Unlocking Article 6.4 OF THE PARIS AGREEMENT: Implications for the Natural Gas Sector

EXPERT COMMENTARY

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1. Executive summary

Carbon pricing and carbon market are key tools for addressing climate change by assigning a financial cost to greenhouse gas emissions. This approach incentivises a shift towards low-carbon alternatives through market forces rather than regulatory mandates. Since the launch of the first carbon market in the EU in 2005, carbon markets have expanded rapidly. By the end of 2024, 38 carbon markets are in operation, covering around 19% of global emissions, with more under development or consideration. However, the carbon markets remain fragmented due to a preference for domestic over international credits and differing eligibility criteria. This fragmentation, combined with low carbon prices and generous free allowances, limits the incentive for firms to purchase credits or invest in emission-reduction projects.

Moreover, recent policy shifts and the rollback of climate commitments in several countries—particularly developed economies—have cast uncertainty over the future of global carbon market growth. These markets rely on a stable and consistent policy environment to assure businesses and investors that emission reductions remain a governmental priority. Unfortunately, this has not been the case in recent years. A notable example is the United States' withdrawal from the Paris Agreement. As one of the world's largest emitters, this move sent a clear message that climate action is no longer a top priority for the U.S. government. It also raised broader concerns about the reliability of other major economies, especially as many developing countries look to them for leadership in advancing global climate solutions.

Despite persistent challenges, the adoption of the Article 6 rules of the Paris Agreement at COP29 marked a pivotal moment, paving the way for cross-border crediting and greater market harmonisation. Article 6 allows governments to use carbon offsets to meet their Nationally Determined Contributions (NDCs). Negotiations on its rules were delayed for nearly a decade due to concerns over environmental integrity, governance, double counting, and carbon removal standards. At COP29, key agreements were reached, including robust monitoring, reporting, and verification (MRV) requirements, safeguards for local communities, and the eligibility of both nature-based and technological carbon removal methods. These breakthroughs have laid the groundwork for a credible and transparent global carbon market. If

implemented effectively, the new framework could restore trust, address market fragmentation, and enhance the role of international credits in achieving global climate goals. Additionally, the upcoming updates to countries' NDCs are expected to provide specific targets for the use of carbon offsets in national climate strategies. Therefore, as countries clarify how offsets will fit into their NDCs, the demand for carbon credits will likely rise, further integrating carbon markets and encouraging international cooperation.

For the natural gas sector, this framework presents both opportunities and strategic pathways to reinforce its role in the low-carbon transition. Natural gas plays a key role in the transition from high-carbon fuels by providing a cleaner alternative in power generation, transportation, and industry, helping to reduce emissions while maintaining an affordable and reliable energy supply. It also supports the integration of renewable energy and can contribute to the hydrogen economy. A well-established, UN-backed global carbon market under Article 6 of the Paris Agreement—known as the Paris Agreement Crediting Mechanism (PACM)— can further promote this transition by making natural gas more economically attractive, encouraging its use alongside cleaner technologies. For instance, in the coal-reliant Asia-Pacific region, our estimates indicate that carbon prices ranging from USD 25 to 75 per tonne of CO_2 could improve the competitiveness of natural gas over coal. A carbon price of USD 60 per tonne is projected to maximise natural gas consumption, resulting in a cumulative increase of over 2500 billion cubic metres of gas use and avoiding more than 12000 million tonne of coal equivalent between 2026 and 2050 in the region.

While carbon pricing also favours renewables and nuclear, several challenges limit their ability to fully replace coal, particularly in developing countries. Renewable deployment is not advancing quickly enough to meet the dual challenge of rising energy demand and coal replacement, and natural gas, as the cleanest dispatchable fuel, remains essential for energy security. Moreover, renewables are inherently intermittent, and natural gas serves as a crucial complement by providing flexible, dispatchable power that stabilises energy systems and ensures reliability.

Most developing countries also lack the infrastructure and investment capacity to transition directly to renewables, and carbon pricing alone cannot bridge this gap. Additionally, the high carbon price required to make such transitions viable could

compromise energy affordability and undermine broader sustainable development goals. Nuclear power, while low in emissions, is capital-intensive and requires long lead times—often a decade or more—for planning, permitting, and construction. Given that the current decade is critical for achieving near-term emissions reduction targets and limiting global warming, nuclear and renewable energy is unlikely to serve as an effective short- to medium-term substitute for coal. The urgency of the transition demands solutions that can be deployed at scale and speed. In contrast, natural gas infrastructure can be developed more rapidly and at lower cost, offering a more immediate pathway for reducing emissions in coal-dependent economies while supporting energy reliability and affordability.

Moreover, to maximise the role of natural gas in future low-emission energy systems, efforts such as carbon capture, utilisation, and storage (CCUS), improvements in energy efficiency, flare reduction, and methane emissions abatement are essential. These measures are critical to ensuring that natural gas remains a credible low-carbon option aligned with global climate goals. However, many of these measures—particularly CCUS—face significant financial and commercial barriers, including the absence of stable revenue streams. By addressing financial barriers, PACM, under Articles 6.2 and 6.4, allows such projects to be credited, thereby reinforcing the contribution of natural gas to the low-carbon transition.

Finally, carbon offsets and removals will play a significant role in addressing those parts of emissions which are associated with the use of natural gas that cannot be mitigated through CCUS. These mechanisms, facilitated by PACM, can help companies neutralize indirect emissions from natural gas consumption, ensuring comprehensive emissions reductions and supporting broader climate goals.

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2. Introduction

At the 29th Conference of the Parties (COP29) to the United Nations Framework Convention on Climate Change (UNFCCC), held in November 2024, a major milestone was reached with the finalization of the long-debated rules for carbon trading under Article 6 of the Paris Agreement. Articles 6.2 and 6.4, which focus on the mechanisms for international collaboration through carbon markets, were formally adopted after years of negotiations. These rules establish a structured framework for carbon trading, allowing countries to meet their climate goals through both market and non-market mechanisms. The finalization of these rules is seen as a key achievement in global climate diplomacy, offering a clear path forward for creating a global carbon market.

