation activity is another important factor in assessing reversal risk. Many forestry and wetland projects, for example, target small, concretely defined carbon reservoirs while jurisdictional REDD+ programmes target carbon reservoirs across large areas. Other activities affect carbon reservoirs that may not be concretely defined, but whose scale can nevertheless be geographically bounded (e.g., using efficient cookstoves can reduce demand for wood from regional forests). Mitigation activities that reduce fossil fuel use are nearly unique in affecting global carbon reservoirs, given that fossil fuel markets are globally interconnected.

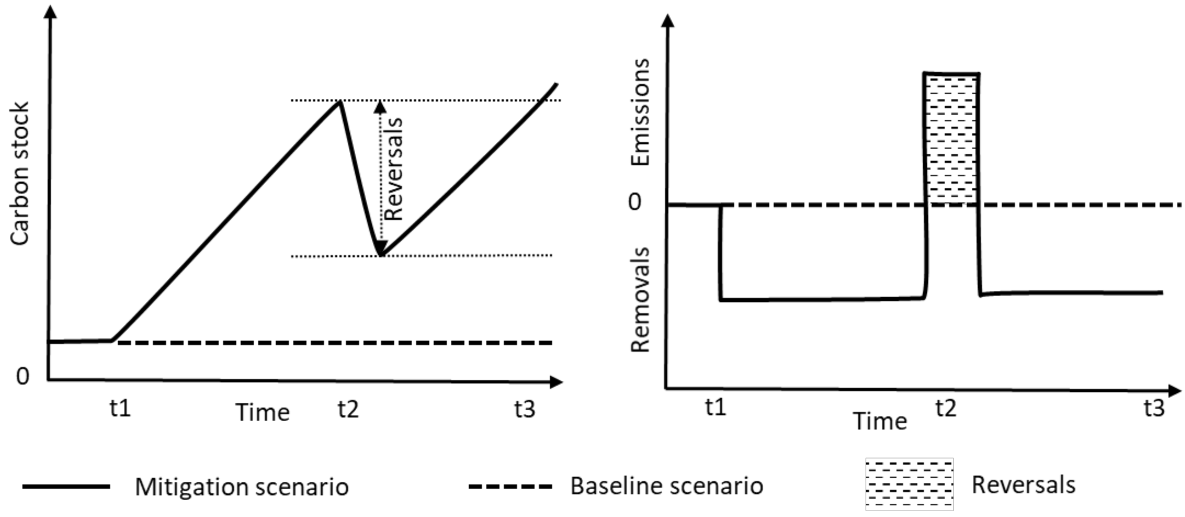
The scale of affected reservoirs matters for two reasons. The first relates to natural disturbance risks. The effect of a wildfire on a small-scale reforestation project, for example, could be catastrophic in terms of reversing prior carbon gains. At a jurisdictional scale, by contrast, even multiple wildfires may simply reduce net mitigation for a time rather than cause reversals.

The second reason relates primarily to human-caused depletion. As Panel B in Figure 7 implies, for mitigation activities that reduce emissions from carbon reservoirs, permanence requires that emissions are ultimately halted and not merely slowed. The permanence of fossil fuel mitigation is premised on the assumption that the world will transition away from fossil fuels long before global carbon reservoirs are exploited (before point t_2 in panel B of Figure 7 is reached). Given the considerable size of remaining global fossil fuel reservoirs and the growing number of countries that embrace a complete phase-out of fossil fuels, this is a reasonable assumption. For biospheric reservoirs – especially over smaller areas – there is, however, a larger risk that some reservoirs are fully depleted in the baseline scenario (e.g., due to fires), at which point reversals could start occurring (point t_2 in panel B of Figure 7). The time horizon for halting human-caused depletion of forests, for example, could therefore be much shorter before reversal risk becomes a concern, depending on their scale and baseline depletion rate.

The non-permanence risk depends also on the nature of the mitigation activity, including whether and how it affects human-caused drivers of carbon reservoir depletion. Avoided deforestation and forest degradation as a mitigation activity needs to be permanently sustained in order not to revert to baseline scenario levels. If the mitigation activity is not sustained, cumulatively over time the same amount of land would be cleared. Other activities seek to enhance and/or preserve a specific carbon reservoir (e.g., afforestation/reforestation, improved forest management, soil carbon enhancement). These types of mitigation activities do not address human-caused drivers for reservoir depletion. Reversal risk therefore depends on the relative susceptibility of affected reservoirs to both natural and human-caused depletion over time, as well as on the size of the reservoirs (see Panel A in Figure 7).

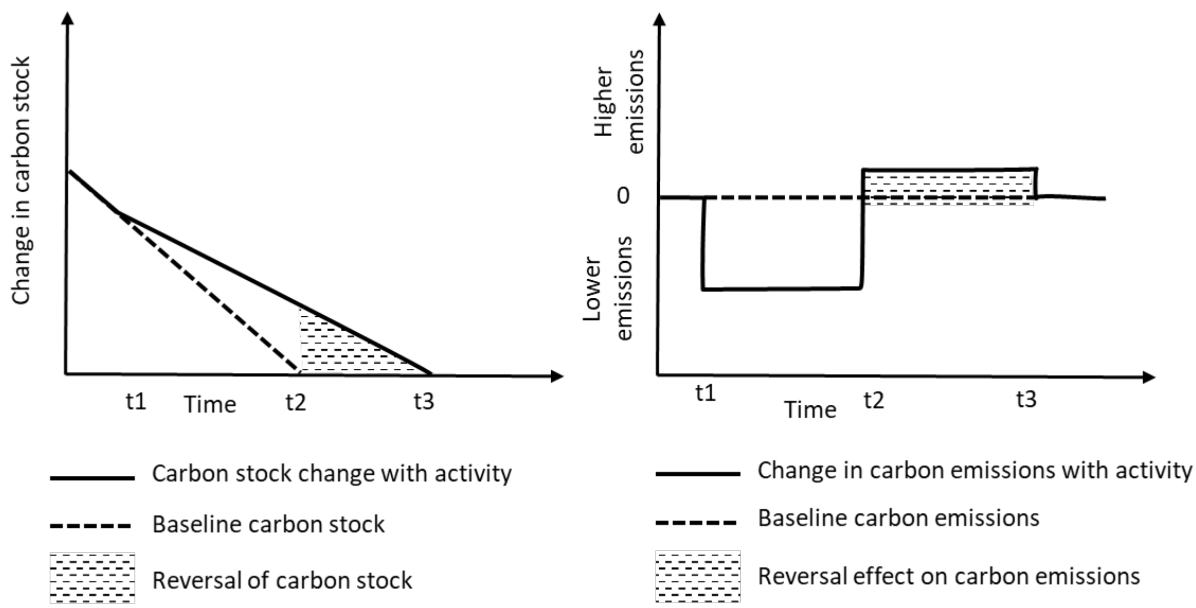
Figure 7: Examples of reversals

Panel A: Reversals from mitigation activities enhancing carbon stocks: afforestation



In the baseline scenario, no afforestation activity is implemented. Carbon stocks on the land are assumed to remain constant. In the mitigation scenario, an afforestation activity starts at point t_1 and increases the amount of carbon stored on the land. At point t_2, a wildfire causes some carbon from the land to be released back to the atmosphere. Because no carbon would have been stored without the mitigation activity, this subsequent release of carbon due to the wildfire would not have occurred in the baseline scenario either. Therefore, the emissions caused by the wildfire constitute a reversal. As the forest regrows, the carbon stocks increase again and reach a level at point t_3 where the previous reversals have been compensated for.

Panel B: Reversals from mitigation activities that slow (but do not halt) losses of carbon stocks: reducing deforestation



In the baseline scenario, a specific area of land containing forest would be deforested. Forest stocks would be completely lost by the time t_2. In the mitigation scenario, a programme starts at point t_1 to slow the rate of deforestation but fails to fully halt deforestation. Carbon stocks reach depletion at a later point in time t_3. Up to the point t_2, emissions are reduced. After t_2, emissions are higher in the mitigation scenario than in the baseline scenario. These reversals continue until t_3, at which point the emission reductions achieved by the activity through t_2 are fully reversed; at that point in time, the carbon stocks and the *cumulative* emissions impact is the same in the mitigation scenario and the baseline scenario.

2.8.2 Addressing non-permanence in practice

A key question for addressing non-permanence is the time horizon over which reversal risks should be considered: does 'permanent' mean forever, or something more finite? This question has been subject to confusion, in part due to misinterpretations of the atmospheric lifetime of CO_2 (Archer et al. 2009; Mackey et al. 2013). From a mitigation perspective, what matters is that the net effect of a 'pulse' of carbon emissions is to raise atmospheric concentrations of CO_2 for many thousands of years (Archer et al. 2009; Mackey et al. 2013; Ciais et al. 2013). Some observers argue that reversible mitigation should not substitute for permanent mitigation at all (Becken und Mackey 2017; Mackey et al. 2013). If reversible mitigation is eligible under carbon crediting mechanisms, an alternative is to consider whether effective mechanisms could be established to insure against and/or compensate for reversal risks over policy-relevant time horizons (Fearnside 2002; Murray et al. 2012).

Four main approaches are pursued by carbon crediting mechanisms to address non-permanence:

1. Reducing non-permanence risks
2. Monitoring and compensation for reversals
3. Issuing temporary carbon credits
4. Discounting

2.8.2.1 Reducing non-permanence risks

This option mainly entails conducting non-permanence risk assessments and based on the results, either excluding mitigation activities with higher risks from eligibility or establishing incentives for mitigation activity proponents to mitigate reversal risks:

- **Ineligibility of activities with high reversal risks**: Some mechanisms exclude mitigation activities if the risk is deemed too high or if projects do not set out how risks will be mitigated. For example, the CDM CCS requires a safety assessment of geological storage sites. Sites shall only be used if there is no 'significant risk' of reversal (the methodology does not further specify this requirement). Requiring a risk assessment or establishing eligibility criteria that exclude activities that imply a high non-permanence risk can decrease the likelihood of reversals.

- **Risk assessment informs contribution to buffer reserve or discounting level**: Some mechanisms use the risk assessment to determine the activity's contribution into a risk buffer reserve out of which reversed mitigation outcomes can be compensated for (see section 2.8.2.2). Under RGGI, for example, the outcomes of the risk assessment determine the rate at which emission reductions or removals are discounted to account for unintentional reversals.

Further approaches to mitigate mainly human-caused reversal risks include a variety of legal instruments, such as long-term obligations for activity proponents to maintain carbon stocks and compensate for reversals. Examples include a Reversal Risk Mitigation Agreement/Risk Mitigation Covenant for geologic and terrestrial sequestration projects (ACR) and legally binding agreements with the landowners (e.g., CAR), management and financial plans submitted to local government or financial institutions and proof of legal requirement to continue the management practice (e.g., VCS), and a legally binding conservation easement signed and approved by the relevant state agency that reduces the risk rating for a project (e.g., ACR, RGGI).

