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King Abdullah Petroleum Studies and Research Center

Commentary

Paris Agreement Article 6 and Geological CO_2 Storage

The State of Affairs After COP 28

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About KAPSARC

KAPSARC is an advisory think tank within global energy economics and sustainability providing advisory services to entities and authorities in the Saudi energy sector to advance Saudi Arabia's energy sector and inform global policies through evidence-based advice and applied research.

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Introduction

The headline decision from the United Nations Climate Change Conference in Dubai (COP 28[1]), held in December 2023, on the Global Stocktake, contains two groundbreaking statements: it calls on countries to transition away from fossil fuels in energy systems and to accelerate the deployment of carbon capture and storage, particularly in hard-to-abate sectors and in low-carbon hydrogen production (UNFCCC 2023a). This marks the first time such statements have been incorporated into key decision text under the United Nations Framework Convention on Climate Change (UNFCCC). While the decision signals a long-awaited global consensus that fossil fuels should be limited to non-combustion or abated uses in the future, it also acknowledges that certain industries and countries will require transitional technologies, such as carbon capture and storage (CCS), as they transition to net-zero emissions.

While this outcome was hailed as a success by many, the major failure of countries to agree on a way forward in operationalizing carbon market mechanisms under the Paris Agreement presents a significant obstacle to pursuing international cooperation in this area. These mechanisms are widely regarded as essential for mobilizing the international funding required for CCS and geological storage initiatives.

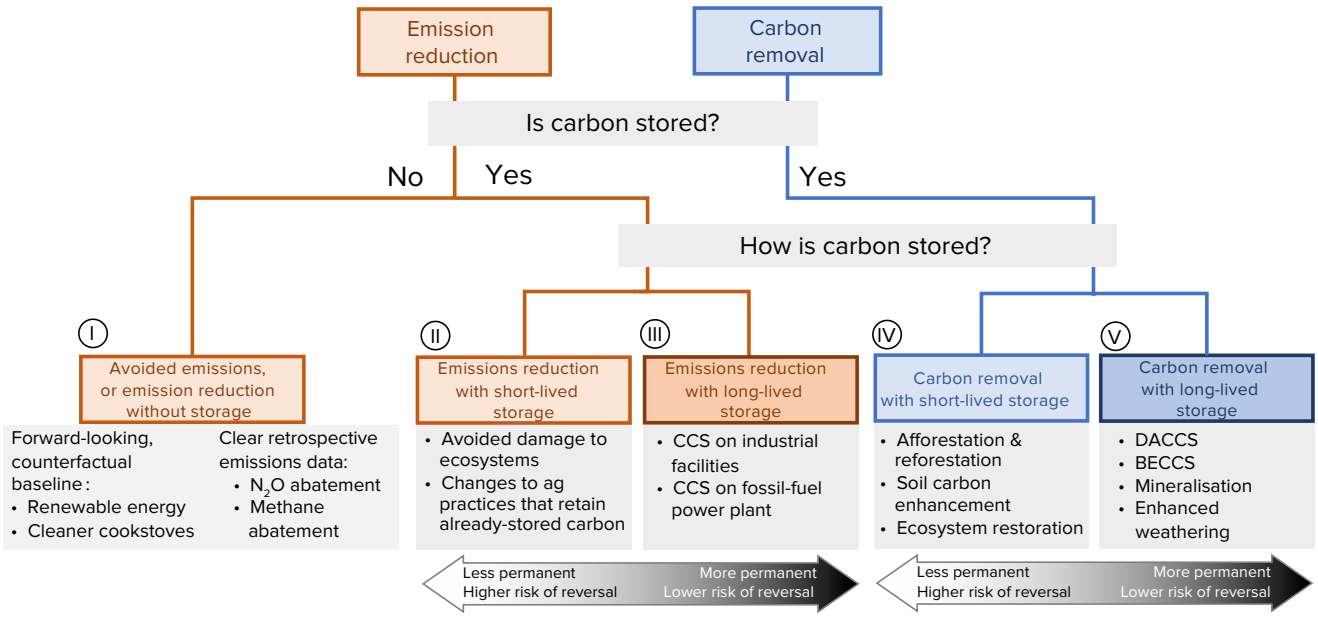
This KAPSARC commentary focuses on the role of CCS within the market mechanisms defined in Article 6 of the Paris Agreement. It discusses how related technologies fit under Article 6 and examines the current progress in implementing this article. The analysis draws insights from the CCS-specific provisions of the Clean Development Mechanism (CDM), which is part of the Kyoto Protocol and aimed to facilitate carbon dioxide (CO_2) emission reduction projects in developing countries. These provisions are revisited as a foundational reference, offering a valuable perspective on the methods and processes necessary for integrating CCS into the market mechanisms of the Paris Agreement. The commentary concludes with an assessment of the next necessary steps to enable the development of CCS crediting projects under Article 6.

[1] *The database can be retrieved at https://www.kapsarc.org/research/publications/the-implications-for-the-power-sector-from-innovation-by-startup-companies/*

The Need for International Economic Incentives to Scale Up Carbon Capture and Storage

Carbon capture and storage comprises a suite of technologies that includes the capture of CO_2 from large-scale energy and industrial sources, the transportation of captured CO_2 and, ultimately, its injection into deep underground rock formations for long-term storage. As CCS prevents the release of captured emissions into the atmosphere, it is recognized in UNFCCC terminology as an emission reduction technology. Additionally, geological storage can also facilitate the removal of CO_2 from the atmosphere. This occurs when the CO_2 submitted for geological storage originates from biogenic sources, that is, the CO_2 has been absorbed by plants through photosynthesis from ambient air before being captured (bioenergy with CCS, BECCS), or when CO_2 is directly removed from the atmosphere through technical processes (direct air capture with carbon storage, DACCS). Both DACCS and BECCS could result in negative CO_2 emissions, that is, the transfer of atmospheric CO_2 to a geological storage formation for long-term storage. Figure 1 illustrates the difference between emission reductions and emission removals and related applications for CCS, and Box 1 provides a list of relevant terminology.

Figure 1. Taxonomy of Abatement Options.



Source: Allen et al. 2020.