The importance of this development cannot be overstated, as it plays a critical role in achieving the overarching goals of the Paris Agreement. Article 6 provides the framework for the transfer of mitigation outcomes across borders, fostering international cooperation in emissions reductions. By creating a reliable and transparent system for carbon trading, the adoption of these rules lays the groundwork for expanding carbon markets globally, potentially unlocking billions of dollars in climate finance. This could significantly reduce the cost of meeting global climate targets, while also promoting sustainable development, particularly in developing countries. The establishment of this framework is expected to rebuild trust in carbon markets, which have faced scrutiny in the past due to concerns over transparency and integrity.

The finalization of Article 6 holds important implications for the natural gas sector. As a lower-emission alternative to high-carbon fuels, natural gas is positioned to benefit from the expansion of carbon markets. Countries that rely heavily on coal or other high-carbon fuels, particularly in developing regions, can use carbon credits from switching to natural gas to offset emissions, making the transition more economically viable. Gas-exporting countries can also benefit by generating credits for emissions reductions when they invest in coal-to-gas switching projects abroad, thereby contributing to the global shift toward cleaner energy and reinforcing the role of natural gas in climate mitigation strategies. The carbon market mechanisms under Article 6 could thus enhance the role of natural gas in the global energy transition by making it a more attractive option for countries seeking to reduce their carbon footprints.

This paper aims to explore the implications of the finalisation of Article 6 of the Paris Agreement—particularly Article 6.4—on the global carbon market and its strategic relevance for the natural gas sector. It examines how the development of international carbon trading mechanisms under the Paris Agreement could shape energy transitions, support emissions reductions, and position natural gas as a key component in the global decarbonisation pathway. Through this discussion, we aim to highlight the potential for carbon markets to facilitate the global shift to a low-carbon economy and the strategic role of natural gas in this transformation.

3. The status of carbon markets

Carbon pricing and carbon market are market-based tools that address climate change by placing a financial cost on carbon emissions. By internalizing the environmental cost of carbon, carbon pricing shifts economic incentives toward low-carbon alternatives, promoting greener practices without relying on strict regulations.

A carbon market typically works by setting a cap or limit on the total amount of greenhouse gas emissions that can be emitted by all participating entities. The cap is divided into a set number of emission allowances, which are either allocated for free or auctioned to entities. These allowances represent the right to emit a certain amount of CO_2 or other greenhouse gases. Entities can then trade these allowances, with companies that can reduce their emissions more cheaply selling their excess allowances to those who face higher reduction costs.

The combination of carbon pricing and carbon market creates a dynamic system where the market itself drives emissions reductions. It provides flexibility, allowing the market to set the price for carbon and determine the most efficient way to meet emissions targets. This market-based approach encourages technological advancements and reduces reliance on government-imposed regulations, offering a more adaptable solution to climate change.

Moreover, carbon market support flexibility in emissions reductions, as countries and companies can participate according to their capacity, thus encouraging broad participation. They also provide an opportunity for developing countries to benefit from technology transfer and financial support, which helps level the playing field globally.

carbon markets have evolved significantly since their inception, with the first system established in the EU in 2005. These systems have grown to become central elements of

climate policies worldwide, with 38 carbon markets now operational, covering 19% of global greenhouse gas emissions. The momentum continues to build, with 11 market under development and 9 more under consideration by the end of 2024 (1).

Carbon market adoption is expanding beyond developed countries, with emerging economies increasingly leading the way. Initially concentrated in developed countries like the EU and California, carbon markets are now expanding rapidly in emerging economies. In the Asia-Pacific region, countries such as China, India, Indonesia, and Vietnam are leading the charge. China launched its national carbon market in 2021, the largest in the world by volume, initially covering the power sector with plans for expansion. India introduced a baseline-and-credit system for energy-intensive industries, while Indonesia is developing a "cap-tax-and-trade" hybrid system. Vietnam is also preparing to implement a pilot carbon market. In Latin America, Brazil, Chile, Mexico, and Colombia are making significant progress in developing their carbon pricing frameworks. Brazil has established the legal foundation for a federal carbon market, while Chile is preparing a pilot carbon market for the energy sector. Mexico is transitioning its pilot carbon market to full implementation, and Colombia has initiated public consultations on its carbon market regulations.

Developed economies are steadily advancing their carbon market frameworks by expanding coverage, tightening emissions caps, and addressing challenges such as carbon leakage and competitiveness. The EU has reformed its carbon market and plans to introduce a separate system for buildings, road transport, and other sectors by 2027, potentially doubling emissions coverage. Canada has drafted regulations for a federal cap-and-trade system targeting emissions from oil, gas, and LNG production. In the United States, Oregon reinstated its system in 2023, Colorado launched its system in 2024, and New York and Maryland are developing or considering economy-wide systems.

In tandem with these developments, increasing attention is being given to aligning carbon markets with climate change targets, especially as emissions caps tighten in line with the 2030 and 2050 goals. However, as caps tighten, the challenge of carbon leakage—where businesses might relocate to regions with weaker climate policies—has become an increasingly pressing concern. Mechanisms such as the EU’s Carbon Border Adjustment Mechanisms (CBAMs) are emerging to address this, shifting away from free allocation of allowances, which becomes unsustainable as caps decline. CBAMs aim to prevent carbon

leakage by imposing tariffs on imported goods from countries with less stringent emissions regulations. However, these mechanisms present significant implementation challenges and have faced pushback from global trading partners, particularly developing countries. On the other hand, several developed countries are considering similar border adjustment mechanisms, highlighting the growing role these tools will play in shaping future climate policy.

Carbon credits are increasingly playing a central role in emissions trading. Offsets[1] and crediting mechanisms are gaining prominence in carbon market design, particularly in the new generation of systems. Out of the 38 carbon markets currently in force, 24 allow the use of carbon credits[2], alongside allowances[3], as a compliance option, typically with strict qualitative and quantitative limits (1). Key emerging economies such as China, Indonesia, India, and Brazil are incorporating domestic carbon credits to broaden the reach of incentives generated by their carbon market price signals. These developments suggest an increasingly central role for carbon credits in emissions trading and growing convergence between compliance and voluntary markets, some elements warrant caution.