2.8.2.2 Monitoring and compensation for reversals

Many carbon crediting mechanisms address non-permanence risks by monitoring and compensating for reversals through cancellation of issued carbon credits. Under this approach, several design features are important for its effectiveness:

- **Time horizon for monitoring and compensating for reversals:** In most cases, it is not practical for carbon crediting mechanisms to establish an indefinite (perpetual) time horizon for monitoring and compensating for reversals. From a private investment perspective, an obligation to compensate for reversals for 100 years resembles nearly an indefinite commitment. Shorter time horizons are more likely to result in reversible mitigation being inefficiently underpriced relative to other mitigation options because the future costs of maintaining the carbon would not be internalised when making investment decisions.
- **Addressing reversals in case of irregular discontinuation of monitoring:** If monitoring of reversals discontinues prior to the required time horizon, future reversals may go undetected. In some instances, activity proponents might even cease monitoring because a reversal has occurred, or because they plan an intentional reversal (e.g., due to wood harvesting or land development). In such instances, compensation of all issued credits is the most robust approach to ensure environmental integrity. Approaches that require no or only a partial compensation do not fully cover actual reversals and create moral hazard issues, as activity proponents could discontinue monitoring and reporting once reversals occur.
- **Addressing reversals after regular ending of monitoring:** A related question is to what extent mechanisms address any reversals that might occur after the end of the defined time horizon for monitoring and compensating for reversals. If a pooled buffer reserve is in place (see next bullet), retiring the activity's carbon credits held in this buffer reserve after the end of regular monitoring provides some safeguard to compensate for future reversals, depending, however, on how well the number of credits held in the pool reflects actual future reversal risks. Keeping the deposits in the buffer promotes environmental integrity to a lesser extent: it enhances the capitalisation of buffers for future compensation of reversals, which might help to address large-scale reversals. However, as the credits may ultimately be used to compensate for reversals from other mitigation activities, they may not at the same time compensate for potential future reversals associated with the original mitigation activity. In terms of practicability, both approaches reduce the carbon credit revenue for activity proponents which might reduce incentives to implement activities.
- **Responsibility for compensating for reversals:** Once reversals have been identified (or their occurrence cannot be excluded as no monitoring report is available), the reversed mitigation needs to be compensated for by enhancing mitigation elsewhere. What approach for compensating is best suited, may depend on the type of reversals? For intentional reversals, activity proponents or landowners should be the primary entity responsible for compensating. They can control and reduce the risk of reversals through appropriate activity design. Moreover, not making them responsible could create moral hazard issues, as they would receive the benefits from carbon credits but do not have strong incentives to keep carbon stocks in place. Many carbon crediting mechanisms use a 'pooled buffer reserve' to

address the risk of reversals. Under this approach, a fraction of the carbon credits from mitigation activities with non-permanence risks is set aside into a common buffer reserve which is managed by the carbon crediting mechanism and which can be drawn upon to cover reversals from any participating activity. Pooled buffer reserves, or well-designed insurances, offer the advantage that they diversify risks and can compensate for large reversals from individual mitigation activities. They can be effective for compensating for unintentional reversals and for stepping in to cover if compensation by the proponents of the mitigation activity is not enforceable (e.g., due to bankruptcy). A key prerequisite for this is that the buffer is sufficiently 'capitalised' and includes a diverse portfolio of activities. Environmental integrity can be further strengthened if mechanisms define additional actors which assume liability in case the mechanism ceases operation or the actor to assume liability in the first place drops out for other reasons. Responsibility by activity proponents and the buffer reserve could be complemented with a country liability to compensate for reversals. This may not only enhance the likelihood that reversals are compensated for but could also reduce transaction costs if a country liability lowers the fraction of credits to be deposited in the buffer reverse. Under VCS JNR, for example, an additional insurance or country liability will lower the risk rating which informs which fraction of carbon credits need to be put in a pooled buffer reserve. Under ACR, ART TREES, JNR, and VCS, for example, reversals are addressed by the buffers in the first place, but the proponents of the mitigation activity are then required to replenish the buffer in case a reversal has occurred.

- **Updating of baselines in case of reversals:** In the event of a reversal, some carbon crediting mechanisms allow or require establishing a new baseline. Some mechanisms allow for the updating of baselines in case of an unintentional reversal (e.g., TFS) or catastrophic events (e.g., VCS), with no limitations as to how the baseline is adjusted. CAR and RGGI have another safeguard in place for the occurrence of large-scale natural disturbances: if carbon stocks fall below a baseline or another defined threshold, the project is automatically terminated. Adjusting emissions baselines upwards requires determining the extent and impact of the disturbance in the baseline scenario. This can be subject to significant uncertainty, which could lead to over-crediting.

2.8.2.3 Issuing temporary carbon credits

The CDM AR uses temporary credits to address non-permanence. Afforestation and reforestation projects can only generate credits that expire after a predefined period. Following their expiry, they must be replaced by permanent units, regardless of whether a non-permanence event has occurred. This approach thus treats carbon storage as 'rented' mitigation that is inherently temporal (Maréchal und Hecq 2006; Marland et al. 2001; Marland und Marland 2009; Sedjo und Marland 2003). Two types of units are distinguished:

- **Temporary certified emission reductions (tCERs)** expire at the end of the subsequent commitment period under the Kyoto Protocol for which they were issued. Project proponents can request the issuance of new tCERs for each subsequent commitment period, subject to verification that the carbon is still stored.

- **Long-term certified emission reductions (lCERs)** are valid until the end of the last crediting period of the project (i.e. up to 60 years) but must be replaced by permanent units in the case of a non-permanence event or in the case that a monitoring report is not submitted.

The main challenge of this approach is that due to the buyer liability for addressing non-permanence, tCERs and lCERs are not fungible with CERs and were consequently excluded from many markets, in particular the European Union Emissions Trading System. This has led to a low market uptake of afforestation and reforestation activities under the CDM, which contributed with only 0.15% to the overall issuance of CDM credits. As the Kyoto Protocol will not have a third commitment period, the approach no longer ensures environmental integrity, as Parties will no longer be able to meet their obligations arising from expiring tCERs and lCERs used under the Kyoto Protocol.

2.8.2.4 Discounting

Some carbon crediting mechanisms discount emission reductions or removals to address non-permanence risks. This means that a fraction of the reductions or removals is not issued as carbon credits.

For example, CAR applies discounting in specific protocols (Canada grassland protocol, Mexico forest protocol, Soil Enrichment Protocol) as an alternative to monitoring and compensating for reversals over a 100-year time horizon.[13] The ERF offers the possibility to set a time horizon of 100 or 25 years during which reversals must be compensated for, and applies a discount of 20% (or another percentage specified) for projects with a 25-year time horizon. The JCM applies a default discount factor of 20% in its REDD+ methodology for Cambodia which is considered here. RGGI applies a project-specific risk adjustment of the issued credits based on a risk assessment to forestry projects that is supposed to compensate for potential unintentional reversals.

In terms of environmental integrity, discounting is problematic because it provides limited incentives for activity proponents to avoid reversals and thus creates moral hazard problems. Moreover, given the lack of incentives to avoid reversals and that reversals are not even reported if activity proponents 'walk away', discount rates may need to be set quite high in order to be on the safe side that non-permanence is addressed. This could also lower the incentives for project proponents to implement and maintain activities, as it reduces the value of the carbon stored relative to other land values (Ellis 2001).

In terms or practicability, discounting is simple to implement. It does not require assigning liability for reversals, provides certainty to activity proponents and reduces their risks as no action needs to be taken in case a reversal takes place. Discounting could be a suitable approach for mitigation activities where the reservoir is not under the control of the activity proponents – as this avoids moral hazard issues – and where the risk of reversals is relatively low and reasonably well known.

2.8.3 Challenges and opportunities

The overall environmental integrity risks depend on how material non-permanence risks are, what combination of measures carbon crediting mechanisms implement to address these risks, and how effective these measures are. For any mitigation activities with significant non-permanence risks, such as in the land-use sector, incentives for activity proponents to cautiously manage reversal risks over time are critical. A combination of excluding high-risk mitigation activities from the generation of credits and linking the results of the risk assessment to the

13 The discount rate depends on the specific length of the crediting period of a project.

amount of credits to be put into a risk buffer reserve may best promote environmental integrity. In terms of practicability, undertaking a risk assessment increases the transaction costs for the proponents of the mitigation activity. At the same time, buyers are likely to consider such an assessment as an additional assurance of integrity.

Sufficiently capitalised pooled buffer reserves or insurances should complement these approaches to address reversals caused by catastrophic events or situations where activity proponents are unable to compensate, e.g., due to bankruptcy. Temporary credits are in principle a conservative approach as they fully account for any reversals but are less attractive for carbon markets as the units are not 'fungible' with other carbon market units. Discounting can raise moral hazard issues and should therefore only be pursued where non-permanence risks are well known and not under the control of the activity proponents.

In implementing these approaches, several issues are critical:

- Understanding non-permanence risks: Non-permanence risks can differ considerably among mitigation activities. Understanding differences in risk between types of mitigation activities as well as individual activities is an essential prerequisite for managing risks. For example, the non-permanence risk of an avoided deforestation project in a fire- and drought-prone area is higher than the one of a peatland restoration project. Moreover, climate change impacts are expected to affect ecosystems differently, adding another dimension to required risk assessments.
- Eligibility of activities for crediting: Carbon crediting mechanisms could refrain from crediting activities where reversal risks are high, such as for commercial plantations; limiting eligibility to activities with low long-term reversal risks can be a very effective means to reduce non-permanence risks.
- Incentives for activity proponents to reduce risks: Appropriate mitigation activity design is essential to reduce non-permanence risks. Measures to reduce risks may be more effective if activity proponents have financial incentives to reduce reversals.
- Responsibility for compensating for reversals: The activity proponents should be the main entity responsible for compensating for reversals. They can best control non-permanence risks and making other entities responsible can create moral hazard issues. Legal agreements are critical to enforce compensation.
- Time horizon for monitoring and compensating for reversals: The time horizon for monitoring and compensating for any reversals is a critical choice that varies considerably among carbon crediting mechanisms. Sufficiently long time periods, such as 100 years, provide incentives for robust activity design and better 'internalise' the cost of reversals.

2.9 Considering safeguards and co-benefits

2.9.1 Definition and relevant aspects

Safeguards are requirements and procedures of carbon crediting mechanisms aimed at avoiding and reducing their potential negative impacts (Fearnehough et al. 2020). Social safeguards relate to human rights, workers' rights, gender issues, rights of indigenous peoples, corruption and economic development, whereas environmental and ecological safeguards, for example, encompass preventing biodiversity loss and maintaining environmental quality (Michaelowa et al. 2019b). Co-benefits refer to positive effects beyond climate change mitigation, that may arise from the implementation of activities under a carbon crediting mechanism, these may be generally related to conserving or promoting ecosystem services and sustainable development goals.

Potential negative impacts of REDD+ activities were an issue early in the UNFCCC negotiations and resulted in the adoption of the so-called **Cancun Safeguards** in 2010[14]. Parties are required to address and respect the following safeguards when implementing REDD+ activities:

- Social safeguards: alignment with objectives of national forest programmes and relevant international agreements, transparency, and effectiveness of governance structures of forests, respect for the knowledge and rights of indigenous peoples and local communities, promotion of full and effective participation of relevant stakeholders.
- Environmental safeguards: consistency with the conservation of natural forests and biological diversity, prevention of conversion of natural forests, protection and conservation of natural forests, ecosystem services and of other social and environmental benefits, addressing the risk of reversal, reducing the displacement of emissions.

Other frameworks or initiatives that address safeguards are:

- The World Bank Social and Environmental Safeguard Policies (Environmental and Social Framework[15]): These include specific operational policies and bank procedures for forests.
- The 'REDD+ Social and Environmental Standards' (REDD+ SES): The standards aim to support governments in addressing the Cancun Safeguards. They explicitly do not address issues of carbon accounting. The standards are structured around principles (objectives of good environmental and social performance), criteria (conditions that must be met) and indicators (information required to show progress) (REDD+ SES 2012).
- The Climate, Community and Biodiversity Standards: Developed by Verra to help projects deliver net positive social and environmental benefits. The standards aim to promote inclusion of safeguards into project design and to help projects demonstrate they comply with relevant Cancun safeguards (VERRA 2017).

Activities in the land sector are usually associated with the delivery of co-benefits or non-carbon benefits. It is straightforward to assume that the protection of natural forests does not only reduce carbon emissions but serves biodiversity and can generate income to a local community. Likewise, AR projects or IFM can address ecosystem degradation and can have positive effects on biodiversity, protection of soil and income generation. However, AR activities can also be detrimental to biodiversity or other environmental aspects, like water cycles, especially if monocultures or non-native species are planted, or formerly non-forest areas are forested. In the UNFCCC non-carbon benefits are considered important for the sustainability of implementation of REDD+ activities but they do not constitute a requirement.

[14] Paragraph 72 and Appendix I of decision 1/CP.16.
[15] https://www.worldbank.org/en/projects-operations/environmental-and-social-policies

2.9.2 Safeguards and co-benefits in practice

The strictest way to put a safeguard into effect is through a negative list, excluding activities that may have a negative impact. This approach was not chosen with regard to activities in the land-use sector. Rather, the UNFCCC approach was to include a comprehensive list of safeguards and to require REDD+ implementing countries to put in place 'systems for providing information on how safeguards are addressed and respected' as a requirement to receive results-based payments.

