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Lessons Learned from the Kyoto Mechanisms for the Article 6.4 Mechanism

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Abstract

This report summarizes key lessons learned from the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI) for the new Article 6.4 mechanism of the Paris Agreement. The report first provides an overview of the issuance and use of carbon credits under these mechanisms. This is followed by an assessment of what elements of the existing mechanisms could be transferred to the Article 6.4 mechanism. Some provisions from the CDM can be transferred with only minor adjustments as they are the result of substantial refinement and overhaul. This includes the rules and regulations for the project cycle, accreditation of auditors, validation and verification, provisions to ensure transparency and the governance structure. However, in other areas, Article 6.4 rules should be strengthened compared to the CDM and JI, mainly with regard to demonstrating additionality, quantifying emission reductions, addressing non-permanence and social and environmental safeguards. Based on the experiences with CDM and JI, we recommend that mitigation activities under the Article 6.4 mechanism should be considered 'high-hanging fruits', enhance ambition, have a high likelihood of additionality, provide co-benefits for other sustainable development targets, and ensure that emission reductions can be reasonably attributable to the mitigation activity.

Kurzbeschreibung

Dieser Bericht fasst die wichtigsten Erkenntnisse aus den projektbasierten Mechanismen des Kyoto-Protokolls zusammen, dem Clean Development Mechanism (CDM) und Joint Implementation (JI), und leitet daraus Empfehlungen für den neuen Mechanismus nach Artikel 6.4 des Pariser Übereinkommens ab. Der Bericht gibt zunächst einen Überblick über die Ausgabe und Verwendung von Emissionsgutschriften im Rahmen dieser Mechanismen. Anschließend analysieren wir, welche Elemente der bestehenden Mechanismen auf den Artikel 6.4 Mechanismus übertragen werden könnten. Einige Regelungen aus dem CDM können mit nur geringfügigen Anpassungen übernommen werden, da sie das Ergebnis eines langen Optimierungsprozesses sind. Dazu gehören die Regeln und Vorschriften für den Projektzyklus, die Akkreditierung von Prüfern, die Validierung und Verifizierung, die Bestimmungen zur Transparenz und Governance. In anderen Bereichen sollten die Regelungen von Artikel 6.4 im Vergleich zum CDM und zur JI erweitert werden, vor allem im Bereich der Zusätzlichkeit, der Quantifizierung der Emissionsreduktionen, der Nicht-Dauerhaftigkeit sowie den Regelungen zu sozialen und ökologischen Schutzmaßnahmen. Auf der Grundlage der Erfahrungen mit CDM und JI empfehlen wir, dass primär die Minderungsmaßnahmen im Rahmen des Artikel 6.4 Mechanismus durchgeführt werden sollen, die hohe Hürden bei der Implementierung haben. Weiterhin sollten sie die Ambitionen des Gastlandes steigern, eine hohe Wahrscheinlichkeit der Zusätzlichkeit aufweisen, Zusatznutzen für andere Ziele der nachhaltigen Entwicklung erzeugen, und es sollte sichergestellt werden, dass die Emissionsreduktionen auf die Maßnahme zurückgeführt werden können.

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A6.4ER	Article 6.4 emission reduction
AAU	Assigned amount unit
AIE	Accredited Independent Entity
BAU	Business-as-usual
CCS	Carbon capture and storage
CCU	Carbon capture and utilization
CDM	Clean Development Mechanism
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CPA-DD	Component project activity design document
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CPA	Component project activity
DEHSt	German Emissions Trading Authority
DNA	Designated National Authority
DNF	Designated National Focal
DOE	Designated Operational Entity
ERU	Emission Reduction Unit
ETS	Emissions trading system
EU	European Union
EU ETS	Emissions Trading System of the European Union
FPIC	Free prior informed consent
GHG	Greenhouse gas
HCFC-22	Chlorodifluoromethane
HFC-23	Fluoroform
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal rate of return
JI	Joint Implementation
JISC	Joint Implementation Supervisory Committee
KP1	First commitment period of the Kyoto Protocol
KP2	Second commitment period of the Kyoto Protocol
lCER	Long-term certified emission reductions
LDC	Least developed country
LEDS	Low emissions development strategy
N_2O	Nitrous oxide

NDC	Nationally determined contribution
OMGE	Overall mitigation in global emissions
PDD	Project design document
PoA	Programme of Activities
RMP	Rules, modalities and procedures
SDG	Sustainable Development Goal
SEF	Standard Electronic Format
SF_6	Sulphur hexafluoride
SoP	Share of proceeds
tCER	Temporary certified emission reduction
UNEP-CCC	Copenhagen Climate Centre of the United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard

Summary

Introduction

The carbon crediting mechanisms under the Kyoto Protocol, the Clean Development Mechanism (CDM) and Joint Implementation (JI), are in the process of being phased out. The new market-based mechanism under Article 6.4 of the Paris Agreement will replace the CDM and JI, providing an opportunity to build upon existing structures and to draw on the lessons learned from these mechanisms. For the new mechanism, the stakes are set high as it not only aims to achieve additional emission reductions and contribute to sustainable development but also includes several new principles and objectives, in particular raising ambition over time. To achieve its objectives, the Article 6.4 mechanism will need to significantly differ from its predecessors. It needs new approaches for demonstrating additionality, setting baselines, avoiding double counting, addressing non-permanence, and ensuring sustainable development.

The Article 6.4 Supervisory Body is tasked with developing the detailed rules of the mechanism and approving mitigation activities. This report intends to support that work by providing an overview of how the CDM and JI have been used, discussing what lessons have been learned, and making suggestions as to what type of mitigation activities may be suitable for the Article 6.4 mechanism. The report is part of the project "Evaluation of International Emission Reduction Projects". As part of this project, a separate paper advances the analysis in this report by looking at how two CDM methodologies could transition to the Article 6.4 mechanism.

Use of the Kyoto mechanisms in numbers

The CDM has been the largest crediting mechanisms to date. As of 4 October 2022, about 2.3 billion certified emission reductions (CERs) had been issued from 8,218 projects. The first CERs were issued in 2005. The issuance of CERs peaked in 2012, when 339 million CERs were issued, and declined rapidly thereafter, following a price crash due to a strong imbalance between supply and demand.

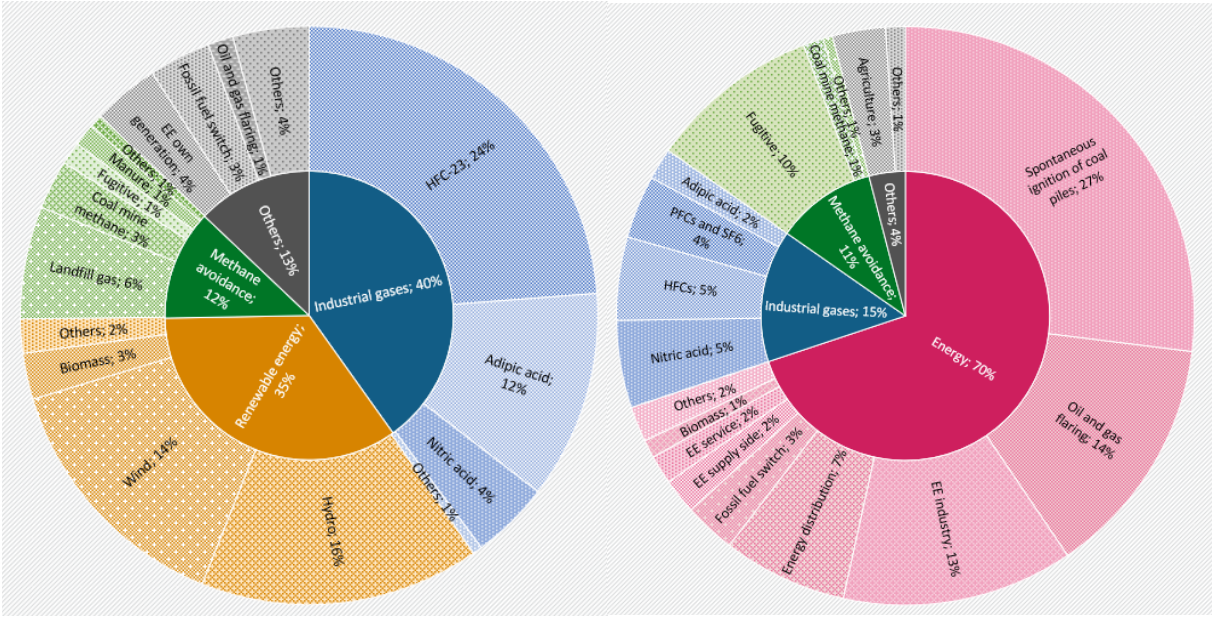
Under JI, 864 million emission reduction units (ERUs) were issued from 761 projects. Issuances under JI started in 2009. The following years saw a constant surge of annual issuances until they reached their peak in 2013 with a volume of 443 million ERUs, due to a surge in projects that significantly overestimated emission reductions. As the Doha Amendment for the second commitment period of the Kyoto Protocol from 2013 to 2020 only entered into force in late 2020, JI was never implemented in the second commitment period and ended in 2014.

Under the Kyoto Protocol, carbon credits were issued from a large variety of projects, though some project types clearly dominated the market. Figure S1 provides an overview of the share of CERs and ERUs issued from different project types. Under the CDM, projects abating industrial waste gases make up the largest share. The 19 registered projects abating fluoroform (HFC-23) alone account for nearly a quarter of CER issuances, and the four registered adipic acid projects make up 12% of all issuances. This is followed by renewable energy projects, where hydro and wind projects rank two and three among the project types with the largest CER issuances. Activities avoiding methane emissions constitute 12% of the overall issuances, with landfill gas projects playing the largest role in this category with 6%.

For JI, the picture is very different from the CDM. Renewable energy did not play a significant role, as it was covered by the EU ETS in EU countries and Russia and Ukraine did not build large capacities of renewable energy plants in this period. Other energy-related projects have a share of 70% of all issuances. The largest portion is made up of projects that avoid the spontaneous ignition of coal piles, a project type for which ERUs are very unlikely to involve actual emission reductions, projects that avoid flaring associated gas in oil and gas production, and energy

efficiency projects in industrial processes. Reducing waste gas emissions in industry accounted for 15% of all issuances and thus also played a significant role, mainly due to four HFC-23 and sulphur hexafluoride (SF_6) abatement projects in Russia. Projects avoiding methane emissions (11% of overall issuances) mainly comprise the repair leaks in natural gas systems.

Figure S1: CDM (left) and JI (right) project types by issuances



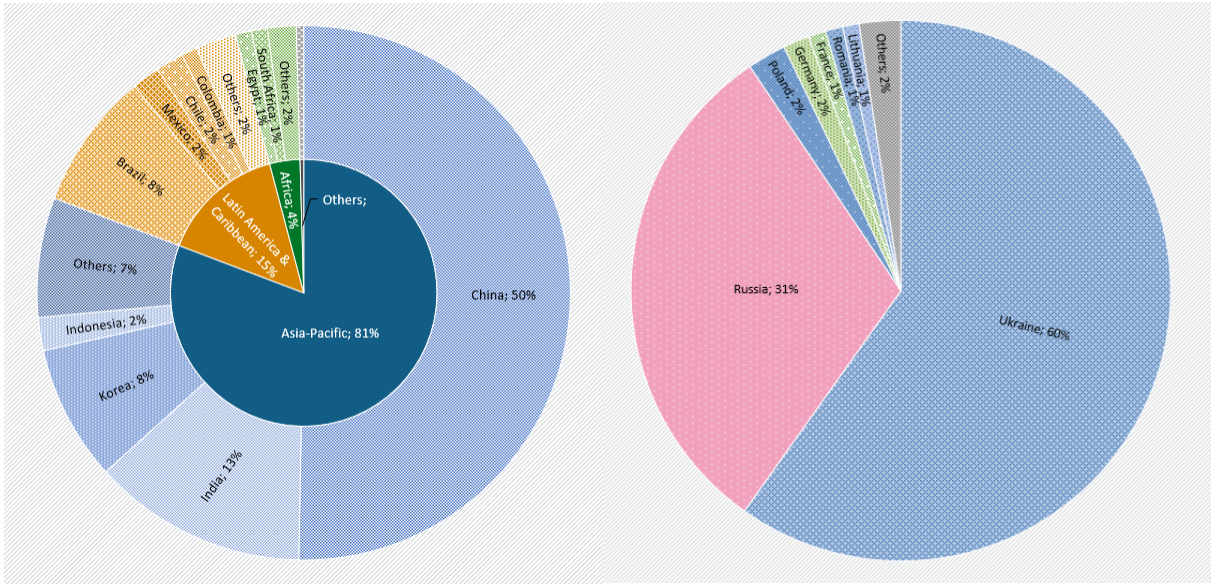
Source: Own illustration based on UNFCCC (2022c) and Fenhann (2022). Deviations from 100% occur due to rounding differences. EE = energy efficiency.

In terms of host countries, the vast majority of CERs were issued in Asia-Pacific. China alone accounts for more than half of all issuances, and India and Korea make up 13% and 8% respectively. With 8% of all issued CERs, Brazil accounts for half of the CERs from Latin America and the Caribbean. Projects in Africa make up only 4% of the issuances.

Compared to the CDM, total issuances under JI are far more concentrated in two countries, Ukraine and Russia, which have a 60% and 31% share of ERU issuances respectively. The remainder is shared by other eastern European countries (Lithuania, Poland, and Romania) and western European countries (Germany and France). The share of issuances from German projects amounts to less than 2%.

Most CERs (46%) and ERUs (63%) have been used in the European Union's Emissions Trading System (EU ETS). Several countries, such as Austria, Japan, Netherlands, Spain, Sweden, or Switzerland, have also purchased CERs or ERUs through national programmes to comply with their Kyoto targets. About 40% of the CERs have not yet been cancelled or retired in the CDM registry or national registries; however, some of these CERs may have already been sold or surrendered in the EU ETS. Similarly, a large amount of ERUs (31%) are still in holding accounts and might never be used. Voluntary cancellations make up about 6% of the use of CERs and 3% of ERUs. These include several different uses, including use for compliance in carbon pricing schemes in developing countries (2.3% of CERs) and use in the voluntary carbon market (1.1% of CERs). In the future, some of the CERs in holding accounts of the CDM registry could be transferred to the Article 6.4 mechanism registry and then be used to achieve NDCs.

Figure S2: Host countries by CER (left) and ERU (right) issuances



Source: Own illustration based on UNFCCC (2022c) and Fenhann (2022). Deviations from 100% due to rounding differences. Korea refers to the Republic of Korea; "Others" in the inner circle comprises projects in Eastern Europe and PoAs in more than one region.

Key lessons from CDM and JI for the Article 6.4 mechanism

Demonstrating **additionality** is crucial for ensuring environmental integrity of carbon crediting mechanism. Under the Kyoto mechanisms, several methods have been used to test for additionality, including prior consideration, regulatory tests, investment analysis, barrier analysis and common practice analysis. Overall, the CDM and JI faced weaknesses in the different tests, such as subjectivity and the presence of loopholes, alongside lack of predictability and clarity.

For the investment and barrier analysis, information asymmetry between project developers on the one hand and validators and the oversight body on the other hand was a major challenge. With regard to the investment analysis, this risk was partially mitigated by introducing more stringent specifications of calculation approaches and default parameters.

Regarding the common practice test, a key challenge is that the test excludes any similar projects registered with the CDM or applying for registration. If the projects registered in the past were not additional, the common practice test will be ineffective because it will show a penetration rate that is too low compared to a real business-as-usual penetration. In addition, it is difficult to define an appropriate comparison group.

Furthermore, a trade-off was noted between environmental integrity and complexity as the level of confidence regarding an activity's additionality increased with the tests' complexity and the associated costs. The CDM Executive Board tried to resolve this conundrum by increasing standardisation of additionality tests and methodologies. Based on these experiences, we recommend the following for the Article 6.4 mechanism:

- A regulatory surplus test to ensure that the mitigation activity is not implemented due to legal requirements. This test should be repeated at appropriate intervals;
- Neither a barrier analysis, nor a common practice test should constitute the sole additionality test;

- For the investment analysis, specific guidance and conservative default parameters should be provided;
- Standardisation will also be a crucial strategy in the context of the Article 6.4 mechanism to keep complexity and associated transaction costs manageable. Particularly negative lists, as already implemented by voluntary carbon market programs, could be used to weed out project categories that are very unlikely to be additional.

Robust **quantification of emission reductions** is another key prerequisite for ensuring environmental integrity. The CDM has approved about 200 methodologies, in addition to methodological tools for aspects covered in multiple methodologies. A key principle under the CDM is that emission reductions or removals must be estimated in a conservative manner. This principle has considerably evolved over time, in particular that the degree of conservativeness should depend on the level of uncertainty. While this principle is acknowledged under the CDM, the evaluations of specific methodologies have revealed challenges in applying it in practice, as a number of methodologies are likely to overestimate emission reductions according to independent analysis. Over time, many CDM methodologies were frequently revised and generally improved in terms of usability and environmental integrity.

Under JI, methodological issues with the quantification of emission reductions were a major challenge in Russia and Ukraine. For some project types, the aggregated emissions from JI projects were larger than the actual national emissions reported by these countries. Based on these experiences, we recommend the following for the Article 6.4 mechanism:

- It is important to have international oversight, and thorough review, of methodologies, as the experiences gathered with JI have highlighted;
- Methodologies should be regularly updated, based on the lessons learned from their application and new scientific findings;
- The Article 6.4 mechanism should assess the overall uncertainty of emission reductions in a more systematic manner, ensuring that this captures uncertainty in scenarios, assumptions, models, data and measurements; and
- The Article 6.4 mechanism should only approve methodologies for project types where the challenges of attributing emission reductions can be appropriately addressed, e.g. by requiring minimum thresholds for the likelihood that emission reductions actually occurred in the light of the overall uncertainty and by requiring that emission reductions are quantifiable.

Double counting of emission reductions can occur in different ways. While CDM and JI largely avoided double counting between countries under the Kyoto Protocol, some forms of double counting were only partially addressed. The CDM successfully avoided double registrations of the same project under the CDM but did not have rules to avoid double registration in relation to other carbon crediting programmes. Double issuance due to indirect overlaps between projects was addressed for some project types (e.g. between biofuel producers and consumers) but not for others (e.g. between efficient cookstove projects and forestry projects). The CDM also did not avoid double claiming due to overlap of CDM projects with mandatory domestic mitigation schemes, such as emission trading systems. JI did not have any provisions to avoid these forms of double counting. We recommend that the Article 6.4 mechanism addresses double counting more comprehensively than CDM and JI and does so by introducing provisions for addressing the following:

- Double registration with other carbon crediting programmes, including through procedures for transitioning mitigation activities from one programme to another;
- Double issuance due to overlapping claims between mitigation activities, including mitigation activities registered under other carbon crediting programmes;
- Double claiming with domestic mitigation schemes, such as emission trading systems; and
- Double use of carbon credits, by making it mandatory to clearly specify the purpose and beneficiary of a cancellation of Article 6.4 emission reductions.

Non-permanence risks are relevant for several project types under the CDM: afforestation and reforestation, carbon capture and storage (CCS), and household projects displacing the use of non-renewable biomass (e.g. efficient cookstoves, biodigesters and water purification projects). For afforestation and reforestation projects, the non-permanence risk was addressed through a buyer liability and temporary credits. Buying countries had to replace the carbon credits at the end of the subsequent commitment period under the Kyoto Protocol or in the case of a reversal. This approach relied on there always being a subsequent commitment period. However, as the second and last commitment period of the Kyoto protocol ended in 2020, the institutional arrangements and the technical infrastructure to replace credits will no longer be in place. Unless these are translated into the Paris Agreement monitoring system, reversals will effectively not be compensated for. Moreover, the approach was highly unattractive to buyers, as they were responsible for replacing the credits. For CCS projects, provisions to address non-permanence were similar; they also included the option for a host country liability and required a risk assessment for the geological reservoir. The CDM did not have any provisions to address the risk of non-permanence for household projects displacing the use of non-renewable biomass.

Based on these experiences, we recommend the following for the Article 6.4 mechanism:

- Temporary crediting is generally a valid approach for addressing non-permanence as it most appropriately reflects the temporary nature of emission reductions or removals with reversal risk. If this approach is pursued under the Article 6.4 mechanism, it is important to establish long-lasting institutional arrangements for monitoring and replacement of temporary credits;
- Monitoring and compensation for reversals, including through pooled buffer reserves, is also a valid approach as long as monitoring and compensation are ensured for long time frames and the shares retained in the buffer are high enough to cover reversal risks, also under future climate change;
- For some project types, a non-permanence risk assessment and corresponding provisions to incentivise risk mitigation should be applied, e.g. by requiring that the share of carbon credits that project developers must set aside in pooled buffer reserves depends on the level of non-permanence risk;
- Non-permanence should be addressed for all project types with reversal risks, including for household projects displacing the use of non-renewable biomass.

In the **CDM project cycle**, the pre-registration procedural requirements comprise an early notification of the intent to register the project under the CDM, the approval by the host country, conducting local stakeholder consultation, the development and publication of the project design document (PDD) by the project participants and the validation of the project by a designated operational entity (DOE).

The experiences with project development under the CDM have shown that clear rules and modalities streamline the project cycle and lower the costs of project development. Furthermore, it became clear in the early years of the CDM that especially small-scale projects encountered disproportionally higher transaction costs for the development of project documentation. This resulted in the adoption of simplified rules and procedures for small-scale project activities from 2005 onwards. Based on these experiences, we recommend the following for the Article 6.4 mechanism:

- When developing the procedures of the new mechanism, an emphasis should be put on clear rules that streamline the process and lower the costs of developing projects;
- Simplified rules and a programmatic approach should be introduced for small and micro-scale projects.

Validation and verification are conducted by third-party auditors. Under the CDM, third-party auditors are accredited by the CDM Executive Board following a comprehensive accreditation process. In the case of non-compliance with the requirements, the CDM Executive Board can suspend or even withdraw the accreditation of an auditor, which happened in various cases and led to the improvement of audit quality. Over the years, the CDM Executive Board strengthened the accreditation process and developed a system to better oversee the performance of auditors; this included regular performance monitoring, spot checks and regular surveillance procedures.

In contrast, the validation and verification processes under JI have drawn strong criticism. When conducting audits under host country oversight, auditors were not accountable to the Joint Implementation Supervisory Committee (JISC) or CDM Executive Board, thus their accreditation could not be suspended or withdrawn in the case of malfeasance.

A criticism to both the CDM and the JI auditing process is that auditors are paid by project developers which raises concerns about their impartiality and the lack of incentives to conduct thorough checks. As the CDM standards and processes for the accreditation and monitoring of third-party auditors are well-established, we recommend that these processes be adopted under the Article 6.4 mechanism, with some adjustments. Specifically, we recommend that the Article 6.4 Supervisory Body:

- Introduces a performance monitoring system for auditors, with escalating sanctions in case of low performances, such as additional spot checks;
- Identifies way to address the potential perverse incentives arising if auditors are directly contracted by project participants, for example through a lottery system whereby projects are allocated to auditors by the Supervisory Body and the project participants pay auditors according to a fee schedule established by the Supervisory Body.

Environmental and social impacts of carbon crediting projects on local communities and ecosystems can be positive or negative. Under the CDM, the main measure to address social and environmental impacts is that host countries' Designated National Authorities (DNAs) have to confirm that a project is beneficial for sustainable development. This approach has drawn criticism as there is no oversight and a strong incentive is lacking for host countries to comprehensively address social and environmental impacts. Furthermore, the CDM provisions to address social and environmental concerns have several gaps: an evaluation of social impacts is only required for afforestation or reforestation projects; there are no requirements to monitor adverse impacts beyond the start of the project and no provisions specifying which social and environmental impacts should be considered; and there is no mechanism available for stakeholders to raise grievances after a project begins. The JI mechanism has no substantive

provisions to mitigate negative social and environmental impacts. Generally, the host country determines the form of social and environmental impact assessments and stakeholder consultations.

For the Article 6.4 mechanism to address social and environmental concerns properly, provisions must go further than under the CDM and the JI mechanism. Specifically, we recommend:

- Reporting on sustainable development impacts should be mandatory and include positive as well as negative aspects. After the start of a mitigation activity, continuous monitoring of the impacts is necessary to be able to address negative impacts as they arise;
- Third-party auditors should not only assess whether any environmental and social impact assessments were conducted and whether procedural requirements were fulfilled, but also assess the appropriateness of the content of such assessments;
- Local and global stakeholder consultation should be conducted prior to the decision of the project participants to proceed with the project. It should be mandatory to obtain free prior informed consent (FPIC) from affected indigenous groups. Stakeholders should have the possibility to voice concerns through a grievance mechanism at any time; and
- Finally, there should be specific safeguards that project developers should adhere to when implementing a project.

The **governance** structures of the CDM and JI have three layers: the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) as the main decision-making body for both mechanisms, the CDM Executive Board or the JISC as a supervisory entity, and the host countries. The two latter groups are responsible for decisions regarding the implementation of the mechanisms.

Under Track 1 of the JI, the host country bares the responsibility for establishing rules for the implementation of projects as well as overseeing project development and implementation. This led to criticism regarding the lack of institutional oversight for Track 1 projects, as there were substantial concerns about their environmental integrity.

The CDM is characterized by a high degree of **transparency**. Under the CDM, project design documents (PDDs) were made public together with relevant additional information. Moreover, the decision-making processes are transparent, as detailed information is available on the CDM Executive Board meetings.

This contrasts with the lack of public information under the JI. Under Track 1, public information is patchy and oftentimes lacking central documents, such as PDDs, monitoring reports and verification reports.