The global carbon credit market is limited, particularly in terms of international credit demand. One of the primary factors is the approach taken by many carbon markets, which prioritize domestic credits. These systems often restrict the use of international credits, driving the market for compliance-grade carbon credits highly fragmented. Additionally, eligibility criteria and the standards for recognizing carbon credits differ significantly between systems. These variations further fragment the market, making it difficult for carbon credits to play a unified role in global emissions reduction efforts. This inconsistency creates complications for businesses operating in multiple jurisdictions, as they may face different regulations and requirements, further complicating the carbon credit market. At present, only South Korea accepts international credits as alternative compliance units within its carbon market. Moreover, even though new and developing carbon markets may

[1] A carbon offset is a specific type of carbon credit that compensates for emissions produced elsewhere by funding projects that reduce or remove an equivalent amount of CO_2 from the atmosphere (reduction happens outside of an ETS jurisdiction).

[2] A carbon credit represents a claim to a reduction, avoidance, or removal of one metric ton of CO_2 or its equivalent in other greenhouse gases.

[3] A carbon allowance is a permit issued by a government under an ETS, granting the holder the right to emit a specific amount of greenhouse gases (GHGs).

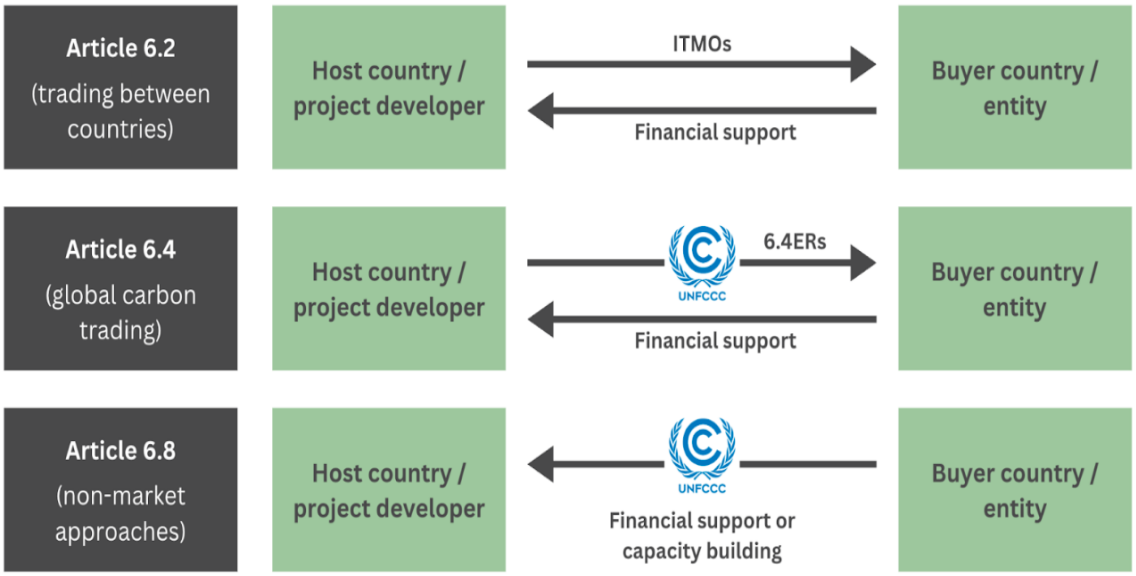
create substantial future demand for carbon credits, several factors are currently dampening the market. Generous free allocation levels in many systems, coupled with low allowance prices, reduce the financial incentive for companies to utilize offsetting provisions. Essentially, businesses covered by these systems are often able to meet their obligations with the free allowances provided, reducing their need to purchase additional carbon credits or offsets.

Despite these challenges, there is optimism for greater international cooperation in the future. The outcomes of Article 6 from COP29 in Baku have opened new possibilities for enhancing international crediting. These discussions aim to foster stronger cross-border collaboration in carbon markets, which could help address fragmentation and enable more widespread use of international credits. Article 6 not only has the potential to boost market credibility but also to increase future demand by providing clearer guidelines and higher standards.

4. Overview of Article 6

Article 6 of the Paris Agreement provides a framework for trading emissions reductions between countries. The rules governing country-to-country trading (Article 6.2), the new international carbon market (Article 6.4), and non-market approaches to emissions reduction (Article 6.8) are outlined in Figure 1.

Figure 1: International cooperation under Article 6



Source: Zero Carbon Analytics

Article 6.2 permits voluntary bilateral or multilateral cooperation between countries or other entities, such as companies, to implement Nationally Determined Contributions (NDCs) through the trade of Internationally Transferred Mitigation Outcomes (ITMOs). ITMOs are transferable units of emission reductions or removals that one country can sell to another to help meet its NDC targets. To prevent double counting of emissions reductions, the selling country must make corresponding adjustments in its national emission inventories.

Article 6.4 of the Paris Agreement, also referred to as the Paris Agreement Crediting Mechanism (PACM), builds on the foundation of the Kyoto Protocol's Clean Development Mechanism (CDM). It offers a standardized approach and a centralized platform for generating and trading emission reduction credits between countries and companies, facilitating global cooperation to achieve climate targets. Unlike the decentralized framework of Article 6.2, where countries engage directly with one another, Article 6.4 operates under a centralized governance structure managed by a supervisory body that oversees all aspects of the process, from project registration to the issuance of emission reductions and the enforcement of reporting guidelines.

Article 6.8 of the Paris Agreement establishes a framework for non-market approaches (NMAs), which involve capacity building, concessional funding, or grants aimed at supporting mitigation and adaptation efforts while advancing sustainable development goals. This commentary will focus specifically on Article 6.4 and its role in shaping the global carbon market.

5. The roadblocks to finalizing Article 6.4’s rules

The negotiations on Article 6 of the Paris Agreement, which sets the rules for a global carbon market, remained unresolved for nearly a decade due to disagreements on issues such as transparency, accounting rules, and environmental integrity. The complexity arose from the potential for carbon market to either accelerate emissions reductions or undermine them through loopholes and weak regulations. The challenge was to design a system that provided flexibility while ensuring that emissions reductions were real, additional, and permanent. Below are the key points of contention, and the Figure 2 illustrates how these issues were addressed during climate change negotiations.

Environmental integrity and credibility: One of the major concerns was ensuring that the emission reductions achieved through Article 6.4 were real, additional, permanent,

verifiable, without causing unintended negative environmental consequences. Critics worried that carbon markets could be used for "greenwashing" if countries were allowed to claim emissions reductions that were not meaningful. To prevent the use of low-quality credits that could undermine the PACM, extensive debate focused on the measurement, reporting, and verification (MRV) of reductions. To address this, robust MRV systems were implemented to ensure that reductions were genuine, measurable, and permanent. Projects were required to meet stringent standards and undergo third-party verification to maintain the credibility of the carbon credits issued.