Box 1: Terminology Related to Storage in the Context of the UNFCCC (from the IPCC Glossary [IPCC 2024], unless otherwise noted)

Anthropogenic removals: The withdrawal of GHGs from the atmosphere as a result of deliberate human activities. These include enhancing biological sinks of CO_2 and using chemical engineering to achieve long-term removal and storage. Carbon capture and storage, which alone does not remove CO_2 from the atmosphere, can help reduce atmospheric CO_2 from industrial and energy-related sources if combined with BECCS or if CO_2 is directly captured from the air and stored (DACCS).

Bioenergy with CO_2 Capture and Storage (BECCS): Carbon dioxide capture and storage technology applied to a bioenergy facility. Note that, depending on the total emissions of the BECCS supply chain, carbon dioxide can be removed from the atmosphere.

Carbon Dioxide Capture and Storage (CCS): A process in which a relatively pure stream of CO_2 from industrial and energy-related sources is separated (captured), conditioned, compressed, and transported to a storage location for long-term isolation from the atmosphere. Sometimes referred to as carbon capture and storage.

Carbon Dioxide Removal (CDR): Anthropogenic activities removing CO_2 from the atmosphere and durably storing it in geological, terrestrial or ocean reservoirs or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical CO_2 sinks and DACCS but excludes natural CO_2 uptake not directly caused by human activities.

Carbon Neutrality: A condition in which anthropogenic CO_2 removals balance anthropogenic CO_2 emissions associated with a subject. The subject can be an entity such as a country, an organization, a district or a commodity, or an activity such as a service or an event. Carbon neutrality is often assessed over the lifecycle, including indirect ('scope 3') emissions, but can also be limited to the emissions and removals over a specified period for which the subject has direct control, as determined by the relevant scheme.

Carbon Sink: Any process, activity or mechanism which removes CO_2 from the atmosphere.

Direct Air CO_2 Capture and Storage (DACCS): A chemical process by which CO_2 is captured directly from the ambient air, with subsequent storage. Also known as direct air capture and storage (DACS).

Geological Storage Site: A paired geological formation, or a series of such formations, consisting of an injection formation of relatively high porosity and permeability into which CO_2 can be injected, coupled with an overlying cap rock formation of low porosity and permeability and sufficient thickness which can prevent the upward movement of CO_2 from the storage formation (UNFCCC 2012).

Net-Zero Emissions: A condition in which anthropogenic CO_2 emissions are balanced by anthropogenic CDRs over a specified period.

Seepage: A transfer of CO_2 from beneath the ground surface or seabed ultimately to the atmosphere or ocean (UNFCCC 2012).

Key applications for CCS are predominantly found in industrial sectors, where it can be employed to mitigate process emissions. Moreover, CCS is integral in the energy sector for producing "blue" hydrogen, that is, low-carbon hydrogen derived primarily from natural gas. On the other hand, the role of DACCS, BECCS and other carbon dioxide removal (CDR) technologies is distinctly different. These technologies are primarily geared toward offsetting emissions that are challenging to eliminate. While CCS focuses on capturing and storing emissions at their source, CDR technologies are pivotal for removing CO_2 from the atmosphere, thereby counterbalancing unavoidable emissions and contributing to achieving net-zero goals.

According to the Global CCS Institute's latest status report, there are currently 41 operational CCS projects worldwide, collectively storing approximately 40 million tons of CO_2 annually (GCCSI 2023). To align with the International Energy Agency's Net-Zero Emissions scenario, this capacity needs to expand significantly (IEA 2021). By 2030, CCS deployment must increase by more than 100 times to reach an annual storage capacity of 1.6 gigatonnes (Gt) of CO_2, escalating further to 7.6 Gt by 2050. The imperative for rapid and large-scale deployment of CCS is underscored by all major emissions scenarios that outline pathways to achieve emission neutrality. These scenarios also underscore that achieving net-zero targets requires more than just the reduction of emissions through CCS. They highlight the necessity of removing CO_2 from the atmosphere by employing CDR technologies, especially DACCS and BECCS.

To enable and accelerate the adoption of CCS technologies, a conducive policy environment is essential. Particularly, given that CCS does not inherently generate revenue streams, the implementation of economic instruments such as carbon pricing and market schemes is key in attracting private investments, thereby enabling the large-scale deployment of CCS technology.

Numerous policies in industrialized countries have been implemented to support CCS at national and regional levels. For instance, the European Union's Directive on the Geological Storage of Carbon Dioxide of 2009 and the inclusion of CCS in the European Emission Trading Scheme aim to support the deployment of CCS within the E.U. Similarly, the United States and Australia have introduced CCS-specific laws and regulations at federal, state and commonwealth levels, respectively. A notable example is the 45Q tax credit in the U.S., which currently offers up to U.S.$85 per ton of CO_2 stored from fossil fuel-fired power plants, increasing to U.S.$130 for DACCS. In Norway, the Sleipner CCS project has been operational since 1996, propelled by a CO_2 tax imposed on offshore activities. Governments in other regions, such as Japan, Canada, the United Kingdom and China, have offered grants and public-private partnerships to support the financing of initial CCS projects. However, a major challenge remains: by and large, there are few economic policy instruments in place in the developing world to support climate mitigation efforts, even though the majority of future emissions growth under business-as-usual scenarios will be coming from these countries. International cooperation is therefore essential to leverage the necessary financial support.

Among available policy instruments, carbon market mechanisms are seen as a crucial enabler for costly technologies such as CCS. Some domestic carbon market and voluntary carbon market (VCM) schemes already incorporate projects applying CCS, including Alberta, Canada and the Verified Carbon Standard (VCS, also known as Verra) (JOGMEC 2023). However, existing mechanisms and the scale at which they operate will be far from sufficient to mobilize the necessary capital for investment in CCS and geological storage. Estimates suggest that scaling CCS and geological storage to the levels required to reach net-zero emissions by 2050 could cumulatively cost up to U.S.$5.3 trillion (or U.S.$160-200 billion annually) compared to the actual investment levels of U.S.$6 billion in 2022 (BNEF 2023; IEA 2021).