Carbon crediting mechanisms take a number of approaches to safeguards. They differ in the overall requirement for safeguards, e.g., do no harm or deliver net positive impact and the reporting and verification requirements. Many rely on the definitions and procedures established by the UNFCCC or other initiatives mentioned above.

For example, if activities affect local stakeholders, VCS establishes a requirement of no net harm and mitigation of potential negative impacts (VERRA 2019). Before validation, activities are required to carry out a stakeholder consultation and a public comment period of 30 days. Potentially affected local stakeholders must be clearly identified, including their legal and customary rights to land and resources. VCS also includes specific rules to prevent ecosystem damage, e.g., the introduction of invasive species is prohibited, use of non-native species needs to be justified, potential negative effects need to be identified before, and the use of chemical inputs must be justified. These are requirements especially relevant for AR activities. Finally, VCS requires that projects put in place a 'grievance and redress procedure' to address disputes with local stakeholders. JNR requirements for nested projects are similar, while jurisdictions are also required to inform how they have addressed and respected the Cancun Safeguards. Jurisdictions are also required to develop a mechanism for receiving feedback and grievances from stakeholders (VERRA 2021).

ACR requires an environmental and community impact assessment of activities and that impacts are net positive (American Carbon Registry 2020). It does not prescribe how to assess, report and monitor on these impacts but recommends using 'The World Bank Safeguard Policies', the 'Climate Community and Biodiversity Alliance (CCBA) Standard' or the 'Social Carbon Standard'.

The TFS requires jurisdictions to establish and enforce their own 'policies, laws and regulations' that meet the Cancun Safeguards and to demonstrate effective implementation of safeguards through reports that are verified by an independent third party and publicly available (ARB 2019).

As a jurisdictional approach, that builds on REDD+, ART TREES also requires consistency with Cancun Safeguards and that activities do no harm (ART 2020). To ensure this, ART TREES individually addresses each of the elements contained in the Cancun Safeguards (referred to as themes) and provides three types of indicators to demonstrate implementation of each element. Structural indicators reflect on governance and institutional arrangements of the jurisdiction that ensure implementation takes place without breaching safeguards. Process indicators refer to relevant institutional mandates and enforced processes and procedures. Outcome indicators reflect the outcomes of the implementation of safeguards, e.g., the activities promote the protection and maintenance of natural forests. This framework aims to support demonstration and verification of compliance with Cancun Safeguards requirements. Reporting on safeguards takes place either using a template provided by ART TREES or the reports under the UNFCCC. The ART TREES approach builds on the REDD+ SES.

2.9.3 Challenges and opportunities

Safeguards are essential to minimise potential social and environmental risks occurring when activities are being implemented under carbon crediting mechanisms. This applies in particular to activities in the land use sector where risks cannot be avoided completely but need to be minimised. However, implementation of safeguards varies greatly. Minimum requirements relate to simply reporting on safeguards, while the strongest provisions include grievance and redress mechanisms. Effectiveness of safeguards depends also on the legislative context and governance structures of the host country.

Co-benefits are important but their practical relevance for carbon crediting mechanisms is limited for two reasons. 1) They are very context-specific and therefore hard to standardise; 2) They are not and should not be the decisive factor for implementing an activity. In a carbon crediting mechanism, the additionality of activities is an essential quality requirement, which is given, when the activity takes place because of the mechanism. Co-benefits can be interpreted as a secondary consideration for starting activities as they tend to increase complexity of the additionality assessment. However, co-benefits are an important element for activities in the land-use sector as a means for increasing acceptance. Co-benefits should play a role whenever costs and efficiency are turn out to be decisive. In such cases they can serve to advertise for activities and buyers may prefer carbon credits with co-benefits compared to credits without. For countries implementing REDD+ co-benefits are relevant in the wider sustainable development context, they are not a requirement for accessing results-based payments. Providers of results-based finance can however consider incentivising co-benefits.

3 Land use in cap-and-trade mechanisms

3.1 Introduction

Land-use activities have not only been introduced under carbon crediting mechanisms but also in some cap-and-trade systems, such as emissions trading systems (ETSs). Table 3 provides an overview of ETSs that currently include land-use activities, along with an indication of the volume of allowances that are related to land-use activities. New Zealand is the only ETS in which land use is included within the scope of an ETS. The remaining ETSs shown in Table 3 all include land-use activities but only via the use of carbon credits.

Table 3: Overview of ETSs including land-use activities directly or through carbon credits

ETS	ETS covers LULUCF activities	Use of carbon credits from LULUCF activities	Covered activities and magnitude
New Zealand	X		Covers afforestation and deforestation. 117.1 million NZUs transferred for forestry removal activities between 2009 and 2018.[16]
South Korea		X	Covers afforestation/reforestation, harvested wood products and forest restoration for offsetting. During Phase I (2015-17) 15.6 million Korean Offset Credits (KOCs) were issued.[17] Share of land-use projects not known.
China ETS pilots		X	Covers forest sink projects. As of April 2018, in total 1,047 CCER projects had been registered, of which 287 were issued. This number includes 13 forestry projects.[18]
Saitama (Japan)		X	Not specified.
California (USA)		X	Covers carbon storage in forest biomass and harvested wood products. Up until 2018, 131.6 million domestic offsets from forestry projects have been issued by the ARB.[19]
Regional Greenhouse Gas Initiative (USA)		X	Covers sequestration of carbon due to afforestation. No offset projects currently registered for that activity.[20]
Alberta Emission Offset System (Canada)		(X)	Alberta's Emission Offset System covered also forest management activities (changes in harvest levels). However, the protocol has been withdrawn.[21]

Source: Own compilation

16 https://www.emissionsregister.govt.nz/Common/ViewPublicReport.aspx?rt=72b8e024-eeeb-4c9c-87f7-b78281e06213
17 https://unfccc.int/sites/default/files/2nd_biennial_update_report_republic_of_korea_eng.pdf
18 https://www.eu-chinaets.org/upload/file/20180906/1536164718942317.pdf
19 https://ww3.arb.ca.gov/cc/capandtrade/offsets/issuance/issuance.htm
20 https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=search.project_offset&setFilter=true&hc=IilOWCAK&nc=5CF5DB5CF1F5A3D480F15278C0764055
21 https://www.alberta.ca/alberta-emission-offset-system.aspx#jumplinks-0

Given that land-use activities are only included within the scope of the New Zealand ETS, this warrants further analysis in order to assess how the risks associated with the inclusion of land-use activities (non-permanence, provisions for natural disturbances, etc.) are addressed. Moreover, the EU established a separate target for the LULUCF sector, known as the EU Regulation on the inclusion of LULUCF in the framework of climate and energy policy until 2030 (EU LULUCF Regulation), and allows units for removals to be issued and traded, including with other sectors (European Union 2018). To assess how land use is integrated into cap-and-trade systems, the New Zealand ETS and the EU LULUCF Regulation are selected as two case studies for further analysis.

3.2 Case study: EU LULUCF Regulation

3.2.1 History and main features

In its updated NDC submitted to the UNFCCC in December 2020, the EU has put forward an economy-wide target of at least 55% greenhouse gas reductions by 2030 compared to 1990, without contributions from international carbon credits but including the LULUCF sector.[22]

In the period up to 2020, selected LULUCF activities were accounted for to achieve the EU's commitment under the Kyoto Protocol. Under its domestic policies, however, the LULUCF sector was included only as a separate target and part of the definition of the overall EU target for GHG emission reductions up to 2020. The target of a 20% reduction of greenhouse gas emissions by 2020 compared to 1990 referred only to the IPCC sectors energy (including international aviation), industrial processes, agriculture and waste but did not include LULUCF and international aviation. The LULUCF sector became more relevant for EU climate targets from 2021 onwards, following the adoption of the LULUCF Regulation in 2018. The LULUCF Regulation makes the sector an independent third pillar alongside the sectors covered by the EU ETS and the sectors covered under the Effort Sharing Regulation (EU 2018/842). Predecessor of the Regulation was the EU LULUCF Decision (529/2013/EU) that set rules for the second commitment period under the KP, that took over most of the rules established there.

The EU LULUCF Regulation forms a binding target for each EU Member State (MS) that the reported emissions from land use must be fully offset by an equivalent removal of CO_2 from the atmosphere through measures in this sector ('no-debit' rule). Furthermore, the scope of mandatory accounting was extended to more land-use categories compared to the KP and the LULUCF Decision. From 2021 onwards, arable land and grassland will be covered by accounting, and from 2026 onwards also wetlands. All three categories will be compared with historic **baselines**, i.e., emissions and removals from these lands over the period 2005 to 2009. Another innovation compared to the rules until 2020 was the transition from the Kyoto Protocol accounting method based on activities to managed land categories as applied to reporting under UNFCCC. The Regulation also advanced the accounting procedures for forests by introducing new rules for setting the forest reference level which exclude future policies with the view to ensuring the **additionality** of mitigation measures to be accounted for.

3.2.2 Definitions, coverage, and accounting rules

Accounting rules under the LULUCF Regulation make use of three different concepts of accounting, i.e., **gross-net** accounting, **net-net** accounting, and accounting **against a baseline**.

22 https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/European%20Union%20First/EU_NDC_Submission_December%202020.pdf

To account emissions and removals from **afforested land** and **deforested land** a gross-net accounting approach is used. It includes total net removals or net emissions resulting from afforestation or deforestation occurring during the accounting periods from 2021 to 2025 and 2026 to 2030 (Böttcher et al. 2019). MS may use a transition period of 30 instead of 20 years for afforested land before it enters the category of managed forest land (Article 6 LULUCF Regulation; IPCC 2013b; 2006).

Rules for the accounting of emissions and removals from **managed cropland, managed grassland and managed wetland** constitute a net-net accounting approach. Under this approach, net emissions or removals in the periods from 2021 to 2025 (except for wetlands, see below) and from 2026 to 2030 are compared to annual emissions and removals during a specific reference period (Böttcher et al. 2019). The reference period covers the period from 2005 to 2009. By contrast, in the LULUCF Decision, applicable to the period up to 2020, the reference year was a single year (2005). The inclusion of the category of managed wetland is planned to be mandatory from 2026 onwards if not postponed by EC to allow MS for gaining more experience with methodologies provided by the IPCC Wetland supplement (Böttcher et al. 2019).

Accounting for **managed forest land** follows another type of net-net accounting where the reference is not a historic period but a projected Forest Reference Level (FRL). The FRL describes emissions and removals hypothetically occurring from managed forest land in the future if 'sustainable forest management practices' as observed in the period from 2000 to 2009 would continue. It also assumes a constant ratio of the use of wood as raw material (entering the HWP pool) and for energy production (accounted as direct emission, Böttcher et al. 2019). The application of such a reference level aims at identifying management changes including those that affect an altered pattern of the use of wood as raw material or for energy production (Böttcher et al. 2019). According to Article 8, paragraph 2 of the Regulation, a cap of 3.5 % of total base year emissions of all sectors excluding LULUCF applies in order to limit the maximum net removals that can be accounted from managed forest land in each accounting period. The FRL is separated into emissions and removals from forests and stock changes within the category of **harvested wood products** (HWPs). The so-called production approach requires to include all HWP from wood harvested in a country, ignoring imports and exports of wood and wood products. It is important that consistent approaches for accounting for HWPs are applied on a global scale in order to avoid double-counting and gaps in accounting of emissions from HWPs as a result of trading of such products. Values for FRL were estimated by MS and assessed and, in some cases, corrected by the European Commission and adopted through a delegated Act (C(2020) 7316 final) in 2020[23], based on recommendations of an international LULUCF Expert Group.

Already the LULUCF Decision allowed MS to exclude **emissions from extreme events** such as disturbances by storms, insect outbreaks or fires in forests from accounting (Böttcher et al. 2019). The rules for this provision were formulated in the IPCC Kyoto Protocol Supplement (IPCC 2013b). For excluding emissions from extreme events, the following steps need to be applied (Böttcher et al. 2019):

- A 'background level' of emissions from natural disturbances is calculated based on statistics on expected emissions from natural disturbances in the absence of extreme events based on the period from 2001 to 2020 (excluding outliers).