Equally important was ensuring that carbon credit projects did not result in harming human rights or causing environmental degradation. Provisions were debated to ensure that carbon offset projects, particularly those in vulnerable ecosystems (such as forests and wetlands), do not cause harm to the environment. For instance, ensuring that large-scale afforestation or reforestation projects do not lead to land degradation or displace local communities. Additionally, a sustainable development tool was introduced to align carbon credit projects with the sustainable development goals (SDGs). This tool was designed to prevent harmful social impacts, such as exploitation or displacement, and to ensure that projects respected both environmental and social safeguards.

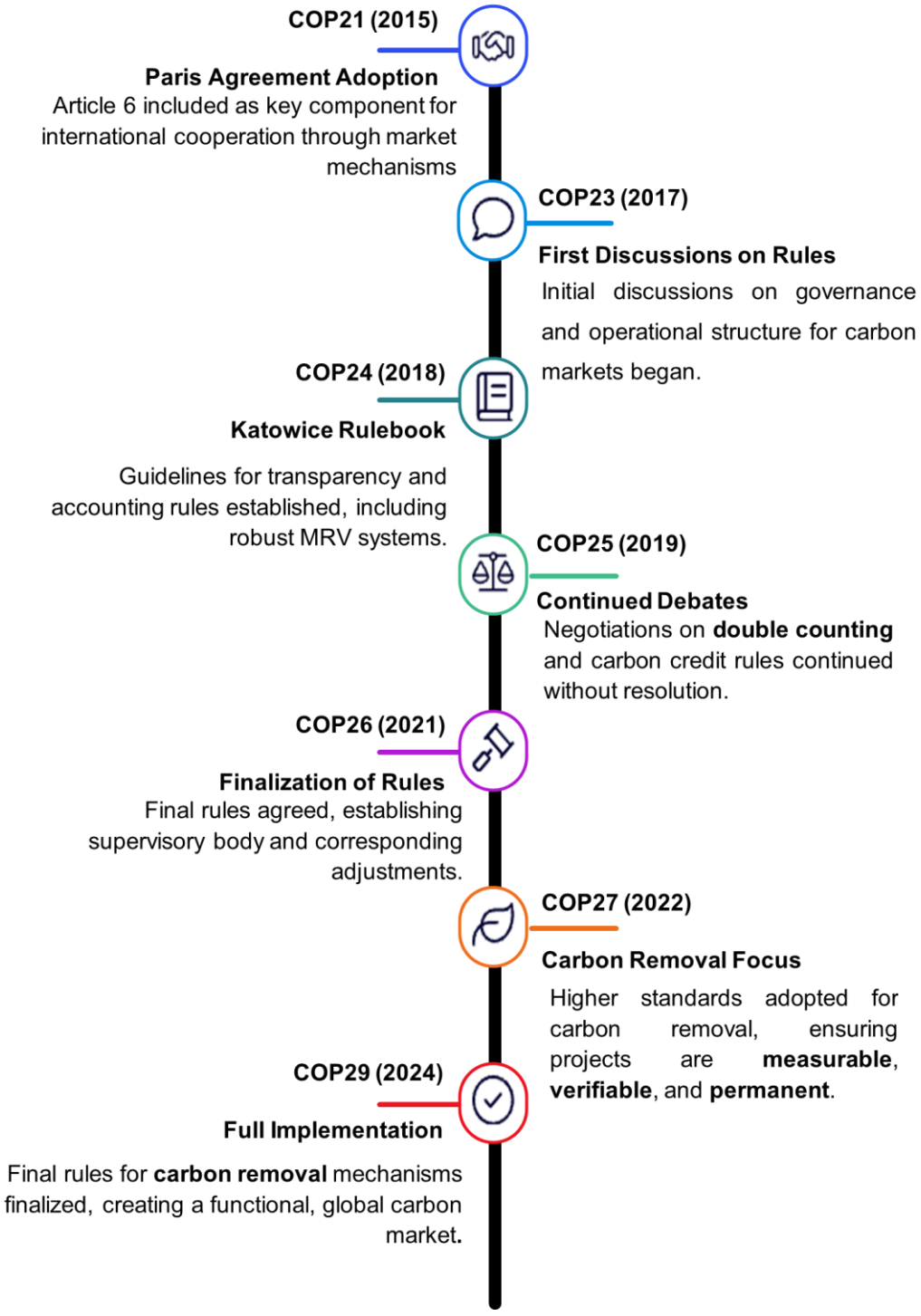
Double counting: Another key issue was preventing double counting of emission reductions. Double counting can occur when two countries or entities claim credit for the same emissions reduction. Strong rules and transparency mechanisms were needed to ensure that emissions reductions were counted only once, both at the point of generation and when they were transferred across borders.

To mitigate this, corresponding adjustments were adopted. This accounting mechanism ensures that when emissions reductions are transferred between countries, the reductions are only counted once towards a country's Nationally Determined Contributions (NDCs), preserving the environmental integrity of the system.

Governance and oversight: A key challenge was establishing a robust governance framework for the carbon crediting mechanism. There were debates about the supervisory body’s powers and responsibilities, particularly its authority to enforce rules and ensure transparency without becoming overly bureaucratic or slow. To address this, a centralized supervisory body was established to oversee the registration of carbon credit projects, ensuring transparency and accountability in credit issuance. This body would be

responsible for approving methodologies, accrediting third-party verification entities, and managing the registry system, ensuring consistent oversight across all projects.

Figure 2: Timeline of Key Milestones for Article 6.4 (Paris Agreement)



Source: Author

Carbon pricing and market design: There was significant disagreement over how the pricing of carbon credits would work and whether the market should be purely market-based or involve certain restrictions. Some countries advocated for flexibility in the system, while others called for stricter rules to prevent the market from becoming a "loophole" for countries to avoid making real emissions reductions. The potential for carbon market to become distorted or manipulated was a major concern. The challenge was to balance the need for a standardized approach with the flexibility to accommodate the diverse circumstances of different countries. The adopted rules provide flexibility in how countries implement carbon crediting activities, while ensuring the maintenance of strict environmental safeguards. This approach allows countries to tailor their participation in the carbon market based on their specific needs and capabilities, promoting broader participation and enhancing global ambition in addressing climate change.