Another challenge is that, for the time being, revenue from market mechanisms alone will not be sufficient, given the wide gap between technology costs and credit prices. Costs for point-source CCS currently range from approximately U.S.$40 to U.S.$100 per tonne of CO_2, and those for DACCS from roughly U.S.$400 to U.S.$1,000 per tCO_2 (Al Juaied and Whitmore 2023; Baylin-Stern and Berghout 2021; Bright 2022). This compares with the average price of Voluntary Emission Reduction (VER) credits of around U.S.$5 per tCO_2 equivalent (MSCI 2023) in December 2023. However, carbon credit revenue can generate an important additional incentive when used in conjunction with fiscal support mechanisms, such as tax credits and contracts for difference (JOGMEC 2023). This is where the market-based mechanisms of the Paris Agreement could be crucial, underlining their significance in addressing the financial challenges of large-scale CCS deployment.

Carbon Capture and Storage and International Climate Governance

Carbon capture and storage appeared on the international climate policy agenda with the publication of the IPCC Special Report on CCS in 2005 (IPCC 2005). This report was one of the first comprehensive assessments of CCS as a potential tool for mitigating climate change. It elevated the significance of CCS technology, establishing its critical role in decreasing worldwide CO_2 emissions and as a key option in long-term scenarios for stabilizing the climate, alongside efficiency improvement, renewable energy and nuclear energy.

The report provided an extensive evaluation of the technology maturity of CCS at that time. It found that the individual components of CCS, namely CO_2 capture, transport and storage, were already technologically mature, having been used in various industrial applications. However, their integration as a combined process for emission reduction was relatively new. Geological storage, including storage in depleted oil and gas fields and deep saline formations, was recognized as feasible and technologically sound, though it was noted that more experience was needed to understand the long-term implications and safety.

Shortly after the publication of its Special Report on CCS, the IPCC released the 2006 Guidelines for National Greenhouse Gas Inventories (IPCC 2006). These guidelines specify the procedures countries need to follow when reporting their emissions to the UNFCCC. For the first time, the 2006 edition of the Guidelines contained detailed procedures for estimating emissions from CO_2 storage projects. The methodology presented in the guidelines aligns with the Special Report and follows a step-by-step process, including conducting a thorough site characterization, modeling and simulation, evaluating the risk of seepage, monitoring the stored CO_2 and reporting the emissions. The methodology emphasizes the importance of proper characterization, selection and monitoring of storage sites to ensure the long-term and environmentally safe storage of CO_2. If CO_2 is injected into well-chosen and well-managed storage sites and the monitoring confirms that it is behaving as expected without any leaks, it can be reported that there are no CO_2 emissions from the storage site.

The Special Report and the 2006 Inventory Guidelines have served as the foundation for the development of CCS-specific policy and legislation at both national and international levels in subsequent years.

In the early 2000s, CCS was primarily viewed as a means to reduce CO_2 emissions from fossil-fuel combustion, especially from coal-fired power generation. However,

the role of CCS and geological storage has evolved significantly in recent years. The more ambitious climate targets set by the 2015 Paris Agreement and the global push to decarbonize the entire energy sector have sparked increased interest in technological solutions to address hard-to-mitigate emissions. Specifically, there has been a focus on reducing emissions from the industrial sector, including steel, chemical and cement production. These sectors are expected to experience significant emissions growth in the coming decades. While improvements in efficiency can contribute to some CO_2 reduction in these sectors, the potential is limited. Transitioning to low-carbon energy sources, such as renewable electricity or low-carbon hydrogen, in the production process can reduce emissions related to energy inputs but cannot address process emissions. Therefore, CCS has emerged as a compelling option for reducing emissions in hard-to-abate sectors.

Moreover, there has been a growing focus on more ambitious forms of CCS that aim to remove CO_2 from the atmosphere to offset unavoidable emissions. In the wake of the IPCC's 2018 Special Report on "Global Warming of 1.5°C" (IPCC 2018), the critical role of atmospheric carbon removal in achieving net-zero emission targets has gained broad recognition. These carbon removal efforts can be implemented through natural methods, such as afforestation and reforestation, as well as through engineered solutions. Two key engineered removal approaches, namely DACCS and BECCS, invoke geological storage but are technologically less mature than conventional CCS.

Carbon Capture and Storage and the Clean Development Mechanism

In the early 2000s, on the international stage, there was a prevailing expectation that the CDM under the Kyoto Protocol would serve as an effective tool for the transfer and deployment of CCS in developing countries. This optimism was based on the belief that the CDM would provide necessary incentives to help integrate CCS into the climate change mitigation strategies of developing nations.

The CDM is a project-based offset mechanism that enabled industrialized nations to fulfill their greenhouse gas emission reduction commitments by investing in emission reduction initiatives in developing countries. Under the CDM, the investing country could claim the effective reduction in emissions as a credit toward meeting its Kyoto Protocol obligations. The CDM's operational framework, known as "Modalities and Procedures," was established in 2001 at COP 7 in Marrakesh (UNFCCC 2002).

During several sessions in 2005 and 2006, the CDM's governing body, the Executive Board (EB), deliberated on incorporating CCS as a CDM project activity (see Dixon et al. 2013a). The EB recognized that CCS, in the context of the CDM, posed unique challenges, particularly concerning site selection, long-term liability, permanence and defining project boundaries. This assessment indicated the need to develop specific modalities and procedures tailored to CCS to address its unique technical and policy characteristics effectively. Consequently, the issue of integrating CCS within the framework of the CDM was redirected to the CMP, the Kyoto Protocol's governing body, for further consideration. After six years of extensive negotiations, two workshops and multiple submissions from Parties and observer organizations, the 2011 Durban COP ultimately adopted the "Modalities and Procedures for CCS as Clean Development Mechanism Project Activities" (CCS M&P) (UNFCCC 2012; see also Dixon et al. 2013b).

In order for any market mechanism, including the CDM, to robustly incorporate CCS, it must include provisions for the following elements:

- Determining suitable methodologies to quantify emissions from the storage site. Numerous pathways could serve as conduits for CO_2 seepage from a storage site, making it essential to systematically and comprehensively evaluate the emission potential of each pathway.

- Managing long-term storage risks. This includes addressing potential issues like CO_2 reversals, that is, seepage, from the storage site back into the atmosphere after the crediting period.

- Ensuring that local environmental, health and safety aspects of the storage project are effectively managed while respecting the sovereignty of the host country.