[23] https://ec.europa.eu/clima/sites/clima/files/forests/docs/c_2020_7316_annex_en.pdf

- In case emissions of a single event exceed the estimated background level including a margin to reflect uncertainties, it can be considered 'extreme', and the exceeding emissions may be excluded from the accounted emissions.
- It must be noted that subsequent removals on the land affected by the natural disturbance also must be excluded until 2030 to avoid an unbalanced accounting. Similarly, emissions from harvesting and salvage logging after a disturbance event, as well as emissions from deforestation or prescribed burning on the disturbed land areas need to be accounted for.

3.2.3 Flexibilities

The calculation of the creditable emissions of the LULUCF sector will be carried out in 2027 for the first period (2021-2025) and in 2032 for the second period (2026-2030). The LULUCF Regulation allows for certain flexibilities. If the LULUCF sector caused net emissions in the period 2021 to 2025, units issued for the Effort Sharing sector (AEAs, Annual Emission Allocations) can be used to offset the net emissions from the LULUCF sector (Art. 12 (1)). Another possibility is to purchase corresponding quantities of credits from other MS that report a net sink for the period (Art. 12 (2)). Member States with net sinks for the first period can also save their own credits and use them, if necessary, to offset any net emissions from the LULUCF sector in the next period (Art. 12 (3)). It is also possible to use them for compliance under the national obligation under the Effort Sharing Regulation (ESR Art.7, Art. 12 (4)). In addition, the LULUCF Regulation (Art. 13) provides flexibility for managed forest areas: If the total emissions exceed the removals in a period, certain quantities, reported according to Annex VII, can be used for compensation if there are net emissions from the managed forest areas. To this end, a strategy with measures to improve sinks and reservoirs from forests must be presented and the EU must nevertheless comply with the 'no-debit' rule at the level of total emissions and total sinks. In 2027 and 2032, the countries must submit 'compliance reports' in which the comparison between emissions and sinks of the individual categories to be credited and the use of flexibilities are presented.

In July 2021, the European Commission proposed a revision LULUCF Regulation EU 2018/841 with the aim to ensure a consistent implementation of the Climate Target Plan. The 2030 Climate Target Plan Impact Assessment identified three options for amendments:

- Option 1: to strengthen the current LULUCF Regulation and to increase its ambition in line with the 2030 Climate Target Plan;
- Option 2: to strengthen flexibility with the Effort Sharing Regulation (ESR);
- Option 3: to combine the agriculture and LULUCF sectors into a single climate policy pillar with a separate target.

As discussed by Böttcher et al. (2021), all three options can be interpreted as different positions along a gradient of flexibility between the LULUCF and other sectors, ranging from no flexibility (Option 1) to limited flexibility with several sectors (ESR, Option 2) and full flexibility with one sector (Agriculture, Option 3).

Due to non-permanence risks and volatility of GHG emissions and removals in the land-use sector, the full-scope inclusion creates uncertainties that create challenges for quantifying and governing sectoral climate targets (Böttcher et al. 2021).

For EU MS with large contributions of the LULUCF sector, changes in GHG inventories due to recalculations are likely to affect reference emissions in the range of several percentage points, making a timely and sanctioned climate protection regime largely ineffective with potentially considerable consequences for other sectors (Böttcher et al. 2021;).

3.2.4 Environmental integrity

The EU LULUCF Regulation for the first time sets a binding commitment for each MS for the emissions and removals from the LULUCF sector. Protecting and restoring carbon-rich ecosystems is also a central target of the EU Biodiversity Strategy. This includes strictly protecting the last primary forests in the EU, which is of high importance to preserve biodiversity in Europe as well as to protect carbon stocks. However, compared to the LULUCF Regulation it does not provide a similar stringency and instruments to enforce the policy.

As discussed by Böttcher et al. (2019) the LULUCF Regulation is much stricter than earlier rules (KP and LULUCF Decision), especially for the category of managed forest land. FMRLs under the earlier Kyoto framework allowed MS to increase intensity of forest management because the reference could also include assumptions about the effect of future policies. Instead, FRLs under the Regulation exclude assumptions on policies but build on historic management intensity observed in a certain base period (2000-2009). The definition and calculation method for FRLs is important for avoiding both issuing credits that may not be backed by additional mitigation measures and hiding the impact of management intensification on GHG emissions and removals in the baseline.

The current version of the LULUCF Regulation does not provide strong environmental safeguards against a number of risks (Böttcher et al. 2021). The restoration of monocultural production forests can be considered an important measure to support biodiversity. This can be achieved by converting non-natural coniferous stands into mixed or deciduous tree stands with high growing stocks. Such forests can potentially improve carbon storage in biomass and similarly be beneficial for forest biodiversity (Böttcher et al. 2021). More structured forests can increase resilience towards climate extremes like storms as uneven tree canopy structures tend to form more resistant stands. The LULUCF Regulation provides the framework for accounting carbon implications of such management decisions and strategic planning. However, biodiversity aspects are not addressed.

Another EU approach including environmental safeguards in policies is, for example, the EU Renewable Energy Directive (RED, EU 2018/2001). It constrains biomass sourcing for energy use inside and outside the EU by applying sustainability criteria including protection of highly biodiverse areas and high carbon stocks. Therefore, companies need to demonstrate that their production does not lead to direct land-use changes and need to minimise the risk of indirect land-use change.

Carbon sink strategies and biodiversity protection targets can have strong synergies but can also include trade-offs (Böttcher et al. 2021). Therefore, measures are most successful if they are regionally adapted and target synergy effects. There is the need for an improved and consistent data basis and an EU-wide monitoring to ensure ecosystems are building up resilient carbon stocks while sinks and biodiversity are maintained or enhanced.

3.2.5 Conclusions from the case study

The EU NDC includes the full scope of GHG emissions in the EU, also crediting in the land-use sector will play a central role for the EU, especially for reaching GHG neutrality in 2050. In scenarios of the EU long-term strategy published in December 2018 (European Commission

2018), including the LULUCF sector in the EU target would allow for a significant reduction of the EU's cumulative emissions budget if the same target was maintained. The 2030 Climate Target Plan increases the ambition level for the 2030 target from -40% to at least -55% compared to 1990 and includes the full scope of emissions and removals. However, the inclusion of the land-use sector has an impact on the overall ambition level of the target. This is because the EU LULUCF net sink is currently as high as it was in 1990 and is expected to be reduced only slightly until 2030 without additional mitigation activities (EC 2019). This implies that other sectors under the target would have to reduce their emissions only by about 53% compared to 1990 for meeting the overall -55% target. Therefore, to ensure that sufficient efforts to reduce and prevent emissions are deployed until 2030, the EC aims to introduce a limit of 225 Mt CO_2eq. to the contribution of removals to the net target[24]. Moreover, a separate net sink target was agreed aiming at a total of -310 Mt CO_2eq. to ensure an increase of efforts for expanding the EU's carbon sinks and by that achieving an overall net effect of a 57% emission reduction compared to 1990.

In the light of recent policies, the EC is reviewing the LULUCF Regulation. The review will also include perspectives for the long-term role of LULUCF climate policy towards achieving GHG neutrality in the EU in 2050. The review of the LULUCF Regulation and other policies carried out in 2021 will further investigate options for rewarding landowners, foresters, and farmers in developing and implementing agriculture and forestry practices to increase and store carbon sequestered from the atmosphere. An option that will be explored is the formation of a joint pillar of the agriculture and LULUCF sectors with a separate AFOLU target. This would imply full flexibility between the two sectors and is expected to deliver more cost-efficient mitigation options. However, there is also the risk of undermining environmental integrity by allowing for direct offsetting at national level of non-CO_2 emissions from the agriculture sector by **non-permanent** removals with considerable uncertainty and reporting gaps at national level offered by the LULUCF sector.

Options also include the development of a carbon certification and crediting system to allow for trade of carbon credits between sectors and MS. In its Farm-to-Fork strategy (EC 2020), the EC announces 'carbon farming' initiatives to provide financial incentives to farmers and foresters.

However, it remains unclear what measures and rules will be applied to achieve **permanence** of traded credits and avoid **leakage** and **double counting**. This requires also improved **monitoring** of GHG emissions and removals from land use in the EU and consistency with national and EU accounting procedures.

Moreover, there is the need to align land use-related policies with climate targets for the sector. There are potential trade-offs to be reduced and synergies to be increased between the LULUCF Regulation, the Renewable Energy Directive, the EU Communication on forest protection, the EU Adaptation Strategy, and the EU Biodiversity Strategy (Böttcher et al. 2021).

3.3 Case study: New Zealand Emissions Trading Scheme

In the following, the Emissions Trading System (ETS) of New Zealand (NZ) is reviewed. It serves as an example on how land-use sector activities can be included within the scope of such a system. The information in this chapter is based on a review of legislation and government documentation. Primary sources are the New Zealand Parliament, the Ministry for Environment and the Ministry for Primary Industries, particularly Te Uru Rākau (Forestry New Zealand).

24 https://www.europarl.europa.eu/pdfs/news/expert/2021/4/press_release/20210419IPR02302/20210419IPR02302_en.pdf

Further consulted literature includes peer-reviewed articles specifically addressing the NZ ETS, reporting to the UNFCCC and grey literature, especially reports from international carbon market initiatives (e.g., ICAP, PMR), think tanks, and independent research institutions (e.g., Motu NZ).

3.3.1 History and main features

The NZ ETS is the country's 'main tool for reducing greenhouse gas emissions' and for 'meeting domestic and international climate change targets' (MfE 2021a). The NZ ETS is the only scheme in the world that includes the forestry sector (ICAP 2020). The design of the NZ ETS started in 2007, when the Minister of Finance and the Minister of Climate Change proposed to introduce a cap-and-trade emissions trading scheme covering all sectors with absolute obligations. The government favoured a broad sectoral coverage because agriculture and energy have made up the largest share of emissions in the country since 1990, accounting for 48% and 41% of gross emissions respectively in 2008[25]. Other considerations in favour of broad sectoral coverage were 'equity, environmental integrity and economic efficiency' (Leining et al. 2019). These core elements of the NZ ETS were subject to stakeholder and Maori consultation (Cabinet Policy Committee 2007).

NZ's climate legislation is contained in the **Climate Change Response Act 2002** (CCRA 2002). It first served as the legal basis for the ratification of the Kyoto Protocol. Continuous amendments have served to update the legislation in response to national and international developments. For example, the NZ ETS was introduced with the **Climate Change Response (Emissions Trading) Amendment Act 2008**. Since its introduction, the NZ ETS has been reformed several times. The main amendments are summarised in Box 3. The latest amendments came into effect in June 2020.

3.3.1.1 Scope of the NZ ETS

The NZ ETS covers all major GHGs (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6). As of 2019, the forestry, waste, industrial and energy sectors have obligations to report GHG emissions and surrender units, covering around 54% of New Zealand's emissions (Leining et al. 2019). The agricultural sector currently has only reporting obligations, but following the 2020 Amendment Act, some form of pricing for livestock emissions will be put in place by 2025.

The rules applying to the forestry sector were designed to align the NZ ETS with the requirements of the Kyoto Protocol and to help New Zealand meet its related obligations (MfE 2015). Thus, forests are treated according to the year of establishment and divided into two categories with the Kyoto base year of 1990 as the cut-off date (MfE 2015). In very broad terms, deforestation of pre-1990 forest land carries mandatory unit liabilities, while landowners of post-1989 can opt into the NZ ETS to receive units for carbon removals achieved with their forests, while surrendering units when forests are harvested (see 3.3.2.4).

Points of obligation differ between sectors. In the energy sector obligations apply to fuel producers or importers, thus at the highest upstream point. In the forestry sector, obligations apply to landowners, thus at the point of emissions. In specific cases, liability can be transferred to the person in charge of managing the forest land.

[25] In 2019, agriculture accounted for 46% of gross emissions and energy for 41% MfE (2021b).

3.3.1.2 Cap and allocation of allowances

The NZ ETS operates on the basis of New Zealand Units (NZU), where one NZU corresponds to one metric tonne of CO_2eq. The government provided a one-time free allocation to owners of pre-1990 forest, to which they could apply until 2011.