Carbon removal: Negotiators faced significant challenges in defining the eligibility of carbon removal projects for carbon crediting under Article 6.4. A key point of debate was the quality control of carbon credits, particularly concerning the permanence and additionality of projects like reforestation and soil carbon sequestration. A breakthrough occurred when it was decided that both nature-based solutions, such as reforestation, and technological solutions, like direct air capture, could generate carbon credits. At COP29, negotiators made crucial progress in finalizing the operational standards for carbon removal (2). This included stronger guidelines to ensure alignment with sustainable development goals (SDGs) and the introduction of social and environmental safeguards to prevent harm to local communities or ecosystems.

The framework for carbon market under the Paris Agreement has been established, but many details still need to be finalized by the UNFCCC Secretariat in the coming months. With this in place, the focus will now shift to implementation and ensuring the carbon market fulfils its promise as a key source of international climate finance and a means of transferring emerging technologies to developing countries, while advancing progress toward the goals of the Paris Agreement in a cost-efficient manner.

6. Prospects for financial flows via PACM

Emissions trading revenues have become an essential source of climate finance, helping governments fund decarbonization efforts and provide support to vulnerable communities affected by climate change. Since the launch of the first carbon markets, their revenues

have steadily grown, reaching a cumulative total of USD 373 billion by the end of 2024. The steady rise in annual revenues, culminating in a record USD 74 billion in 2023, highlights the increasing role of carbon pricing in driving emissions reductions globally (1).

However, in 2024, emissions trading revenues declined to approximately USD 70 billion, marking a decrease of USD 4 billion compared to the previous year. This decline is a significant shift after years of steady growth and reflects several factors. One key element is the lower average prices for carbon credits recorded across most carbon market systems. A variety of dynamics contributed to this price drop, including economic uncertainty, regulatory adjustments, and shifting market sentiment.

In 2024, there was a noticeable decline in momentum toward achieving global climate change targets, marked by policy shifts and rollback of climate commitments in many countries. Several nations, particularly in developed economies, reduced the ambition of their climate goals or delayed the implementation of key decarbonization policies. This shift in focus significantly impacted market sentiment, as carbon markets rely on the belief that governments will continue to tighten emissions regulations over time. When this belief is questioned, market participants may become more cautious, leading to decreased demand for carbon credits, and ultimately, a drop in prices.

Nevertheless, the operationalization of PACM is poised to drive growth in carbon markets. By advancing Article 6, it enables governments to buy carbon offsets as part of their efforts to meet their climate targets, including Nationally Determined Contributions (NDCs). The upcoming updates to countries' NDCs are expected to provide specific targets for the use of carbon offsets in national climate strategies. These updates will provide essential insights into how each country plans to incorporate carbon markets and offsets into their broader climate strategies, offering a clearer path for market participants. Therefore, as countries clarify how offsets will fit into their NDCs, the demand for carbon credits will likely rise, further integrating carbon markets and encouraging international cooperation.

However, the potential of the PACM to catalyse global carbon market growth is significantly affected by the participation of major economies. The United States’ withdrawal from the Paris Agreement would pose a major setback. As the world’s largest economy and one of the biggest emitters, the absence of the US from the Agreement would prevent its carbon markets from being formally integrated with international mechanisms under Article 6. This fragmentation weakens global carbon price convergence limits demand for carbon credits

and reduces the overall scale and liquidity of PACM. Without active US participation, the credibility and ambition of the global carbon market could fall short of expectations, slowing progress toward climate goals and undermining the collaborative spirit at the heart of Article 6.

Nonetheless, if major emitters remain engaged, the benefits of Article 6 cooperation could be transformative. Studies by the International Emissions Trading Association (IETA) and the Center for Global Sustainability at the University of Maryland estimate that cooperative implementation of NDCs could reduce costs by up to $250 billion annually by 2030(3). Looking further ahead, if countries align their net-zero targets through Article 6-based cooperation, cross-border carbon market flows could exceed $1 trillion per year by 2050, while reducing global mitigation costs by an estimated $21 trillion between 2020 and 2050(4). These financial flows would primarily benefit developing countries, helping them invest in clean technologies and advance sustainable development goals. However, capturing these benefits will require sustained political will, and the effective scaling of Article 6 mechanisms.

7. Impact on the Natural Gas Sector

A well-functioning, UN-backed carbon pricing mechanism can significantly enhance decarbonization efforts and reshape the energy landscape, with important implications for the natural gas market.

PACM can expedite the shift from high-carbon fuels to natural gas. In terms of decarbonization, few measures have been as effective as the switch from coal to natural gas. The IPCC's sixth assessment report highlights a 0.3% annual decline in global carbon intensity (CO_2 emissions per unit of primary energy) from 2010 to 2019, primarily driven by coal-to-gas switching, limited coal expansion, and growing renewable energy adoption (5).

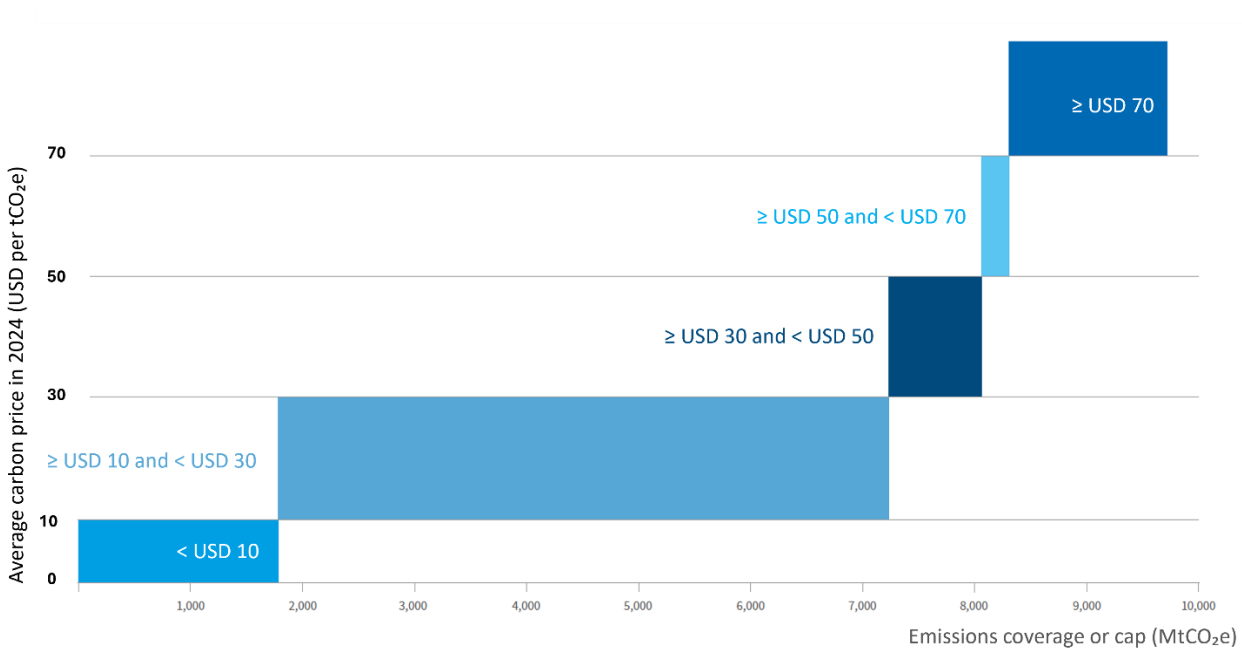
considering natural gas significant role in reducing the carbon intensity of power generation by replacing coal, carbon pricing mechanisms, such as carbon markets, are essential in promoting its use over coal, as they change the relative cost of natural gas production compared to coal and create financial incentives for power generators to make this shift.