Different options are available to tackle these challenges. To address the first issue on the list, the CCS M&P utilize the sequential approach outlined in the 2006 IPCC Greenhouse Gas Inventory Guidelines.

The second concern, the risk of reversals, is addressed by the CCS M&P by withholding 5% of the CDM credits allocated to the storage during its operation phase and placing them in a 'buffer' account. These credits are subsequently released to the project operator after their liability for the project ends, contingent on the condition that no seepage has occurred.[4]

The CCS M&P recognize that only countries, not private institutions, have the capacity to responsibly manage CO_2 storage sites in the long term. Therefore, managing long-term risks involves transferring the liability for CO_2 storage from the project operator to the host country. This transfer can only occur after a minimum of 20 years since CO_2 injection has stopped and is subject to specific requirements to ensure minimal risk of future release. The CCS M&P allow the host country to determine the specific details of the liability transfer.

To ensure adherence to minimum standards for managing local environmental, health and safety risks associated with storage projects, the CCS M&P stipulates that countries intending to host storage projects must establish a regulatory framework for CCS.[5] This framework must fulfill several criteria, including provisions for compensating any harm caused by the project (Box 2).

For the first time, the CCS M&P established an internationally recognized framework for a project-based market mechanism dedicated to funding and managing the long-term storage of CO_2 in geological formations. The principles of the CCS M&P established a crucial precedent for integrating CCS projects into the international carbon market and point to the vital role of state involvement in promoting CCS markets by providing storage space, assuming long-term liability and establishing comprehensive CCS regulations. These points retain their validity for the current discussion on CCS in the context of Article 6.

[4] Ultimately, liability for reversal lies either with the host country or with the Annex B Party holding the Certified Emission Reductions (CERs).

[5] For an overview of the emergence of CCS regulation globally, see Odeh and Haydock (2013).

Box 2: Clean Development Mechanism "Participation Requirements" for Countries Hosting Carbon Capture and Storage Projects.

To be eligible for earning CDM credits, CCS projects were required to be located in countries with established national laws and regulations governing CCS (referred to as "Participation Requirements"). These laws and regulations had to be designed to address the following key aspects:

- **Permitting Procedures:** The laws should include permitting procedures that align with specific technical guidance in the modalities and procedures. These procedures must ensure the appropriate selection, characterization, and development of geological storage sites for CCS projects.
- **Rights and Access to Subsurface Pore Space:** Clear provisions should be defined in the regulations to confer rights to store carbon dioxide in subsurface pore space and grant access to project proponents.
- **Redress Mechanisms:** The laws must establish timely and effective redress mechanisms for affected entities, individuals, and communities in the event of significant damages caused by the CCS project activity. This includes environmental damage, harm to ecosystems, other material damages, or personal injuries, even in the post-closure phase.
- **Remedial Measures and Environmental Restoration:** The regulations should mandate timely and effective remedial measures to halt or control any unintended physical leakage or seepage of CO_2. Additionally, they should outline procedures for restoring the integrity of a defective geological storage site and recovering long-term environmental quality significantly affected by CCS project activities.
- **Liability Arrangements:** The laws need to establish mechanisms for addressing liability arrangements specifically related to carbon dioxide geological storage sites.

Ensuring compliance with these obligations might necessitate modifying existing laws, such as those applicable to mining, oil and gas extraction, and environmental permitting. It may also require the creation of new laws tailored to accommodate the unique requirements of CCS projects. Many developed countries have already established national laws and regulations that meet these criteria, setting examples for others to follow in promoting safe and sustainable CCS initiatives.

Source: Shabaneh and Heidug 2023.

The Article 6.4 Mechanism

Methodologies for CCS-related crediting projects already exist or are being developed under domestic or VCM standards. However, the Paris Agreement's Article 6.4 mechanism, the successor to the CDM, can also help scale up international financing for geological storage in regulated markets worldwide. It provides a "gold standard" for both voluntary and regulated markets. This development is crucial because, as noted previously, current mechanisms will not suffice to leverage financing at the required levels, especially in countries that lack the ability to finance CCS with domestic sources alone.

Under Paris Agreement Article 6, CCS projects can potentially be credited under Article 6.2 or Article 6.4. Article 6.2 provides overarching rules for direct cooperation among parties on carbon markets and currently has no direct UNFCCC oversight. It allows for international trading in both emission reductions and removals, known as internationally transferred mitigation outcomes (ITMOs). As of early December 2023, a total of 67 bilateral Article 6.2 agreements had been signed between 7 buyers and 42 host countries. However, none of the 139 pilot projects initiated under these agreements included CCS technologies (UNEP 2023). As first movers in this space, Sweden and Switzerland signed a declaration of intent at the 2023 U.N. Climate Change Conference in Dubai (COP 28) to "test the rules" under Article 6 in removals, potentially involving BECCS, with the transfer of a "symbolic amount" of credits (Manuell 2023a).

The Paris Agreement also establishes a crediting mechanism under Article 6.4, which aims to contribute to mitigation of GHG emissions and support sustainable development. This mechanism is not yet fully operational, and significant technical work and some key higher-level approvals by the parties to the Paris Agreement are still required before projects can be submitted and approved.

The Article 6.4 mechanism shares numerous similarities with the CDM, building on its extensive experience and acting as its successor. Under the CDM, project registration and credit issuance for post-2020 emission reductions are no longer possible (UNFCCC 2022a), although transitioning activities and units to the Article 6.4 mechanism is allowed under certain conditions. Similarities between the two mechanisms include the voluntary nature of participation, the involvement of both public and private sector actors, a requirement to demonstrate additionality (that is, emission reductions must be additional to those that would occur in the absence of the project), centralized governance and a centralized registry.

At the same time, the Article 6.4 mechanism is intended to improve upon the CDM. In this regard, it introduces several principles, including more stringent approaches to baselines that encourage ambition over time, a grievance mechanism, broader opportunities for stakeholder inputs, a higher share of proceeds allocated to adaptation finance (5% of issued credits, compared to 2% under the CDM) and the cancellation of an additional 2% share of credits issued for delivering "overall mitigation in global emissions" (UNFCCC 2022b).