As the CDM has a positive track record regarding transparency, we recommend that its provisions be adopted under the Article 6.4 mechanism. Specifically, we recommend:

- Documents to be made publicly available should include all information submitted by mitigation activity proponents to the Supervisory Body, such as requests for registration and issuance with all accompanying information, comments received from local and global stakeholder consultation, the analysis of environmental and social impacts, as well as documents relating to validation and verification.

Suitability of mitigation activities for the Article 6.4 mechanism

Important lessons have been learned from CDM and JI, including on the project portfolio and the rulebook of these mechanisms. This raises the question of which type of mitigation activities are particularly suited for the new mechanism. Based on an analysis of the new rules and the experience with CDM and JI, we identify a number of key issues that should guide the approval of mitigation activities under the Article 6.4 mechanism:

- High-hanging rather than low-hanging fruits: To avoid the risk that host countries sell cheap mitigation options and then face difficulties in achieving their own NDC targets, and to enable the ambition of NDCs to be enhanced over time, it is critical that only those mitigation activities are pursued which are clearly out of reach for host countries.
- Enhancing ambition: Enhancing ambition is a key objective of the Article 6.4 mechanism. The possibility of selling carbon credits could provide perverse incentives for host countries not to enhance the ambition of their NDCs, as this would lower the potential for selling carbon credits. To avoid this, it is important that host countries can use part of the emission reductions achieved through Article 6 to achieve their own NDC. This can be achieved in different ways, including by setting baselines well below the likely business-as-usual (BAU) emissions and in line with the long-term goal of the Paris Agreement, which can be implemented by applying an "ambition coefficient" that declines over time.
- High likelihood of additionality: The likelihood of additionality varies considerably among project types. The Article 6.4 Supervisory Body should ensure a high level of assurance that registered activities are additional. We recommend that the Supervisory Body excludes project types that have a low likelihood of additionality. This approach is also pursued by several carbon crediting programmes in the voluntary carbon market.
- Attributability of calculated emission reductions to the mitigation actions and quantifiability of the emission reductions: To ensure environmental integrity, it is important that the calculated emission reductions are caused by the underlying mitigation actions, and not by exogenous factors that are outside the control of the mitigation activity participants. This key principle may be difficult to ensure for some types of mitigation activities for which the uncertainty in baselines is high and observed changes might be due to exogenous factors (e.g. avoided deforestation). Furthermore, it is important the emission reductions can be robustly quantified. We recommend that activities for which these principles cannot be ensured to a satisfactory level should not be eligible under the Article 6.4 mechanism.
- Synergies with other sustainable development objectives: Mitigation activities should advance the sustainable development of the host country by providing co-benefits for the environment and local communities and have a low risk of adverse social and environmental impacts.
- Long-term climate benefits: To achieve the long-term goals of the Paris Agreement, it is critical that any reversals are limited in size. We therefore recommend that only those mitigation activities that have the ability to store carbon for long periods are allowed under the Article 6.4 mechanism.

Zusammenfassung

Einleitung

Die die projektbasierten Mechanismen des Kyoto-Protokolls, der Clean Development Mechanism (CDM) und der Joint Implementation (JI), laufen derzeit aus. Der neue Marktmechanismus nach Artikel 6.4 des Pariser Abkommens wird den CDM und den JI ersetzen. Dabei ergibt sich die Möglichkeit, auf bestehenden Strukturen aufzubauen und aus den vorangegangenen Mechanismen Lehren zu ziehen. An den neuen Mechanismus gibt es hohe Erwartungen, da er nicht nur zusätzliche Emissionsminderungen erzielen und zur nachhaltigen Entwicklung beitragen soll, sondern auch mehrere neue Grundsätze und Ziele umfasst, insbesondere die Steigerung der Ambitionen im Laufe der Zeit. Um seine Ziele zu erreichen, muss sich der Mechanismus nach Artikel 6.4 deutlich von seinen Vorgängern unterscheiden. Es braucht neue Ansätze, um Zusätzlichkeit nachzuweisen, Baselines zu bestimmen, Doppelzählung zu vermeiden, Nicht-Dauerhaftigkeit zu berücksichtigen und einen Beitrag zur nachhaltigen Entwicklung zu gewährleisten.

Der Artikel 6.4 Supervisory Body hat die Aufgabe, detaillierten Regeln für den Mechanismus zu entwickeln und Minderungsmaßnahmen zuzulassen. Dieser Bericht soll diese Arbeit unterstützen, indem er einen Überblick über die Umsetzung des CDM und die JI gibt und daraus Empfehlungen ableitet. Weiterhin widmet er sich der Frage, welche Arten von Minderungsaktivitäten für den Artikel 6.4-Mechanismus geeignet sein könnten. Der Bericht ist Teil des Projekts "Auswertung Internationaler Klimaschutzprojekte". Im Rahmen dieses Projekts wird in einem weiteren Bericht untersucht, wie zwei CDM-Methoden in den Mechanismus nach Artikel 6.4 überführt werden könnten.

Die Kyoto-Mechanismen in Zahlen

Der CDM war bisher das größte Kohlenstoffmarktprogramm. Bis zum 4. Oktober 2022 wurden etwa 2,3 Milliarden zertifizierte Emissionsreduktionen – Certified Emission Reductions (CERs) – aus 8.218 Projekten ausgegeben, angefangen im Jahr 2005. Die Ausgabe von CERs erreichte im Jahr 2012 mit 339 Millionen CERs ihren Höhepunkt und ging danach nach einem Preisabsturz aufgrund eines großen Überangebots stark zurück.

Unter dem JI wurden 864 Millionen Emission Reduction Units (ERUs) aus 761 Projekten ausgestellt, angefangen im Jahr 2009. In den darauffolgenden Jahren stiegen die jährliche Ausgabe von Emissionsgutschriften kontinuierlich an, bis sie 2013 mit einem Volumen von 443 Millionen ERUs ihren Höhepunkt erreichte. Dieser Anstieg ist auf eine Flut von Projekten zurückzuführen, welche die Emissionsminderungen deutlich überschätzten. Da die Doha-Änderung für die zweite Verpflichtungsperiode des Kyoto-Protokolls von 2013 bis 2020 erst Ende 2020 in Kraft trat, wurde JI in der zweiten Verpflichtungsperiode nie umgesetzt und endete 2014.

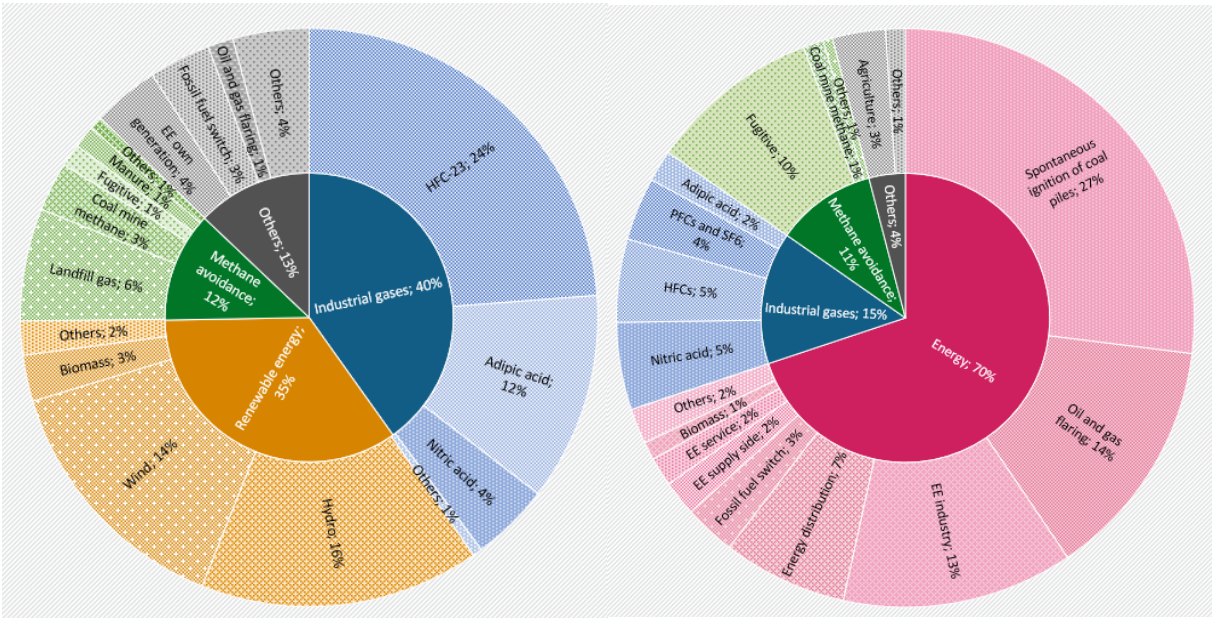
Im Rahmen des Kyoto-Protokolls wurden Emissionsgutschriften für eine Vielzahl von Projekten ausgegeben, wobei einige Projekttypen den Markt eindeutig dominierten. Abbildung 1 gibt einen Überblick über den Anteil der CERs und ERUs nach Projekttyp. Unter dem CDM machen Projekte zur Minderung von Industrieabgas den größten Anteil aus. Ein Viertel der gesamten ausgegebenen Emissionsgutschriften fällt allein auf die 19 registrierten Projekte zur Reduzierung von Fluorform (HFKW-23), und die vier registrierten Adipinsäure-Projekte machen weitere 12 % der Emissionsgutschriften aus. Es folgen Projekte im Bereich der erneuerbaren Energien, wobei Wasser- und Windkraftprojekte auf den Plätzen zwei und drei der Projekttypen mit den meisten ausgegebenen CER liegen. Aktivitäten zur Vermeidung von Methanemissionen

haben einen Anteil von 12 %, wobei Deponiegasprojekte mit 6 % die größte Rolle in dieser Kategorie spielen.

Für JI ergibt sich ein anderes Bild als für den CDM. Erneuerbare Energien spielten keine große Rolle, da sie in den EU-Ländern unter das EU-Emissionshandelssystem fielen und Russland sowie die Ukraine in diesem Zeitraum keine großen Kapazitäten an erneuerbaren Energien hinzubauten. Andere energiebezogene Projekte haben einen Anteil von 70 % an allen ausgegebenen Emissionsgutschriften. Der größte Anteil entfällt auf Projekte, welche die Selbstentzündung von Kohleabraumhalden vermeiden – einem Projekttyp, bei dem es sehr unwahrscheinlich ist, dass ERUs zu tatsächlichen Emissionsreduktionen führen. Es folgen Projekte, die das Abfackeln von Begleitgas in der Gas- und Ölindustrie vermeiden, sowie Energieeffizienzprojekte in industriellen Prozessen.

Die Minderung von Abgasemissionen in der Industrie machte 15 % aller Emissionsgutschriften aus und spielte damit ebenfalls eine wichtige Rolle, vor allem aufgrund von vier Projekten zur Verringerung von HFKW -23 und Schwefelhexafluorid (SF_6) in Russland. Projekte zur Vermeidung von Methanemissionen (11% aller Emissionsgutschriften) umfassen hauptsächlich die Reparatur von Lecks in Erdgassystemen.

Abbildung 1 Projekttypen nach Anzahl der Emissionsausgaben für den CDM (links) und JI (rechts)



Quelle: Eigene Darstellung basierend auf UNFCCC (2022c) und Fenhann (2022). Abweichungen von 100% aufgrund von Rundungen sind möglich. EE = Energieeffizienz.

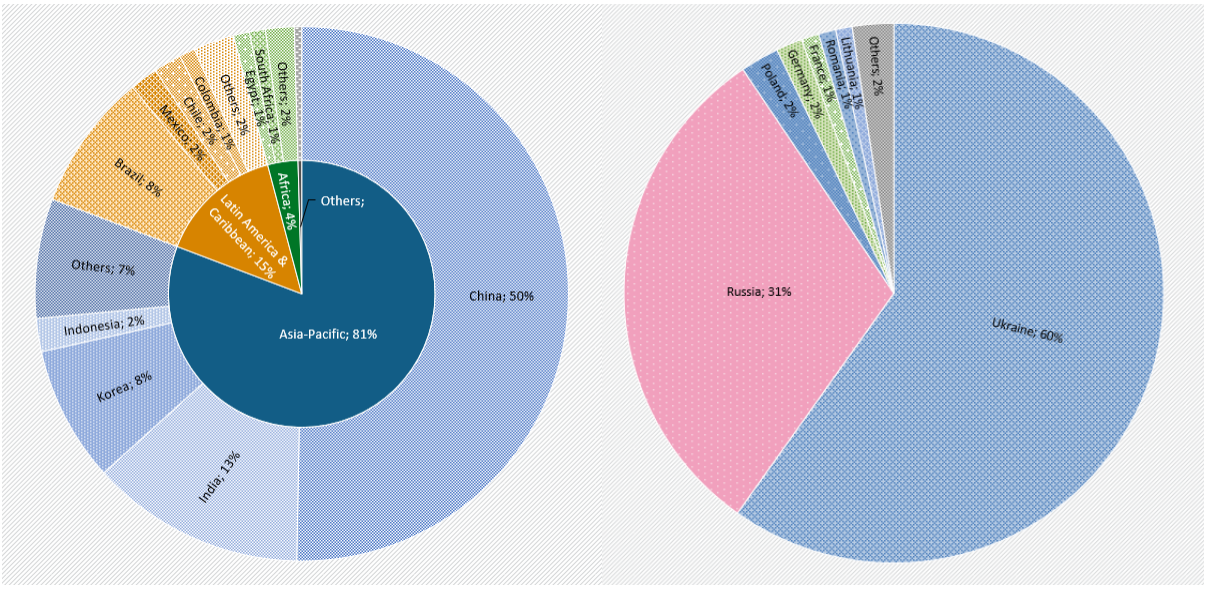
Was die Gastländer betrifft, so wurde die überwiegende Mehrheit der CERs aus Projekten im asiatisch-pazifischen Raum ausgegeben. Auf China allein entfällt mehr als die Hälfte aller ausgegebenen Emissionsgutschriften, auf Indien und Korea jeweils 13 % und 8 %. Mit 8 % aller ausgegebenen CERs wurden die Hälfte der Emissionsgutschriften aus Lateinamerika und der Karibik für Projekte in Brasilien ausgegeben. Auf Projekte in Afrika entfallen nur 4 % der ausgegeben CERs.

Im Vergleich zum CDM sind ist die Ausgabe von ERUs stark auf zwei Länder konzentriert: die Ukraine und Russland, die jeweils einen Anteil von 60 % und 31 % ausmachen. Der Rest entfällt auf andere osteuropäische Länder (Litauen, Polen und Rumänien) und westeuropäische Länder

(Deutschland und Frankreich). Der Anteil der Ausgaben an deutsche Projekte beläuft sich auf weniger als 2 %.

Die meisten CERs (46 %) und ERUs (63 %) wurden im Rahmen des EU-Emissionshandelssystems (EU ETS) verwendet. Mehrere Länder wie Österreich, Japan, die Niederlande, Spanien, Schweden oder die Schweiz haben CERs oder ERUs über nationale Aufkaufprogramme erworben, um ihre Kyoto-Ziele zu erfüllen. Etwa 40 % der CERs sind noch nicht im CDM-Register oder in den nationalen Registern gelöscht oder stillgelegt worden; einige dieser CERs könnten jedoch bereits verkauft oder im Rahmen des EU ETS genutzt worden sein. Ähnlich verhält es sich mit einer großen Anzahl von ERUs (31 %), die noch ungenutzt auf Konten im CDM-Register liegen und möglicherweise nie genutzt werden. Etwa 6 % der CERs und 3 % der ERUs wurden freiwillig gelöscht. Darunter fallen verschiedene Verwendungen, unter anderem zur Erfüllung von Verpflichtungen unter nationalen Klimaschutzinstrumenten in Entwicklungsländern (2,3 % der CER) und die Nutzung auf dem freiwilligen Kohlenstoffmarkt (1,1 % der CER). Zukünftig könnten einige der CERs, die noch auf Konten des CDM-Registers liegen, in das Register des Mechanismus nach Artikel 6.4 übertragen und damit zur Erreichung von Klimazielen unter dem Pariser Übereinkommen verwendet werden.

Abbildung 2 Gastländer nach Ausgaben von CERs (links) und ERUs (rechts)



Quelle: Eigene Darstellung basierend auf UNFCCC (2022c)
und Fenhann (2022). Abweichungen von 100% aufgrund von Rundungen sind möglich. Korea bezieht sich auf die Republik Korea; “Sonstige” im inneren Ring beinhaltet Projekte in Osteuropa und PoAs in mehr al seiner Region.

Wichtige Erkenntnisse aus CDM und JI für den Artikel 6.4 Mechanismus

Der Nachweis der **Zusätzlichkeit** ist von entscheidender Bedeutung für die Gewährleistung der Umweltintegrität von Kohlenstoffmarktprogrammen. Im Rahmen der Kyoto-Mechanismen wurden verschiedene Ansätze zum Nachweis der Zusätzlichkeit angewandt, darunter die Prüfung, ob Emissionsgutschriften bei der Investitionsentscheidung bereits in Erwägung gezogen wurden, die Prüfung von Rechtsvorschriften, die Investitionsanalyse, die Analyse von Hemmnissen und die Analyse, ob die Projekte bereits gängige Praxis sind. Insgesamt hatten alle Ansätze des CDM und des JI Schwächen, wie fehlende Objektivität, Schlupflöcher sowie mangelnde Transparenz.

Bei der Investitions- und Hemmnisanalyse stellte die Informationsasymmetrie zwischen den Projektentwicklern einerseits sowie den externen Prüfern und den Aufsichtsorganen

andererseits eine große Herausforderung dar. Bei der Investitionsanalyse wurde dieses Risiko durch strengere Vorgaben für Berechnungen und Standardparameter teilweise gemindert.

Bei der Prüfung der gängigen Praxis besteht eine wesentliche Herausforderung darin, dass alle ähnlichen Projekte ausgeschlossen werden, welche beim CDM registriert sind oder eine Registrierung beantragen. Wenn es sich bei den in der Vergangenheit registrierten Projekten um nicht-zusätzliche Projekte handelt, werden die Ergebnisse verzerrt. Es würde von einer Marktdurchdringungsrate ausgegangen werden, die im Vergleich zu der realen Durchdringung zu niedrig ist. Darüber hinaus ist es schwierig, eine geeignete Vergleichsgruppe zu definieren.

Darüber hinaus gab es einen Zielkonflikt zwischen Umweltintegrität und Komplexität der Prüfung. Die Prüfung der Zusätzlichkeit ist tendenziell zuverlässiger, je komplexer sie ist und je höher die damit verbundenen Kosten sind. Der Exekutivrat des CDM versuchte, dieses Dilemma durch eine stärkere Standardisierung des Nachweises über die Zusätzlichkeit und der Quantifizierungsmethoden zu lösen. Basierend auf diesen Erkenntnissen empfehlen wir für den Mechanismus nach Artikel 6.4 Folgendes:

- Eine sollte geprüft werden, ob die Minderungsaktivität über den regulatorischen Rahmen hinausgeht. Dies würde sicherstellen, dass die Minderungsmaßnahme nicht aufgrund gesetzlicher Vorgaben durchgeführt wird. Dieser Test sollte in angemessenen Abständen wiederholt werden.
- Weder eine Hemmnisanalyse noch eine Prüfung der gängigen Praxis sollte der einzige Nachweis über die Zusätzlichkeit sein.
- Für die Investitionsanalyse sollten genaue Vorgaben und konservative Standardparameter festgelegt werden.
- Standardisierung wird auch im Rahmen des Mechanismus nach Artikel 6.4 eine entscheidende Strategie sein, um die Komplexität und die damit verbundenen Transaktionskosten im Rahmen zu halten. Insbesondere mit Negativlisten, wie sie bereits von freiwilligen Kohlenstoffmarktprogrammen eingeführt wurden, könnten Projekttypen, die wahrscheinlich nicht zusätzlich sind, ausgeschlossen werden.

Die **zuverlässige Quantifizierung der Emissionsminderungen** ist eine weitere wichtige Voraussetzung für die Gewährleistung der Umweltintegrität. Im Rahmen des CDM wurden etwa 200 Methoden genehmigt, dazu methodischen Tools für Aspekte, die mehrere Methoden betreffen. Ein zentraler Grundsatz des CDM besteht darin, dass Emissionsminderungen oder CO_2-Entahmen auf konservative Weise abgeschätzt werden. Dieser Grundsatz hat sich im Laufe der Zeit dahingehend weiterentwickelt, dass die Berechnungen umso konservativer sein sollten, je größer die Unsicherheit ist. Obwohl dieser Grundsatz unter dem CDM anerkannt wird, haben unabhängige Analysen von Methoden gezeigt, dass die Anwendung dieses Grundsatzes in der Praxis problematisch ist. Einige Methoden überschätzen wahrscheinlich die Emissionsreduzierungen. Im Laufe der Zeit wurden viele CDM-Methoden häufig überarbeitet und in Hinblick auf ihre Anwendbarkeit und Umweltintegrität verbessert.

Unter dem JI stellten methodische Probleme bei der Quantifizierung von Emissionsminderungen in Russland und der Ukraine eine große Herausforderung dar. Bei einigen Projekttypen waren die aggregierten Emissionen aus JI-Projekten größer als die nationalen Emissionen dieser Länder. Basierend auf diesen Erkenntnissen empfehlen wir für den Mechanismus nach Artikel 6.4 Folgendes:

- Wie die Erfahrungen mit JI gezeigt haben, ist eine internationale Kontrollinstanz und gründliche Überprüfung eingereichter Methoden wichtig.
- Die Methoden sollten auf der Grundlage neuer Erkenntnisse aus Praxis und Wissenschaft regelmäßig aktualisiert werden.
- Der Mechanismus nach Artikel 6.4 sollte das Ausmaß der Unsicherheit bei der Bestimmung der Emissionsminderung systematischer betrachten und dafür sorgen, dass die Unsicherheit bei Szenarien, Annahmen, Modellen, Daten und Messungen erfasst wird.
- Der Mechanismus nach Artikel 6.4 sollte nur Methoden für Projekttypen genehmigen, bei denen die Probleme bei der Zurechnung von Emissionsreduktionen angemessen berücksichtigt werden. Beispiele für Anforderungen an Methoden sind eine Untergrenze für die Wahrscheinlichkeit, dass Emissionsreduktionen unter Berücksichtigung der Unsicherheit tatsächlich stattgefunden haben, oder die Vorgabe, dass die Emissionsminderungen quantifizierbar sein müssen.

Die **Doppelzählung von Emissionsreduktionen** kann auf unterschiedliche Art zustande kommen. Während unter dem CDM und JI die Doppelzählung zwischen Ländern im Rahmen des Kyoto-Protokolls weitgehend ausgeschlossen wurde, wurden andere Formen der Doppelzählung nur teilweise berücksichtigt. Der CDM verhinderte eine doppelte Registrierung des gleichen Projekts unter dem CDM, verfügte jedoch nicht über Regelungen zur Vermeidung einer doppelten Registrierung Projekten unter anderen Kohlenstoffprogrammen. Eine doppelte Ausgabe von Emissionsgutschriften aufgrund von indirekten Überschneidungen zwischen Projekten wurde für einige Projekttypen berücksichtigt (z. B. zwischen Biokraftstoffherstellern und -verbrauchern), nicht aber für andere Projekttypen (z. B. zwischen effizienten Kochherdprojekten und Waldprojekten). Der CDM verhinderte auch nicht die doppelte Anrechnung von Emissionsminderungen aufgrund von Überschneidungen von CDM-Projekten mit nationalen Klimaschutzinstrumenten, wie zum Beispiel Emissionshandelssystemen. JI enthielt keine Regelungen zur Vermeidung dieser Arten der Doppelzählung. Wir empfehlen, dass der Mechanismus nach Artikel 6.4 das Risiko der Doppelzählung umfassender als der CDM und der JI adressiert, und zwar durch zusätzliche Regelungen für folgende Fälle:

- Doppelte Registrierungen mit anderen Kohlenstoffprogrammen, wobei es unter anderem Regelungen für das Überführen von Minderungsmaßnahmen von einem Programm zum anderen geben sollte.
- Doppelte Ausgaben von Emissionsgutschriften aufgrund von Überlappungen zwischen Projekten, einschließlich Projekten, die unter anderen Kohlenstoffprogrammen registriert sind.
- Doppelte Anrechnung von Emissionsminderungen in Bezug auf nationalen Klimaschutzinstrumente, wie zum Beispiel Emissionshandelssystemen.
- Doppelte Nutzung von Emissionsgutschriften, indem der Mechanismus erfordert, dass die Nutzung und die Begünstigten bei einer Löschung von Emissionsgutschriften angegeben werden müssen.

Das Risiko der Nicht-Dauerhaftigkeit ist für mehrere Projekttypen unter dem CDM von Bedeutung: Aufforstung und Wiederaufforstung, Kohlenstoffsequestrierung und -speicherung (CCS) sowie Projekte, welche den Verbrauch nicht-erneuerbarer Biomasse in Haushalten reduzieren (z. B. effiziente Kochherde, Biogasanlagen oder Wasseraufbereitungsprojekte).