In regions with both coal and gas power plants, market forces—particularly the prices of coal, natural gas, and carbon—play a crucial role in driving this transition. Our estimations suggest that a carbon price between USD 25 and USD 75 per tonne of CO_2 could

significantly accelerate this transition (6). A global carbon market that strengthens carbon pricing in coal-dependent regions could therefore stimulate greater demand for natural gas.

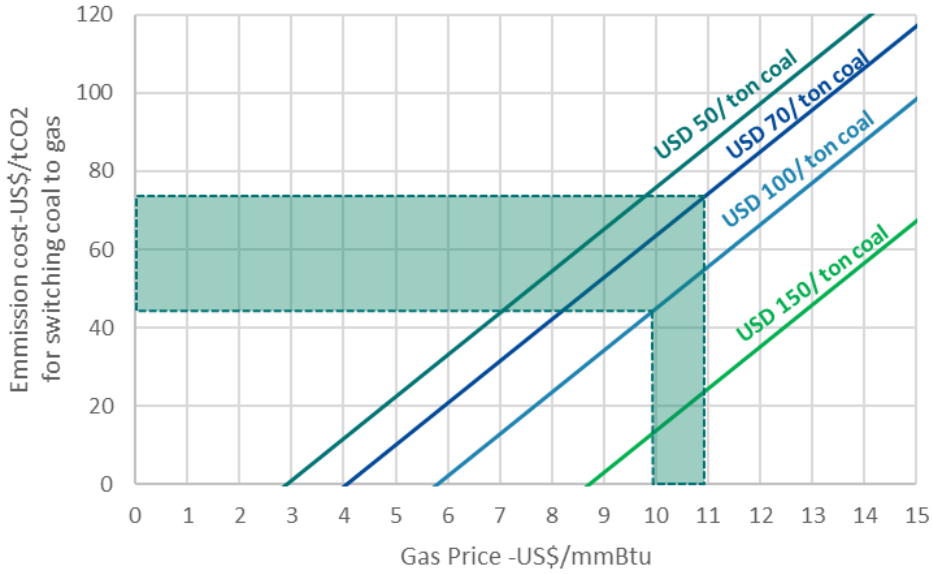
However, many of the current carbon markets have price levels too low to effectively signal this shift. Figure 3 shows that in 2024, many emissions allowances were traded at prices too low to significantly impact the energy mix. For example, according to the GECF projections, the average long-term price for natural gas in Asia pacific is expected to settle between USD 10-11/mmbtu while projection for coal is between USD 70-100/ton between 2025 to 2050. Having these prices Figure 4 indicates that if carbon is priced between USD 50 to $75 per ton, natural gas can effectively compete with coal. Our analysis indicates that a carbon price of USD 60/ton CO_2 would maximize natural gas consumption, resulting in a cumulative increase of 2,588 billion cubic meters of natural gas and avoiding 12,561 million tons of coal equivalent between 2024 and 2050 in this region (7). However, carbon prices in this region have mostly remained below USD 10 per ton of CO2, limiting the economic incentive for coal-to-gas switching.

Figure 3: The range of allowance prices in 2024 within carbon markets in force and the associated volume of covered emissions



Source: the ICAP Status Report 2023

Figure 4: The interplay among carbon, gas, and coal prices and the appropriate range of carbon prices in the Asia-Pacific region to incentivize coal-to-gas switching in the power sector



Source: Author calculation

Carbon pricing can also enhance the competitiveness of low- and zero-carbon energy sources such as renewables and nuclear. However, several critical barriers hinder their widespread adoption, particularly in developing countries. Despite rapid advances in renewable technologies, deployment is not keeping pace with the dual challenge of meeting rising global energy demand while phasing out coal. In many regions, especially in the Global South, renewable energy alone cannot yet meet baseload requirements. Natural gas, as the cleanest fossil fuel and a flexible, dispatchable power source, remains vital for maintaining the reliability and stability of energy systems as intermittent renewables continue to expand.

Moreover, most developing countries have energy systems heavily reliant on fossil fuels and lack the technical, institutional, and financial capacity to shift directly to renewables. Achieving such a transition would require significant investments in grid upgrades, energy storage, and regulatory reform—investments that carbon pricing alone is unlikely to deliver. On the other hand, nuclear energy involves high upfront capital investment, making it less feasible for many developing countries.

By contrast, natural gas infrastructure is more compatible with existing systems and offers a more accessible, cost-effective pathway for reducing emissions while preserving energy security and supporting development priorities.