Although initial plans for the NZ ETS provided for auctioning of NZUs, this allocation method was not implemented, given the supply of Kyoto units (Leining und Kerr 2018). Auctioning was introduced with the 2020 Amendment Act and started in March 2021 (ICAP 2021).The overall limit of allowances supplied into the ETS, by free allocation and auction, will be specified for any given year and five years in advance, thus enhancing predictability for NZ ETS participants. Trade-exposed and emission-intensive industries receive free allocations, these will be phased down by a rate of 0.01 per year from 2021 to 2030 and 0.02 starting 2031 and 0.03 starting 2014 (Environment Committee 2020).

3.3.1.3 Linking to the Kyoto Protocol market

Between 2009 and 2015 the NZ ETS was linked to the Kyoto Protocol market. Participants could meet their obligations either with NZUs or with certain types of Kyoto Protocol units. Specifically, participants could use certified emission reductions (CERs) from the Clean Development Mechanism (CDM), emission reduction units (ERUs) from Joint Implementation (JI) and removal units (RMU) issued for LULUCF activities in Annex I countries; use of AAUs from other countries, temporary CERs (tCER), long-term CERs (lCER) and ERUs 'from industrial-gas, large-scale-hydro and nuclear projects' was not permitted (Leining und Kerr 2018).

Moreover, with the introduction of the NZ ETS, each NZU in the NZ-Emission Unit Register had to be backed with a Kyoto Protocol Unit held by the Government. This provision was revoked with the 2012 Amendment Act and only applied retrospectively from 2008 to 2012 (Leining 2016). In 2012, the NZ Government decided not to participate in the second commitment period of the Kyoto Protocol.

Currently, the NZ ETS is a domestic system but linking remains a viable option and NZ has stated in its first NDC that it intends to make use of international carbon markets.

3.3.1.4 Institutional arrangements

The NZ Emissions Trading Register is maintained by the NZ Environmental Protection Authority (EPA). The Emissions Trading Register serves as the Unit Registry for NZ. All transactions, namely issuance, transfer, cancellation, retirement, surrender, conversion or replacement of units must be registered. Participants have holding accounts of units, which are assigned unique account numbers. NZ ETS participants use these accounts for receiving units from the Government and surrendering units. The forestry sector part of the NZ ETS is managed by the Ministry for Primary Industries, all other sectors fall under the jurisdiction of the Ministry for the Environment. The Minister of Finance has the power to carry out trading activities with the country's Kyoto Units.

3.3.1.5 Reporting

NZ ETS participants have the obligation to report on the emissions resulting from their activities or on the removals of their activities. To do so they submit a so-called **Annual Emissions Return** online via the NZ Emissions Trading Register. The Annual Emissions Return contains information on the activities in the previous calendar year and an assessment of the liability to surrender units, either depending on the quantity of emissions resulting from an activity or, in the case of forestry, from the change in forest carbon stock. The Government allocates NZUs to post-1989 forest owners in the NZ ETS based on the information in the Emissions Return.

Box 3: Overview of main legal reforms of the NZ ETS

► The **Climate Change Response (Moderated Emissions Trading) Amendment Act 2009**, following a change in government in 2008 (Leining and Kerr 2018) and in the aftermath of the global financial crisis of 2007/2008, introduced two transitional price moderation measures into the NZ ETS and delayed the starting date for the surrender of units for some sectors. One price moderation is the 'fixed price option', through which NZ ETS participants can pay NZ$25 per tonne to the government instead of surrendering units.

► The **Climate Change Response (Emissions Trading and Other Matters) Amendment Act 2012** was adopted following an independent review mandated by statutory requirement in 2011. Reforms aimed to stabilise the costs for the economy (Leining and Kerr 2018) and thus extended the transitional price moderation measures, without specifying an end date.

► The **Climate Change Response (Unit Restriction) Amendment Act 2014** targeted the forestry sector and made technical changes to prevent market dynamics that resulted in an excess of Kyoto Units in the Government's holding account and a fiscal risk for the country (Government of New Zealand 2014).

► The **Climate Change Response (Removal of Transitional Measure) Amendment Act 2016** included the outcomes of the first phase of the 2015/2016 review of the NZ ETS, which aimed to assess the operation and effectiveness of the scheme up to and beyond 2020. The first phase of the review focused on the application of the transitional price moderation measures as well as on the conditions and timeframes for free allocation for 'emissions intensive and trade exposed' activities (MfE 2015). The 2016 Amendment Act included a roadmap for the phase-out of the transitional price moderation measures.

► The **Climate Change Response (Zero Carbon) Amendment Act 2019** set New Zealand's climate policies into the context of the Paris Agreement and a 1,5 °C temperature increase limit and thus recalibrated the country's climate ambition. The act introduced five-yearly emissions budgets[26] for New Zealand and the establishment of a Climate Change Commission to advise government policy. The Climate Change Commission will provide recommendations on the quantity of emissions permitted in each budget period and on the rules that will apply to measure progress towards meeting the emissions budget and the 2050 target. NZ intends to reduce all greenhouse gases, except biogenic methane to net zero by 2050. The reduction target for biogenic methane emissions is 24% to 47% below 2017 by 2050.

► The **Climate Change Response (Emissions Trading Reform) Amendment Act 2020** resulted from the second phase of the 2015/2016 review, which focused on operational and design issues considering New Zealand's 2030 target under the Paris Agreement. The Act establishes that emissions covered by the NZ ETS will be capped in accordance with the five-yearly emissions budgets. Other changes relate to unit supply, price moderation and accounting in the forestry sector (Environment Committee 2020).

[26] Each emissions budget includes all GHGs and states the total emissions that are permitted for the relevant period. It is expressed as a net quantity of CO_2 equivalents. Budget periods cover five years, except the first period which lasts from 2022 to 2025. One current and two prospective emissions budgets are to be in place at any time starting 31 December 2021 (CCRA, Section 5 X). New Zealand will consider its budget met, when net accounted emissions do not exceed the emissions of the relevant budget period. '"As far as possible" NZ intends to meet its budget through domestic emissions reductions and removals, but '"offshore mitigation" may be used in the case of significant changes in circumstances that affect '"the considerations on which the emissions budget was based" and the domestic ability to meet the budget.

3.3.2 Definitions, coverage and accounting

3.3.2.1 Definitions

The NZ ETS uses the following definitions of land-use categories:

- **Forest land** is defined as 'an area of land of at least one hectare that has, or is likely to have, tree crown cover of more than 30% in each hectare'. It also includes land that does not meet these requirements temporarily due to human intervention or natural causes but is likely to revert to the previous status (Section 4.1. CCRA 2002). Also, the crown cover of a forest patch must cover more than 30 metres in any direction. The NZ ETS differentiates between pre-1990 forest and post-1989 forest land. Fruit or nut trees are excluded from the ETS (Ministry for Primary Industries New Zealand 2020).

- **Pre-1990 forest land** is defined as land that was forested land on 31 December 1989 and remained as such on 31 December 2007. It is composed predominantly of exotic forest species. Land covered with indigenous forest on 31 December 1989 and thereafter until 31 December 2007 is not considered pre-1990 forest land.

- **Post-1989 forest land** is land that was not forested on 31 December 1989 or if it was forested, was then deforested in the period lasting until 31 December 2007. Non-exempt pre-1990 forest land (see below for exemptions) that was deforested on or after 1 January 2008 is also considered as post-1989 forest land if surrender obligations have been satisfied.

- **Standard forest/forestry** refers to post-1989 forest in the NZ ETS that undergoes a commercial forestry rotation. The term was introduced with the 2020 Amendment Act. It will apply from 2023.

- **Permanent forest/forestry** refers to post-1989 forest in the NZ ETS that cannot be clear felled for at least 50 years. The permanent forestry activity was introduced with the 2020 Amendment Act. It will apply from 2023. Permanent forest in the ETS replaces the Permanent Forest Sink Initiative (PFSI), which aimed to incentivise the creation of permanent forests by awarding landowners NZUs for doing so. Permanent forests were created if forest owners committed to long-term sustainable management for the primary purpose of carbon sequestration. The 2020 Amendment Act replaced the PFSI with the option to register post-1989 forest in the NZ ETS as permanent forest. Land under the PFSI can be transferred to the new permanent forestry activity.

Table 4: Requirements for temporarily unstocked forest land to be considered forest land

Years after clearing	Requirements
4 year after clearing	Replanting: at least 500 stems per ha of forest species or at least 100 stems per ha of willows or poplars Regeneration: cover of at least 500 stems per ha of exotic forest species or predominantly indigenous forest likely to be forest land in 10 years after clearing
10 years after clearing	Forest is covered by predominantly exotic forest species with a tree crown cover of at least 30% and tree height of 5 metres

Years after clearing	Requirements
	or Forest land composed of predominantly indigenous forest
20 years after clearing	Predominantly indigenous forest species, with tree crown cover of at least 30% and trees at least 5 metres high

Source: (MPI 2017)

- **Forestry classification**[27] is the classification of an area specifying how the legislation applies to the land. The classification is provided by the EPA. Classification differentiates between pre-1990 forest land, post-1989 forest land, land that is eligible to become post-1989 forest land, and exempt land.
- **Deforestation** is the permanent conversion of forest land to non-forest land. The term is also used for temporarily unstocked forest land, that does not meet specific criteria (Table 4) of replanting or natural regeneration after 4, 10 or 20 years (MPI 2017).[28] Deforestation carries liabilities to surrender units. Clearing of forest edges required by best practice management below one ha or less than 30 m wide and next to pre-1990 forest, is not considered deforestation.

3.3.2.2 Reporting

Owners of pre-1990 forest have an annual reporting obligation like other sectors and must submit a Mandatory Annual Emissions Return covering the previous year of activities. Owners of post-1989 forest land can voluntarily opt into the NZ ETS. They must at least submit a Mandatory Emissions Return every five years. The five-year periods are fixed through the ETS. The next Mandatory Emissions Return for post-1989 forest will cover the 2018-2022 period, the previous one covered 2013-2017. Each Mandatory **Emissions Return** must cover the complete respective five-year period, even if registration took place in the middle or at the end of this period and must be submitted within six months from the end of a relevant five-year period. If post-1989 forest owners want to receive NZUs for the increase in their forest carbon stock they can provide an annual voluntary Annual Emissions Return (MPI 2021).

3.3.2.3 Accounting approaches for forestry in the NZ ETS

In its NDC, NZ has broadly outlined the accounting methodologies it will apply for the LULUCF sector to assess the achievement of its 2030 target under the Paris Agreement. The outlined methodologies include:

- 1990 will remain the base year for activities.
- Accounting will be either land-based or activity-based.
- Post-1989 forest will be accounted for as under the Kyoto Protocol until it reaches its long-term average carbon stock. It will then be accounted for against a BAU reference level and treated under the forest remaining forest category.
- All deforestation emissions will be accounted for.

[27] See Section 196 of the Climate Change Response Act

[28] Section 179 of the Climate Change Response Act

- Pre-1990 forests will be accounted for against a BAU reference level (as is current practice).
- Building on current guidance NZ will address 'natural disturbance, land-use flexibility, legacy effects, non-anthropogenic effects and additionality'.

For the 2013 to 2020 period, NZ assumed an unconditional target in the context of the Cancun Pledges under the UNFCCC instead of a commitment under the Kyoto Protocol. However, the country decided to continue fulfilling reporting requirements of the Kyoto Protocol. Forest management is accounted for against a projected business-as-usual forest management reference level (FMRL) (MfE 2016b). NZ will also account for its NDC against its national carbon budgets, the first covering the years 2022 to 2025.

NZ applies a **carbon stock change accounting** to account for deforestation of **pre-1990 forest.** Emissions from deforestation are calculated by multiplying the area of the forest land with an average carbon stock per ha. To determine the carbon stock, NZ uses look-up tables that 'specify default average carbon stock values per forest type, age and for *Pinus radiata*, region'. The look-up tables specify values for five forest types: *Pinus radiata*, Douglas fir, Other Exotic Hardwoods, Other Exotic Softwoods and Indigenous. Information for *Pinus radiata* is regionally specific because growth patterns differ across NZ and regionally specific information is available. For plantation forest, forest age is the age of trees at the point of harvest. For indigenous forests, age is calculated since the year of regeneration. In mixed species or uneven-aged forests, the basal area of the trees for each forest species and age-class needs to be determined by calculating a weighted average age of the forest.