Perhaps the most significant difference from the CDM is that under the Paris Agreement, all countries have a mitigation target, making all countries potential hosts of projects and either sellers or buyers of credits — or Article 6 ITMOs. Under the Kyoto Protocol, there were no emission reduction target requirements for developing countries; only developing countries could host projects, while developed countries could use credits from these projects to meet their mitigation obligations under the Protocol. This arrangement posed no risk of double counting emission reductions by the host country and the party purchasing related credits. To avoid double counting, Article 6 of the Paris Agreement introduces the concept of corresponding adjustment, which ensures that transferred mitigation outcomes are only counted in one place (and not both in the host country's and the purchasing party's emission inventories).

Projects under the Article 6.4 mechanism are also required to support the host country in achieving its nationally determined contribution (NDC). Host countries, specifically their designated national authorities (DNAs),[6] bear significantly more responsibility than under the CDM, as they not only approve activities (i.e., projects) but also have the authority and will need to decide whether to authorize Article 6.4 units for international transfer under Article 6. In such cases, corresponding adjustments will be applied to the participating countries' emission inventories. Authorization therefore carries potentially significant implications for a country's NDC achievement, particularly if it "oversells" ITMOs or authorizes the transfer of a large amount of less costly emission reductions.

There are two possible types of units that can be generated from projects registered under the Article 6.4 mechanism, each serving different purposes. The first type is authorized Article 6.4 units (A6.4ERs), which are also considered ITMOS under Article 6.2. This means that related guidance and principles, including corresponding adjustments, apply to them. A6.4ERs can be used toward NDC achievement, other international purposes, such as offsetting under the UN aviation scheme CORSIA, as well as in the VCM, among others. The second type is mitigation contribution units (MCUs), which are non-authorized and therefore support the host country in achieving its NDC, as they do not require a corresponding adjustment. Possible uses for MCUs include domestic carbon pricing schemes, results-based finance and the VCM.

Importantly, as with the CDM,[7] activities under the Article 6.4 mechanism can result in either emission reductions or emission removals. Further guidance from the Article 6.4 governing body is needed to operationalize these options. Specific guidance related to removals was expected to be adopted at the Dubai U.N. Climate Change Conference (COP 28) in December 2023.

[6] *In most countries, CDM DNAs will also serve Article 6.4, with expanded roles and responsibilities. According to the UNFCCC (2024), as of January 25, 2024, 71 countries had designated a DNA for the Mechanism.*

[7] *Under the CDM, removal activities were limited to afforestation and reforestation (UNFCCC 2004). The CDM CCS M&P do not cover removal, as they require the stored CO_2 to be from an anthropogenic source.*

Latest Developments Under Article 6.4 Related to Carbon Capture and Storage

For projects to be approved under the Article 6.4 mechanism, methodologies first need approval by the Article 6.4 mechanism Supervisory Body, which in turn reports to the Paris Agreement's governing body CMA.[8] The CMA agreed on the general principles relating to Article 6.4 mechanism methodologies – called rules, modalities and procedures (RMPs) – already at the Glasgow Climate Change Conference (COP 26) in 2021 as part of the so-called Article 6 rulebook (UNFCCC 2022b). The RMPs stipulate that a wide range of actors can develop methodologies, including activity (project) participants, host parties, the Supervisory Body and other "stakeholders" (UNFCCC 2022b). The approval process is envisioned as technical in nature, with approvals based on the technical merits of the methodologies and alignment with any related guidance from the CMA or the Supervisory Body. Methodologies themselves do not require the CMA's approval.

At the 2022 Sharm El-Sheikh Climate Change Conference (COP 27), the CMA agreed to request the Supervisory Body to prepare more detailed recommendations for the development and assessment of methodologies for the CMA's consideration at COP 28 in Dubai. The prevailing expectation was that these proposals would be adopted, thereby enabling the submission of methodologies to support the funding of storage projects.

Of significant relevance for CCS under the Paris Agreement, starting in 2022, before COP 27, the Supervisory Board began developing overarching requirements for the crediting of removals pertaining to the extraction of CO_2 from the atmosphere and its subsequent storage in either terrestrial or geological sinks. That year, it had limited time to produce recommendations, and, as a result, many countries

[8] *Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA).*

and observers did not consider the guidance ready for adoption, citing concerns about the absence of environmental and social safeguards, references to human rights, provisions for reversals and differentiation between different removal types (IISD-ENB 2022). As a result, the CMA requested the Supervisory Body to continue working on the recommendations for another year. It also underscored the need for more stakeholder consultation (UNFCCC 2023b).

In 2023, the Supervisory Body received a total of 289 inputs on removals as part of a structured public consultation process (UNFCCC 2023c). In May, a draft information note circulated ahead of one of the Body's meetings contained a taxonomy of removal activities for both removal methods (biological, geochemical and chemical) and storage methods (ecosystem pools, geological reservoirs and durable products). However, it also included a table of "pros and cons" of different activity types and described "engineering-based removal activities" as "technologically and economically unproven, especially at scale, and pos[ing] unknown environmental and social risks," concluding that they "do not contribute to sustainable development, are not suitable for implementation in the developing countries and do not contribute to reducing the global mitigation costs, and therefore do not serve any of the objectives of the Article 6.4 mechanism" (A6.4M-SB 2023).

Following a flood of inputs from the removals community and other stakeholders, the recommendations, agreed upon by the Supervisory Body just two weeks before COP 28 and sent for the CMA's endorsement, no longer contained a taxonomy. Instead, they defined removals simply as "the outcomes of processes to remove GHGs from the atmosphere through anthropogenic activities and destroy or durably store them" (UNFCCC 2023d). Notably, the document did not distinguish between nature-based and technological removals. The removal recommendations included requirements for activities related to the following: monitoring; post-crediting period monitoring; reporting and remediation of reversals; reporting; accounting for removals; methodologies applicable to the crediting period; addressing reversals (including both avoidable and unavoidable); avoidance of leakage; avoidance of other negative environmental and social impacts; and host party roles (including those related to sovereign guarantees).