PACM could drive a shift to cleaner fuels like LNG and CNG in the transport sector. If Article 6 succeeds in establishing an effective global carbon pricing mechanism, it could significantly influence fuel choices across the transport sector, where diesel, gasoline, and heavy fuel oil continue to dominate. A well-designed carbon trading system would shift the economic balance in favour of lower-carbon alternatives such as compressed natural gas (CNG) and liquefied natural gas (LNG). LNG, in particular, emits up to 25% less CO_2 than traditional marine fuels and substantially reduces local pollutants such as sulphur oxides (SOx), nitrogen oxides (NOx), and particulate matter. This makes it especially attractive in maritime shipping and heavy road freight, where environmental regulations are tightening and zero-emission alternatives are still emerging. In the light-duty vehicle segment and public transit, while electrification remains the long-term goal, natural gas can offer a viable solution in markets where infrastructure limitations or vehicle costs hinder large-scale deployment of electric mobility. Overall, a well-established global carbon market would not only drive emissions reductions but also support the broader shift toward cleaner transport fuels—positioning natural gas as part of a practical and flexible decarbonisation strategy.

PACM can promote the shift to cleaner natural gas. To maximise the role of natural gas in future low-emission energy systems, its use must be complemented by mitigation measures such as improving energy efficiency across the gas value chain, reducing flaring, abating methane emissions, deploying CCUS, and advancing carbon removal technologies. These measures are essential to maintaining natural gas as a credible low-carbon solution in line with global climate objectives. However, many of these measures face significant financial and commercial barriers, largely due to the lack of stable and predictable revenue streams.

Article 6 of the Paris Agreement plays a crucial role in advancing these measures, particularly CCS[1] and carbon removal[2] technologies, which are essential for decarbonising the natural gas value chain and offsetting emissions. CCS can be applied to mitigate process emissions in natural gas production and reduce emissions from gas-fired power plants by capturing and storing CO_2 at the source. Additionally, CCS is key to producing blue hydrogen, which provides a low-carbon alternative while maintaining the role of natural gas in the energy system.

Beyond emission reductions, there is increasing attention on carbon removal solutions to offset unavoidable emissions, for example from natural gas use in household heating or transportation. These removals can be achieved through natural solutions like afforestation and reforestation or engineered approaches such as Direct Air Capture with Carbon Storage (DACCS)[3] and Bioenergy with Carbon Capture and Storage[4] (BECCS). However, DACCS and BECCS remain less technologically mature compared to conventional CCS.

A major challenge for large-scale CCS deployment is its lack of inherent revenue generation, making economic instruments like carbon pricing and carbon market mechanisms essential for attracting private investment. Some domestic and voluntary carbon markets, such as Alberta's regulatory framework and the Verified Carbon Standard (Verra), already incorporate CCS projects (8). However, current mechanisms operate on too small a scale to mobilise the necessary capital for widespread CCS adoption. This is

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[1] 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.

[2] Removals are the outcomes of processes by which greenhouse gases are removed from the atmosphere as a result of deliberate human activities and are either destroyed or durably stored through anthropogenic activities.

[3] Direct Air CO_2 Capture and Storage (DACCS): A chemical process by which CO2 is captured directly from the ambient air, with subsequent storage. Also known as direct air capture and storage (DACS).

[4] 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.

where the market-based mechanisms of the Paris Agreement become critical. Under Articles 6.2 and 6.4, CCS projects can be credited with helping to address financial barriers.

8. An overview of relevant methodologies

Article 6.4, as the successor to the Clean Development Mechanism (CDM), benefits from its extensive experience while expanding eligibility for new methodologies. Under the Article 6 rulebook, the Supervisory Body is tasked with reviewing CDM methodologies and adapting them for Article 6.4 activities, ensuring alignment with current decarbonisation needs Below is a review of several CDM methodologies that can be adapted under Article 6.4, with natural gas being a key beneficiary:

Fuel switching to natural gas in power generation: Under CDM, ACM0011 (Large-scale Consolidated Methodology) is designed for projects that involve switching from coal or petroleum fuels to natural gas in existing power plants. This methodology applies to power plants with at least three years of operational history using coal or petroleum fuels and provides a robust framework for calculating emissions reductions. The success of this methodology under CDM sets a solid foundation for Article 6.4, where this methodology can be referenced and adapted to ensure that the transition to natural gas in the power sector continues to align with the global emissions reduction goals.

Fuel switching in industry: Methodologies like ACM0009, which covers the switching from coal or petroleum fuel to natural gas in industrial heat generation, and AM0049, which addresses gas-based energy generation in industrial facilities, are already established under CDM. These methodologies are applicable to industries that use coal or petroleum fuels for heating or energy generation, providing a framework for switching to natural gas.

Fuel switching in transportation: In the transportation sector, One relevant CDM methodology is AMS-III.S, which supports the introduction and operation of low-emission vehicles or technologies in commercial vehicle fleets. This methodology covers vehicles such as CNG, LPG, electric, or hybrid vehicles used for both passenger and freight transport, operating on routes with comparable conditions. Additionally, AMS-III.S also allows for the retrofitting of existing vehicles to adopt these low-emission technologies, further extending the impact of the transition to cleaner fuels.

Another important methodology is AMS-III.AY, which specifically focuses on the introduction and operation of LNG buses for passenger transportation. This methodology

applies to both new and existing bus routes and supports the transition from diesel-powered buses to LNG buses, offering significant reductions in emissions compared to traditional fuels.

CCS and removal projects: The Modalities and Procedures for CCS as CDM Project Activities (CCS M&P), adopted at the 2011 Durban COP, ensured that CCS projects remain valid within the framework of Article 6 (9). However, under the CDM, removal activities were limited to afforestation and reforestation, excluding DACCS and BECCS, as CCS projects required the stored CO_2 to originate from anthropogenic sources. Furthermore, at the 2022 Sharm El-Sheikh Climate Change Conference (COP27), the CMA requested the Supervisory Body to develop more detailed recommendations for assessing and implementing methodologies.

With the endorsement of new Article 6.4 documents on methodologies and removals at COP29, there will be no obstacles preventing different types of CCS projects from being implemented under the Article 6.4 mechanism.

9. Formulating realistic decarbonization pathways

The world is facing an urgent race against time to decarbonize the global economy. With limited time to meet the climate goals set under the Paris Agreement, the need for an affordable, reliable, and effective transition to low-carbon energy systems has never been greater. Developing countries, which are heavily reliant on coal for power generation, face the additional challenges of limited financial resources, insufficient infrastructure, and growing energy demand. In this context, ensuring affordable and reliable energy while reducing emissions is critical. The growing public opposition to climate policies that result in higher energy costs, as witnessed in recent years, further emphasizes the need for a balanced and pragmatic approach to decarbonization.