Bei Aufforstungs- und Wiederaufforstungsprojekten wurde das Risiko der Nicht-Dauerhaftigkeit durch eine Käuferhaftung und befristete Emissionsgutschriften berücksichtigt. Wurde die Aufnahme von CO_2 rückgängig gemacht, mussten die Käuferländer die Emissionsgutschriften am Ende der nächsten Verpflichtungsperiode des Kyoto-Protokolls ersetzen. Dieser Ansatz setzte voraus, dass es immer eine weitere Verpflichtungsperiode geben würde. Da jedoch die zweite und letzte Verpflichtungsperiode des Kyoto-Protokolls 2020 auslief, werden die Institutionen und die technische Infrastruktur für den Ersatz von Gutschriften nicht mehr vorhanden sein. Solange diese nicht unter dem Pariser Abkommens übernommen werden, kann nicht kompensiert werden, wenn die Aufnahme von CO_2 rückgängig gemacht wurde. Außerdem war dieser Ansatz für die Käufer höchst unattraktiv, da sie für die Kompensation der Gutschriften verantwortlich waren. Für CCS-Projekte galten ähnliche Regelungen. Sie sahen auch die Möglichkeit einer Haftung des Gastlandes vor, und forderten darüber hinaus eine Risikobewertung für das geologische Reservoir. Der CDM enthielt keine Regelungen für das Risiko der Nicht-Dauerhaftigkeit von Haushaltsprojekten, welche den Verbrauch von nicht-erneuerbarer Biomasse reduzieren. Basierend auf diesen Erkenntnissen empfehlen wir für den Mechanismus nach Artikel 6.4 Folgendes:

- Befristete Emissionsgutschriften sind generell ein geeigneter Ansatz, um das Risiko der Nicht-Dauerhaftigkeit zu adressieren. Sie spiegeln den temporären Charakter der Minderungsmaßnahmen wider, bei denen ein solches Risiko besteht. Sollte dieser Ansatz im Rahmen des Mechanismus nach Artikel 6.4 implementiert werden, ist es wichtig, dauerhafte institutionelle Strukturen für die Kontrolle und die Kompensation von befristeten Emissionsgutschriften zu etablieren.
- Ein weiterer geeigneter Ansatz ist ein Monitoring der Projekte und die Kompensation von Emissionsminderungen, die rückgängig gemacht wurden. Ein Beispiel für einen solchen Ansatz ist ein gepooltes Versicherungssystem. Wichtig ist, dass das Monitoring und die Kompensation für lange Zeiträume gewährleistet sind und die Beiträge für das Versicherungssystem hoch genug sind, um das Risiko der Nicht-Dauerhaftigkeit abzudecken.
- Bei einigen Projekttypen sollten eine Risikoanalyse gefordert und Anreize für die Minderung des Risikos geschaffen werden. Ein Beispiel wäre, Versicherungsbeitrage an das Risikos der Nicht-Dauerhaftigkeit zu koppeln.
- Die Nicht-Dauerhaftigkeit sollte bei allen Projekttypen berücksichtigt werden, bei denen das Risiko besteht, dass die Emissionsminderungen wieder rückgängig gemacht werden. Das schließt auch Haushaltsprojekten ein, welche den Verbrauch nicht-erneuerbarer Biomasse reduzieren.

Im **CDM-Projektzyklus** muss vor der Registrierung eines Projektes Folgendes durchgeführt werden: eine frühzeitige Mitteilung der Absicht, das Projekt im Rahmen des CDM zu registrieren; die Genehmigung des Gastlands; eine Konsultation mit lokalen Interessengruppen; die Ausarbeitung und Veröffentlichung des Project Design Document (PDD) durch die Projektentwickler und die Validierung des Projekts durch eine Designated Operation Entity (DOE).

Die Erfahrungen mit der Projektentwicklung unter dem CDM haben gezeigt, dass klare Regeln und Modalitäten den Projektzyklus straffen und die Kosten für die Projektentwicklung senken. Darüber hinaus wurde in den ersten Jahren des CDM deutlich, dass insbesondere bei kleinen Projekten unverhältnismäßig hohe Transaktionskosten bei der Erstellung der Projektdokumentation entstehen. Dies führte dazu, dass im Jahr 2005 vereinfachte Regeln und

Verfahren für kleine Minderungsmaßnahmen eingeführt wurden. Basierend auf diesen Erkenntnissen empfehlen wir für den Mechanismus nach Artikel 6.4 Folgendes:

- Bei der Entwicklung der Verfahren des neuen Mechanismus sollte der Schwerpunkt auf klare Regeln gelegt werden, welche den Prozess straffen und die Kosten für die Entwicklung von Projekten senken.
- Vereinfachte Regeln und ein programmatischer Ansatz sollten für kleine und kleinste Projekte eingeführt werden.

Validierung und Verifizierung werden von externen Prüfern (DOEs) durchgeführt. Unter dem CDM wurden externe Prüfer vom CDM-Exekutivrat nach einem umfassenden Verfahren akkreditiert. Wurden die Voraussetzungen nicht erfüllt, konnte der CDM-Exekutivrat die Akkreditierung eines Prüfers aussetzen oder sogar entziehen. Dies ist in mehreren Fällen geschehen ist und hat zu einer Verbesserung der Qualität geführt. Im Laufe der Jahre hat der CDM-Exekutivrat das Akkreditierungsverfahren ausgebaut und ein System entwickelt, mit dem die Leistung der Prüfer besser überwacht werden kann. Dazu gehören ein Monitoring der Leistungen der Prüfer, Stichprobenkontrollen und periodische Evaluierungsverfahren.

Im Gegensatz dazu wurden die Validierungs- und Verifizierungsverfahren im Rahmen von JI stark kritisiert. Bei der Durchführung von Prüfungen unter Aufsicht des Gastlandes waren die Prüfer weder dem Joint Implementation Supervisory Committee (JISC) noch dem CDM-Exekutivrat gegenüber rechenschaftspflichtig. Deshalb konnte ihre Akkreditierung im Falle eines Fehlverhaltens nicht ausgesetzt oder entzogen werden.

Ein Kritikpunkt sowohl am CDM- als auch am JI-Prüfungsprozess ist, dass die Prüfer von den Projektentwicklern bezahlt wurden. Die hat zu Bedenken hinsichtlich ihrer Unparteilichkeit und der fehlenden Anreize zur Durchführung gründlicher Prüfungen aufkommen lassen.

Da sich die CDM-Standards und -verfahren für die Akkreditierung und Überwachung von Prüfern bewährt haben, empfehlen wir, diese Verfahren mit wenigen Anpassungen für den Artikel 6.4 Mechanismus zu übernehmen. Insbesondere empfehlen wir, dass der Artikel 6.4 Supervisory Body:

- Ein Monitoringsystem für Prüfer einführt, welches eskalierende Sanktionen bei unzureichender Leistung einschließt, z. B. zusätzliche Stichprobenkontrollen;
- Möglichkeiten auslotet, potenzielle Fehlanreize für Prüfer zu beseitigen, zum Beispiel durch ein Lotteriesystem, bei dem der Supervisory Body den Prüfern Projekte zuweist und die Projektentwickler die Prüfer nach einer festgelegten Gebührenordnung bezahlen.

Die **ökologischen und sozialen Auswirkungen** von Kohlenstoffmarktprojekten auf die lokale Bevölkerung und Ökosysteme können positiv oder negativ sein. Unter dem CDM ist die wichtigste Anforderung in diesem Bereich eine Bestätigung der Designated National Authorities (DNAs) der Gastländer, dass ein Projekt förderlich für die nachhaltige Entwicklung ist. Dieser Ansatz wurde kritisiert, da eine Kontrolle der Wirkungen der Projekte fehlte und die Gastländer keine Anreize hatten, die sozialen und ökologischen Auswirkungen umfassend zu berücksichtigen. Darüber hinaus weisen die Regelungen des CDM zur Berücksichtigung sozialer und ökologischer Belange Lücken auf: Es ist nur für Aufforstungs- oder Wiederaufforstungsprojekte vorgeschrieben, soziale Auswirkungen zu prüfen; es gibt keine Anforderungen, negative Auswirkungen über den Projektbeginn hinaus zu beobachten; es ist nicht festgelegt, welche sozialen und ökologischen Auswirkungen zu berücksichtigen sind; und

es gibt kein System, über welches Interessengruppen nach Beginn eines Projekts Beschwerden vorbringen können.

Der JI-Mechanismus enthält keine wesentlichen Regelungen, um negative soziale und ökologische Auswirkungen abzufedern. Normalerweise bestimmt das Gastland die Art der Sozial- und Umweltverträglichkeitsprüfungen und die Konsultation mir den Interessengruppen.

Damit der Artikel 6.4 Mechanismus soziale und ökologische Belange angemessen berücksichtigen kann, müssen die Regelungen weiter gehen als unter dem CDM und JI. Wir empfehlen insbesondere Folgendes:

- Das Berichten über Auswirkungen auf die nachhaltige Entwicklung sollte verpflichtend sein und sowohl positive als auch negative Aspekte umfassen. Nach Beginn einer Minderungsmaßnahme ist ein kontinuierliches Monitoring erforderlich, um negative Auswirkungen anzugehen, sobald sie auftreten.
- Externe Prüfer sollten nicht nur überprüfen, ob Umwelt- und Sozialverträglichkeitsprüfungen durchgeführt und die Verfahrensanforderungen erfüllt wurden, sondern auch bewerten, ob die Prüfung inhaltlich angemessen ist.
- Lokale und globale Konsultationen mit Interessengruppen sollten durchgeführt werden, bevor die Projektentwickler das Projekt implementieren. Es sollte verpflichtend sein, die freie, auf Kenntnis der Sachlage gegründete Zustimmung (FPIC) der betroffenen indigenen Gruppen einzuholen. Interessensgruppen sollten die Möglichkeit haben, ihre Bedenken jederzeit über einen Beschwerdesystem zu äußern.
- Schließlich sollte es spezifische Schutzmaßnahmen geben, die Projektentwickler bei der Durchführung eines Projekts implementieren sollten.

Die **Governance-Strukturen** des CDM und des JI bestehen aus drei Ebenen: der Vertragsstaatenkonferenz als übergeordnetem Entscheidungsgremium für beide Mechanismen, ein von der Vertragsstaatenkonferenz einberufendes Aufsichtsorgan (der CDM-Exekutivrat oder der JISC) als Aufsichtsorgan sowie die Gastländer. Die beiden letztgenannten treffen die Entscheidungen über die Umsetzung der Mechanismen.

Unter Track 1 des JI trägt das Gastland die Verantwortung für die Regelung und die Kontrolle der Projektentwicklung und -durchführung. Dies führte zu Kritik an der mangelnden systematischen Kontrolle von Track-1-Projekten, da es erhebliche Bedenken hinsichtlich ihrer Umweltintegrität gab.

Der CDM zeichnete sich durch ein hohes Maß an **Transparenz** aus. Unter dem CDM wurden die PDDs zusammen mit relevanten zusätzlichen Informationen veröffentlicht. Darüber hinaus sind die Entscheidungsprozesse transparent, da detaillierte Informationen über die Sitzungen des CDM-Exekutivrats verfügbar sind.

Dies steht im Gegensatz zu dem Mangel an öffentlich verfügbaren Informationen unter JI. Unter Track 1 ist die Information der Öffentlichkeit lückenhaft und es fehlen oft wichtige Dokumente wie PDDs, Monitoring- und Verifizierungsberichte.

Da für den CDM eine positive Bilanz in Bezug auf Transparenz gezogen werden kann, empfehlen wir, seine Regelungen für Mechanismus nach Artikel 6.4 zu übernehmen. Wir empfehlen insbesondere Folgendes:

- Die öffentlich zugänglichen Dokumente sollten alle Informationen beinhalten, welche die Projektentwickler dem Supervisory Body vorlegen, zum Beispiel die vollständigen Anträge auf Registrierung, Kommentare aus lokalen und globalen Konsultationen von Interessengruppen, die Umwelt- und Sozialverträglichkeitsprüfung sowie Dokumente zur Validierung und Verifizierung.

Eignung von Minderungsaktivitäten für den Mechanismus nach Artikel 6.4

Aus dem CDM und dem JI können wichtige Schlüsse gezogen werden, auch über das Projektportfolio und das Regelwerk dieser Mechanismen. Dabei kommt die Frage auf, welche Art von Minderungsmaßnahmen für den neuen Mechanismus besonders geeignet sind. Auf der Grundlage einer Analyse der neuen Anforderungen und der Erfahrungen mit CDM und dem JI identifizieren wir eine Reihe von zentralen Themen, welche wegweisend bei der Zulassung von Minderungsmaßnahmen im Rahmen des Artikel 6.4 Mechanismus sein sollten:

- Hoch hängende statt tiefhängender Früchte: Um zu vermeiden, dass Gastgeberländer günstige Minderungsoptionen verkaufen und dann Schwierigkeiten haben, ihre eigenen Klimaziele zu erreichen, sollten nur solche Minderungsaktivitäten zugelassen werden, die für Gastländer eindeutig unerreichbar sind. Das würde zudem dabei helfen, die Ambitionen der Klimaziele im Laufe der Zeit zu steigern.

- Steigerung der Ambitionen: Die Steigerung der Ambition ist ein Hauptziel des Mechanismus nach Artikel 6.4. Die Möglichkeit, Emissionsgutschriften zu verkaufen, könnte für die Gastgeberländer den perversen Anreiz schaffen, die Ambition ihrer Klimaziele nicht zu steigern, da dies die Möglichkeiten zum Verkauf von Emissionsgutschriften einschränken würde. Um dies zu vermeiden, ist es wichtig, dass die Gastländer einen Teil der Emissionsminderungen für das Erreichen ihrer eigenen Klimaziele verwenden können. Dies kann auf verschiedene Weise umgesetzt werden, u. a. durch die Festlegung von Referenzszenarien, welche deutlich unter den wahrscheinlichen Referenzemissionen liegen und mit dem langfristigen Ziel des Pariser Abkommens in Einklang stehen. Dies könnte durch einen "Ambitionskoeffizienten" implementiert werden, der im Laufe der Zeit abnimmt.

- Hohe Wahrscheinlichkeit der Zusätzlichkeit: Die Wahrscheinlichkeit der Zusätzlichkeit ist je nach Projekttyp sehr unterschiedlich. Der Artikel 6.4 Supervisory Body sollte das Risiko der Nicht-Zusätzlichkeit von Minderungsmaßnahmen minimieren. Wir empfehlen daher, dass der Supervisory Body Projekttypen ausschließt, bei denen die Wahrscheinlichkeit der Zusätzlichkeit gering ist. Dieser Ansatz wird auch von einigen Programmen auf dem freiwilligen Kohlenstoffmarkt verfolgt.

- Zurechenbarkeit der Emissionsminderungen zu den Minderungsmaßnahmen und Quantifizierbarkeit der Emissionsminderungen: Um die Umweltintegrität zu gewährleisten, ist es wichtig, dass die berechneten Emissionsminderungen durch die zugrunde liegenden Minderungsmaßnahmen verursacht werden und nicht durch exogene Faktoren, die außerhalb der Kontrolle der Projektentwickler liegen. Dieses wichtige Prinzip ist bei einigen Arten von Minderungsmaßnahmen schwer zu gewährleisten, da die Unsicherheit bei der Bestimmung der Referenzszenarien groß ist und die beobachteten Veränderungen auf exogene Faktoren zurückzuführen sein könnten (z. B. vermiedene Entwaldung). Darüber hinaus ist es wichtig, dass die Emissionsminderungen robust quantifiziert werden können. Wir empfehlen, dass Maßnahmen, bei denen diese Grundsätze nicht eingehalten werden können, nicht unter dem Artikel 6.4 Mechanismus zugelassen werden sollten.

- Synergien mit anderen Zielen der nachhaltigen Entwicklung: Minderungsmaßnahmen sollten die nachhaltige Entwicklung des Gastlandes fördern, indem sie einen Zusatznutzen für die Umwelt und die lokalen Gemeinschaften sowie ein geringes Risiko negativer sozialer und ökologischer Auswirkungen haben.
- Langfristiger Nutzen für das Klima: Um die langfristigen Ziele des Pariser Abkommens zu erreichen, sollte das Risiko, dass Emissionsminderungen wieder rückgängig gemacht werden, gering sein. Wir empfehlen daher, dass im Rahmen Mechanismus nach Artikel 6.4 nur solche Minderungsmaßnahmen zugelassen werden, die in der Lage sind, Kohlenstoff über lange Zeiträume zu speichern.

1 Introduction

The carbon crediting mechanisms under the Kyoto Protocol, the Clean Development Mechanism (CDM) and the Joint Implementation (JI), are in the process of being phased out. Under JI, emission reduction units (ERUs) were only issued for the first commitment period of the Kyoto Protocol from 2008 to 2012, and the CDM issues only emission reductions that have occurred up to 31 December 2020.

The new market-based mechanism under Article 6.4 of the Paris Agreement will replace the CDM and JI, providing an opportunity to build upon existing structures and to draw on the lessons learned from these mechanisms. For the new mechanism, the stakes are set high as it not only aims to achieve additional emission reductions and contribute to sustainable development but also includes several new principles and objectives, in particular raising ambition over time.

To achieve its objectives, the Article 6.4 mechanism will need to significantly differ from its predecessors. The Article 6.4 mechanism will introduce new approaches for demonstrating additionality, setting baselines, avoiding double counting, addressing non-permanence, and ensuring sustainable development. Because all countries must communicate climate mitigation contributions under the Paris Agreement, and not only developed countries as under the Kyoto Protocol, the role of the host countries will also change; they need to make sure that engagement in Article 6 will help and not hinder achieving their Nationally Determined Contributions (NDCs).

The decision 1/CP.21, which adopted the Paris Agreement, states that “experience gained with and lessons learned from existing mechanisms and approaches adopted under the Convention and its related legal instruments" should be taken into account when developing the Article 6.4 mechanism. The Article 6.4 Supervisory Body, the body developing the detailed rules of the mechanism and approving mitigation activities, has been tasked with reviewing baseline and monitoring methodologies, the sustainable development tool as well as accreditation standards procedures of the CDM and gauging their suitability for the Article 6.4 mechanism (paragraph 5 of decision 3/CMA.3). The body will develop key standards and procedures for the Article 6.4 mechanism in the next years, including regarding the activity cycle, methodologies, registry requirements, and accreditation. It will also create various tools, including a Sustainable Development tool (UNFCCC 2022e). The development of these standards and procedures may also draw upon elements from the CDM.

This report intends to support that work by providing an overview of how the CDM and JI have been used, discussing what lessons have been learned from their implementation, and making suggestions as to what type of mitigation activities may be suitable for the Article 6.4 mechanism.

The report is part of the project “Evaluation of international Emission Reduction Projects”. It first provides a quantitative analysis of the use of CDM and JI projects, including for projects with German involvement or implemented in Germany (chapter 2). It then gives an overview of key lessons learned with the rulebook of both mechanisms, juxtaposing them with provisions of the Article 6.4 mechanism that have already been decided on, and deriving recommendations for the design of the Article 6.4 mechanism (chapters 3 and 4). A separate paper under this project advances the analysis in this report by looking at how two CDM methodologies could transition to the Article 6.4 mechanism.

2 Use of the Kyoto mechanisms in numbers

This section provides an overview of how the CDM and JI have been used. This includes information on the number of carbon credits issued; the predominant project types, methodologies, and host countries; the purposes for which carbon credits have been used; and the development of carbon credit prices. In some instances, this information is also specifically analysed for projects with German involvement or implemented in Germany.

2.1 Methodological approach

For analysing the issuance of certified emission reductions (CERs) under the CDM and (ERUs under JI, as well as the share of project types, methodologies, and host countries, data was retrieved from a database managed by the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCCC 2022c) and a database managed by the Copenhagen Climate Centre of the United Nations Environment Programme (UNEP-CCC), referred to as "JI Pipeline" (Fenhann 2022). To identify projects with German involvement or implemented in Germany, a database managed by the German Emissions Trading Authority (DEHSt) has been used (DEHSt 2022). DEHSt hosts the German Designated National Authority (DNA) for the CDM and the Designated National Focal (DNF) point for JI. For the CDM, German involvement refers to projects for which participants were authorized by the German DNA. In the case of JI, our analysis focuses on projects which were implemented in Germany. To analyse how carbon credits have been used, we draw upon a report by Michaelowa et al. (2021), data provided by the CDM (UNFCCC 2022a, UNFCCC 2022b), the standard electronic format (SEF) tables reported by countries to the UNFCCC and aggregated data for the Emissions Trading System of the European Union (EU ETS) as provided by the European Environment Agency (EEA 2022) and the European Commission (European Commission 2021). As the datasets are based on different cut-off dates, combining the data may lead to some minor discrepancies in the results. Data on ERU and CER prices were sourced reports that draw upon data from exchanges (Michaelowa et al. 2019b). In the following, we present key information on the CDM and JI, distinguishing between total aggregated information for all countries and projects, and information relating to projects with German involvement.

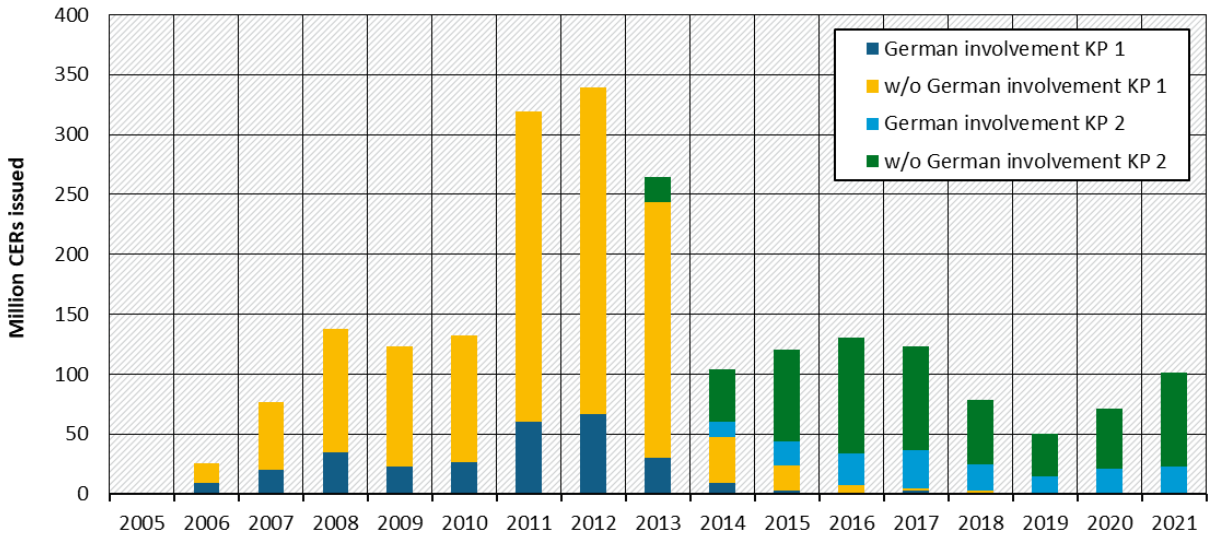
2.2 Carbon credit issuance under the CDM and JI

The first CERs were issued in 2005. In the period 2008 to 2010, the total annual issuance volume reached a level between 120 and 140 million CERs, followed by a strong surge in 2011. The peak was reached in 2012 when 339 million CERs were issued. Thereafter, annual issuances rapidly decreased due to CER prices falling to well below one EUR per CER – a level where issuance of CERs is no longer economically viable, as the transaction costs for issuing CERs would be higher than the revenue from selling CERs (see Figure 1).

The CER price crash was due to a strong imbalance between supply and demand. Various factors played a role. Under JI, Russia and Ukraine issued a large volume of units in a short period. As both CERs and ERUs were eligible under the EU ETS, this also reduced the demand for CERs. At the same time, a large number of projects registered in 2011 and 2012 without having a buyer, hoping that credit prices would remain high. And third, due to concerns on the integrity of CERs and ERUs, the European Union (EU) decided that the cap of about 1.6 billion carbon credits that were eligible under its Emissions Trading System (ETS) in the period 2008 to 2012 will apply to the period up to 2020 – thereby strongly limiting the use of CERs and ERUs in the trading period from 2013 to 2020.

After 2013, no large demand sources emerged that could have led to a recovery of CER prices. Issuance shifted from CERs issued for emission reductions from the first commitment period of the Kyoto Protocol (KP1) from 2008 to 2012 to CERs issued for reductions from the second commitment period (KP2) from 2013 to 2020. The annual number of issuances stabilized in a range between 100 and 150 million for the period 2014 to 2017, and further declined to about 50 million issuances in 2019. In 2021, however, the volume slightly exceeded the 100 million mark again, mostly due to an increase in voluntary cancellation of CERs. As of 4 October 2022, about 2.3 billion CERs had been issued from 8,218 projects registered under the CDM. About 468 million CERs, corresponding to 20.6%, were issued from 565 projects with German involvement.