At COP 28, countries discussed issues related to the Article 6.4 mechanism throughout the two-week conference, with the methodological and removals recommendations documents being among the key topics. Many expressed unease with both, but the removals document faced more reservations. Criticisms by countries of the removals document pertained to determining the consequences of a failure to monitor, defining "reversals," the absence of references to social and environmental safeguards and human rights, responsibilities of parties related to reversals and the lack of natural removals-specific guidance (IISD-ENB 2023). Observers also expressed concerns regarding the lack of definitions of "avoidable" and "unavoidable" reversals; what they perceived as a weak reversal risk assessment tool and buffer pool arrangements; provisions that potentially allow project developers to be discharged of their responsibility to conduct post-crediting monitoring; and a significant amount of further technical work being deferred to 2024 (Manuell 2023b; CAN 2023).

Some countries were ready to adopt the methodological recommendations, but others insisted on adopting both as a package (see, e.g., Carbon Brief 2023). As a result, the CMA was unable to agree on a decision, and neither document was adopted. Consequently, the CMA simply issued a request to the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) to continue working to operationalize Article 6.4 through 2024, including based on mandates from COP 27. The SBSTA will continue these deliberations in its next session in June 2024, and the next possible time to adopt the guidance documents will be the next CMA session at COP 29 in Baku in November 2024.

This outcome means that no new methodologies can be submitted to the Article 6.4 mechanism Supervisory Body for approval until at least November 2024. Some sources estimate that, as a result, the Article 6.4 mechanism may not be issuing credits until 2026 (Garside 2023).

Those viewing the outcome favorably argued that the removals recommendations would not have ensured that the Article 6.4 mechanism introduces more robust and transparent standards than the VCM, which through 2023 in particular saw various shocks to its credibility in delivering real emission reductions (Carbon Market Watch 2023). Those perceiving the result as a failure pointed to how repeated delays threaten the credibility of Article 6 and leave domestic carbon market mechanisms and the VCM without the much-awaited clarity that could help scale up markets and boost credit prices worldwide (IETA 2023; Manuell 2023c).

What's Next?

As this commentary has argued, Article 6 can provide both the framework and mechanisms for significantly scaling up financing for CCS internationally, particularly in developing countries. Under Articles 6.2 and 6.4, countries can collaborate in various ways to support each other in achieving their NDCs and offsetting emissions, including through adjusted (ITMOs) and non-adjusted credits (Article 6.4 MCUs). The Article 6.4 mechanism is also expected to establish an international benchmark for CCS methodologies and procedures, which could be adopted by other market schemes worldwide. These could also ensure the environmental integrity and overall robustness of related projects while maintaining sufficient market attractiveness for project participants.

The COP 28 Global Stocktake decision notably highlights CCS and geological storage. However, the conference's inability to agree on methodological guidance under Article 6.4 and the delay in operationalizing the mechanism, which could help incentivize investment in CCS and geological storage, represents a significant disappointment.

During the negotiations on Article 6.4, all carbon removal methods were considered collectively. Many of the concerns cited about the removals document related to nature-based projects, which have a long history under the CDM and the VCM. Challenges faced by nature-based removals projects, such as difficulties in monitoring and verifying storage, susceptibility to natural and human disruptions and the extended timeframe required for tangible removals, are either non-existent or less pronounced in geological storage. In this context, it could be argued that further guidance on technological removals under Article 6.4 was potentially held back by the approach of considering all removals as one document by the Supervisory Body.

Having a single guidance document for all removal approaches and technologies also increases the risk of further delays. For example, disagreements on forestry-related aspects of removals could end up stalling progress in CCS-related removals guidance. The rationale behind the decision to combine guidance for all removal methods in a single document could be questioned, given that nature-based removals and engineered removals involve markedly distinct processes and technological characteristics. In the current situation, there is a risk that disagreements in negotiating details of one removal method might hinder the development of guidance for the other. Such an impasse could lead to a complex scenario that would be challenging to communicate to market participants.

Moreover, specific issues facing geological storage could potentially be addressed based on the CDM M&P for CCS, established in 2011, without the need for prolonged further negotiations. The IPCC guidelines and the CDM CCS M&P provide a solid foundation for cooperation under both Article 6.2 and Article 6.4 mechanism to build upon, and their adoption by the mechanism's Supervisory Body would be the next logical step toward getting both CCS reduction and removal projects into the pipeline. Yet, given the failure at COP 28 to agree on high-level generic and removals-specific methodological guidance for the mechanism and the postponement of such decisions to COP 29 in November 2024, discussions on a CCS-specific methodologies and procedures document do not seem likely to be initiated until 2025 at the earliest.

Importantly, while there has not yet been a decision addressing the status of the CDM CCS M&P document under the 6.4 mechanism, it is anticipated that this

document will be drawn upon by the Article 6.4 Supervisory Body as it eventually considers related methodologies. In 2021, the CMA asked the Supervisory Body to review methodologies in use for the CDM with a view to applying these, with revisions, for activities under the Article 6.4 mechanism; however, there was no specific reference to the CCS M&P document. The CDM CCS M&P is not a methodology per se but rather a framework of guidance for developing methodologies. Hierarchically, it would be situated between the high-level guidance documents and project-type-specific methodologies. Notably, while any emission removal project applying geological storage under Article 6.4 will need to wait for the CMA's agreement on related high-level guidance, in principle, an agreement on the methodological recommendations document alone would enable discussions on emission reduction projects applying CCS to anthropogenic point sources of CO_2 (as included in the CDM CCS M&P document) to proceed, even in the absence of agreement on removals recommendations.[9]

To further emphasize the importance of the CDM CCS M&P in the current discussion on Article 6, it is significant that the guidance provided by the CDM for the storage component of a CCS project is also directly applicable to a removal project employing geological storage. Essential elements such as monitoring, verification and addressing issues of non-permanence are comprehensively addressed in the CDM guidelines.

It could be hoped that countries would have learned lessons from past delays in adopting international carbon market guidance — the CDM CCS M&P, for example, took six years to negotiate — and would, therefore, not seek to reinvent the wheel where a robust methodological guidance document like this already exists.

As it currently stands, bilateral trading under Article 6.2 represents the de facto sole operational component of Article 6 and is likely to maintain this role for the foreseeable future. In this context, it is crucial to reiterate that the development of a commercial, large-scale storage industry, whether facilitated by Article 6.2 or Article 6.4, hinges on the active involvement of host countries. Only countries, not non-state actors, can ensure the permanence of storage through the establishment of necessary institutions, appropriate legislation and robust enforcement processes, all of which are essential for generating high-quality credits.