Carbon stock change accounting also applies to **post-1989 forest** registered in the NZ ETS. If a Carbon Accounting Area (CAA) is smaller than 100 ha, the carbon stock of a post-1989 forest is calculated using look-up tables. CAAs of 100 ha or more need to apply the Field Measurement Approach. For this forest owners collect information on their forest in sample plots, determined by the Ministry for Primary Industries. The Ministry then uses this information to create look-up tables specific to the forest land to calculate the carbon stock. For the first rotation, carbon stock change is calculated by subtracting the carbon stock in a CAA at the beginning of an emissions return period from the carbon stock at the end of this period. For the second and following rotations the carbon stock in residual wood and below-ground roots is also accounted for, applying a continuous discount of that stock by 10% per year after harvest. In each rotation period, forest owners receive NZUs if carbon stocks increase and surrender NZUs if stocks are reduced.

Carbon stock change accounting will also apply to the new **post-1989 permanent forestry activity**. Requirements for **post-1989 permanent forestry** are that they that will remain in the ETS for 50 years. In this period, crown cover must remain over 30% and clear-felling is forbidden. After the 50th year, the ETS participant may decide to extend the activity for another 25 years or to retire the land from the ETS. If permanent forest is retired from the NZ ETS, the forest owner must surrender NZUs. NZUs coming from permanent forestry will be tagged for future identification (Cortés Acosta et al. 2020).

The Emissions Trading Reform Amendment Act 2020 introduced **averaging accounting** as an alternative accounting method **for standard forest** in the 2020 Amendment Act. The accounting method to be applied for standard post-1989 forest depends on the registration year (see Table 5).

Table 5: Accounting method for post-1989 forest according to registration date in the NZ ETS

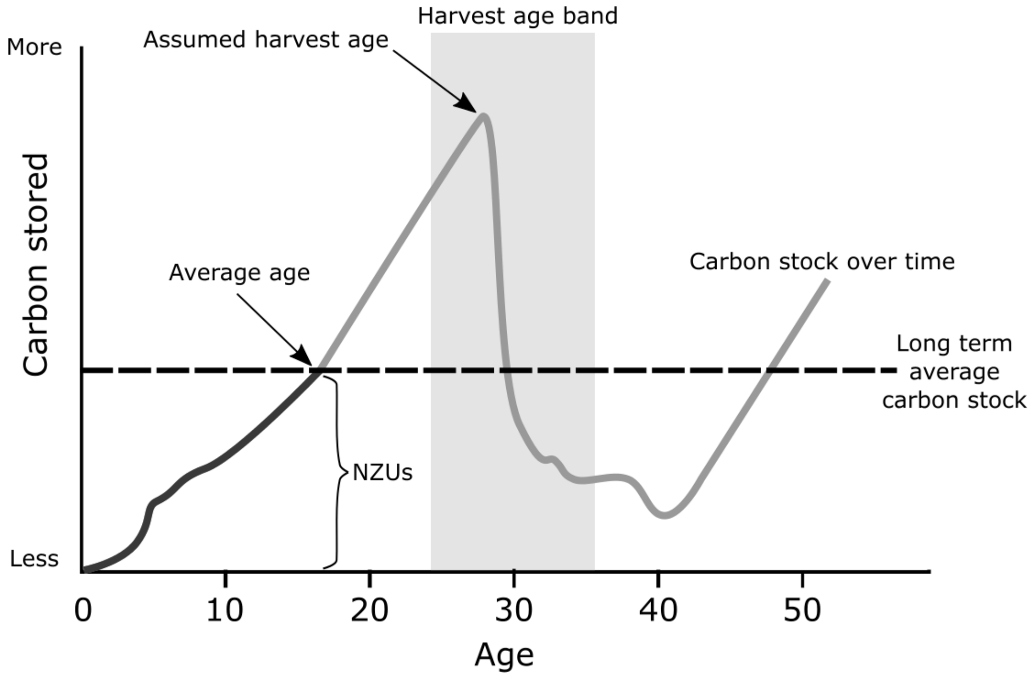
Registration date of post-1989 forest	Accounting method
Before 2019	Carbon stock change accounting
Between 2019 and 2022	Carbon stock change accounting. Forest owners will have a one-time opportunity to change to averaging accounting in the first half of 2023.
After 2022 (starting 01.01.2023)	Averaging accounting

Source: (Cortés Acosta et al. 2020)

Averaging accounting uses the long-term average carbon storage of a forest and an assumed harvest age as a reference. When forest owners register post-1989 forest (first rotation) they will receive NZUs in each year until their forest reaches the 'age equivalent to its long-term average carbon storage'. If forest owners harvest the forest in a typical range of harvest age (age band) and replant it with the same tree species, they do not have to surrender units (Figure 8). In the second and subsequent rotation periods, NZUs may need to be surrendered if harvest takes place earlier than in the previous rotation period, whereas additional NZUs may be earned if harvest takes place later than in the previous rotation period.

The operational details of forestry accounting in the NZ ETS are set out in the **Climate Change (Forestry Sector) Regulations 2008**. These Regulations are currently under review to implement the changes introduced with the Emissions Trading Reform Amendment Act 2020. For example, the long-term average carbon stock and the average age for different forest types need to be determined (Te Uru Rākau 2021). Also, Te Uru Rākau is still consulting on the width of the age band, e.g., 3 years, 7 years or mixed (a default broad age band framed by narrow aged bands) (Te Uru Rākau 2021). The nature of age bands will determine management flexibility and will have an impact on the cost and complexity of the NZ ETS (Te Uru Rākau 2021).

Figure 8: Carbon stock diagram with reference long-term average carbon stock



Source: Figure adapted from Te Uru Rākau (2021)

Harvested wood products

Currently, NZ applies a stock change approach to harvested wood products as specified in the 2013 IPCC Good Practice Guidance for the Kyoto Protocol. Landowners must surrender 60% of the allocated units at the time of harvest (MfE 2016a). The remaining 40% of units is accounted for as remaining biomass, including tree stumps and roots using the carbon stock change method described above. In its first NDC NZ has indicated that it will account for harvested wood products using the production approach.

Provisions for natural disturbances

A registered carbon accounting area of post-1989 forest land that is affected by a natural disturbance that 'permanently prevents re-establishing' of forest land, ceases to be part of the ETS without creating an obligation for the landowner to surrender units. The EPA notifies the respective NZ ETS participating landowner of the exclusion of the respective carbon accounting area. This provision was introduced with the Amendment Act 2012 and took effect on 1 January 2013.

3.3.2.4 Obligations for surrendering units

Deforestation of pre-1990 forest land requires landowners to surrender a respective number of units, unless the deforested area is below two hectares in the five-year period commencing from 2008-2012 or any subsequent five-year period[29]; or if forest cover clearance is due to a natural event that permanently prevents the re-establishment of forest[30]. Once a forest land area above 2 ha is deforested within any five-year period, landowners are obligated to register in the NZ ETS and surrender the equivalent units for the carbon lost[31]. The detailed steps required for the deforestation of pre-1990 forest land are shown in Figure 9. Harvesting and replanting of pre-1990 forest land does not carry liabilities (Ministry for Primary Industries New Zealand 2020).

Exemptions to the obligation to surrender units can apply to pre-1990 forest land. Landowners can apply for the exemptions if their land holding is below 50 ha[32] or for deforestation of forest land that is covered by species specified as tree weeds[33]. Some tree species are considered tree weeds because of their potential to spread and establish themselves on other land, for example *Pinus radiata*, *Pinus sylvestris*, *Fraxinus excelsior*, *Pseudotsuga menziesii* and *Betula pendula*. In New Zealand, land with tree weeds is deforested, to protect the 'amenity, recreational, ecological and economical values of the surrounding landscape' (MPI 2018). There are no surrender obligations for deforestation of forest land that is exempt.

[29] The first five-year period started on 1. January 2008, subsequent five-year periods are defined with this date.

[30] Section 179A of the Climate Change Response Act

[31] Schedule 3 of the CCRA 2002

[32] Section 183 Climate Change Response Act

[33] Section 184 Climate Change Response Act.

Figure 9: Requirements in the case of deforestation of pre-1990 forest land

1. Holding account	2. Notification	3. Calculation of emissions	4. Emissions return	5. Surrender of units	6. De-registration
• Landowners must create an account in the NZ Emissions Trading Register	• Landowners give notice to the MPI of deforestation within 20 working days.	• Landowners must calculate emissions released by deforestation using look-up tables to determine the forest carbon stock at the time of clearing	• 1 NZU is surrendered per tonne of released CO_2 • Landowners indicate the amount of NZUs they have to surrender in one year.	• Using their holding accounts, landowners surrender units by 31 May of the year following deforestation.	• After deforestation landowners must deregister from the ETS. • They start the process anew, when another area of pre-1990 forest is cleared

Source: own figure based on (MPI 2020)

Owners of post-1989 forest who opt into the NZ ETS must register to the system and declare a Carbon Accounting Area (CAA). In line with the forest land definition, a CAA must measure at least one ha. Each CCA is registered with information on its area (in ha), the predominant forest type, or the area of each respective forest type standing in the CAA, thus forming a sub-area, and the age of the trees.

If a carbon accounting area is harvested or cleared, an amount of NZUs equivalent to the CO_2 emissions resulting from this forest loss must be surrendered. Forest owners can opt in or out of the NZ ETS at any time and as many times as they wish (MfE 2016a). However, when landowners deregister from the NZ ETS, they must surrender the NZUs allocated to them. The Amendment Act 2014 established that post-1989 forest owners who opted out of the NZ ETS were only allowed to use NZUs for fulfilling their unit liabilities (Leining 2016). As stated in the legislation, this amendment was necessary to 'prevent reregistration arbitrage'. The significant price difference between high priced NZUs and cheap Kyoto units at the time provided the incentive for landowners with post-1989 forests to register and deregister in the NZ ETS, while making profit in the process. They sold their allocated NZUs into the market and acquired cheap Kyoto units to meet their unit liabilities when ending their registration in the ETS (Farm Forestry New Zealand 2014).

NZUs from the forestry sector are tagged as such and traced separately. From 2010 to 2018, 20% (over 44 million) of units surrendered in the NZ ETS were forestry NZUs (Environmental Protection Authority New Zealand 2017; 2018). The number of NZUs issued to the forestry sector for removal activities is not limited. 17% (over 38 million) of surrendered units were NZUs from other sectors and 43% (over 96 million) were ERUs. Starting 2015, Kyoto Units other than NZ AAUs could not be surrendered anymore. Over 130 million NZUs are currently stockpiled in private accounts. The government has announced it will reduce this amount by 27 million NZUs until 2025 (ICAP 2020).

3.3.2.5 Offsetting of deforestation

As of 2013, pre-1990 forest landowners also have the option to offset expected emissions from deforestation. Under this option pre-1990 forest owners must not surrender units for deforestation if they replant an equivalent area of forest land, that will achieve carbon equivalence and qualifies as forest land, before the deforestation takes place (MPI 2017). The offset forest applications must be submitted to the EPA and approved before deforestation operations.

Starting in 2023 offsetting will also be possible for standard post-1989 forest using averaging accounting. Forest owners must submit an application to offset deforestation specifying the CAA that will be offset. Post-1989 forest established through natural regeneration is excluded from offsetting. Land for offsetting post-1989 deforestation must fulfill certain criteria, for example it cannot already be forested or be post-1989 forest that is more than two years old[34]. Offset post-1989 forest cannot be transferred to the permanent forestry activity.

3.3.3 Conclusions from the case study

Since 1990 NZ's net emissions have continuously increased. In 2019 gross emissions amounted to 82.3 Mt CO_2eq. (+26%), net emissions to 54.9 Mt CO_2eq. (+36%) (MfE 2021b). The NZ NDC aims at a 30% reduction compared to 2005 levels for the period 2021 to 2030. This target is an economy-wide target covering all sectors, but the NZ NDC submission does not specify if it refers to a net reduction. This information is necessary to understand the stringency of the target and is for example included in the EU NDC. Since averaging accounting for post-1989 forest was introduced to align how NZ will account for its NDC with accounting in the NZ ETS (Office of the Minister of Forestry und Office of the Minister for Climate Change 2019), we assume that the NZ NDC refers to a net reduction. The country has stated that it will rely on international carbon markets to achieve its NDC.