Figure 1: CER issuances over time

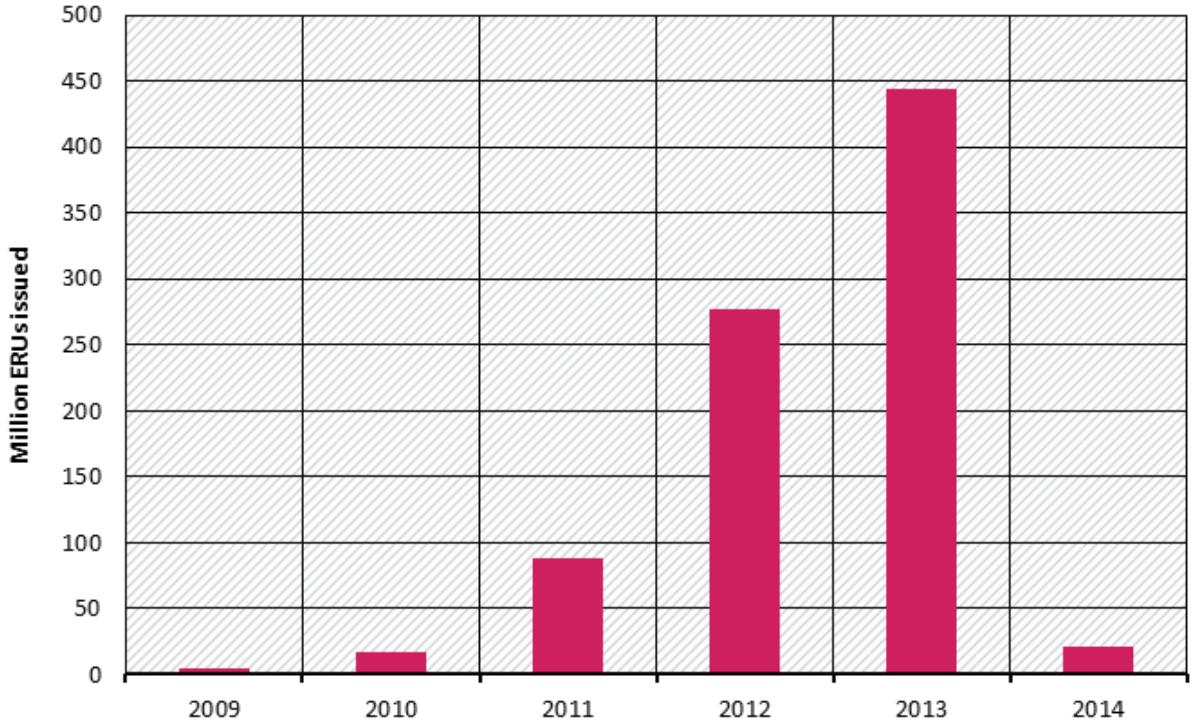


Source: Own illustration based on UNFCCC (2022c) and DEHSt (2022). KP1 refers to CERs issued for emission reductions that occurred during the first commitment period of the Kyoto Protocol from 2008 to 2012. KP2 refers to CERs issued for emission reductions that occurred during the second commitment period from 2013 to 2020. In 2005 there were only 103,732 issuances overall.

Figure 2 provides an overview of total ERU issuance over time. Issuances under JI started in 2009. The following years saw a constant surge of annual issuances until they reached their peak in 2013 with a volume of 443 million ERUs, due to a surge in projects that significantly overestimated emission reductions (Kollmuss et al. 2015). In 2014, the last year of issuance under JI, this number diminished to 20.5 million. As the Doha Amendment for the second commitment period of the Kyoto Protocol from 2013 to 2020 only entered into force in late 2020, JI was never implemented in the second commitment period. Overall, 761 registered projects have issued a total of 864 million ERUs. 23 JI projects, which issued 13.5 million ERUs, were implemented in Germany.

Overall, almost three quarters of the carbon credits issued under the Kyoto Protocol's mechanisms came from the CDM and about one quarter from JI. The demand from the EU ETS and the late entry into force of the Doha Amendment were key factors in the issuance over time.

Figure 2: ERU issuances over time

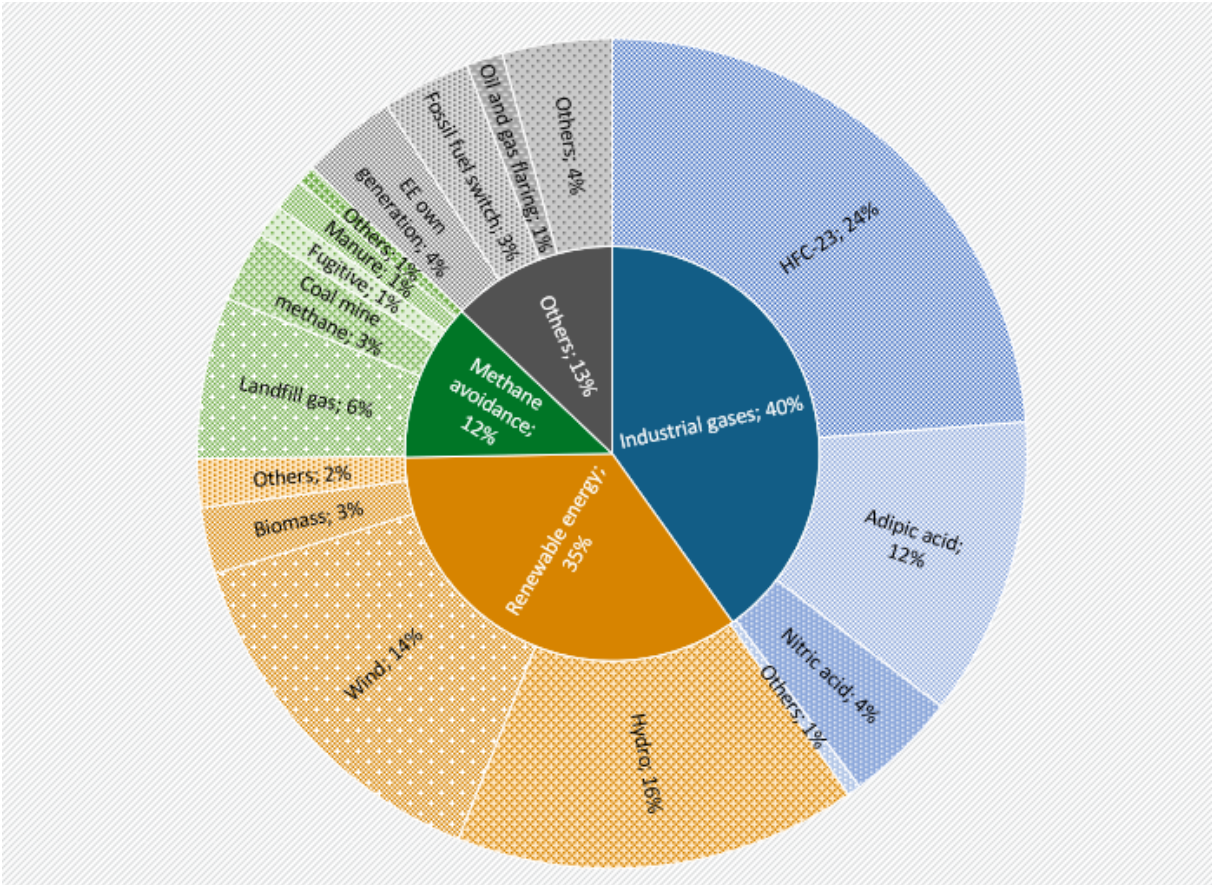


Source: Own illustration based on Fenhann (2022). Note that information on the year of issuance is not available for projects with German involvement.

2.3 Project types

Under the Kyoto Protocol, carbon credits were issued from a large variety of projects, though some project types clearly dominated the market. Figure 3 provides an overview of the share of CERs issued from different project types. Projects abating industrial waste gases make up the largest share. The 19 registered projects abating fluoroform (HFC-23) alone account for almost a quarter of CER issuances, and the four registered adipic acid projects make up 12% of all issuances. This is followed by renewable energy projects, where hydro and wind projects rank two and three among the project types with the largest CER issuances. Activities avoiding methane emissions constitute 12% of the overall issuances, with landfill gas projects playing the largest role in this category with 6%.

Figure 3: CDM project types by CER issuances

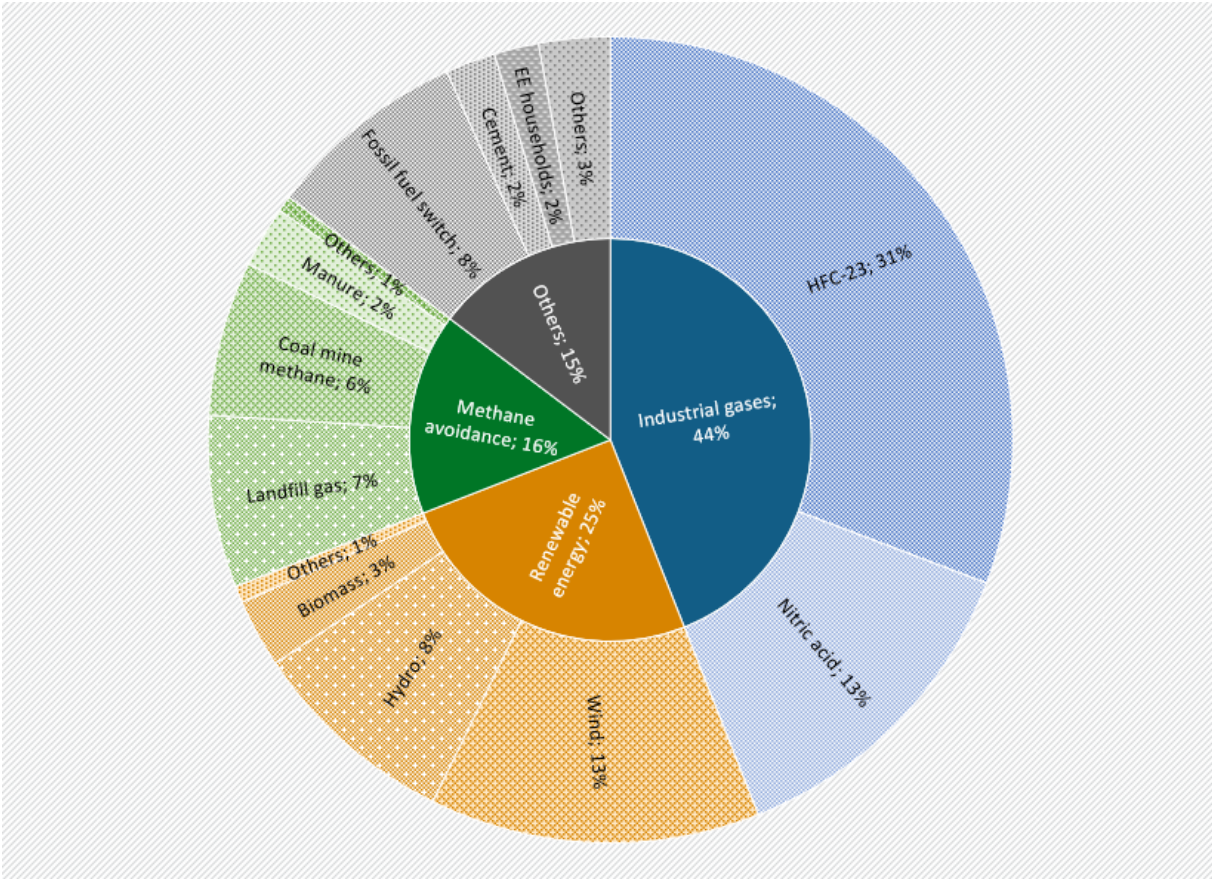


Source: Own illustration based on UNFCCC (2022c). Deviations from 100% occur due to rounding differences. EE = energy efficiency

The picture slightly shifts when only considering CER issuances from projects with German involvement (Figure 4). Although activities related to industrial gases remain the most relevant project type category by the number of issuances, the shares within this category changed, as there are no adipic acid projects with German involvement. Instead, HFC-23 and nitric acid projects account for an even bigger share (31% and 13% respectively). The relevance of renewable energy projects is lower than on the global level, with hydro projects contributing only 8% to overall issuances. With a share of 13%, wind projects are the second most relevant project type. Landfill gas, coal mine methane and fossil fuel switch projects with German involvement make up a bigger share compared to the global level.

Figure 4). Although activities related to industrial gases remain the most relevant project type category by the number of issuances, the shares within this category changed, as there are no adipic acid projects with German involvement. Instead, HFC-23 and nitric acid projects account for an even bigger share (31% and 13% respectively). The relevance of renewable energy projects is lower than on the global level, with hydro projects contributing only 8% to overall issuances. With a share of 13%, wind projects are the second most relevant project type. Landfill gas, coal mine methane and fossil fuel switch projects with German involvement make up a bigger share compared to the global level.

Figure 4: CDM project types by CER issuances from projects with German involvement

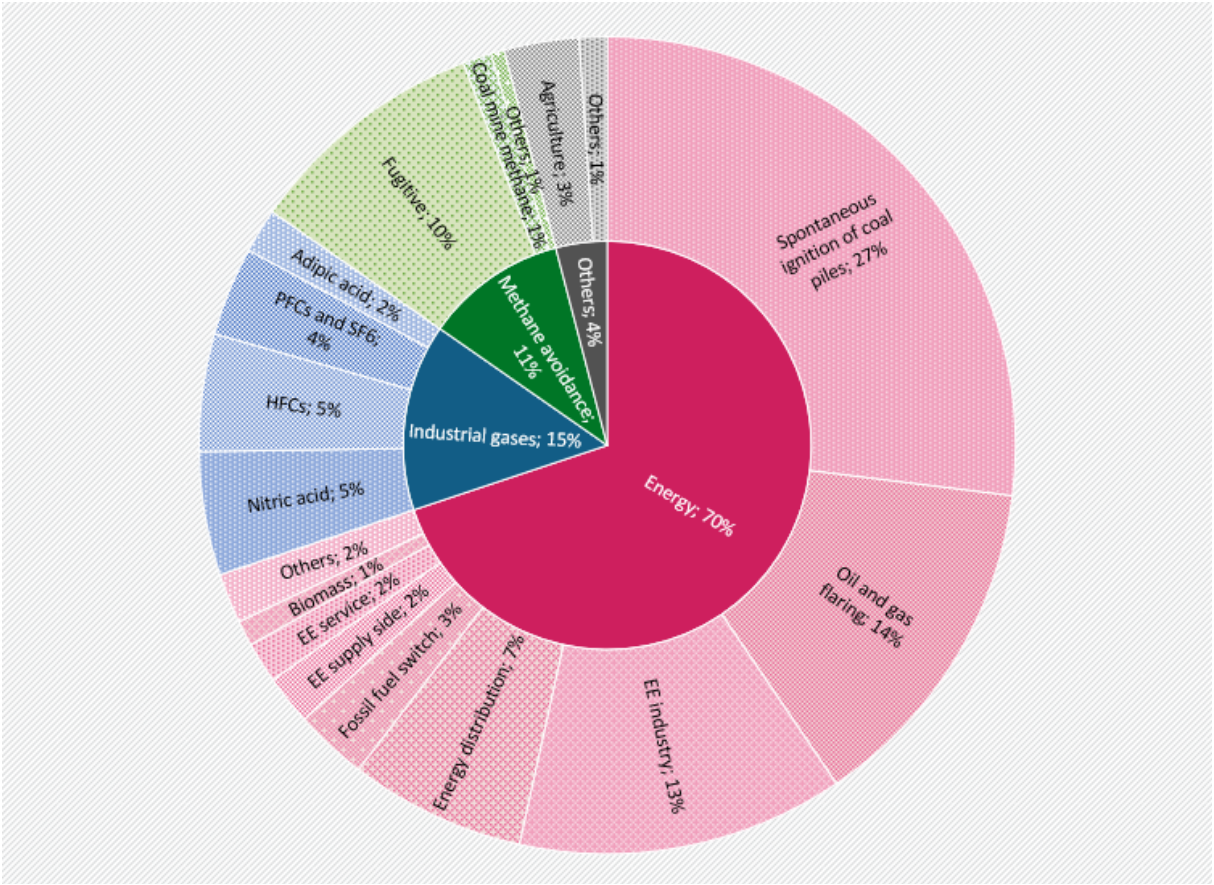


Source: Own illustration based on UNFCCC (2022c) and DEHSt (2022). Deviations from 100% occur due to rounding differences. EE = energy efficiency.

For JI, the picture is very different than from the CDM (Figure 3). Renewable energy did not play a significant role, as it was covered by the EU ETS in EU countries and Russia and Ukraine did not build large capacities of renewable energy plants in this period. Other energy-related projects have a share of 70% of all issuances. The largest portion is made up of projects that avoid the spontaneous ignition of coal piles (27% of overall issuances), a project type for which ERUs are very unlikely to involve actual emission reductions (Kollmuss et al. 2015), projects that avoid flaring associated gas in oil and gas production (14%), and energy efficiency projects in industrial processes (13%). Reducing waste gas emissions in industry accounted for 15% of all issuances and thus also played a significant role, mainly due to four HFC-23 and sulphur hexafluoride (SF_6) abatement projects in Russia. Projects avoiding methane emissions (11% of overall issuances) mainly comprise the repair leaks in natural gas systems.

Almost all issuances from projects implemented in Germany originate from nitrous oxide (N_2O) abatement from adipic acid production (69%) and nitric acid production (28%). SF_6 abatement and coal mine methane projects account for the remainder.

Figure 5: JI project types by ERU issuances



Source: Own illustration based on Fenhann (2022). Deviations from 100% occur due to rounding differences. EE = energy efficiency.

2.4 Methodologies

The use of methodologies under the CDM and JI is linked to the portfolio of project types and similar trends can be observed. Table A1 in the appendix provides a detailed overview of the most frequently used methodologies under the CDM. Methodologies used for industrial gas and renewable energy projects make up the largest share of CER issuances, in particular ACM0002 for large-scale renewable power generation (29% of overall issuances), AM0001 for HFC-23 abatement from chlorodifluoromethane (HCFC-22) production (24%), and AM0021 for N_2O abatement from adipic acid (12%). This does not hold when methodologies are ranked by their number of project registrations, however. Due to the large size of industrial gas projects, AM0001 and AM0021 comprise only 23 projects, whereas thousands of renewable energy projects used the methodology ACM0002 (Table A1).

Considering only issuances from projects with German involvement, the distribution shifts slightly again. The role of ACM0002 is significantly smaller here (21% of issuances from projects with German involvement), whereas AM0001 accounts for an even bigger portion (31%). Since there were no adipic acid projects approved by the German DNA, AM0021 does not play a role.

Under JI, most projects used JI specific approaches (Table 1). These methodological approaches were specified in each project design document (PDD), sometimes using CDM methodologies as the basis. JI specific approaches accounted for 74% of all ERUs issued. The picture is different for

projects implemented in Germany. Most projects used CDM methodologies and only less than 1% JI specific approaches.

Table 1: The most relevant JI methodologies by issuances

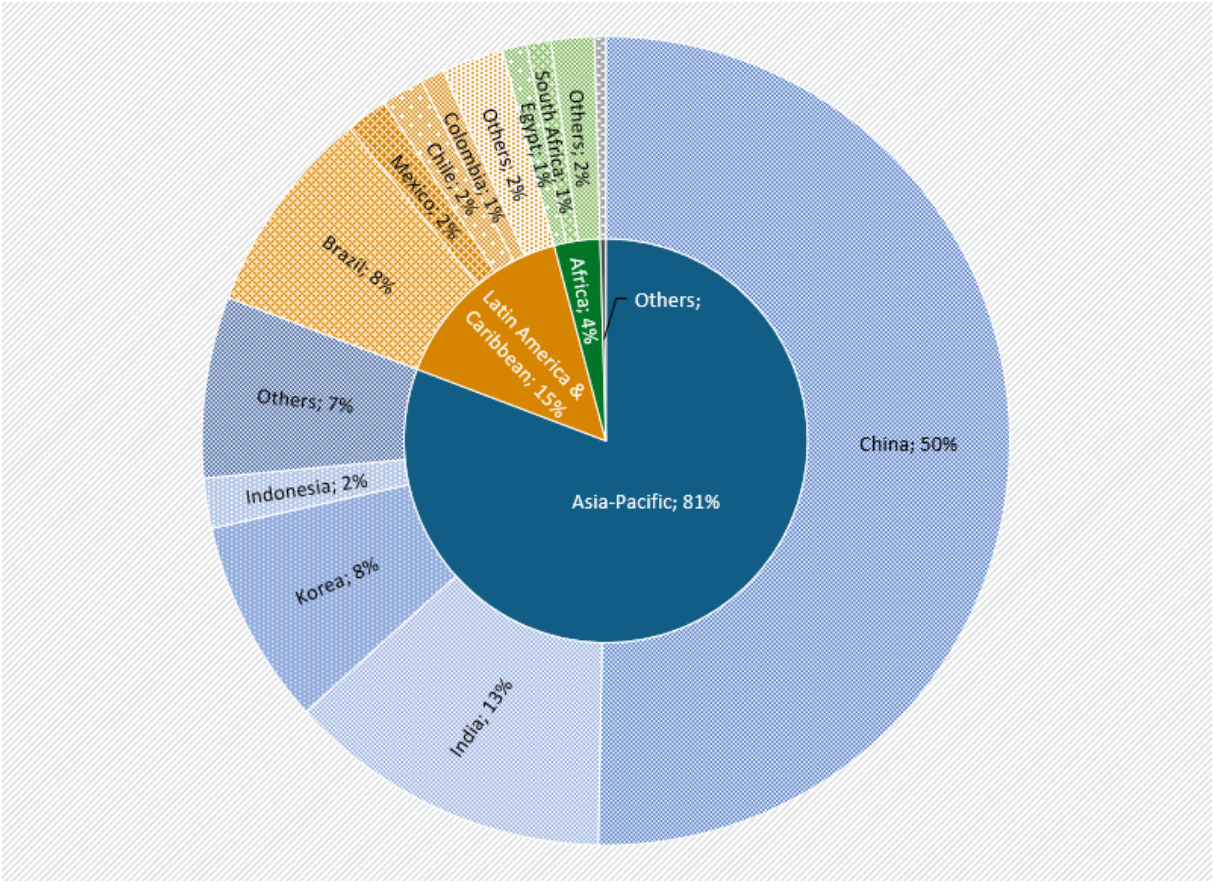
Methodology	Project type	ERUs issued (million)	Share
JI specific approach	-	639.1	74.0%
Based on AM0023	Natural gas pipelines	36.1	4.2%
AM0034	Nitric acid	26.2	3.0%
AM0001 extended to SF_6	SF_6	19.8	2.3%
AM0001	HFC-23	19.8	2.3%
AM0023	Natural gas pipelines	15.9	1.8%
ACM0009	Fossil fuel switch	15.7	1.8%
ACM0002	Renewable energy	13.5	1.6%
Based on AM0061	Higher efficiency oil power	9.9	1.1%
AM0021	Adipic acid	9.4	1.1%
AM0009	Oil field flaring reduction	8.7	1.0%
ACM0008	Coal Mine Methane	6.9	0.8%
AM0028; AM0034	Nitric acid	5.8	0.7%
Based on AM0044	District heating	5.2	0.6%
Based on AM0009	Oil field flaring reduction	4.2	0.5%
Not available	-	3.9	0.5%
AM0061	Higher efficiency oil power	3.1	0.4%
Based on AM0029	Natural gas plant	2.5	0.3%
ACM0012	Waste energy recovery	2.1	0.2%
AM0020	Energy efficiency in water delivery	2.1	0.2%
Total		849.9	98.4%

Source: Own calculations based on Fenhann (2022). The table contains the methodologies which belong to the top 20 by ERU issuances, based on all projects.

2.5 Host countries

This section provides an overview of the distribution of host countries and United Nations regional groups by CER issuances (see Figure 6). The vast majority of CERs were issued in Asia-Pacific. China alone accounts for more than half of all issuances, and India and Korea make up 13% and 8% respectively. With 8% of all issued CERs, Brazil accounts for half of the CERs from Latin America and the Caribbean. Projects in Africa make up only 4% of the issuances.

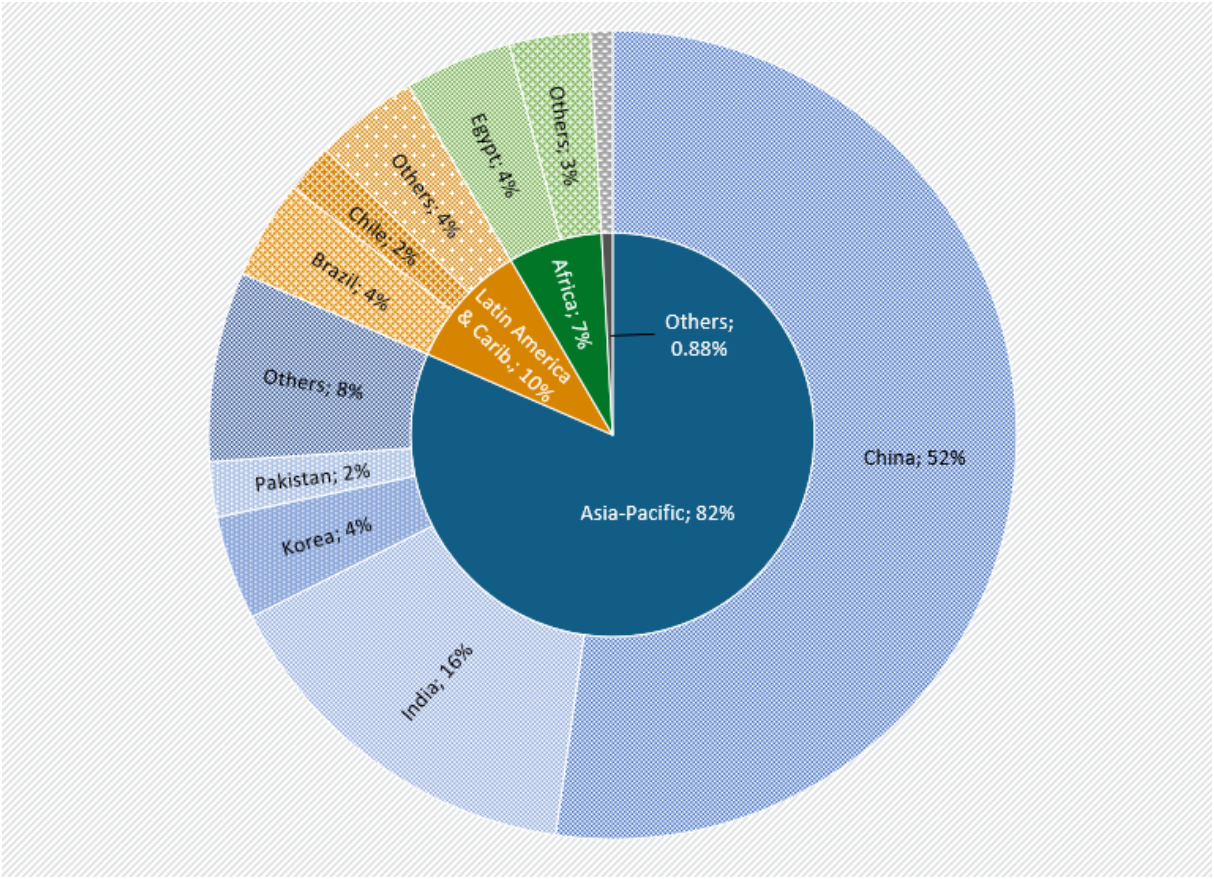
Figure 6: CDM host countries by CER issuances



Source: Own illustration based on UNFCCC (2022c). Deviations from 100% due to rounding differences. Korea refers to the Republic of Korea, "Others" in the inner circle comprises projects in Eastern Europe and PoAs in more than one region.