In addressing this challenge, coal-to-gas switching presents a more cost-effective and feasible pathway than switching from coal to renewable energy. While renewable energy such as wind and solar plays a crucial role in the long-term decarbonization strategy, the transition from coal to renewables is more costly and complex, especially for developing coal-dependent countries. The necessary infrastructure to support renewable energy—including storage solutions, grid upgrades, and energy management systems—is often lacking or expensive to implement, making it a difficult and slow process in many parts of

the world. In contrast, natural gas offers a lower-carbon alternative with existing infrastructure and relatively lower investment costs compared to a full-scale transition to renewables. Furthermore, renewables still face the challenge of intermittency—meaning they cannot reliably meet energy demand on their own. This is where natural gas plays a key role as a dispatchable fuel, able to provide backup power and stability to the grid when renewable generation is insufficient.

Given the time constraints and financial limitations we face, coal-to-gas switching should be prioritized as a practical and immediate solution to reduce emissions in the power sector. While renewables will undoubtedly be central to the long-term energy transformation, natural gas offers a cleaner alternative that can be implemented more swiftly, supporting the decarbonization of the energy system without significant disruptions to the energy supply or affordability. Additionally, technologies to make natural gas even cleaner, such as CCUS, should also be accelerated. CCUS technology can further reduce the emissions from natural gas, making it a crucial part of a low-carbon future. Similarly, carbon removal projects can address unavoidable emissions, particularly in sectors where electrification or direct emissions reductions are more challenging.

A well-functioning PACM, has the potential to drive these changes by incentivizing the transition from coal to natural gas, as well as the development of CCUS and carbon removal technologies. By focusing on these pathways, PACM can provide the necessary incentives to transition toward a low-carbon future in a way that is both affordable and reliable.

Gas-rich countries are in a unique position to support the decarbonization of coal-reliant nations, particularly in the developing world, through Article 6 of the Paris Agreement. By investing in the potential of Article 6.2 and Article 6.4, these countries can help facilitate the coal-to-gas transition, which offers numerous advantages both for the gas-exporting nations and the countries making the shift. This transition is crucial for developing countries that rely heavily on coal for electricity generation but lack the financial resources and infrastructure to transition. Gas-exporting countries can accelerate this transition by ensuring stable, affordable natural gas supplies, investing in the infrastructure required for transportation and storage, and helping provide climate finance to coal-dependent countries. The expertise of these countries in LNG production and transportation can further enable the replacement of coal with cleaner natural gas, driving down emissions in key sectors.

However, the long-term success of the coal-to-gas transition will depend on continued investment in emissions-reduction technologies such as carbon capture, utilization, and storage (CCUS) and methane abatement. Therefore, targeted climate finance directed toward the development and deployment of these technologies will be critical in ensuring that natural gas remains competitive as a low-carbon solution. By supporting the decarbonization of the natural gas value chain, gas-exporting countries can enhance the role of natural gas in the global energy transition while addressing climate change and ensuring energy security for developing economies.

Article 6 mechanisms offer a platform for coal-reliant countries to access the necessary financial and technological support for this transition. By cooperating within the framework of Article 6.2 and Article 6.4, natural gas-rich countries can create a win-win scenario, advancing both global climate goals and energy security for emerging economies. This cooperation will not only contribute to reducing global emissions but also strengthen the role of natural gas as a sustainable and reliable energy source in the transition to a low-carbon economy.

10. Final remarks

Article 6.4 enables countries to collaborate in achieving their NDCs through market-based mechanisms by allowing the purchase of carbon offsets to meet climate targets. At COP29, leaders reached agreement on high standards for project methodologies, social safeguards, and the finalisation of Article 6 rules. However, the real challenge now lies in translating these rules into action. Many developing countries still lack the capacity to effectively engage in carbon markets. This includes the need to build robust policy and regulatory frameworks, develop market participation strategies, strengthen institutional capacity, and ensure transparent governance and infrastructure for accurate greenhouse gas accounting.

Moreover, the success of carbon markets depends on a stable policy environment that consistently signals to businesses and investors that emission reductions will remain a priority for governments—something that has not been the case recently. The recent policy shifts and rollback of climate commitments in many countries, particularly in developed economies, have cast a shadow over the prospects for global carbon market growth.

A key example is the United States' withdrawal from the Paris Agreement. As one of the world's largest emitters, the decision to step away from this landmark global accord sent a powerful signal to the international community that climate action is not a top priority for the U.S. government at this moment. This retreat has raised doubts about the commitment of other major economies, as countries expect developed nations to take bold climate action and drive global solutions.

This loss of political will have a direct impact on carbon markets. For carbon markets to succeed, there must be consistent and reliable signals that emissions regulations will become progressively stricter. Carbon pricing mechanisms depend on this principle, as the price of carbon credits reflects the expectation that future regulatory measures will increase the cost of emitting carbon. When this expectation is challenged by policy shifts or uncertainty, as we have seen in recent years, carbon prices may fall, and businesses may lack the financial incentives to invest in emissions-reduction technologies. Furthermore, the broader public may lose confidence in the efficacy of carbon markets, which could dampen participation in these markets. Without these elements, the effectiveness of PACM and the pace of global decarbonization will be significantly hindered.

These challenges will undoubtedly be reflected in the updated NDCs (NDC 3.0), which countries are expected to submit before COP30. The new iteration of NDCs will present a critical opportunity to clarify how carbon offsets and Article 6 mechanisms will be integrated into national climate strategies. Countries are expected to outline their plans for engaging with Article 6 during this update cycle, which will be pivotal in addressing gaps in global climate commitments and revitalizing carbon markets.

However, before the PACM can become a transformative tool for financing climate action, significant groundwork is still needed. In 2025, efforts must focus on advancing methodologies and building the necessary infrastructure to ensure the credibility and effectiveness of the market. The UN Supervisory Body plays a central role in this process, tasked with refining methodological frameworks. This includes updating and adapting methodologies inherited from the Clean Development Mechanism (CDM), as well as creating new approaches aligned with the evolving goals of the Paris Agreement.

Although the issuance of PACM credits may begin as early as 2025, the global carbon market is unlikely to be fully operational until the following year. This interim period is critical for laying the technical and institutional foundation that will allow developing countries to

participate meaningfully in the market. Ensuring transparency, environmental integrity, and equitable access will be essential for PACM to deliver on its promise as a key mechanism for mobilising climate finance and supporting low-carbon transitions.

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