Having a regulatory framework specifically tailored to oversee the long-term storage of CO_2 in geological formations is a crucial indicator of a country's preparedness to host storage projects. Such a framework would, among other things, regulate the ownership of the stored CO_2 and identify the scope of potential liabilities associated with a storage project, as well as remediation obligations. The "Participation Requirements" of the CDM M&P for CCS provide insight in this respect (see Box 2).

Given that several countries with a strategic interest in geological storage have not yet implemented appropriate domestic regulations, capacity building in regulatory oversight for geological storage could become a key enabler for mobilizing carbon market funds for storage projects. This applies equally to voluntary and compliance markets, as they are both embedded within the same regulatory context.

[9] *However, some countries may still prefer to adopt the methodological and removals recommendations as a package, which could make such a scenario unlikely.*

References

Al Juaied, Mohammed, and Adam Whitmore. 2023. "Prospects for Direct Air Carbon Capture and Storage: Costs, Scale and Funding." *Belfer Centre for Science and International Affairs, Harvard Kennedy School*, November 30, 2023. https://www.belfercenter.org/publication/prospects-direct-air-carbon-capture-and-storage-costs-scale-and-funding.

Allen, Myles, Kaya Axelsson, Ben Caldecott, Thomas Hale, Cameron Hepburn, Conor Hickey, Eli Mitchell-Larson, Yadvinder Malhi, Friederike Otto, Nathalie Seddon, and Steve Smith. 2020. "The Oxford Principles for Net Zero Aligned Carbon Offsetting." *Oxford Net Zero*, September 2020. https://www.smithschool.ox.ac.uk/publications/reports/Oxford-Offsetting-Principles-2020.pdf.

Article 6.4 Mechanism Supervisory Body (A6.4M-SB). 2023. "Information Note: Removal Activities under the Article 6.4 Mechanism." Version 04.0, A6.4-SB005-AA-A09. https://unfccc.int/sites/default/files/resource/a64-sb005-aa-a09.pdf.

Baylin-Stern, Adam, and Niels Berghout. 2021. "Is Carbon Capture Too Expensive?" *Commentary, International Energy Agency*, February 17, 2021. https://www.iea.org/commentaries/is-carbon-capture-too-expensive.

Bloomberg New Energy Finance (BNEF). 2023. "BNEF Database." Accessed December 2023. https://about.bnef.com/ Aggregate estimates by KAPSARC.

Bright, Matt. 2022. "The Inflation Reduction Act Creates a Whole New Market for Carbon Capture." *Clean Air Taskforce*, August 22, 2022. https://www.catf.us/2022/08/the-inflation-reduction-act-creates-a-whole-new-market-for-carbon-capture/.

Carbon Brief. 2023. "COP28: Key Outcomes Agreed at the U.N. Climate Talks in Dubai." December 13, 2023. https://www.carbonbrief.org/cop28-key-outcomes-agreed-at-the-un-climate-talks-in-dubai/.

Carbon Market Watch. 2023. "COP28: Article 6 Failure Avoids a Worse Outcome." Press release, December 13, 2023. https://carbonmarketwatch.org/2023/12/13/cop28-article-6-failure-avoids-a-worse-outcome/.

Climate Action Network. 2023. "Article 6: Removing Ambition." *ECO—NGO Newsletter*, November 30, 2023. https://climatenetwork.org/wp-content/uploads/2023/11/ECO-2023.30.11.pdf.

Dixon, Tim, Gregory Leamon, Paul Zakkour, and Luke Warren. 2013a. "CCS Projects as Kyoto Protocol CDM Activities." *Energy Procedia* 37: 7596-7604. https://doi.org/10.1016/j.egypro.2013.06.704.

Dixon, Tim, Katherine Romanak, Samantha Neades, and Andy Chadwick. 2013b. "Getting Science and Technology into International Climate Policy: Carbon Dioxide Capture and Storage in the UNFCCC." *Energy Procedia* 37: 7590-7595. DOI: 10.1016/j.egypro.2013.06.703.

Garside, Ben. 2023. "Business Leader Lays Blame for U.N.'s Article 6 Talks Collapse Firmly with E.U." *Carbon Pulse*, December 16, 2023. https://carbon-pulse.com/246162/.

Global Carbon Capture and Storage Institute (GCCSI). 2023. Global Status of CCS Report 2023. November 2023. https://res.cloudinary.com/dbtfcnfij/images/v1700717007/Global-Status-of-CCS-Report-Update-23-Nov/Global-Status-of-CCS-Report-Update-23-Nov.pdf.

IETA (International Emissions Trading Association). 2023. "IETA Regrets Article 6 Failure, Calls for End to 'Politicization' of Markets." Press release, December 13, 2023. https://www.ieta.org/ieta-regrets-article-6-failure-calls-for-end-to-politicisation-of-markets/.

IEA (International Energy Agency). 2021. *Net Zero by 2050. A Roadmap for the Global Energy Sector*. Paris: IEA. https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.

IISD-ENB (International Institute for Sustainable Development Earth Negotiations Bulletin). 2022. "Summary of the Sharm El-Sheikh Climate Change Conference: 6–20 November 2022." *Earth Negotiations Bulletin* Vol 12, No. 818, November 23, 2022. https://enb.iisd.org/sites/default/files/2022-12/enb12818e_0.pdf.

———. 2023. “Dubai Climate Change Conference: Tuesday, December 5, 2023.” *Earth Negotiations Bulletin* Vol 12, No. 836, December 6, 2023. https://enb.iisd.org/sites/default/files/2023-12/enb12836e.pdf.

IPCC (Intergovernmental Panel on Climate Change). 2005. *Special Report on Carbon Dioxide Capture and Storage*. Edited by Bert Metz, Ogunlade Davidson, Heleen de Coninck, Manuela Loos, and Leo Meyer. https://www.ipcc.ch/report/carbon-dioxide-capture-and-storage/.

———. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Edited by Simon Eggleston, Leandro Buendia, Kyoko Miwa, Todd Ngara, and Kiyoto Tanabe. https://www.ipcc-nggip.iges.or.jp/public/2006gl/.

———. 2018. “Global Warming of 1.5 °C.” Accessed January 31, 2024. https://www.ipcc.ch/sr15/.