Considering only CERs issued from projects with German involvement, the fraction of projects in China (52%) and India (16%) becomes even bigger. The share of Korea and Brazil is smaller (4% each), while the role of Egypt is much more important, reaching 4% as well.

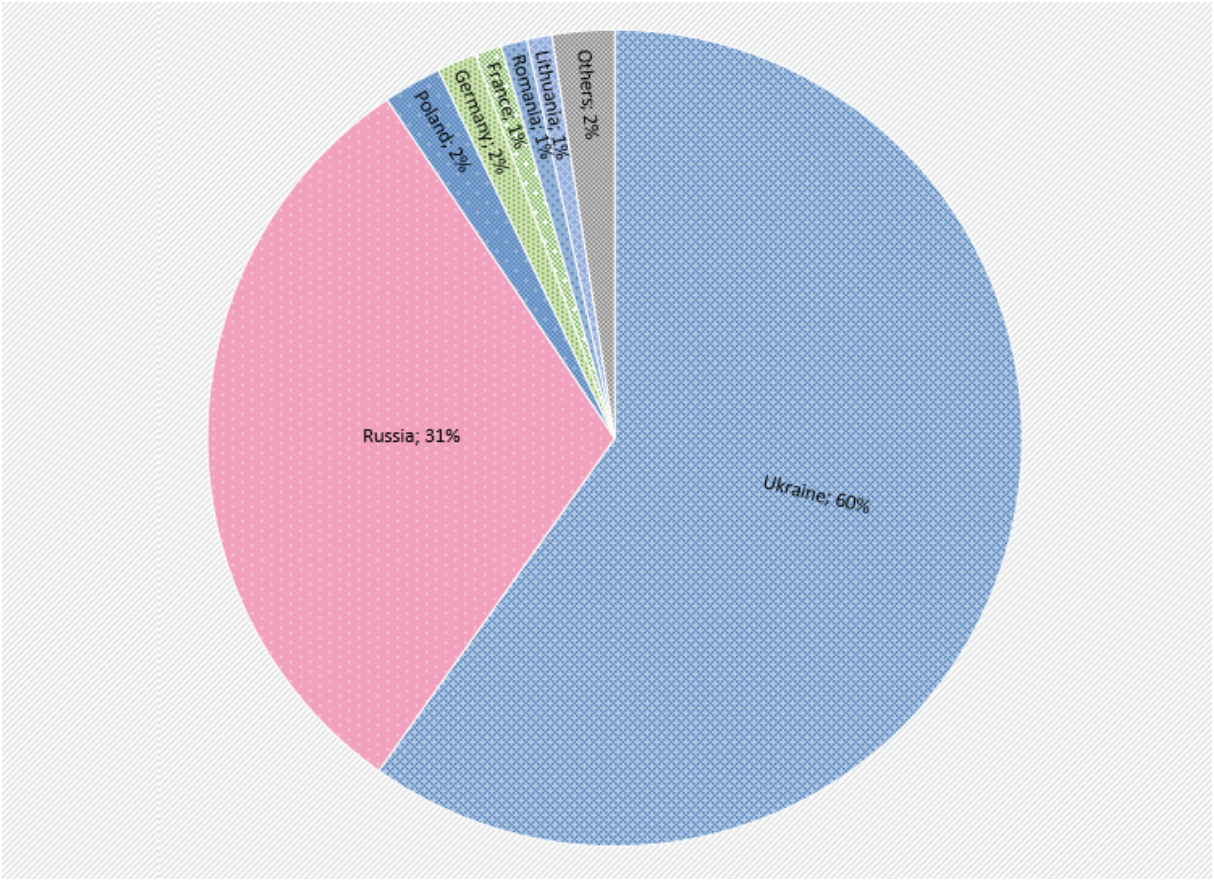
Figure 7: CDM host countries by CER issuances from projects with German involvement



Source: Own illustration based on UNFCCC (2022c), DEHSt (2022). Deviations from 100% due to rounding differences. Korea refers to the Republic of Korea, "Others" in the inner circle comprises projects in Eastern Europe and PoAs in more than one region.

Compared to the CDM, total issuances under JI are far more concentrated in two countries, Ukraine and Russia, which have a 60% and 31% share of ERU issuances respectively. The remainder is shared by other eastern European countries (Lithuania, Poland, and Romania) and western European countries (Germany and France). The share of issuances from German projects amounts to less than 2%.

Figure 8: JI host countries by ERU issuances



Source: Own illustration based on Fenhann (2022). Deviations from 100% due to rounding differences

2.6 Credit use under the CDM and JI

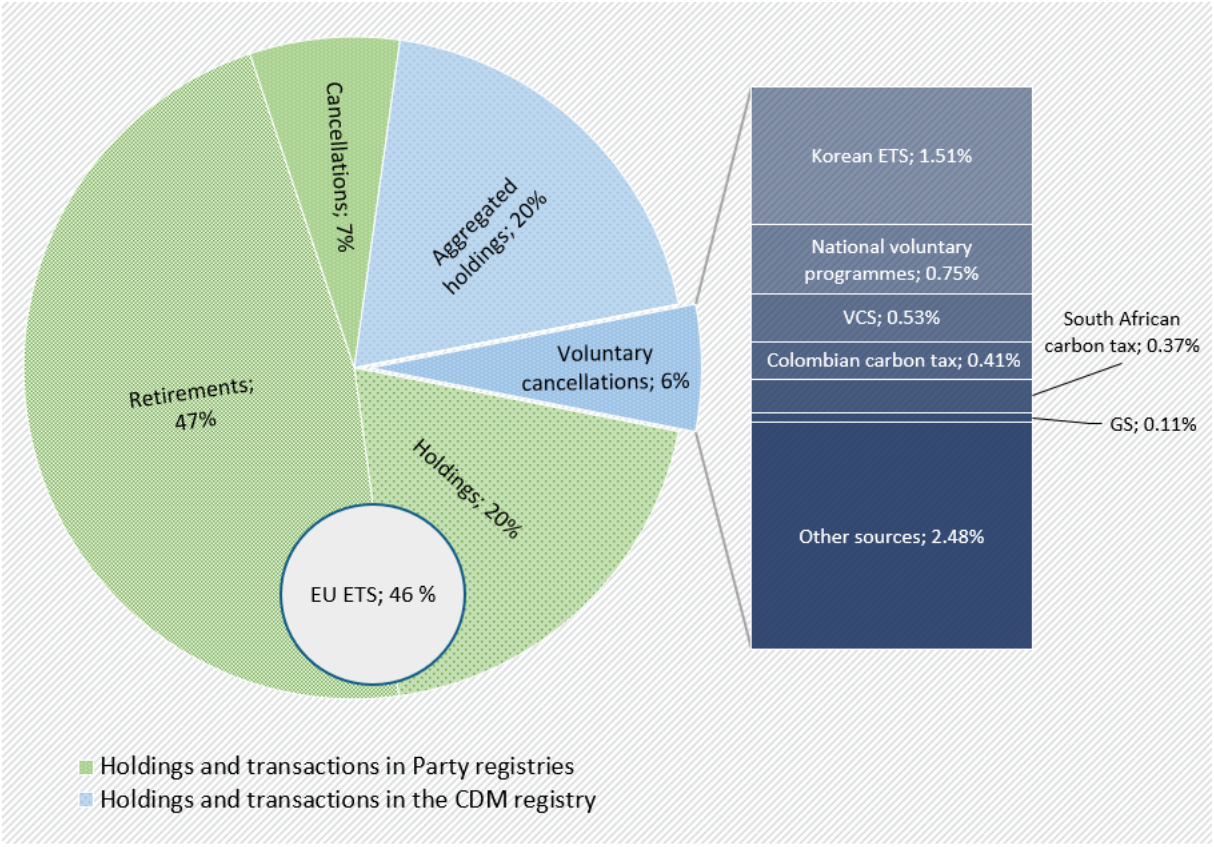
This section provides an overview of how CERs and ERUs have been used (see Figure 9). Of the total of 2.3 billion CERs that were issued, about 46% have been used in the EU ETS. While most of these CERs have been moved into retirement accounts in national registries, some of them are still in holding accounts. Several countries, such as Austria, Japan, Netherlands, Spain, Sweden, or Switzerland, have also purchased CERs through national programmes to comply with their Kyoto targets (this number is not known from currently available data). About 40% of the CERs have not yet been cancelled or retired in the CDM registry or national registries; however, some of these CERs may have already been sold or surrendered in the EU ETS.

Voluntary cancellations in the CDM registry make up about 6% of the use of CERs. These include several different uses, including use for compliance in carbon pricing schemes in developing countries which do not have emissions targets under the Kyoto Protocol (2.3%), use in the voluntary carbon market (1.1%), use as vehicle to disburse results-based climate finance (unknown), as well as personal use (unknown). Notably, about 1.5% of CERs have been used in the South Korean ETS and about 0.4% against the Colombian and South African carbon taxes. Some CERs were cancelled in order to be re-issued as other units under voluntary carbon market programmes, such as the Verified Carbon Standard (VCS) operated by Verra (0.5%).

In the future, some of the CERs in holding accounts of the CDM registry, including any potential further issuances for emission reductions up to 31 December 2020, could be transferred to the Article 6.4 mechanism registry and then be used to achieve NDCs. This possibility is limited to CERs from projects that were registered on or after 1 January 2013. Fearnehough et al. (2021)

estimate that in total up to about 300 million CERs could be transferred to the Paris Agreement for use towards NDCs. Information on the share of projects with German involvement is not available.

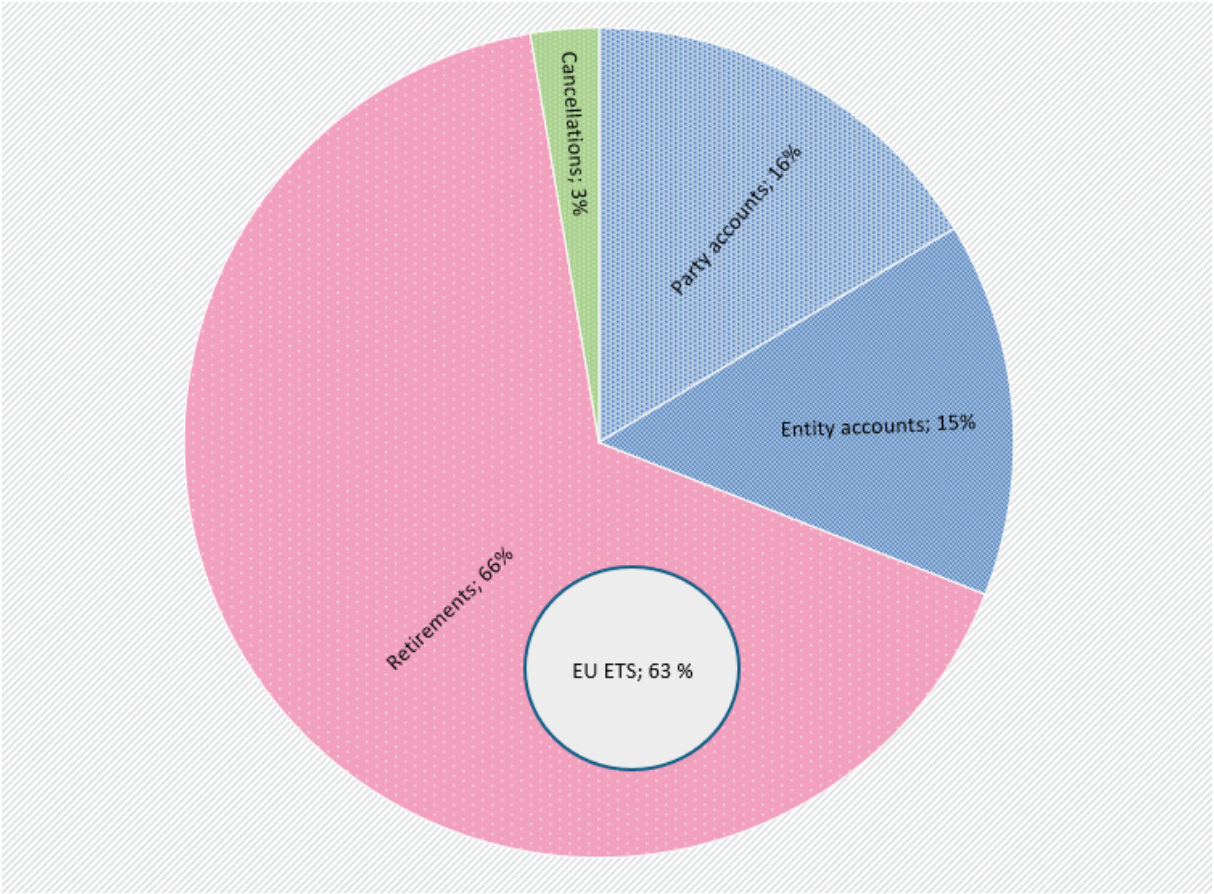
Figure 9: Use of CERs issued



Source: Own illustration based on Michaelowa et al. (2021), EEA (2022), European Commission (2021), UNFCCC (2022a), UNFCCC (2022b). All percentages refer to the respective share in total issuances. EU = European Union; ETS = emissions trading system; VCS = Voluntary Carbon Standard; GS = Gold Standard.

Figure 10 provides an overview of how ERUs have been used. As it was the case with CERs, the majority of ERUs have been used in the EU ETS (63%). In addition, some countries have purchased ERUs through national purchase programmes; however, this amount is likely to be relatively small compared to the use in the EU ETS. A large amount of ERUs (31%) are still in holding accounts and might never be used. Only 3% of ERUs were voluntarily cancelled, indicating that ERUs played only a minor role in the voluntary carbon market.

Figure 10: Use of ERUs issued

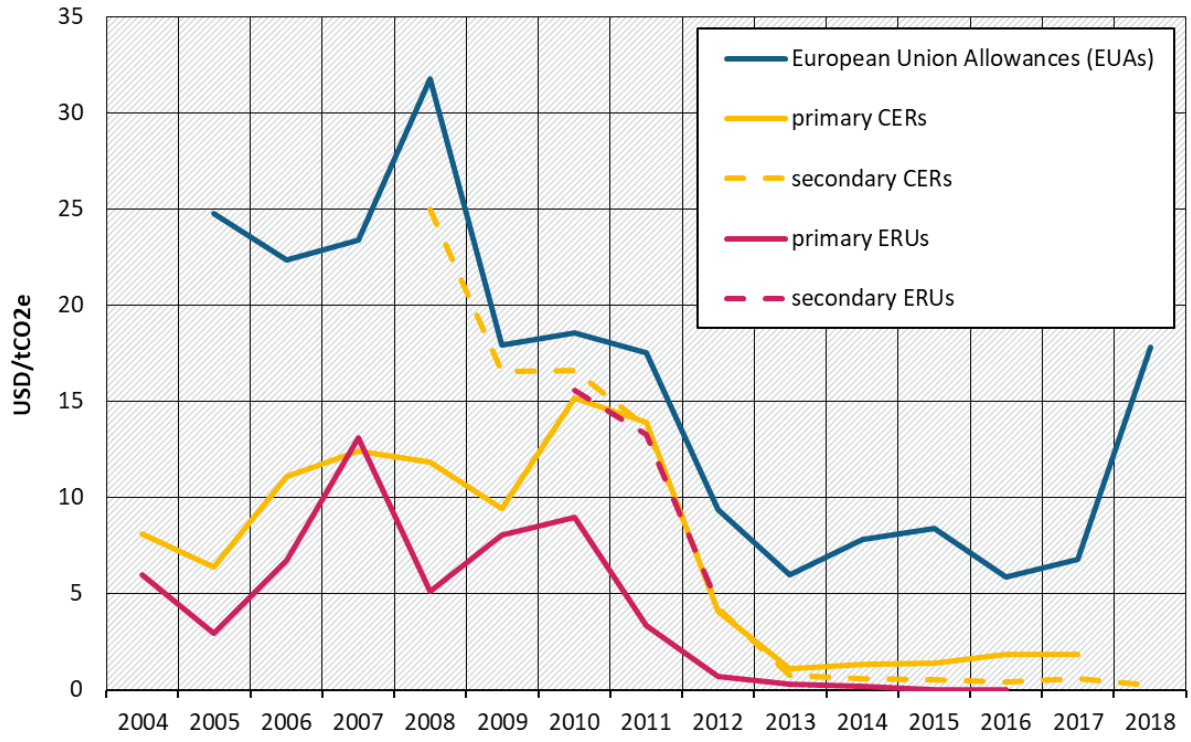


Source: Own illustration based on Takahashi (2022), EEA (2022), European Commission (2021). All percentages refer to the respective share in total issuances. EU ETS = Emissions trading system of the European Union.

2.7 Carbon credit prices

This section describes how the price for CERs and ERUs developed over time, compared to other carbon market units (see Figure 11). The prices did not only vary over time but also depended on the type of contract. Direct sales of not-yet-issued CERs from a project developer (primary CERs) initially fetched a lower price than the sale of an issued CER on an exchange (secondary CERs) while the opposite was the case more recently. In the early years of the CDM up to 2010, prices for primary CERs were typically in the range between 5 and 12 USD. From 2008 to 2012, the prices for secondary CERs and ERUs were strongly linked to the allowance prices in the EU ETS. This is because the EU ETS constituted the largest demand source for CERs and ERUs (see section 2.6). After 2012, the price for both CERs and ERUs crashed to below 1 USD, due to the reasons discussed in section 2.2 above (i.e., a surge in supply and decreasing demand). It should be noted that in the period 2013 to 2020 some primary CER types could achieve higher prices, in particular CERs that were attractive for buyers in the voluntary carbon market, CERs that were eligible in compliance schemes, such as the South Korea ETS, or CERs supported through other funding sources, such as the World Bank's Pilot Auctioning Facility. However, the quantities that could fetch higher prices were relatively small.

Figure 11: Prices over time of selected emission units



Source: Adapted from Michaelowa et al. (2019b). USD = US dollars; tCO2e = tonnes of CO_2 equivalents. Data on secondary CERs represent spot prices in the period 2008 to 2012 and futures due by December 2016 for the period 2013 to 2016.

3 Key lessons from CDM and JI for the Article 6.4 mechanism

This section gives an overview of key lessons learned from the CDM and JI, juxtaposing them with the provisions of the Article 6.4 mechanism that have already been decided upon. It covers key aspects of carbon crediting mechanisms, namely additionality, quantification of emission reductions, double counting, non-permanence, the project cycle, validation and verification, environmental and social impacts as well as governance and transparency.

3.1 Commonalities and differences between the Kyoto mechanisms and the Article 6.4 mechanism

This section provides an overview of commonalities and differences in the rules between the CDM and JI of the Kyoto Protocol and the Article 6.4 mechanism under the Paris Agreement. Further background on these issues is discussed in the following sections.

Overall, the rules of the Article 6.4 mechanism, laid out in the Glasgow Agreement, are in many areas stricter than under CDM and JI (see Table 2). However, the actual integrity and ambition of the Article 6.4 mechanism will strongly hinge on how the Article 6.4 Supervisory Body will implement the mechanism over the next years.

A key difference between the Article 6.4 mechanism and the CDM and JI is the objective of the mechanisms. All market-based mechanisms aim to enhance cost-effectiveness in achieving emission reductions. Additionally, the CDM and the Article 6.4 mechanism intend to provide finance for sustainable development. The imperative for the Article 6.4 mechanism goes one step further, as it aims to enhance the climate ambition of participating countries over time (UNFCCC 2015). This aims to address the criticism against the CDM and JI that they were only offsetting mechanisms, with an emission reduction in one place being offset by an increase in another place, not leading to any net reduction of emissions to the atmosphere. By contrast, the Article 6.4 mechanism aims to lead to globally enhanced mitigation action.

Another important difference between the Article 6.4 mechanism and the CDM is that the Paris Agreement requires all countries to communicate climate mitigation pledges, whereas under the Kyoto Protocol only Annex I countries had binding commitments. Hence, under the Article 6.4 mechanism, provisions are needed to avoid that the emission reductions or removals are counted both by the host country as well as the buyer country, referred to as “double counting”. Under the Paris Agreement, such double counting is avoided through “corresponding adjustments”, which require host countries to adjust their reported emissions. Under JI, such double counting was avoided by issuing ERUs through the conversion of assigned amount units (AAUs) which represent the emissions budget of each Annex I country.

The requirements for assessing additionality are also different under the Article 6.4 mechanism. The assessment of additionality must be conducted in a conservative manner and must take into account national policies on emission reductions. Moreover, activities are only eligible if they do not lock in emissions levels that are incompatible with the NDC or the long-term low emissions strategy of the host country and the temperature goals of the Paris Agreement (Paragraph 38 of the Annex to decision 3/CMA.3). This is a shift from the respective provisions of the CDM, which specifically allowed not considering relevant national mitigation policies implemented after a threshold year and did not consider lock-in risks (UNFCCC 2018c).

In line with stricter additionality requirements, baselines under the Article 6.4 mechanism must be set lower, thereby encouraging higher ambition. Under the CDM and JI, the baseline was

usually based on business-as-usual (BAU) emissions, considering more conservative scenarios in the case of uncertainty. Under the Article 6.4 mechanism, baselines shall be below BAU and aligned with the host country's NDC, any long-term low greenhouse gas (GHG) emission development strategy and the long-term goals of the Paris Agreements (Paragraphs 33 and 36 of the Annex to decision 3/CMA.3).

There were no social and environmental safeguards under the CDM, except a limited set of safeguards for afforestation or reforestation activities and more elaborated provisions for carbon capture and storage (CCS) activities (paragraph 97 UNFCCC 2018c). Generally, a host country authorization to confirm that the project contributed to sustainable development was deemed sufficient (Schneider et al. 2016). JI did not have any rules regarding environmental and social safeguards. This will change under the Article 6.4 mechanism, as "robust, social and environmental safeguards" are required under the Glasgow Climate Pact (Paragraph 24 of Annex B to decision 3/CMA.3). However, details are still undecided.

Compared to the CDM, the duration of crediting periods has been reduced under the Article 6.4 mechanism: While it was up to 21 years under the CDM (and up to 60 years for forest projects), it has been reduced to up to 15 years (and up to 45 years for removal activities) under the Article 6.4 mechanism (paragraph 31 of the Annex to decision 3.CMA/3 and 49 of the Annex to the decision 17.CP/7).

A completely new feature of the Article 6.4 mechanism is that a share of 2% of issued carbon credits must be cancelled to benefit the atmosphere, an approach referred to as overall mitigation in global emissions (OMGE; Paragraph 59 of Annex to the decision 3/CMA.3).

The 'share of proceeds', a share dedicated towards assisting developing countries through the Adaptation Fund, will increase to 5% under the Article 6.4 mechanism, instead of 2% under the CDM, in addition to a monetary contribution for each Article 6.4 emission reduction (A6.4ER) issued and a share of the funds received from administrative fees (paragraph 67 of Annex to decision 3.CMA/3).

Non-permanence has been addressed in a variety of ways under the CDM, depending on the project type. For afforestation projects, there were two types of credits available: Temporary certified emission reductions (tCERs), which were valid until the end of a Kyoto commitment period and then had to be replaced, and long-term certified emission reductions (lCERS), which were valid until the end of the last crediting period (i.e. up to 60 years) but had to be replaced in case of reversals. The non-permanence risk of CCS project was approached in a similar manner, as either the host country or the buyer country had to replace CERs in the case of reversals. However, none of the approaches proved to be effective, as institutional arrangements of the Kyoto Protocol will end with the second commitment period and replacing Kyoto units to account for reversals will no longer be possible from 2024 onwards. For the Article 6.4 mechanism, there are no provisions yet, only the requirement to minimize and compensate for reversals (paragraph 31 of Annex V to the decision 3/CMA.3).

The role of host countries is likely to change as well. They will have more responsibility under the Article 6.4 mechanism. They must decide whether projects are allowed to issue "mitigation contribution" credits or "authorized" credits (i.e., credits backed by corresponding adjustments for which double claiming with NDCs is avoided). Furthermore, they may determine the baseline approach and other methodological requirements, including additionality, and the crediting period, as long as these approaches are consistent with the rules, modalities and procedures (RMP) (paragraph 27 of the Annex to decision 3/CMA.3).