The NZ ETS will be a central instrument for achieving the emission reduction and the 2020 Amendment Act introduced several changes to improve its effectiveness. The main improvement is the introduction of a cap, which was planned since the beginning but never implemented. For the 2021 to 2025 period the NZ ETS cap will be at 160 Mt CO_2eq.[35] (ICAP 2020). Other important changes are the implementation of auctioning, the slow phase-out of free industry allocations and an increase in the fixed price option (from 25 NZ$ to 35 NZ$).

Forestry is a central component of NZ's efforts to achieve its GHG emission reduction targets. The recent reform of the NZ ETS aims to incentivise afforestation. The introduction of averaging accounting is expected to provide ETS participants with post-1989 standard forest with a larger number of NZUs without facing the same unit liability at the time of harvest as with stock-change accounting (Cortés Acosta et al. 2020). Depending on the final decision regarding age bands, the new settings could also create incentives for forest owners to extend the rotation periods for the second and subsequent rotations, further increasing carbon stocks. The new permanent forestry activity is also expected to incentivise conservation of carbon stocks, because it restricts harvesting and has lower administrative barriers. Also, it can potentially deliver other environmental benefits. Thus, the planned changes are expected to deliver additional removals from the forestry sector. The NZ ETS has strong institutional arrangements in place to ensure robust monitoring, reporting, and accounting. It also includes penalties, i.e. for not providing emission returns, which were further strengthened with the 2020 Amendment Act. However, the system for measuring and keeping track of forest carbon stocks is complex and resource intensive.

In the past, the NZ ETS has proven to be ineffective for reducing the country's emissions. This is partly because many key features, like the cap, were not implemented. The ETS was designed to function in the context of the Kyoto Protocol, which led to a surplus of units, especially ERUs. Other features that contributed to an oversupply were free allocations to industry and price moderation measures. Moreover, biogenic methane emissions are not subject to a price signal from the NZ ETS. The agricultural sector is part of the NZ ETS, but only has reporting obligations.

[34] See section 192B of the Climate Change Response (Emissions Trading Reform) Amendment Act 2020.
[35] The provisional emissions budget for 2022 to 2025 is 354 Mt CO_2eq.

The recent amendments have the potential to improve the effectiveness of the ETS. Planned changes for the representation of the forestry sector aim to increase participation and incentivise improved management and afforestation, eventually this could impact the supply demand balance of the NZ ETS. Increased forestry carbon removals might in turn reduce the need for decarbonising other sectors. Under future climate change, NZ may also face challenges regarding permanence of land-based mitigation. Especially non-native plantations, like *Pinus radiata*, are prone to fire (Morton 2021). While such reversals could be considered natural disturbances and excluded from accounting, effects on the atmosphere could be detrimental.

4 Synthesis

4.1 The importance of the land-use sector for achieving the goals of the Paris Agreement

The land-use sector plays a critical role for achieving the goals of the Paris Agreement. First, it can provide for natural carbon removals by sinks and thus help to balance in the long-term remaining emissions that cannot be avoided to achieve net-zero targets. Second, the sector can provide biomass that may be used as fuel, feedstock or material to reduce emissions in other sectors. The sector can, however, also be a source of emissions, in particular as a result of deforestation or drainage of wetlands. Moreover, due to natural processes there is a high volatility of both removals and emissions and carbon stocks are vulnerable to natural disturbances and climate change.

The land-use sector provides multiple ecosystem services and is therefore subject to different, often opposing policy regimes. In integrating the land-use sector in climate policy, a key consideration for finding the necessary political support is establishing environmental and social safeguards to minimise trade-offs and considering co-benefits in decision making.

To date, emission reductions and removals in the land-use sector have been incentivised through non-market-based approaches, e.g., in forest-rich tropical countries, in particular through official development assistance (ODA) and the Warsaw Framework for REDD+. Over the last years, however, there is enhanced interest in using market-based approaches to incentivize emission reductions and removals from the sector. This interest arises as policymakers and stakeholders realise the importance of achieving net removals for stabilising atmospheric GHG concentrations and achieving the long-term goals of the Paris Agreement.

4.2 Opportunities and challenges of using carbon market mechanisms for the land-use sector

The inclusion of land-use activities in carbon market approaches has been discussed controversially for more than two decades. The main debate relates to whether and how the particular challenges of the sector can be appropriately addressed in order to preserve environmental integrity and not delay the required process of decarbonisation of other sectors. However, there have also been concerns about social and environmental impacts of land-use activities, in particular in relation to indigenous people and local communities, trade-offs for other ecosystem services, and whether 'cheap' carbon credits from the land-use sector may 'flood' the market. Some researchers and stakeholders have also questioned whether emission reductions from the land-use sector should be used at all to offset emissions from fossil fuel combustion or have called for separate targets and accounting regimes for the land-use sector. Different perceptions of these opportunities and risks lead to different views on whether carbon market approaches should be used to incentivise emission reductions and removals from the land-use sector, and if yes, for which type of activities they should be used and what approaches are best suited to address the risks.

Recently, this debate has gained new momentum, for several reasons:

- First, as more and more companies adopt net-zero emission targets, demand for voluntary offsetting is growing and certificates from the land-use sector are playing an increasing role in the voluntary market. These certificates are often derived from projects which are labelled as nature-based solutions, but which not always fulfil the requirements according to the

IUCN NbS definition, which e.g., requires for a net-positive effect for biodiversity. There is thus an increased willingness to pay for emission reductions and removals in the land-use sector and carbon markets seem to offer an opportunity for additional investments in the sector.

- Second, there is an increased awareness of the need to enhance removals in order to achieve net zero emissions and some stakeholders prioritise enhancing removals over reducing fossil fuel emissions.
- Third, this debate re-emerges at a time when efforts are underway to generally strengthen the integrity of carbon market approaches. Two existing cap-and-trade approaches for the land-use sector - the NZ ETS and the EU LULUCF Regulation - have been strengthened over time. Similarly, various stakeholders pursue efforts to address environmental integrity concerns related to carbon credits. Some carbon crediting mechanisms have narrowed their scope and excluded activities for which additionality is unlikely or for which the quantification of emission reductions or removals is too uncertain. Several initiatives aim to establish minimum quality requirements for carbon credits. For example, Mark Carney, UN Special Envoy for Climate Action, initiated the 'Task force for scaling the voluntary carbon market'. Part of the work includes establishing minimum quality requirements for carbon credits, referred to as Core Carbon Principles (CCPs). Other organisations establish quality criteria or gradings of carbon credits. Overall, there is widespread consensus that the quality of carbon credits needs to increase if the market ought to have a future. A key question is therefore how well quality concerns, which are also observed in other sectors, can be addressed for the land-use sector. Key considerations include, for example, limiting the use of carbon market approaches to those types of land-use mitigation activities for which environmental integrity concerns are more manageable, or by requiring that monitoring and compensation for reversals takes place for sufficiently long time periods.

4.3 Carbon crediting mechanisms

The integration of land-use activities into carbon crediting mechanisms remains controversial. A general conclusion on whether including land-use activities in carbon markets constitutes a risk for environmental integrity is not possible. Key guiding questions for a differentiated assessment of the risk need to consider the type of activity and its scale and how potential risks can be appropriately addressed. In assessing these risks, the report looks at the land-use sector in the same way as at any other sector, as indeed many risks do not uniquely apply to land-use activities.

With regard to crediting approaches, we find that some environmental integrity risks differ substantially among different types of activities, while others apply uniquely to all land-use activities. Some risks seem also more material than others. In our assessment, risks related to additionality, baselines and leakage vary considerably among different types of activities (see Table 6):

- **Additionality** assessments need to establish whether the crediting mechanism is the decisive factor for the implementation of the activity. Additionality is better ensured where a single intervention is undertaken and where the observed results can be clearly attributed to that intervention. Determining causality between a mitigation activity and emission reductions and removals in the land use sector is particularly challenging, because national and sub-national policies strongly influence land-use decisions, and land-use change is driven by multiple direct and indirect social and economic drivers. This is especially true for activities avoiding GHG emissions (reduced emissions from deforestation and forest degradation and wetland management). This is because it seems difficult, if not impossible, to establish a causality between the mitigation activities pursued and the observed results in terms of emission reductions and removals. Similar challenges are also observed in other sectors. Additionality can be reasonably assessed for some other specific land-use activities, in particular afforestation and reforestation as well as wetland restoration. The likelihood of additionality of these activities depends considerably on whether they generate financial benefits other than from carbon credits.

- **Baselines** represent the level of emissions or removals against which actual emissions or removals are compared to in order to determine the emission reductions or removals resulting from an activity. For some activities, such as reducing deforestation or forest degradation, the uncertainty of the baseline can be significantly larger than the envisaged emission reductions. For other activities, such as afforestation and reforestation, uncertainty is relatively low. If baseline emissions are overestimated, environmental integrity is undermined. If they are underestimated, harm to the environment might be limited but overall acceptability of activities and the potential for funding can be reduced.

- **Leakage** effects need to be identified, mitigated to the degree possible, quantified and finally included in determining total emission reductions or removals. Besides leakage of emissions that is more commonly addressed, also ecological leakage and spillover effects should be included when assessing leakage risks. Wherever risks of global leakage occur, activities should be excluded from crediting. The risk of leakage depends partly on the type of activity (e.g., wetland restoration leading to ecological leakage) but even more on the activity design, scale and underlying drivers. Default leakage approaches for any type of activity ignore such differences and cause more leakage by poor activity design or implementation. Low-risk activities are those to be implemented on abandoned land with no ongoing agricultural use and for cases where the displaced activity is banned on land potentially affected by leakage. This applies more often to afforestation and reforestation activities than activities avoiding GHG emissions that are usually caused by economic activities on the targeted area that need to be reduced or ceased for achieving reductions in GHG emissions.

These differences suggest that some type of land-use activities may be better suited for crediting than others. This is, however, not a unique feature of the land-use sector, as similar challenges are observed in other sectors. Indeed, many activities in other sectors were rejected for crediting under existing carbon crediting mechanisms, due to similar concerns (e.g., avoided fossil fuel switch or avoiding fires from waste coal piles). Applying the same standard to the land-use sector as to any other sectors suggests that some activities, such as avoiding deforestation,, may not be well suited for crediting as the underlying issues are difficult or impossible to address. This is due to the high uncertainties associated with determining a credible baseline for attributing activities to monitored changes in GHG emissions. This finding calls for alternative approaches for addressing especially the situation of High Forest, Low Deforestation (HFLD) countries.

There are also risks that apply to all land-use activities, in particular **addressing non-permanence.** Reversals are associated with carbon pools. The susceptibility of a specific carbon pool for reversal depends on the underlying processes how carbon is stored and in which form it is fixed, as well as the natural and human-induced drivers underlying potential losses at a later stage. The non-permanence risk depends also on the nature of the mitigation activity: avoided deforestation and degradation as a mitigation activity need to be permanently sustained in order not to revert to baseline scenario levels. Similarly, afforestation and reforestation activities can be subject to reversal of stored carbon if natural or human-caused drivers for reservoir depletion are not adequately addressed (e.g., through adaptation measures to increase ecosystem resilience). Efforts for stabilising atmospheric GHG concentration should not rely on potentially non-permanent emission reductions to offset permanent emissions. This leads to the conclusion that avoiding emissions is better for environmental integrity than removing carbon with considerable risks for non-permanence. However, for land-use activities the risk of non-permanence is of similar relevance for any activity.

Regarding the risk of **double counting**, most issues are common to all sectors. Some are specific to land-use activities but can be addressed rather easily. This includes ensuring unique rights to emission reductions and using nested accounting approaches to avoid double issuance between projects and jurisdictional approaches.

Safeguards are essential to minimise potential social and environmental risks occurring when activities are being implemented under carbon crediting mechanisms. This applies in particular to activities in the land use sector where risks cannot be avoided completely but need to be minimised. **Co-benefits** are important but their practical relevance for carbon crediting mechanisms is limited for two reasons. 1) They are very context-specific and therefore hard to standardise; 2) They are not meant to be the decisive factor for implementing an activity. However, co-benefits are an important element for activities in the land-use sector as a means for increasing acceptance.