———. 2024. IPCC Glossary. Accessed January 31, 2024. https://apps.ipcc.ch/glossary/.

JOGMEC (Japan Organization for Metals and Energy Security). 2023. Handbook for CCS Credits: Workshop Report on “Global Carbon Market and CCS: Towards ASEAN Decarbonization.” March 2023. https://www.jogmec.go.jp/content/300382578.pdf.

Manuell, Roy. 2023a. “COP28: Sweden and Switzerland Announce Carbon Removals Article 6 Cooperation.” Carbon Pulse, December 9, 2023. https://carbon-pulse.com/243864/.

———. 2023b. “ANALYSIS: Observers Welcome Late Agreement on Article 6 Crediting, Concerned by Gaps.” Carbon Pulse, November 20, 2023. https://carbon-pulse.com/237949/.

———. 2023c. “Article 6 Body Unanimously Agrees Crediting Methodology Guidance in Last-ditch Talks Before COP28.” Carbon Pulse, November 17, 2023. https://carbon-pulse.com/237204/.

MSCI. 2023. “Carbon Credit Prices.” Accessed December 16, 2023. https://trove-research.com/en/intelligence-platform/carbon-credit-prices.

Odeh, Naser, and Heather Haydock. 2013. International CCS Policies and Regulations. WP5.1a/WP5.4 Report. NZEC Carbon Capture & Storage. https://www.globalccsinstitute.com/archive/hub/publications/162813/international-ccs-policies-regulations-WP5.1a-WP5.4-report.pdf.

Shabaneh, Rami, and Wolfgang Heidug. 2023. “Enabling Blue Hydrogen for A Low-Carbon Future: Certifying Emissions and CO_2 Storage.” KAPSARC Discussion Paper, December 14, 2023. https://www.kapsarc.org/research/publications/enabling-blue-hydrogen-for-a-low-carbon-future-certifying-emissions-and-CO_2-storage/.

UNEP (United Nations Environment Programme). 2023. “Article 6 Pipeline.” Accessed December 12, 2023. https://unepccc.org/article-6-pipeline/.

UNFCCC (United Nations Framework Convention on Climate Change). 2002. “Modalities and Procedures for a Clean Development Mechanism as Defined in Article 12 of the Kyoto Protocol.” Decision 17/CP.7, FCCC/CP/2001/13/Add.2, January 21, 2022. https://unfccc.int/sites/default/files/resource/docs/cop7/13a02.pdf.

———. 2004. “Modalities and Procedures for Afforestation and Reforestation Project Activities under the Clean Development Mechanism in the First Commitment Period of the Kyoto Protocol.” Decision 19/CP.9, FCCC/CP/2003/6/Add.2, March 30, 2004. https://unfccc.int/sites/default/files/resource/docs/cop9/06a02.pdf.

———. 2012. “Modalities and Procedures for Carbon Dioxide Capture and Storage in Geological Formations as Clean Development Project Activities.” Decision 10/CMP.7, FCCC/KP/CMP/2011/10/Add.2, March 15, 2012. https://unfccc.int/sites/default/files/resource/docs/2011/cmp7/eng/10a02.pdf.

———. 2022a. “Guidance Relating to the Clean Development Mechanism.” Decision 2/CMP.16, FCCC/KP/CMP/2021/8/Add.1, March 8, 2022. https://unfccc.int/sites/default/files/resource/cmp2021_08_add1E.pdf.

———. 2022b. “Rules, Modalities and Procedures for the Mechanism Established by Article 6, Paragraph 4, of the Paris Agreement.” Decision 3/CMA.3, FCCC/PA/CMA/2021/10/Add.1, March 8, 2022. https://unfccc.int/sites/default/files/resource/cma2021_10a01E.pdf#page=25.

———. 2023a. “Outcome of the First Global Stocktake.” Decision -/CMA.5, Advance unedited version, December 13, 2023. https://unfccc.int/sites/default/files/resource/cma5_auv_4_gst.pdf.

———. 2023b. “Guidance on the Mechanism Established by Article 6, Paragraph 4, of the Paris Agreement.” Decision 7/CMA.4, FCCC/PA/CMA/2022/10/Add.2, March 17, 2023. https://unfccc.int/sites/default/files/resource/cma2023_10a02E.pdf.

———. 2023c. “Annual Report of the Supervisory Body for the Mechanism Established by Article 6, Paragraph 4, of the Paris Agreement to the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement.” FCCC/PA/CMA/2023/15, November 2, 2023. https://unfccc.int/sites/default/files/resource/cma2023_L15E.pdf.

———. 2023d. “Annual Report of the Supervisory Body for the Mechanism Established by Article 6, Paragraph 4, of the Paris Agreement to the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement. Addendum.” FCCC/PA/CMA/2023/15/Add.1, December 1, 2023. https://unfccc.int/sites/default/files/resource/cma2023_15a01.pdf.

———. 2024. “Designated National Authority for Article 6.4 Mechanism.” Accessed January 31, 2024. https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism/national-authorities.

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About the Project

KAPSARC's Carbon Markets and Paris Agreement Article 6 project aims to support Saudi Arabia's participation in and engagement with domestic and international carbon markets. It seeks to contribute to increasing awareness and strengthening understanding of carbon markets in Saudi Arabia and the broader Gulf Cooperation Council (GCC) region through empirical, evidence-based, policy-oriented research and analysis. Carbon markets can support both private sector and government efforts to reduce or remove greenhouse gas (GHG) emissions and contribute to reaching the goals of the Paris Agreement in an effective way while providing various benefits to multiple stakeholders. Among other things, well-functioning carbon markets can lower the costs of GHG emission reductions, support the transfer of clean technologies and finance, and unlock higher mitigation ambition over time.

The project focuses on questions including the following:

What lessons can be learned from Saudi Arabia's and the Gulf region's past experience with carbon markets that are helpful for the post-2020 era?

How is the international carbon market landscape shaping up, including in relation to regulated carbon markets, voluntary carbon markets (VCM) and mechanisms linking to Article 6, and what are the related challenges and opportunities?

What can Saudi Arabia do to reap the most benefits from both regulated and VCM approaches and instruments? Which design options best suit Saudi Arabia's priorities and goals?

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