Table 2: Comparison CDM, JI and Article 6.4 Mechanism

	Clean Development Mechanism (CDM)	Joint Implementation (JI)	Article 6.4. Mechanism
Countries	Host countries: Non-Annex I Buyer countries: Annex I	Annex I countries	All countries
Double claiming	Not relevant, as projects are implemented in countries without binding commitment (but overlap with Cancun targets)	Addressed, as countries had to give up an AAU for each ERU issued	Addressed through corresponding adjustments
Additionality	Methods used: barrier test, regulatory additionality tests, investment tests, common practice tests	Not defined	Additionality assessment must be conservative, consider national legislation and activities must avoid locking in emissions
Methodology and baseline principles	Baselines should be set in a conservative manner, based on actual or historical emissions or comparable economically attractive technologies, or average emissions of top 20% similar project activities	Baselines are project specific, should be conservative and take into account national and sectoral policies	Baselines should be conservative, below BAU and based on (i) the best available technology, (ii) the best performing comparable activities, or (iii) actual and historic emissions, adjusted downwards in line with the long-term goal of the Paris Agreement
Environmental and social safeguards	Host country authorization sufficient; voluntary tool to assess sustainable development impacts	No reference to safeguards	The application of robust, social and environmental safeguards is required
OMGE	Not included	Not included	2% of A6.4ERs
Share of proceeds	2% towards assisting developing countries, through the Adaptation Fund, least developed countries (LDCs) are exempt	No provisions in the first commitment period of the Kyoto Protocol	5% of A6.4ERs at issuance; a monetary contribution by each project; and a regular transfer of an amount from the fund raised from administrative fees
Non-permanence	Efficient cookstoves: no provisions. Afforestation and reforestation: Buyer liability through tCERs or ICERs. CCS projects: Host or buyer country liability	Provisions differ between project types	Reversals must be minimized and compensated for. Further rules are still under discussion.
Role of host countries	Host country confirms that the projects support sustainable development	Track 1: Host countries establish their own rules for approving projects Track 2: Joint Implementation Supervisory Committee (JISC) sets rules and	Host country decides whether to issue authorized or mitigation contribution credits; can specify methodological issues.

	Clean Development Mechanism (CDM)	Joint Implementation (JI)	Article 6.4. Mechanism
		procedures, host country endorses project	

Source: Evaluation of rules set out in the Kyoto Protocol and the Paris Agreement, and relevant decisions taken under these treaties.

3.2 Additionality

Additionality is a core principle for carbon crediting mechanisms and thus played a crucial role in the methodologies of the Kyoto mechanisms. Generally, a mitigation activity is considered additional if the activity could not have been implemented without the incentive from the market-based cooperation (Michaelowa 2009). If a mitigation activity is not additional but nevertheless receives carbon credits, this can lead to an increase in global emissions (Schneider and La Hoz Theuer 2019).

Aspects that are crucial for assessing additionality include the presence of policy interventions that drive the implementation of mitigation activities and the financial attractiveness of the activities. For instance, a project that is mandated by a policy that is enforced in the host country cannot be seen as additional, even if it may not be financially viable (Gillenwater 2012). With regard to financial parameters, in case the profitability of a mitigation activity is lower than that of a realistic reference scenario activity (business-as-usual) or is lower than a pre-defined minimum rate of return, then the project can be deemed additional (Michaelowa et al. 2019b). While some researchers (Cames et al. 2016) see additionality only as given if the revenues from credit sales exceed a certain level, other researchers (Michaelowa et al. 2019a) do not see this as critical indicator for additionality.

Under JI Track 1, it was up to the host country to decide whether mitigation outcomes were additional, and the host country could decide to issue ERUs without international oversight. The lack of transparency and oversight in this process enabled projects with highly doubtful additionality to issue ERUs (Spalding-Fecher et al. 2012; Kollmuss et al. 2015). A first lesson learned for the Article 6.4 mechanism is thus the need for transparent and robust additionality tests, including for simplified approaches (e.g. due to special circumstances of some host countries).

Under the CDM and JI Track 2, additionality has been validated by an accredited independent auditor, referred to as designated operational entity (DOE) under the CDM and accredited independent entity (AIE) under JI. Validations were conducted based on information provided in the PDD and the requirements of the relevant methodology and other rules approved by the CDM Executive Board, or general methodological guidance adopted by the JISC, respectively. Under JI Track 2, a JI-specific approach to baseline setting was defined in 2011, which stated that the baseline should be established taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector (UNFCCC 2011b). Regarding additionality, three approaches were allowed: a) Provision of traceable and transparent information showing that the project scenario is not part of the identified baseline scenario, b) Provision of traceable and transparent information showing that the same approach for additionality demonstration has already been taken in cases for which determination is deemed final and which can be regarded as comparable, c) Application of the most recent version of the CDM Additionality Tool.

To assess the additionality of projects and programmes, different methods have been used under the Kyoto mechanisms, including prior consideration, regulatory tests, investment analysis, barrier analysis and common practice analysis. In the following, these methods are analysed with a focus on factors that have enabled ensuring high quality of carbon credits and those that have not. This leads to recommendations what approaches could be further used under the Article 6.4 mechanism.

When the first CDM project was registered in 2003, the main method to demonstrate additionality in the CDM, especially for small-scale projects, included the qualitative identification and description of barriers that would prevent the implementation of the activities. The barrier analysis was, however, considered to be very subjective, especially against the background that many project developers did not provide objective, third-party evidence for the prohibitive character of the identified barriers in their project documents (Schneider 2009). Sometimes the reported barriers were also found not to be credible.

For large-scale projects, a consolidated methodological 'tool for the demonstration and assessment of additionality' (TOOL01) that comprises an investment test or a barrier analysis, complemented by a common practice analysis, was adopted in 2004 (Ahonen et al. 2021). The latest version (v. 7) of this tool from 2012 includes five steps to demonstrate additionality: demonstration of being a first-of-its-kind project activity, identification of alternatives to the project activity consistent with current laws and regulations, investment analysis (and/or next step), barrier analysis and common practice analysis (UNFCCC 2012). Another widely applied CDM tool was the 'combined tool to identify the baseline scenario and demonstrate additionality' (TOOL02) with its latest version from September 2017 (UNFCCC 2017). So far, no other broadly applicable additionality tool was submitted, so that the two additionality tools became the *de facto* standard for additionality testing (Ahonen et al. 2021).

After some project rejections from 2007 onwards (Michaelowa 2009), the CDM Executive Board adopted new guidelines, requiring project developers to provide an objective demonstration how the CDM helps to overcome barriers (Spalding-Fecher et al. 2012). However, the information asymmetry between project developers on one side and validators and the oversight body on the other side persisted and thus it proved impossible to have a convincing approach to barrier testing. Validators became increasingly unwilling to validate projects that applied the barrier test and thus the share of projects successfully validated applying the barrier test fell significantly. This leads to the conclusion that barrier analysis should never constitute the sole additionality test in the context of the Article 6.4 mechanism.

Investment analysis also remained contested as validators and project participants found it burdensome due to the need to collect financial parameters for calculating the internal rate of return (IRR) (World Bank 2018). Observers felt a lack of transparency regarding data sources and there is again the problem of information asymmetry, which was seen to lead to gaming of parameters by project developers and thus undermining the test's robustness (PMR 2016; Ahonen et al. 2021). The Executive Board's answer was a more stringent specification of calculation approaches and the provision of default parameters for IRR thresholds and cost of capital in 2008 and 2011 (Spalding-Fecher et al. 2012), updated regularly since then. These measures have reduced the risk associated with information asymmetries and therefore criticism of the investment analysis has been reduced. Therefore, specific guidance for investment analysis and conservative default parameters should be provided in the Article 6.4 context.

Regarding the common practice test, Vicente Marcos (2012) raised the problem that the test excludes any similar project registered in the CDM or applying for registration. If the projects

registered in the past were not additional, the common practice test will be ineffective because it will show a penetration rate that is too low compared to a real BAU penetration. In addition, it is difficult to define an appropriate comparison group (i.e., related to technological specifications or geographical extent). A stand-alone common practice test thus should not be applied under Article 6.4.

Overall, the CDM and JI faced weaknesses in the different additionality tests, such as subjectivity and the presence of loopholes, alongside lack of predictability and clarity. Further, a trade-off was noted between environmental integrity and complexity as the level of confidence regarding an activity's additionality increased with the tests' complexity and the associated costs. The CDM Executive Board tried to resolve this conundrum by increasing standardisation of additionality tests and methodologies. Standardisation will also be a crucial strategy in the context of the Article 6.4 mechanism to keep complexity and associated transaction costs manageable.

The increasing standardisation of additionality tests and methodologies by the Executive Board also resulted in the emergence of positive lists of technologies that are deemed automatically additional. In 2018, for example, the Board adopted TOOL32 on "Positive lists of technologies" (UNFCCC 2022f). In contrast, negative lists could exclude projects that are not additional under most circumstances; such an approach has been applied for grid-connected renewable energy projects on the voluntary markets by Verra and the Gold Standard. For the CDM, the negative list includes nuclear energy, land-use activities other than afforestation or reforestation, such as avoided deforestation and forest degradation projects, but not on grounds of lacking additionality. This negative list was developed mainly due to perceived general risks to sustainable development as well as problems with assessing the actual mitigation contribution. Next to positive lists, negative lists could be used more extensively in the context of Article 6 cooperation, in order to weed out project types that are very unlikely to be additional.

Regarding specific project types and methodologies, some further lessons learned can be derived. In the context of JI, for example, some European countries had introduced mandatory requirements for the GHG emissions intensity of nitric acid plants (Ahonen et al. 2021). Thus, plants just achieving these requirements were deemed non-additional even if the project generated only costs but no benefits and would have passed the investment analysis. Newly introduced mitigation policies thus had an impact on the additionality decision of JI activities despite their financial attractiveness.

This discussion leads to a major issue in additionality determination under the CDM – whether mitigation policies newly introduced by the host country should be taken into account in additionality (or baseline) determination. After a long discussion that the CDM could generate perverse incentives that weaken emission reduction policies within host countries (Spalding-Fecher 2013), the "E+ and E- policies" rule was introduced (UNFCCC 2013). Under these rules, policies that increased emissions ("E+ policies") would not be considered for baseline setting and additionality assessment if those policies had been introduced after 1997. On the other hand, policies that reduced emissions ("E- policies") would not be considered in the baseline and additionality if introduced after 2001. The "E- policies" rule was interpreted in different ways, including that renewable electricity feed-in tariffs would not need to be considered in the investment analysis although they would make these projects clearly commercially attractive (Ahonen et al. 2021). Given this problematic outcome, the Article 6.4 rules have clearly specified that all policy instruments need to be taken into account at validation of activities, regardless of the date of their introduction or their impact (paragraph 38 of Annex V to the decision 3/CMA.3).

3.3 Quantification of emission reductions

While the approach to determine additionality was similar for most project types under the CDM, the quantification of emission reductions and removals is very dependent on the project type. The CDM has approved about 200 methodologies, which prescribe the quantification approaches for specific project types. For aspects that are common for several project types, the CDM has developed methodological tools that can be referred to in methodologies. The CDM methodologies and tools are the most comprehensive source for approaches to quantify emission reductions. Some voluntary carbon market programmes, such as the VCS and the Gold Standard, allow using CDM methodologies, next to their own methodologies.

Ever since CDM methodologies have started to be approved, there is debate regarding the balance between environmental integrity on the one hand and transaction costs and reasonably rewarding project developers for their mitigation on the other hand. A key principle under the CDM, and the Article 6.4 mechanism, is that emission reductions or removals must be estimated in a conservative manner. This principle has considerably evolved over time, in particular that the degree of conservativeness should depend on the level of uncertainty. While this principle is acknowledged under the CDM, the evaluations of specific methodologies have revealed challenges in applying it in practice, as a number of methodologies were assessed to overestimate emission reductions (Schneider 2011; Bailis et al. 2015; Schneider et al. 2010; Cames et al. 2016; Sonter et al. 2015). Common issues observed include:

- Use of outdated or not conservative default values;
- Use of data from questionable (literature) sources;
- Application of data to regions with different characteristics;
- Risks of adverse selection where project developers can "pick and choose" between different quantification approaches (e.g. measurements or default values);
- Large uncertainties in some assumptions or parameters, e.g. regarding usage patterns of appliances;
- Insufficient consideration of trends in a sector, for example, by relying on historical average data while the performance of appliances or installations changes dynamically over time;
- "Signal-to-noise" or attribution challenges, where observed changes in emissions are only partially attributable to mitigation activities, but occur to a large degree due to exogenous factors (e.g. changes of carbon stocks in vegetation or soils may be driven by natural factors, not human interventions);
- Perverse incentives for project developers to maximize carbon credit issuance through the operation of plants in a certain manner, like exceeding the nameplate design capacity or shifting operation to periods where a higher level of emission credits can be generated.

Over time, many CDM methodologies were frequently revised and generally improved in terms of usability and environmental integrity. In some instances, revisions addressed major risks for environmental integrity that were only identified in the course of the application of the methodologies (Schneider 2011), sometimes leading to significant reductions in the number of CERs that could be claimed by projects (e.g. AM0001, ACM0019, ACM0010). This documents that a lot has been learned over time with regard to the robustness of quantification approaches.

Under JI, methodological issues with the quantification of emission reductions were a major challenge in Russia and Ukraine. For some project types, the aggregated emissions from JI projects were larger than the actual national emissions reported by these countries. Methodological approaches in some sectors were highly questionable (Kollmuss et al. 2015). HFC-23 and SF_6 projects in Russia increased their waste gas formation above historical levels, at a time when perverse incentives for these projects were well known and being addressed under the CDM (Schneider and Kollmuss 2015). Baselines for natural levels of coal fires in coal mine tailings were heavily overestimated.

These experiences provide important lessons for the Article 6.4 mechanism. We recommend that the mechanism specifically addresses the following:

- It is important to have international oversight, and thorough review, of methodologies, as the experiences gathered with JI have highlighted. This process should include experienced experts without conflict of interest;
- Methodologies should be regularly updated, based on the lessons learned from their application and new scientific findings;
- Given that uncertainty in overall emission reductions was found to be a major risk for environmental integrity, the Article 6.4 mechanism should assess the overall uncertainty of emission reductions in a more systematic manner, ensuring that this captures uncertainty in scenarios, assumptions, models, data and measurements. The degree of conservativeness should be based on the uncertainty of overall emission reductions, applying approaches used for example in the Guidelines for national GHG inventories provided by the Intergovernmental Panel on Climate Change (IPCC);
- Attributability of calculated emission reductions or removals to mitigation actions can be a major challenge for some project types. The Article 6.4 mechanism should only approve methodologies for project types where these challenges can be appropriately addressed, e.g. by requiring minimum thresholds for the likelihood that emission reductions actually occurred in the light of the overall uncertainty and by requiring that emission reductions are quantifiable.

3.4 Double counting

Avoiding double counting of emission reductions or removals is another cornerstone for the integrity of carbon credits. Double counting can occur in three ways: through double issuance, through double claiming and through double use.

3.4.1 Double issuance

Double issuance means that two carbon credits are issued for the same emission reduction or removal. This can occur due to double registration of the same project and indirectly overlapping claims between two different projects.

Double registration occurs if a project is registered more than once, either under the same or a different programme. The risk of double registration within one programme can be mitigated by providing detailed information on individual projects on the carbon crediting programmes' websites and checks by programmes that the project has not yet been registered. Double registration of a project under two different carbon crediting programmes, however, is more difficult to address. Approaches to address this risk include the establishment of processes for transitioning projects to other programmes, requiring legal attestations from project developers

that they will not register the programme under another programme, or conducting checks with other relevant carbon crediting programmes to confirm the project is not registered elsewhere (Schneider et al. 2014). The CDM has provisions in place to address double registration within the CDM but does not address double registration between programmes (Oeko-Institut 2022a).

The other form of double issuance, overlapping claims, means that two projects claim the same emission reductions from the same source. It occurs when projects include emission reductions in their accounting boundaries that occur upstream or downstream of the mitigation action. For example, renewable power projects claim emission reductions occurring at fossil fuel plants elsewhere. This risk can be managed through requirements in methodologies that address potential overlaps, such as requiring other entities that may potentially claim the same emission reductions to declare that they will not do so, regulating which type of entity may claim the emission reductions (e.g. only the producer of the renewable electricity but not the user), or limiting the scope of methodologies to on-site emission sources (Schneider et al. 2014; Schneider et al. 2022a). The CDM partially addresses this risk. Some methodologies, such as biofuel methodologies, provide specific guidance to avoid indirect overlaps. Other methodologies, such as efficient cookstoves and biodigester methodologies, do not address this risk. They allow the distributers of the cookstoves or biodigesters to claim emission reductions from nearby land areas on which also afforestation projects could be implemented that would claim the same changes in carbon stocks. Moreover, the CDM only addresses overlapping claims among CDM projects and not overlaps with projects registered under other carbon crediting programmes (Oeko-Institut 2022b).

3.4.2 Double Claiming

Double claiming happens when the same emission reduction is claimed by the buyer of a carbon credit and countries or entities that report lower emissions to fulfil their mitigation commitments (Schneider et al. 2022a).

There are again two subtypes: double claiming with national targets, such as those enshrined in the NDCs, and double claiming with domestic mitigation schemes, such as ETSs. The former was less relevant in the context of the CDM, as CDM host countries had no mandatory mitigation targets under the Kyoto Protocol, though some of them pledged targets under the Cancun Agreements. JI addressed the issue through its design: host countries have to convert emission permits, their AAUs to the credits of the JI, the ERUs. This way, the overall emission budget of Annex B countries did not change (Kollmuss et al. 2015).

Under the Paris Agreement, double claiming is avoided by introducing a form of double-entry bookkeeping called “corresponding adjustments”, which means that host countries must adjust their reported emission level by the number of credits transferred to buyer countries or other entities. With the adoption of the rules for Article 6.2 at the 27th Conference of the Parties (COP) in Glasgow, a system to apply and report these corresponding adjustments has been put in place. Implementing this approach raises, however, several challenges due to the heterogenous nature of NDCs (Schneider et al. 2019), in particular with regard to accounting for single-year targets (Siemons and Schneider 2022).

Double claiming can also happen with domestic mitigation schemes, such as an ETS or a renewable electricity generation quota. This risk can be addressed through not allowing for the registration of projects that overlap with mitigation schemes, or establishing provisions that prohibit counting the reductions from projects towards mandatory domestic mitigation schemes (Schneider et al. 2022a). Under JI, for example, the EU addressed the risk of double counting

with the EU ETS through the Linking Directive (Directive 2004/101/EC). The CDM does not have provisions to address double claiming with domestic mitigation schemes (Oeko-Institut 2023a).

3.4.3 Double Use

Double use means that a single carbon credit is counted twice towards the same climate target or is used to attain several mitigation targets. This can be addressed through an effective registry that prevents cancelling the same credit more than once. In addition, it is important to avoid that several claims are made in association to one single cancellation. This can be prevented by requiring account holders to specify for which purpose carbon credits are used and to make this information publicly available (Schneider et al. 2022a). In the CDM registry and registries of Annex B countries, CERs cannot be cancelled twice. However, while the CDM registry allows to name the purpose of the cancellation and make this information public, it does not require it (Oeko-Institut 2022c).

Besides using corresponding adjustments to address the risk of double claiming with NDCs, the Article 6.4 mechanism should address other forms of double counting more comprehensively than the CDM. The mechanism should specifically introduce provisions for addressing:

- double registration with other carbon crediting programmes, including through procedures for transitioning mitigation activities from one programme to another;
- double issuance due to overlapping claims between mitigation activities, including mitigation activities registered under other carbon crediting programmes;
- double claiming with domestic mitigation schemes, such as ETS; and
- double use of carbon credits, by making it mandatory to clearly specify the purpose and beneficiary of the cancellation of an A6.4ER.

3.5 Non-permanence

The term non-permanence refers to the risk that emission reductions or removals are reversed. This may happen through anthropogenic interventions, such as land conversion, or natural occurrences, such as droughts or wildfires. This risk of reversal is relevant for project types that involve the enhancement or protection of carbon reservoirs, such as afforestation, as the stored carbon dioxide (CO_2) can be released back to the atmosphere. Other project types, such as landfill methane destruction, have no non-permanence risk as they are physically irreversible. The non-permanence risk is also low for projects displacing fossil fuels, such as renewable energy projects (Schneider et al. 2022a). Among the eligible project types under the CDM, there is a material non-permanence risk for afforestation, CCS and household projects displacing the use of non-renewable biomass (e.g. efficient cookstoves, biodigesters and water purification projects).

With regard to afforestation projects, the CDM addressed non-permanence through temporary crediting with buyer liability. There are two types of credits between which project developers can choose, tCERs and lCERs (see section 3.1).

Practice has shown that both approaches have several pitfalls. First, they rely on there always being subsequent commitment periods. However, as the second and last commitment period of the Kyoto protocol ended in 2020, the institutional arrangements and the technical infrastructure to replace tCERs and lCERs will no longer be in place (Schneider et al. 2022a). Unless these are translated into the Paris Agreement monitoring system, reversals will effectively not be compensated for. Second, the approach of buyer liability was unattractive for

buyers because they were responsible for replacing carbon credits. This is likely the reason why only 0.2% of all registered CDM projects are afforestation projects and less than 1% of issued credits were tCERs or lCERs (World Bank 2011; UNFCCC 2022c).

For CCS projects, the provisions for addressing non-permanence are similar to the CDM. In case of reversals or if a monitoring report is not submitted, credits have to be replaced with credits from a reserve, and if the reserve is not sufficient, the pending account or the holding account. Ultimately, either the buyer country or the host Party are liable for compensating for reversals (Annex to Decision 10.CMP/7). Moreover, CCS projects are the only project type under the CDM that has provisions for reducing the risk that reversals occur: It is mandatory to assess the geological reservoirs and develop a contingency plan (Appendix B to the Decision 10.CMP/7). However, since no CCS methodology was ever submitted to the CDM Executive Board and thus no project has ever been registered under the CDM, it is not clear how these provisions would hold up in practice.

Under the CDM, projects that displace the use of non-renewable biomass, such as efficient cookstove projects, have no provisions to assess or mitigate non-permanence risk (Oeko-Institut 2022d). However, there is non-permanence risk for these project types: They aim to reduce the demand for non-renewable biomass, *i.e.,* the degradation of forests or other land due to demand for firewood or charcoal. There is a material risk that these effects can be reversed, as forests are susceptible to various natural disturbances, such as wildfires (Oeko-Institut 2023b). Furthermore, there is also the possibility that the degradation of these forests will be halted and reversed in the future, even without these projects. For example, households may become richer in the future and adopt cleaner cooking methods that require less firewood or charcoal allowing the forest to regenerate in the long term. In a sense, this would also result in a non-permanent impact of the project.

Under JI, all project types were eligible, including those with non-permanence risks. A key difference to the CDM is that all activities are covered under mitigation targets under the Kyoto Protocol. Any reversals would thus be automatically accounted for, as long as reversals are visible in GHG inventories and accounted for as land-use activities under Article 3.3 and 3.4 of the Kyoto Protocol. Under JI, one project type in the fossil fuel sector was implemented that is also associated with reversal risks, namely the extinguishing of fires in coal waste piles (Kollmuss et al., 2015). No provisions other than the general Kyoto Protocol accounting rules were in place to address reversals.

Under the Article 6.4 mechanism, there are no regulations for non-permanence yet, besides the mandate for project activities to "[m]inimize the risk of non-permanence of emission reductions over multiple NDC implementation periods and, where reversals occur, ensure that these are addressed in full" (paragraph 31 of Annex V to the decision 3/CMA.3).

Key lessons learned regarding the project cycle from the CDM and JI experience for the Article 6.4 mechanism include the following:

- While temporary crediting was not attractive to buyers, it is generally considered a valid approach for addressing non-permanence as it most appropriately reflects the temporary nature of emission reductions or removals with reversal risk (Schneider et al. 2022b). If this approach is pursued under the Article 6.4 mechanism, it is important to establish long-lasting institutional arrangements for monitoring and replacement of temporary credits;
- Other approaches pursued in the voluntary carbon market may, however, also be valid, such as monitoring and compensation, including through pooled buffer reserves if monitoring and

compensation are ensured for long time frames and if the shares retained in the buffer are high enough to cover reversal risks, also under future climate change;

- Furthermore, for some project types it could make sense to require a non-permanence risk assessment and corresponding provisions to incentivise risk mitigation, for example, by requiring that the share of carbon credits that project developers must set aside in pooled buffer reserves depends on the level of non-permanence risk;
- Non-permanence should be addressed for all project types with reversal risks, including for household projects displacing the use of non-renewable biomass.