Monitoring forms a crucial element of carbon crediting as it is the main tool for tracking progress of an activity but often also a prerequisite for demonstrating additionality, determining adequate baselines, identifying and compensating reversals, measuring and addressing leakage, and identifying and tracking co-benefits. While biomass pools can be monitored with high accuracy, challenges still exist for accurate soil carbon estimates. However, global data, modelling and remote sensing data can help to increase accuracy and consistency. There can be a discrepancy between different levels of monitoring, e.g., activity-based reporting and accounting under REDD+ and carbon crediting and land-based reporting applying specific land-use categories in GHG inventories under UNFCCC. To increase consistency, any credits to be transferred need to correspond to emissions and removals included in national emissions inventories and be included under a country's NDC. Otherwise the host countries may not be able to use achieved emission reductions or removals for achieving their NDC targets.

4.4 Cap-and-trade mechanisms

The inclusion of the land-use sector in cap-and-trade programmes can be a good alternative for exposing the sector to a carbon price with the view to incentivising further emission reductions or removals. This holds in particular for the vision of achieving net-zero emissions.

However, an appropriate set-up of such systems is critical to avoid that removals that occur anyway are rewarded and used to offset emissions in other sectors. If the sector is expected to be a net sink under BAU scenarios, inclusion of the sector in ETSs or other cap-and-trade systems would lower the overall ambition of the system (Böttcher et al. 2021). This does even hold if the net sink declines at a rate lower than the average overall emission reduction target. In case the net sink declines faster or the sector is expected to become a net source, the inclusion of the sector means an increased ambition level for other sectors.

To avoid a reduction of the level of ambition, the targets for the land-use sector and other sectors should be separate. This would imply that MS need to achieve both, an emission reduction target and a sink enhancement/land-use net sink target. A minimum of flexibility can be allowed, as currently provided by the EU LULUCF Regulation, to help MS achieve their targets.

The land-use sector target, in theory, could be addressed by setting a negative target, i.e. an obligation for all forest holders to surrender units while having zero allocation. Sufficient knowledge about mitigation potentials and their cost-effective implementation is required to determine a net sink target. A quantitative CO_2 target could be accompanied by quantitative targets using non-GHG metrics, e.g., targets for forest restoration or protection area (Böttcher et al. 2021).

A crucial element for ensuring environmental integrity of including the land-use sector in cap-and-trade systems are well designed accounting rules. Current rules applied under the EU LULUCF Regulation differentiate between different activities (e.g., afforestation gross-net accounting, managed cropland net-net accounting, managed forest accounting against a projected reference level). Accounting rules involving projections have proven to be intransparent and therefore difficult to review and reconcile. Accounting land use under cap-and-trade mechanisms using a net-net approach can significantly increase transparency if periods for establishing the reference are close to the accounting period.

Accounting under cap-and-trade systems should be based on land areas and not activities. Moreover, it should include all relevant land-use categories of a country. This ensures a more complete coverage of lands and avoids leakage within land-use categories. Such an accounting approach allows also for comparison and consistency checks with independent global data, e.g., remote sensing information.

4.5 Overall conclusions

Including land-use activities into carbon market mechanisms under the PA raises particular environmental integrity challenges. In considering the role of the sector, key questions are for which type and scale of activities environmental integrity risks are high, and, whether and how these risks can be appropriately addressed.

Table 6 provides an overview of the different environmental integrity risks and whether and how they can be addressed in the context of **crediting mechanisms**. Some environmental integrity risks uniquely apply to all land-use activities, while others differ substantially among different types of activities.

Table 6: Environmental integrity risks for different types of land-use activities and whether and how they can be addressed with current approaches

<table>
<tr><th></th><th>Afforestation and reforestation</th><th>Reduced deforestation or forest degradation</th><th>Improved forest management</th><th>Wetland management</th></tr>
<tr><td>Mitigation type</td><td>Increasing carbon removals</td><td>Avoiding GHG emissions</td><td>Increasing carbon removals</td><td>Increasing carbon removals and/or avoiding GHG emissions</td></tr>
<tr><td>Assessing additionality</td><td>Can be assessed</td><td>Difficult to assess</td><td>Difficult to assess</td><td>Wetland restoration: Can be assessed
Wetland preservation: Difficult to assess</td></tr>
<tr><td>Addressing non-permanence</td><td colspan="4">• Cannot be ensured - risks can only be mitigated;
• Activities with high non-permanence risks should be excluded from crediting;
• Appropriate activity design, responsibility of project owners to monitor and compensate for reversals over long time horizons, coupled with sufficiently capitalised and diversified pooled buffer reserves, are best suited to reduce reversal risks.</td></tr>
<tr><td>Determining baselines</td><td>Can be determined, as uncertainty of future developments is limited</td><td colspan="2">Difficult to determine as it involves considerable uncertainty about future developments</td><td>Wetland restoration: Can be determined
Wetland preservation: Difficult to determine due to uncertainties</td></tr>
<tr><td rowspan="2">Addressing leakage</td><td>Depends on design of activity, e.g., status of land to be afforested</td><td>Depends on design of activity, e.g., deforestation drivers to be addressed</td><td>Depends on design of activity, e.g., forest products affected by activity</td><td>Depends on design of activity, e.g., alternative land uses considered</td></tr>
<tr><td colspan="4">• Increasing the boundaries of land-use activities from projects to jurisdictional scale can avoid direct leakage within the jurisdiction;
• Activities causing global leakage should generally be excluded from crediting.</td></tr>
<tr><td>Effective monitoring</td><td colspan="4">• Can effectively be done;
• Biomass pools can be monitored with higher accuracy than soil carbon pools;
• Global data and remote sensing can help to increase accuracy and consistency;
• Consistency between lower level activities and national level reporting can be challenging.</td></tr>
<tr><td>Avoiding double counting</td><td colspan="4">• Can be avoided;
• Provisions to ensure unique claims to carbon stored in the land are important;
• ‘Nested’ accounting can avoid double issuance between jurisdictional approaches and crediting at project level.</td></tr>
<tr><td>Considering safeguards and co-benefits</td><td colspan="4">• Can in general be considered;
• Risks and co-benefits are very context-specific: Land-use activities can pose particular risks but also considerable opportunities regarding adaptation, biodiversity protection and ecosystem restauration.</td></tr>
</table>

Source: Own compilation.

Among the environmental integrity risks applicable to all land-use-activities, perhaps the most important risk is **non-permanence**. In contrast to most other mitigation measures, the permanence of emission reductions or removals in the land-use sector cannot be ensured, but reversal risks can only be mitigated. If the goal is to stabilise GHG concentrations in the long term, the degree to which measures in the land-use sector are used to enable continued GHG emissions from fossil fuels, which do not face any material non-permanence risks, becomes questionable. If land-use activities are pursued under crediting mechanisms, it is critical to appropriately manage reversal risks. First, carbon crediting programmes should refrain from crediting activities where reversal risks are high, such as for commercial plantations. Second, it is critical that the owners of the mitigation activity have incentives to reduce reversal risks. This can be best achieved by establishing requirements or incentives to appropriately design and maintain land-use activities and by requiring the activity owners to monitor and compensate for any reversals. Monitoring and compensation should be undertaken for sufficiently long time periods, such as 100 years, in order to provide incentives for robust activity design and to appropriately 'internalise' the cost of reversals. Sufficiently capitalised pooled buffer reserves or insurances should complement these approaches to address reversals caused by catastrophic events or situations where activity proponents are unable to compensate, e.g., due to bankruptcy.

Double counting of emission reductions and removals is another risk to all land-use activities as well as activities in other sectors. Two aspects are of particular importance to the land-use sector: potential competing claims on the carbon stored in the land and the potential overlap of action at the jurisdictional and project level. These risks can be robustly addressed if carbon crediting programmes have provisions in place to ensure unique claims and pursue 'nested' accounting approaches to prevent double issuance of units due to overlap between crediting at jurisdictional and project level.

Some environmental integrity risks, in particular assessing **additionality**, establishing **baselines**, and preventing **leakage**, differ substantially among different types of activities:

- For **afforestation and reforestation activities**, additionality can be assessed with a reasonable degree of confidence, using the common tools applied for assessing additionality. Moreover, it can reliably be determined how much carbon has been absorbed. Leakage risks can be reasonably mitigated if the forest is established on abandoned land or if the project design ensures that no shift in services or products occurs.
- For **avoiding deforestation and forest degradation** activities, assessing additionality, establishing baselines and addressing leakage are major challenges that are difficult to resolve. Demonstrating additionality is difficult or even impossible, as observed changes in carbon stocks can be caused by multiple reasons, with the crediting mitigation activity being only one of them. Establishing a baseline scenario for the rate of future deforestation is associated with considerable uncertainties. And lastly, deforestation is strongly driven by demand for global agricultural commodities or services, which is beyond the control of activities and may induce leakage.
- For **improved forest management activities**, assessing additionality and establishing baselines are similarly challenging as for avoided deforestation as it requires approaches for accurate assessments that are data demanding and tend to lack transparency (e.g., Forest

Reference Levels). Whether leakage can be addressed depends on activity design, e.g., the type of products affected by the activity.

- For **wetland management** activities, the risks differ between wetland restoration and wetland preservation. While additionality is more easily assessed for wetland restoration, similarly to afforestation and reforestation, additionality of wetland preservation is difficult or impossible to prove. As for avoided deforestation, baselines for wetland preservation are associated with high uncertainties. Like for other activities, approaches for addressing leakage need to consider the activity design.

Given the diverging risks and possibilities to address them, policymakers should carefully consider which types of activities should be pursued under crediting approaches. Among the activities analysed in this report, avoiding deforestation and preserving wetlands pose the highest environmental integrity risks. In other sectors, similar activities, such as avoiding fuel switching, have been excluded from crediting due to similar uncertainties in making assumptions about future developments, such as international fuel prices, in assessing additionality and determining baselines. In the light of the concerns with regard to the quality of some carbon credits and the various efforts underway to enhance quality, a a practical policy approach might be restricting crediting mechanisms to activities with high likelihood of additionality and thus baselines can be estimated with reasonable certainty - irrespective of the sector where the mitigation activities are implemented.

Cap-and-trade mechanisms avoid some of the challenges that carbon crediting approaches bring about. They do not require assessing counterfactual scenarios regarding the additionality and baselines of specific mitigation activities. They also avoid any leakage within the scope of the system. The main challenge of cap-and-trade mechanisms is establishing the cap sufficiently below business-as-usual emissions from the regulated entities. Initial over-allocation of allowances in ETSs has been a major challenge in nearly all established ETSs.

In principle, capping emissions from the land-use sector in line with overarching mitigation targets, such as under the EU LULUCF Regulation, can be a viable alternative to crediting approaches. If designed well, it could expose the sector to a carbon price and thereby create incentives for enhancing carbon stocks. This is particularly important for achieving net zero emissions over the next decades.

However, several aspects need careful consideration. First, non-permanence needs to be addressed. This means that a land type or activity type, once included, should remain included. It also means that accounting should encompass all years, and not only single target years, in order to ensure that all reversals are accounted for, regardless of when they occur. A second important challenge is that the land-use sector is currently a net sink in most countries. If under such circumstances the sector is included under a cap-and-trade mechanism that covers also other sectors, this implies that entities in the land-use sector could sell allowances to entities from other sectors, without enhancing any removals. This could undermine the overall mitigation achieved through the cap-and-trade system. Third, using allowances from potentially non-permanent emission reductions or removals from the land-use sector to enable more permanent emissions to occur, such as from fossil fuel combustion, can undermine the long-term ability to stabilise CO_2 concentrations in the atmosphere, given that the biosphere and oceans have limited capacity to absorb CO_2 and that biomass and soil carbon stocks are subject to natural disturbances under a changing climate.

Overall, the possible inclusion of land-use sector activities into carbon market mechanisms needs to follow a long-term perspective. This holds in particular for the transition phase towards net zero emissions, in which the pressure for permanent emission reductions should not be reduced by the inclusion of the land-use sector in crediting or cap-and-trade systems. An early reliance on potentially non-permanent removals from the land-use sector for offsetting permanent emissions bears the danger of lock-in into systems with remaining emission levels too high for achieving the PA goals.

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