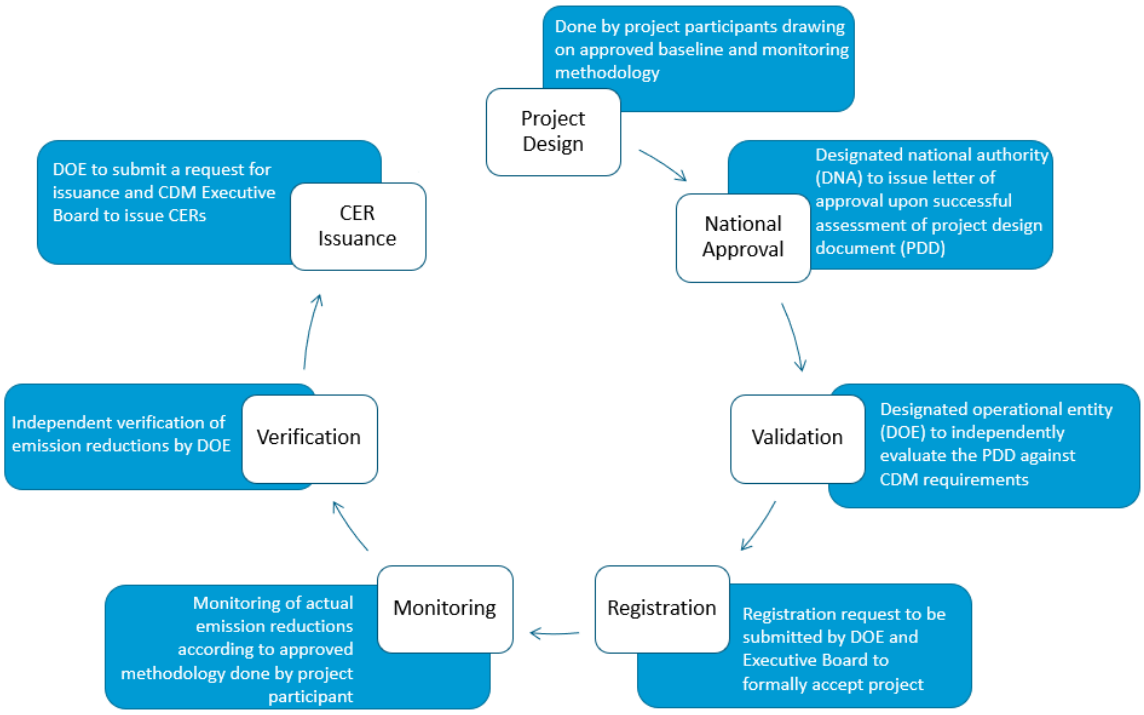
3.6 Project cycle

The CDM has gained wide-ranging experience with procedural requirements and associated transaction costs. Those lessons learned will be helpful for the operationalisation of the Article 6.4 mechanism.

The CDM project cycle refers to the stages that a project activity will need to run through before CERs can be issued (see Figure 12). The project cycle for JI Track 2 did not differ substantively from the CDM.

In the CDM project cycle, the pre-registration procedural requirements comprise an early notification of the intent to register the project under the CDM, the approval by the host country, conducting local stakeholder consultation, the development and publication of the PDD by the project participants and the validation of the project by a DOE. Once the registration request was submitted, the secretariat is to confirm whether and what registration fee is to be paid, to conduct a completeness check and to register the proposed activity in the absence of requests for review by the CDM Executive Board. The main pre-issuance cycle activities include the preparation of a monitoring report by the project participants and the verification of the monitoring outcomes by a DOE. Upon the receipt of the issuance request, the secretariat communicates the applicable share of proceeds (SoP) to the project participants, conducts the completeness check and, if positive, publishes the request on the website. Finally, if no review requests from an involved Party or at least three Executive Board members are received, the CERs are issued to the project participants. Furthermore, procedures have been established for any changes to the project design, changes to the participants involved in the project, or a change of the DOE.

Figure 12: CDM project cycle



Source: Own illustration based on UNFCCC (2021a)

In the early years of the CDM it became clear that especially small-scale projects encountered disproportionally higher transaction costs[1] for the development of project documentation (Michaelowa et al. 2019b; Kreibich et al. 2011). This resulted in the adoption of simplified rules and procedures for small-scale project activities from 2005 onwards (UNFCCC 2006).

In addition, the purely project-based approach of the CDM was expanded by the new concept of Programme of Activities (PoA) from 2005 onwards. It allows for adding an unlimited number of activities, referred to as component project activities (CPAs) to a programme that can have a crediting period of up to 28 years (Michaelowa et al. 2019b). Multiple CPAs can be included in a PoA at different points of the PoA lifetime through a streamlined process, thus enabling gradual expansion (UNFCCC 2022d). CPAs can cover different measures or the application of different technologies under one PoA (UNFCCC 2021). Also, a PoA can cover activities in several countries if all host countries involved provide their approval. CPAs may be small or large in scale with thresholds applying at the CPA level but not at the PoA level, meaning that thresholds do not limit the scaling-up potential of the PoA while a small-scale, stand-alone project is capped at emission reductions of 60,000 tCO_2 e per year.

The new concept was developed with the objective of reducing transaction costs and enhancing flexibility, standardisation and streamlining to enabling small-scale and/or dispersed project activities that would not be feasible as stand-alone projects under the CDM. Most importantly, the CPAs do not need to undergo the complete CDM project cycle to be added to a registered PoA (UNFCCC 2022d).

In general, transaction costs can negatively influence the viability of projects. In the early years of the CDM, the share of small projects was low as transaction costs for completing the project cycle were prohibitive for projects below a certain size. But as experience increased and rules

[1] Transaction costs comprise costs for the preparation of the PDD, the validation and verification process, monitoring, the registration and issuance fee and for the development of new methodologies if required.

were revised, e.g. introducing default parameters that allowed to do away with costly monitoring provisions, the share of small and even micro-scale projects grew considerably, showing that a credible international carbon market mechanism can be operated at low costs.

The PoA concept has proven to be an effective way to lower transaction costs especially for small-scale, dispersed projects. Compared to a stand-alone project structure, the PoA framework not only provides more flexibility in terms of temporal inclusion but also in terms of scope, meaning the type of technologies and measures. However, it took until 2011 to achieve clarifications on demonstration of additionality for PoAs and the definition of eligibility criteria for the inclusion of CPAs; and simplification of the use of multiple methods and technologies, including for city-wide programmes (UNFCCC 2011a). From 2011 onwards, the number of PoAs exploded. Over the following decade, the regulatory documents were streamlined further which led to PoAs being the only category of CDM activities that saw a significant expansion after the crash of CER prices in 2013. For example, in 2016 sampling was allowed for inclusion of CPAs. In March 2017, a PoA-specific project cycle procedure, project standard, validation and verification standard replaced a flurry of diverse regulatory documents.

The registration of a PoA follows basically the same steps as the CDM project cycle (UNFCCC 2021). The validation by the DOE is not required if the CPA is deemed automatically additional through a positive list. The DOE or the coordinating/managing entity (of the PoA) is then to upload the component project activity design document (CPA-DD).

Key lessons learned regarding the project cycle from the CDM and JI experience for the Article 6.4 mechanism include the following:

- When developing the procedures of the new mechanism, an emphasis should be put on clear rules and modalities as these will streamline the process and therefore lower the costs of developing projects (Cacho et al. 2013).
- Simplified rules and a programmatic approach should be introduced for small and micro-scale projects.
- Regarding upscaled approaches, an emphasis should be put on the simplification of the use of methods and the streamlining of regulatory documents to keep the administrative burden as low as possible.

3.7 Validation and verification

Validation and verification are third-party auditing processes to confirm that CDM requirements have been fulfilled by projects. Validation is the assessment before registration and renewal of crediting periods, whereas verification is the assessment before carbon credits are issued (Schneider et al. 2022a, see also 3.6).

Under the CDM, third-party auditors are accredited by the CDM Executive Board and referred to as DOEs. The accreditation process for DOEs is comprehensive; it includes, inter alia, checks on financial liability, management structure, mechanisms to safeguard impartiality, the availability of human resources, and assures necessary competencies as well as that a quality management system is present (UNFCCC 2018b). In case of non-compliance with the requirements, the Executive Board can suspend or even withdraw the accreditation of a DOE (Paragraph 20 and 21 of the Annex to decision 17.CP/7), which happened in various cases and led to the improvement of audit quality.

The current CDM accreditation process is the result of two decades of refinement and overhaul. In the early years of the CDM, severe concerns were raised regarding the quality of DOE

assessments; indeed, many DOEs were suspended (CDM Policy Dialogue 2012). Over the years, the Executive Board strengthened the accreditation process and developed a system to better oversee the performance of DOEs, including through regular performance monitoring, spot checks and regular surveillance procedures. Moreover, the capacity of the UNFCCC secretariat to double-check the assessments DOEs was enhanced. These regulatory changes led to the suspension of several DOEs and an increase in rejections of projects.

In principle, the system under Track 2 works similarly to the CDM: The JISC supervised and controlled third-party auditors, which were referred to as AIE under JI (Kollmuss et al. 2015; Joint Implementation Supervisory Committee 2015). Under Track 1, the host country was responsible for validation and verification. Host countries oftentimes chose AIEs accredited under Track 2 or DOEs accredited under the CDM. However, in this case the auditors were not accountable to the JISC or CDM Executive Board when auditing under Track 1, thus their accreditation could not be suspended or withdrawn in case of malfeasance. This most likely disincentivized AIE to conduct thorough audits, as audits were reportedly of low quality under JI Track 1. As the overwhelming majority of projects under JI were registered under Track 1, the lack of robust auditor oversight was found to be a severe integrity issue under JI (Kollmuss et al. 2015). A further major criticism to the CDM and JI auditing process is that auditors are paid by project developers which raises concerns about their impartiality and the lack of incentives to conduct thorough checks (Kollmuss et al. 2015; CDM Policy Dialogue 2012).

Key lessons learned regarding the project cycle from the CDM and JI experience for the Article 6.4 mechanism include the following:

- As the CDM standards and processes for the accreditation and monitoring of third-party auditors are well-established, we recommend that these processes be adopted under the Article 6.4 mechanism, with some adjustments. The Article 6.4 Supervisory Body should specifically introduce a DOE performance monitoring system, with escalating sanctions in case of low performances, such as additional spot checks.
- The Article 6.4 Supervisory Body should identify ways to address the potential perverse incentives arising if DOEs are directly contracted by project participants. This could, for example, be addressed through a lottery system whereby projects are allocated to DOEs by the Supervisory Body and the project participants pay DOEs according to a fee schedule established by the Supervisory Body.

3.8 Environmental and social impacts

While achieving emission reductions is the primary goal of carbon crediting mechanisms, both the CDM and the Article 6.4 mechanism also aim to support sustainable development. This comes with various challenges, as projects can advance sustainable development in host countries, but also come with the potential risk of harming local communities and ecosystems.

Many CDM project types are assessed to have potentially positive environmental and social impacts (Wissner et al. 2022; Hyman and Bailis 2018; Mori-Clement 2019). However, there have been CDM projects that drew criticism because of their negative effect on local communities and the environment. Cases of negative impacts have been reported in, inter alia, Brazil, China, Guatemala, Honduras, India and Panama (Carbon Market Watch 2013; Global Forest Coalition 2020). Besides the harm they cause, negative examples like these can severely damage the credibility of carbon crediting mechanisms.

Under the CDM, host countries' DNAs have to confirm that a project is beneficial for sustainable development. This approach has drawn criticism, as there is neither oversight nor a strong

incentive for host countries to comprehensively address social and environmental impacts (Fuessler et al. 2019).

To be able to address social and environmental impacts, they have to be identified and documented. The modalities and procedures of the CDM require an analysis of the environmental impact and, if potential impacts are deemed to be significant, an environmental impact analysis. An evaluation of social impacts is only required for afforestation or reforestation projects. Third-party auditors must attest that the analysis was conducted according to the procedures required by the host Party. However, there are no requirements to monitor adverse impacts beyond the start of the project and no provisions specifying which social and environmental impacts should be considered (Wissner and Schneider 2022).

To mitigate negative social impacts, stakeholder consultations are crucial. Local consultations help to include the groups in the process that are directly impacted, whereas global consultations give a wide range of stakeholders the opportunity to voice their concerns. In order to be effective, the feedback that is generated during these consultations should be considered by project developers (Wissner et al. 2022).

The CDM requires a local consultation with "as a minimum, representatives of local stakeholders directly impacted by the proposed CDM project activity and representatives of local authorities relevant to the project activity" (paragraph 97 UNFCCC 2018c). The stakeholder input must be considered, and it has to be described in the PDD how it was addressed (paragraph 206 UNFCCC 2018c). However, the validation of these processes as well as the consultation's timing depend again on the host countries' rules (Wissner and Schneider 2022).

The CDM also requires a global consultation process: the PDD has to be made public prior to the registration of a project, giving stakeholders the opportunity to comment for at least 30 days. These comments have to be addressed and documented (paragraph 18 UNFCCC 2018a; paragraph 255 UNFCCC 2018d). However, there is no mechanism available for stakeholders to raise grievances after a project begins (Oeko-Institut 2022e).

In 2014, the Executive Board released a tool to document the ways of how a project contributes to various sustainable development aspects (UNFCCC 2022g). However, this tool did not lead to the desired improvement, as it was voluntary, not widely used and focuses reporting the benefits of the projects, not their potential damages.

The JI mechanism has no substantive provisions to mitigate negative social and environmental impacts. Generally, the host country determines the form of social and environmental impact assessments and stakeholder consultations. In addition, requirements of Track 2 mandate a local stakeholder consultation process (albeit without specifying details) and require a third-party auditor to verify if an environmental analysis has been conducted (paragraph 3 of the Annex to 9/CMP.1). For both tacks, global stakeholder consultation is optional (Kollmuss et al. 2015).

To appropriately address social and environmental concerns under the Article 6.4 mechanism, a paradigm shift is necessary in comparison to the CDM and JI. We recommend that the Article 6.4 should include the following provisions:

- Reporting on sustainable development impacts should be mandatory and include positive as well as negative aspects. After the start of a mitigation activity, continuous monitoring of the impacts is necessary to be able to address negative impacts as they arise. The Sustainable Development Goals (SDGs) and their targets could be used as a framework for this as there are already several approaches using them to address sustainable development impacts (Wissner et al. 2022). Alternative frameworks are the World Bank's 'Environmental and Social Framework', the IFC Performance Standard 1 under the Sustainability Framework of

the International Finance Corporation (IFC) or the United Nations Development Program's Social and Environmental Standards (International Finance Corporation 2012; UNDP 2021; World Bank 2017).

- Third-party auditors should not only assess whether any environmental and social impact assessments were conducted and whether procedural requirements were fulfilled, but also assess the appropriateness of the content of such assessments.
- Local and global stakeholder consultation should be conducted prior to the decision of the project participants to proceed with the project. It should be mandatory to obtain free prior informed consent (FPIC) from affected indigenous groups (Wissner and Schneider 2022). Stakeholders should have the possibility to voice concerns through a grievance mechanism at any time.
- Finally, there should be specific safeguards that project developers should adhere to when implementing a project. These should at least include requirements regarding labour rights, health, environmental concerns, marginalized groups, specifically indigenous groups, and gender (Wissner and Schneider 2022).

3.9 Governance and transparency

The governance structures of the CDM and JI have three layers: the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) as the main decision-making body for both mechanisms, a UNFCCC body as a supervisory entity and the host countries. The two latter groups are responsible for decisions regarding the implementation of the mechanisms (Schneider et al. 2016).

The CDM Executive Board is the main supervisory entity for the CDM, supported by the UNFCCC secretariat and technical panels. In the participating countries, DNA approve projects, confirming that the project supports sustainable development in the country, and may authorize entities to participate in the mechanism (Schneider et al. 2016). The DOEs function as third-party auditors and are responsible for the validation and verification of projects (see also section 3.7).

Under JI, the governance structure depends on the track. The governance structure of Track 2 parallels the CDM's: the JISC is the counterpart to the CDM Executive Board and oversees the mechanism's implementation, while AIEs function as third-party auditors. Under Track 1, the host country bears the responsibility for establishing rules for the implementation of projects as well as overseeing project development and implementation (Schneider et al. 2016). This led to criticism regarding the lack of institutional oversight for Track 1 projects, as there were substantial concerns about their environmental integrity (Kollmuss et al. 2015).

Under JI, many host countries had Kyoto targets that were much looser than their BAU emissions. The resulting excess budget of AAUs was also referred to as 'hot air'. Under these circumstances, host countries had no incentives for ensuring environmental integrity of JI projects. This likely contributed to particularly questionable projects in these countries, whereas the integrity of projects in countries with ambitious Kyoto targets was generally higher (Kollmuss et al. 2015). Overall, this suggests that ambitious host country mitigation targets can provide a backstop and safeguard for ensuring integrity.

The governance structure under the Article 6.4 mechanism follows the same lines as under the CDM and the JI Track 2: The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA) is the main decision-making body, the Supervisory Body the central

supervisory entity and the involved Parties will have to approve project activities, next to further responsibilities (Schneider et al. 2016).

The CDM is characterized by a high degree of transparency. Under the CDM, PDDs are made public together with a summary of the comments received from local and global stakeholder consultation, a summary of the environmental impact assessment, if conducted, the applied baseline and monitoring methodology, authorization of the DNAs as well as validation and verification reports (paragraph 19 UNFCCC 2018a; 2023). Moreover, the decision-making processes are transparent, as detailed information is available on the CDM Executive Board meetings (CDM EB 2023).

This contrasts with the lack of public information under JI. The guidelines for Track 2 projects require the preparation of a PDD (paragraph 32 9/CMP.1). However, as there are no clear requirements on transparency for Track 1, public information is patchy and oftentimes lacking central documents, such as PDDs, monitoring reports and verification reports. Furthermore, many project developers used their own methodologies to calculate emission reductions and demonstrate additionality, which made it difficult to verify calculations (Kollmuss et al. 2015).

Key lessons learned regarding the project cycle from the CDM and JI experience for the Article 6.4 mechanism include the following:

- As the CDM has a positive track record regarding transparency, we recommend that its provisions be adopted under the Article 6.4 mechanism.
- Documents to be made publicly available should include all information submitted by mitigation activity proponents to the Supervisory Body, such as requests for registration and issuance with all accompanying information, comments received from local and global stakeholder consultation, the analysis of environmental and social impacts, as well as documents relating to validation and verification.

4 Suitability of mitigation activities for the Article 6.4 mechanism

The rules of the new Article 6.4 mechanism will substantially differ from the rules of the CDM and JI. At the same time, important lessons have been learned with CDM and JI, including on the project portfolio and the rulebook of these mechanisms. This raises the question of what types of mitigation activities are particularly suited for the new mechanism. Based on an analysis of the new rules and the experience with CDM and JI, we identify a number of key issues that should guide the approval of mitigation activities under the Article 6.4 mechanism:

- **High-hanging rather than low-hanging fruits:** Under the Paris Agreement, all countries have to communicate NDCs. To avoid the risk that host countries sell cheap mitigation options and then face difficulties in achieving their own NDC targets, and to enable the ambition of NDCs to be enhanced over time, it is critical that only those mitigation activities are pursued which are clearly out of reach for host countries. This typically involves more costly mitigation options and excludes low-cost, no-regret options. The exact type of mitigation activities to be pursued should be carefully considered in the light of the host country's NDC and any long-term low emission development strategy (LEDS) of the host country (Warnecke et al. 2018; Spalding-Fecher et al. 2020).

- **Enhancing ambition:** Enhancing ambition is a key objective of the Article 6.4 mechanism. The possibility of selling carbon credits could provide perverse incentives for host countries not to enhance the ambition of their NDCs, as this would lower the potential for selling carbon credits. To avoid this, it is important that host countries can use part of the emission reductions achieved through Article 6 to achieve their own NDC. This can be achieved in different ways: by sharing A6.4ERs between the host country and the buyer; by setting baselines well below the likely BAU emissions and in line with the long-term goal of the Paris Agreement, which can be implemented by applying an "ambition coefficient" that declines over time; and/or by choosing crediting periods shorter than the technical lifetime of the mitigation activities. Methodological choices under the Article 6.4 mechanism should thus be informed by the overall objective of enhancing ambition and ensure that only part of the achieved emission reductions is internationally transferred.

- **High likelihood of additionality:** The likelihood of additionality varies considerably among project types. The Article 6.4 Supervisory Body should ensure a high level of assurance that registered activities are additional. This does not hold for many popular project types under the CDM and JI. We recommend that the Article 6.4 Supervisory Body excludes projects from eligibility that have a low likelihood of additionality. This approach is also pursued by several carbon crediting programmes in the voluntary carbon market. Additionality rules should further encompass the following:

  - A notification of the intent to register a project with the Article 6.4 mechanism, submitted prior to the decision to proceed with the implementation of the mitigation activity;

  - A regulatory surplus test to ensure that the mitigation activity is not implemented due to legal requirements. This test should be repeated at appropriate intervals;

  - Assessments of the viability of the mitigation activity, based on standardized approaches, such as common practice, and/or project-specific approaches, such as investment analyses;

- An assessment that the mitigation activity does not lead to the lock-in of GHG emission intensive technologies or practices.

- **Attributability of calculated emission reductions to the mitigation actions and quantifiability of the emission reductions:** To ensure environmental integrity, it is important that the calculated emission reductions are caused by the underlying mitigation actions, and not by exogenous factors that are outside the control of the mitigation activity participants. This key principle may be difficult to ensure for some type of mitigation activities, such as avoiding deforestation, where the uncertainty in baselines (i.e., future deforestation rates) is high and observed changes in deforestation may occur due to exogenous factors affected the drivers of deforestation, such as changes in prices for palm oil, and measures undertaken as part of the mitigation activity. Furthermore, it is important the emission reductions can be robustly quantified. We recommend that activities for which these principles cannot be ensured to a satisfactory level should not be eligible under the Article 6.4 mechanism.

- **Synergies with other sustainable development objectives:** Mitigation activities should advance the sustainable development of the host country by providing co-benefits for the environment and local communities. Correspondingly, it should be carefully considered which types of mitigation activities have a high risk of adverse social and environmental impacts. The approaches pursued to ensure safeguards could be based on the risk of the associated type of mitigation activity, and activities with high risks could be excluded from eligibility under the mechanism.

- **Long-term climate benefits:** Mitigation activities that are subject to reversals, such as activities in the land-use sector, may substantially differ in the duration over which carbon is stored. To achieve the long-term goals of the Paris Agreement, it is critical that any reversals are limited in size. We therefore recommend that only those mitigation activities that have the ability to store carbon for long periods are allowed under the Article 6.4 mechanism. This does not apply, for example, for short-rotation plantations or to some carbon capture and utilization (CCU) options.

5 Conclusions

The carbon crediting mechanisms under the Kyoto Protocol, the Clean Development Mechanism (CDM) and Joint Implementation (JI), are in the process of being phased out. The new market-based mechanism under Article 6.4 of the Paris Agreement will replace the CDM and JI, providing an opportunity to build upon existing structures and to draw on the lessons learned from these mechanisms. For the new mechanism, the stakes are set high as it not only aims to achieve additional emission reductions and contribute to sustainable development but also includes several new principles and objectives, in particular raising ambition over time.

To achieve its objectives, the Article 6.4 mechanism will need to significantly differ from its predecessors. Thus, in many areas, provisions must go further than in the CDM and JI to ensure environmental integrity, mainly with regard to additionality testing, quantifying emission reductions and addressing non-permanence. The overlap with NDC goals is a new context that did not apply to the CDM. Moreover, the Article 6.4 mechanism needs to implement comprehensive social and environmental safeguards as these were mostly absent under the CDM and JI.

Some provisions can be transferred to the Article 6.4 mechanism with only minor adjustments as they are the result of substantial refinement and overhaul. This includes the rules and regulations addressing the project cycle, accreditation of auditors, validation and verification processes, provisions to ensure transparency and the governance structure.

Finally, based on the experiences under the carbon crediting mechanisms of the Kyoto protocol, we identified key issues that should be considered when developing the project portfolio. We recommend that mitigation activities under the Article 6.4 mechanism should be 'high-hanging fruits', enhance ambition, have a high likelihood of additionality, provide co-benefits for other sustainable development targets, and ensure that emission reductions can be reasonably attributable to the mitigation activity.

6 List of References

Ahonen, H.-M.; Michaelowa, A.; Espelage, A.; Kessler, J.; Christensen, J.; Dalfiume, S.; Danford, E. (2021): Safeguarding integrity of market-based cooperation under Article 6, Additionality determination and baseline setting (Background paper). Perspectives Climate Research gGmbH (ed.). Freiburg. Online available at https://www.zora.uzh.ch/id/eprint/208160/, last accessed on 11 Oct 2023.

Bailis, R.; Drigo, R.; Ghilardi, A.; Masera, O. (2015): The carbon footprint of traditional woodfuels. In: NATURE CLIMATE CHANGE 5 (3), pp. 266–272. DOI: 10.1038/nclimate2491.

Cacho, O.; Lipper, L.; Moss, J. (2013): Transaction costs of carbon offset projects: A comparative study. In: Ecological Economics 88, pp. 232–243. DOI: 10.1016/j.ecolecon.2012.12.008.

Cames, M.; Harthan, R.; Füssler, J.; Lazarus, M.; Lee, C.; Erickson, P.; Spalding-Fecher, R. (2016): How additional is the Clean Development Mechanism?, Analysis of the application of current tools and proposed alternatives. Oeko-Institut e.V. Berlin. Online available at https://www.oeko.de/en/publications/p-details/how-additional-is-the-clean-development-mechanism-1, last accessed on 11 Oct 2023.

Carbon Market Watch (2013): Local realities of CDM projects, A compilation of case studies. Online available at https://carbonmarketwatch.org/wp/wp-content/uploads/2013/11/case-studies-06-mail-2-dec-2013_final_light.pdf, last accessed on 11 Oct 2023.

CDM EB (2023): EB Meetings. Online available at https://cdm.unfccc.int/EB/index.html.

CDM Policy Dialogue (2012): CDM Policy Dialogue Research Programme - Research area: Governance. Luxembourg. Online available at http://www.cdmpolicydialogue.org/research/1030_governance.pdf, last accessed on 11 Oct 2023.

DEHSt - German Emissions Trading Authority (2022): German JI and CDM Project Database. Online available at https://www.dehst.de/EN/climate-projects_maritime-transport/project-mechanisms/project-database/projects_node.html, last accessed on 4 Oct 2022.

EEA - European Environment Agency (2022): EU Emissions Trading System (ETS) data viewer. Online available at https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1, last accessed on 22 Dec 2022.

European Commission (2021): Credits exchanged by 30 April 2021, European Commission. Online available at https://climate.ec.europa.eu/news-your-voice/news/updated-information-exchange-and-international-credits-use-eu-ets-2021-05-25_en, last accessed on 22 Dec 2022.

Fearnehough, H.; Schneider, L.; Warnecke, C. (2021): The potential impact of transitioning CDM units and activities to the Paris Agreement, Understanding implications of key policy choices on the table in Glasgow. Webinar, New Climate Institute; Öko Institut e.V. Online available at https://www.oeko.de/en/publications/p-details/the-potential-impact-of-transitioning-cdm-units-and-activities-to-the-paris-agreement, last accessed on 11 Oct 2023.

Fenhann, J. (2022): JI Pipeline overview. CDM/JI Pipeline Analysis and Database, UNEP Copenhagen Climate Centre. Online available at https://www.cdmpipeline.org/index.htm, last accessed on 4 Oct 2022.

Fuessler, J.; La Hoz Theuer, S.; Schneider, L. (2019): Transitioning elements of the Clean Development Mechanism to the Paris Agreement. Discussion Paper. Oeko-Institut e.V. German Emissions Trading Authority (DEHSt) at the German Environment Agency (ed.). Berlin. Online available at https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/discussion-papers/transitioning_elements.pdf;jsessionid=0CE24D49AA25A3B7D53B0FA233846736.1_cid292?__blob=publicationFile&v=2, last accessed on 11 Oct 2023.

Gillenwater, M. (2012): What is Additionality?. GHG Management Institute. Washington D.C. Online available at https://ghginstitute.org/wp-content/uploads/2015/04/AdditionalityPaper_Part-1ver3FINAL.pdf, last accessed on 11 Oct 2023.

Global Forest Coalition (2020): Vallourec: junk offset credits through charcoal production for the iron and steel sector in Brazil. Online available at https://globalforestcoalition.org/wp-content/uploads/2020/12/vallourec-CORSIA-case-study.pdf, last accessed on 11 Oct 2023.

Hyman, J. and Bailis, R. (2018): Assessment of the Cambodian National Biodigester Program. In: Energy for Sustainable Development 46, pp. 11–22. DOI: 10.1016/j.esd.2018.06.008.

International Finance Corporation (2012): Performance Standards on Environmental and Social Sustainability. Online available at https://www.ifc.org/content/dam/ifc/doc/2010/2012-ifc-performance-standards-en.pdf, last accessed on 11 Oct 2023.

Joint Implementation Supervisory Committee (2015): Joint Implementation Supervisory Committee thirty-seventh meeting, Version 01.0. JI-JISC37 (Meeting report). Online available at https://ji.unfccc.int/UserManagement/FileStorage/CINM47ARB1GWHKF6ZOPUDY2EJVQ5XT, last accessed on 11 Oct 2023.

Kollmuss, A.; Schneider, L.; Zhezherin, V. (2015): Has Joint Implementation reduced GHG emissions? Lessons learned for the design of carbon market mechanisms (Working Paper, 2015-07). Stockholm Environment Institute. Stockholm. Online available at http://www.sei-international.org/publications?pid=2803, last accessed on 11 Oct 2023.

Kreibich, N.; Arens, C.; Fechtner, H. (2011): Programmes of Activities – First Experiences with the programmatic CDM, Policy Brief 5/2011. Wuppertal Institut für Klima, Umwelt, Energie (ed.). Wuppertal. Online available at https://www.carbon-mechanisms.de/fileadmin/media/dokumente/Publikationen/Policy_Brief/PB_2011_05_Current_State_PoAs_eng_bf.pdf, last accessed on 11 Oct 2023.

Michaelowa, A. (2009): Interpreting the Additionality of CDM Projects: Changes in Additionality Definitions and Regulatory Practices over Time. In: Freestone, D. and Streck, C. (ed.): Legal Aspects of Carbon Trading. Kyoto, Copenhagen, and beyond. Oxford, UK: Oxford University Press, pp. 248–271.

Michaelowa, A.; Censkowsky, P.; Espelage, A.; Singh, A.; Betz, R.; Kotsch, R.; Dzukowski, T. (2021): Volumes and types of unused Certified Emission Reductions (CERs), Lessons learned from CDM transactions under the Kyoto Protocol, transparency gaps and implications for post-2020 international carbon markets. Perspectives Climate Group. Freiburg. Online available at https://www.zora.uzh.ch/id/eprint/207960/1/ZORA207960.pdf, last accessed on 11 Oct 2023.

Michaelowa, A.; Hermwille, L.; Obergassel, W.; Butzengeiger, S. (2019a): Additionality revisited: guarding the integrity of market mechanisms under the Paris Agreement. In: Climate Policy 19 (10), pp. 1211–1224. DOI: 10.1080/14693062.2019.1628695.

Michaelowa, A.; Shishlov, I.; Brescia, D. (2019b): Evolution of international carbon markets: lessons for the Paris Agreement. In: WIREs Clim Change (Wiley Interdisciplinary Reviews: Climate Change) 10 (6). DOI: 10.1002/wcc.613.

Mori-Clement, Y. (2019): Impacts of CDM projects on sustainable development: Improving living standards across Brazilian municipalities? In: World Development 113, pp. 222–236. DOI: 10.1016/j.worlddev.2018.06.014.

Oeko-Institut (2022a): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 2.2.1. Avoiding double issuance due to double registration. CDM. Online available at

https://carboncreditquality.org/download/Assessments/2.2.1%20CDM%20%2831%20May%202022%29.pdf, last accessed on 11 Oct 2023.

Oeko-Institut (2022b): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 2.2.2: Avoiding indirect overlaps between projects. CDM. Online available at https://carboncreditquality.org/download/Assessments/2.2.2%20CDM%20(31%20January%202023).pdf, last accessed on 11 Oct 2023.

Oeko-Institut (2022c): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 2.3: Avoiding double use. CDM. Online available at https://carboncreditquality.org/download/Assessments/2.3%20CDM%20%2831%20May%202022%29.pdf, last accessed on 11 Oct 2023.

Oeko-Institut (2022d): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 3.2. Robustness of the carbon crediting program's approaches for addressing non-permanence risks. CDM-Efficient cookstoves. Online available at https://carboncreditquality.org/download/Assessments/3.2.%20CDM%20Efficient%20cookstoves.pdf, last accessed on 11 Oct 2023.

Oeko-Institut (2022e): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 6.1 Robustness of the carbon crediting program's environmental and social safeguards. CDM - Landfill gas utilization & efficient cookstoves. Online available at https://carboncreditquality.org/download/Assessments/6.1%20CDM%20AR%20%2831%20January%202023%29.pdf, last accessed on 11 Oct 2023.

Oeko-Institut (2023a): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 2.4.3 Avoiding double claiming with mandatory domestic mitigation schemes. CDM. Online available at https://carboncreditquality.org/download/Assessments/2.4.3%20CDM%20%2831%20January%202023%29.pdf, last accessed on 11 Oct 2023.

Oeko-Institut (2023b): Application of the Oeko-Institut/WWF-US/EDF methodology for assessing the quality of carbon credits, 3.1 Significance of non-permanence risks. Efficient cookstoves. Online available at https://carboncreditquality.org/download/Assessments/3.1%20Efficient%20cookstoves%20%2831%20January%202023%29.pdf, last accessed on 11 Oct 2023.

Schneider, L. (2009): Assessing the additionality of CDM projects: practical experiences and lessons learned. In: Climate Policy 9 (3), pp. 242–254. DOI: 10.3763/cpol.2008.0533.

Schneider, L. (2011): Perverse incentives under the CDM: an evaluation of HFC-23 destruction projects. In: Climate Policy 11 (2), pp. 851–864. DOI: 10.3763/cpol.2010.0096.

Schneider, L. and Kollmuss, A. (2015): Perverse effects of carbon markets on HFC-23 and SF6 abatement projects in Russia. In: Nature Climate change 5 (12), pp. 1061–1063. DOI: 10.1038/nclimate2772.

Schneider, L. and La Hoz Theuer, S. (2019): Environmental integrity of international carbon market mechanisms under the Paris Agreement. In: Climate Policy 19 (3), pp. 386–400. DOI: 10.1080/14693062.2018.1521332.

Schneider, L.; Broekhoff, D.; Cames, M.; Healy, S.; Fuessler, J.; La Hoz Theuer, S. (2016): Market mechanisms in the Paris Agreement – Differences and commonalities with Kyoto mechanisms, Discussion paper. German Emissions Trading Authority (DEHSt) at the German Environment Agency (ed.). Berlin. Online available at https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/discussion-papers/Differences_and_commonalities_paris_agreement.pdf?__blob=publicationFile&v=3, last accessed on 11 Oct 2023.

Schneider, L.; Duan, M.; Stavins, R.; Kizzier, K.; Broekhoff, D.; Jotzo, F.; Winkler, H.; Lazarus, M.; Howard, A.; Hood, C. (2019): Double counting and the Paris Agreement rulebook. In: Science 366 (6462), pp. 180–183. DOI: 10.1126/science.aay8750.

Schneider, L.; Fallasch, F.; De León, F.; Rambharos, M.; Wissner, N.; Colbert-Sangree, T.; Progscha, S.; Schallert, B.; Holler, J.; Kizzier, K.; Petsonk, A.; Hanafi, A.; Barata, P. et al. (2022a): Methodology for assessing the quality of carbon credits, Version 2.0. World Wildlife Fund (WWF-US), Environmental Defense Fund (EDF), Oeko-Institut. Freiburg. Online available at https://carboncreditquality.org/download/Methodology/CCQI%20Methodology%20-%20Version%202.0.pdf, last accessed on 11 Oct 2023.

Schneider, L.; Fallasch, F.; De León, F.; Rambharos, M.; Wissner, N.; Colbert-Sangree, T.; Progscha, S.; Schallert, B.; Holler, J.; Kizzier, K.; Petsonk, A.; Hanafi, A.; Barata, P. et al. (2022b): Methodology for assessing the quality of carbon credits, Version 3.0. World Wildlife Fund (WWF-US), Environmental Defense Fund (EDF), Oeko-Institut. Freiburg. Online available at https://carboncreditquality.org/download/Methodology/CCQI%20Methodology%20-%20Version%203.0.pdf, last accessed on 11 Oct 2023.

Schneider, L.; Kollmuss, A.; Lazarus, M. (2014): Addressing the risk of double counting emission reductions under the UNFCCC. Stockholm Environment Institute. Online available at https://www.sei.org/publications/addressing-the-risk-of-double-counting-emission-reductions-under-the-unfccc-wp/.

Schneider, L.; Lazarus, M.; Kollmuss, A. (2010): Industrial N2O Projects Under the CDM: Adipic Acid - A Case of Carbon Leakage?, SEI working paper: WP-US-1006. Stockholm Environment Institute - US. Somerville. Online available at https://www.sei.org/publications/industrial-n2o-projects-cdm-adipic-acid-case-carbon-leakage/, last accessed on 11 Oct 2023.

Siemons, A. and Schneider, L. (2022): Averaging or multi-year accounting? Environmental integrity implications for using international carbon markets in the context of single-year targets. In: Climate Policy 22 (2), pp. 208–221. DOI: 10.1080/14693062.2021.2013154.

Sonter, L. J.; Barrett, D. J.; Moran, C. J.; Soares-Filho, B. S. (2015): Carbon emissions due to deforestation for the production of charcoal used in Brazil's steel industry. In: NATURE CLIMATE CHANGE 5 (4), pp. 359–363. DOI: 10.1038/nclimate2515.

Spalding-Fecher, R. (2013): National policies and the CDM rules: options for the future. Carbon Limits. Oslo. Online available at https://www.energimyndigheten.se/4a9bc6/contentassets/f3fd4d21d25a4aed8946ae5a33e9917f/carbon-limits---national-policies-and-cdm.pdf, last accessed on 11 Oct 2023.

Spalding-Fecher, R.; Achanta, A. N.; Erickson, P.; Haites, E.; Lazarus, M.; Pahuja, N.; Pandey, N.; Seres, S.; Tewari, R. (2012): Assessing the impact of the Clean Development Mechanism, Report commissioned by the High Level Panel on the CDM Policy Dialogue. United Nations Framework Convention on Climate Change (ed.). Bonn. Online available at http://www.cdmpolicydialogue.org/research/1030_impact.pdf, last accessed on 11 Oct 2023.

Spalding-Fecher, R.; Kohli, A.; Fuessler, J.; Broekhoff, D.; Schneider, L. (2020): Practical strategies to avoid over-selling. Oslo: Swedish Energy Agency. Online available at https://www.oeko.de/fileadmin/oekodoc/practical-strategies-to-avoid-overselling-final-report.pdf http://www.energimyndigheten.se/globalassets/webb-en/cooperation/practical-strategies-to-avoid-overselling-final-report.pdf.

Takahashi, K. (2022): IGES Kyoto Units Transfer Database (CP1 & CP2). In collaboration with Louhisuo, M., Institute for Global Environmental Strategies. Online available at https://doi.org/10.57405/iges-1456, last accessed on 19 Oct 2022.

UNDP - United Nations Development Programme (2021): Social and Environmental Standards. Online available at https://www.undp.org/content/undp/en/home/librarypage/operations1/undp-social-and-environmental-standards/, last accessed on 11 Oct 2023.

UNFCCC (2006): Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005. FCCC/KP/CMP/2005/8/Add.1. Online available at https://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf, last accessed on 11 Oct 2023.

UNFCCC (2011a): Executive Board of the Clean Development Mechanism sixty-third meeting report. Online available at https://cdm.unfccc.int/UserManagement/FileStorage/39JSGCP1Z0IHE26VAUMD4WNQRTOX5K, last accessed on 11 Oct 2023.

UNFCCC (2011b): Guidance on criteria for baseline setting and monitoring, Annex 2 of the twenty-sixth meeting report. Version 03. Joint Implementation Supervisory Committee. Online available at https://ji.unfccc.int/Sup_Committee/Meetings/026/Reports/Annex2.pdf, last accessed on 11 Oct 2023.

UNFCCC (2015): Decision 1/CP.21 Adoption of the Paris Agreement. FCCC/CP/2015/10/Add.1. Online available at https://unfccc.int/documents/9097, last accessed on 11 Oct 2023.

UNFCCC (2017): Methodological tool, Combined tool to identify the baseline scenario and demonstrate additionality. Version 05.0.0. Tool 02. Online available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v5.0.0.pdf, last accessed on 11 Oct 2023.

UNFCCC (2018a): Procedure, CDM project cylcle procedure for project activities. Version 01.0. CDM-EB93-A06-PROC. Online available at https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20170307130803756/pc_proc03.pdf, last accessed on 11 Oct 2023.

UNFCCC (2018b): Standard, CDM Accreditation Standard. Version 07.0. CDM-EB46-A02-STAN. Online available at https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20180323155152132/accr_stan01.pdf, last accessed on 11 Oct 2023.

UNFCCC (2018c): Standard, CDM project standard for project activities. Version 03.0. CDM-EB93-A04-STAN. Online available at https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20210921115735176/reg_stan03_v03.0.pdf, last accessed on 11 Oct 2023.

UNFCCC (2018d): Standard, CDM validation and verification standard for project activities. Version 02.0. CDM-EB93-A05-STAN. Online available at https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20181221092105818/Reg_stan06v02.pdf, last accessed on 11 Oct 2023.

UNFCCC (2021): Procedure, CDM project cycle procedure for programmes of activities. Version 03.0. CDM-EB93-A09-PROC. Online available at https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20210921110723406/pc_proc02_v03.0.pdf, last accessed on 11 Oct 2023.

UNFCCC (2022a): Aggregated holdings in the CDM Registry as at 30 November 2022, UNFCCC. Online available at https://cdm.unfccc.int/Registry/index.html, last accessed on 22 Dec 2022.

UNFCCC (2022b): Annual report of the Executive Board of the clean development mechanism to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol. FCCC/KP/CMP/2022/7. Online available at https://unfccc.int/documents/615071, last accessed on 19 Oct 2022.

UNFCCC (2022c): CDM Database for PAs and PoAs, UNFCCC. Online available at https://cdm.unfccc.int/Projects/projsearch.html, last accessed on 4 Oct 2022.

UNFCCC (2022d): CDM Programmes of Activities. Online available at https://cdm.unfccc.int/ProgrammeOfActivities/index.html, last accessed on 4 Oct 2022.

UNFCCC (2022e): Information note, Workplan of the Supervisory Body 2022–2023. Version 01.0. A6.4-SB002-A02. Online available at https://unfccc.int/sites/default/files/resource/a64-sb002-a02.pdf, last accessed on 11 Oct 2023.

UNFCCC (2022f): Methodological tool, Positive lists of technologies. Version 04.0. Tool 32. Online available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v4.0.pdf, last accessed on 11 Oct 2023.

UNFCCC (2022g): Sustainable Development co-Benefits Tool. Online available at https://www4.unfccc.int/sites/sdcmicrosite/Pages/SD-Tool.aspx, last updated on 9 Dec 2022, last accessed on 11 Oct 2023.

UNFCCC (2023): CDM project activities. Online available at https://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html, last updated on 31 May 2023, last accessed on 11 Oct 2023.

Vicente Marcos, M. (2012): First-of-its-Kind and Common Practice. Online available at https://carbonmarketwatch.org/2012/05/30/first-of-its-kind-and-common-practice/, last accessed on 23 Feb 2023.

Warnecke, C.; Höhne, N.; Tewari, R.; Day, T.; Kachi, A. (2018): Opportunities and safeguards for ambition raising through Article 6, The perspective of countries transferring mitigation outcomes. NewClimate Institute. Cologne. Online available at https://newclimate.org/2018/05/09/opportunities-and-safeguards-for-ambition-raising-through-article-6/, last accessed on 11 Oct 2023.

Wissner, N. and Schneider, L. (2022): Ensuring safeguards and assessing sustainable development impacts in the voluntary carbon market, An overview of approaches. Oeko-Institut e.V. Stiftung Allianz für Entwicklung und Klima (ed.). Online available at https://www.oeko.de/en/publications/p-details/ensuring-safeguards-and-assessing-sustainable-development-impacts-in-the-voluntary-carbon-market, last accessed on 11 Oct 2023.

Wissner, N.; Schneider, L.; Jung, H.; Hernández Orozco, E.; Kwamboka, E.; Johnson, F. X.; Bößner, S. (2022): Sustainable development impacts of selected project types in the voluntary carbon market. Öko Institut e.V.; Stockholm Environment Institute. Stiftung Allianz für Entwicklung und Klima (ed.). Online available at https://www.oeko.de/en/publications/p-details/sustainable-development-impacts-of-selected-project-types-in-the-voluntary-carbon-market, last accessed on 11 Oct 2023.

World Bank (2011): BioCarbon Fund Experience, Insights from Afforestation and Reforestation Clean Development Mechanism Projects. Online available at https://openknowledge.worldbank.org/handle/10986/27108, last accessed on 11 Oct 2023.

World Bank (2017): Environmental and Social Framework. Online available at https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf, last accessed on 11 Oct 2023.

World Bank (2018): Carbon Markets Under the Kyoto Protocol, Lessons Learned for Building an International Carbon Market Under the Paris Agreement (World Bank Working Paper). Online available at https://elibrary.worldbank.org/doi/abs/10.1596/31210, last accessed on 11 Oct 2023.

Appendix: Most frequently used CDM methodologies

Table A1: Most frequently used CDM methodologies by issuances and project registrations

Methodology	Project type	All projects				Projects with German involvement			
		CER issuances		CDM project registrations		CER issuances		CDM project registrations	
		CERs (millions)	Share	Number	Share	CERs (millions)	Share	Number	Share
ACM0002	Large-scale renewable power generation	659	29.0%	3252	39.6%	97	20.6%	225	39.8%
AM0001	HFC-23 abatement from HCFC-22 production	540	23.8%	19	0.2%	144	30.8%	3	0.5%
AM0021	N_2O abatement from adipic acid	264	11.6%	4	0.0%	0	0.0%	0	0.0%
ACM0001	Landfill gas capture	118	5.2%	220	2.7%	28	6.0%	15	2.7%
AM0029 (replaced by ACM0025)	New natural gas power plants	74	3.2%	52	0.6%	37	8.0%	5	0.9%
AMS-I.D.	Small-scale renewable power generation	74	3.2%	1993	24.3%	10.2	2.2%	103	18.2%
ACM0008	Coal mine methane capture	62	2.8%	76	0.9%	29	6.2%	8	1.4%
AM0028	N2O abatement from nitric acid production	62	2.7%	17	0.2%	52	11.0%	5	0.9%
ACM0004 (replaced by ACM0012)	Waste energy recovery	60	2.6%	111	1.4%	3.8	0.8%	4	0.7%

Methodology	Project type	All projects				Projects with German involvement			
		CER issuances		CDM project registrations		CER issuances		CDM project registrations	
		CERs (millions)	Share	Number	Share	CERs (millions)	Share	Number	Share
AM0009	Oil field flaring reduction	33	1.5%	26	0.3%	0	0.0%	0	0.0%
AM0023	Reduction of methane leaks from natural gas pipelines	29	1.3%	18	0.2%	0	0.0%	0	0.0%
AM0034 (replaced by ACM0019)	N2O abatement from nitric acid production	28	1.2%	51	0.6%	6.5	1.4%	3	0.5%
ACM0012	Waste energy recovery	24	1.0%	145	1.8%	0.1	0.0%	2	0.4%
AMS-II.G.	Efficient cookstoves	21	0.9%	97	1.2%	6.1	1.3%	15	2.7%
ACM0006	Biomass power generation	19	0.8%	144	1.8%	2.0	0.4%	9	1.6%
ACM0005	Clinker replacement	11	0.5%	17	0.2%	9.4	2.0%	3	0.5%
AMS-I.C.	Small-scale renewable energy generation	11	0.5%	200	2.4%	2.9	0.6%	26	4.6%
ACM0019	N2O abatement from nitric acid production	10	0.4%	25	0.3%	3.8	0.8%	1	0.2%
AM0003 (replaced by ACM0001)	Landfill gas capture	8.8	0.4%	5	0.1%	0	0.0%	0	0.0%
AR-AM0005 (replaced by AR-ACM0003)	Afforestation or reforestation	7.6	0.3%	5	0.1%	0	0.0%	0	0.0%
AMS-I.E.	Cooking with renewable energies	5.5	0.2%	29	0.4%	5.2	1.1%	7	1.2%

Methodology	Project type	All projects				Projects with German involvement			
		CER issuances		CDM project registrations		CER issuances		CDM project registrations	
		CERs (millions)	Share	Number	Share	CERs (millions)	Share	Number	Share
AM0016 (replaced by ACM0010)	Manure management	5.3	0.2%	40	0.5%	0	0.0%	0	0.0%
AMS-I.I.; AMS-III.R.	Household biodigesters	5.0	0.2%	4	0.0%	5.0	1.1%	1	0.2%
AMS-III.H	Manure management	4.8	0.2%	210	2.6%	0	0.0%	9	1.6%
AM0025 (replaced by ACM0022)	Alternative waste treatment	4.8	0.2%	62	0.8%	1.3	0.3%	5	0.9%
AMS-III.D.	Waste water treatment	4.5	0.2%	177	2.2%	0.1	0.0%	1	0.2%
AM0022 (replaced by ACM0014)	Wastewater treatment	4.1	0.2%	13	0.2%	1.1	0.2%	6	1.1%
AMS-III.AV.	Water purification	3.8	0.2%	9	0.1%	3.8	0.8%	2	0.4%
AMS-II.J.	Efficient lighting	3.3	0.1%	56	0.7%	0.1	0.0%	2	0.4%
AMS-III.E.	Biomass power generation	2.5	0.1%	26	0.3%	2.5	0.5%	4	0.7%
AMS-I.A.	Household renewable energies	2.3	0.1%	16	0.2%	2.3	0.5%	5	0.9%
ACM0014	Wastewater treatment	2.1	0.1%	28	0.3%	0.6	0.1%	5	0.9%
ACM0018	Biomass power generation	1.9	0.1%	56	0.7%	0.4	0.1%	7	1.2%
AMS-I.C.; AMS-III.E.	Biomass power generation	1.9	0.1%	12	0.1%	1.6	0.3%	3	0.5%
AMS-II.D.	Fuel switch in industry	1.1	0.0%	55	0.7%	0.4	0.1%	4	0.7%

Methodology	Project type	All projects				Projects with German involvement			
		CER issuances		CDM project registrations		CER issuances		CDM project registrations	
		CERs (millions)	Share	Number	Share	CERs (millions)	Share	Number	Share
AMS-III.F.	Composting	0.8	0.0%	61	0.7%	0.3	0.1%	13	2.3%
AMS-II.C.	Energy efficient household appliances	0.6	0.0%	21	0.3%	0.1	0.0%	6	1.1%
AMS-III.Q.	Waste energy recovery	0.4	0.0%	45	0.5%	0.1	0.0%	3	0.5%
AMS-III.G.	Landfill gas capture	0.1	0.0%	40	0.5%	0	0.0%	11	1.9%
Total		**2169**	**95.5%**	**7437**	**90.5%**	**456**	**97.5%**	**521**	**92.2%**

The table contains all methodologies which belong to the top 20 by either CER issuances or CDM project registrations, both based on all projects and projects with German involvement. The share of each methodology in issuances/project registrations is relative to all projects and all projects with German involvement respectively. Sorted by CER issuances from all projects. Methodologies in italic have been withdrawn and are therefore no longer active.
Source: Own calculations based on UNFCCC (2022c), DEHSt (2022)