

UNLOCKING CLIMATE SOLUTIONS: CARBON CREDITS, OFFSETS, AND CLEAN DEVELOPMENT MECHANISM

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ABSTRACT

Carbon credits are instrumental in creating a market-based mechanism for incentivizing emission reductions and promoting sustainable practices. By trading carbon credits, businesses and industries can efficiently manage their carbon footprint by reducing emissions internally or purchasing credits from projects that mitigate emissions elsewhere. This flexibility allows cost-effective solutions to combat climate change while encouraging innovation and investment in clean technologies. Reducing greenhouse gas emissions is just one aspect of carbon offset projects. Such projects also support by creating jobs and educational prospects, technology transfer, and providing economic and social benefits worldwide. CDM serves as a vital mechanism for channeling climate finance, fostering international cooperation, and incentivizing emission reductions while promoting sustainable development worldwide.

INTRODUCTION

The rapid expansion of industries undoubtedly signifies the economic development of a country, contributing to increased foreign revenue. However, this growth is simultaneously taking its toll on the environment due to the release of greenhouse gases (GHGs). GHGs, both natural and anthropogenic in origin, have been identified as significant contributors to climate change. Greenhouse gases may be originated both by natural and anthropogenic processes in the atmosphere. Various studies indicate that human activities like forest razing and combusting fossil fuels, among others, are directly associated with the increased level of GHGs in the atmosphere (Table 1). The amount of GHGs in the environment is increasing day by day (Friedlingstein et al. 2019; Minx et al. 2021). These GHGs absorb and re-emit radiations within the thermal infrared range (UNFCCC) and are responsible for the greenhouse effect, which results in the rise of the earth's temperature by the absorption of thermal radiation. Our earth gets heated by solar radiation, but the increase in these gases causes the earth's temperature to increase which is known as global warming. The relative

quantity of heat captured by a given mass of a greenhouse gas in the atmosphere over a definite time interval is considered as Global Warming Potential (GWP). The time duration may be 20, 100, or 500 years. The increase in the average global surface temperatures has far-reaching outcomes, including rising levels of the sea, altered weather systems and climatic patterns, and disruptions to ecosystems and biodiversity. Recognizing this global adversity called climate change, international agreements like the Kyoto Protocol have outlined measures to mitigate GHG emissions. According to Kyoto Protocol's Annexure A, six primary greenhouse gases are reported that are urgently required to be reduced or limited, these are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and hydrofluorocarbons (HFCs). These gases have varying Global Warming Potentials (GWPs), indicating their relative effectiveness in trapping heat compared to CO₂ over specific timeframes. The major sources of these gases are represented in Table 2.

Table-1: Responsible sectors for the emission of GHGs

S. No.	Sectors	Source
1.	Energy	Combustion of fuel: In the transport sector, industries, etc. Fugitive emissions from fuels: Oil, natural gas, solid fuels, etc.

2.	Industrial activities	Chemical industry Production of mineral and metal products Production and consumption of sulfur hexafluoride and halocarbons
3.	Solvent and other products	Emissions of non-methane volatile organic compounds (NMVOCs) In dry cleaning, printing, vapor degreasing, textile manufacture, etc. Surface coating (Paints): lacquers, thinners, and related materials used in coatings in a variety of industrial, commercial, and household products
4.	Agriculture	Enteric fermentation, Manure management, and Rice cultivation Field burning of agricultural residues etc.
5.	Waste	Solid waste and wastewater Waste incineration

Source: Annex A, Conference of The Parties, Third session Kyoto, 1-10 December 1997 Agenda item

Ultimately, addressing the challenges posed by GHG emissions

Table-2: Greenhouse gases (GHGs) and their sources

S.No.	Name of gas	Sources
1.	Carbon dioxide (CO ₂)	Fuel (Coal and Natural gas) Cement production Refineries Iron and steel industry Petrochemical industry (Ethylene, Ammonia, Ethylene oxide) Biomass (Bioenergy and Fermentation)
2.	Methane (CH ₄)	Produced by anaerobic decomposition in natural wetlands, paddy rice fields Emission from livestock (By intrinsic fermentation and animal waste) Biomass burning (forest fires, charcoal combustion, and firewood burning) Anaerobic decomposition of organic waste in landfills Emission during the exploration and transport of fossil fuels (fossil methane) (Heilig et al. 1994)
3.	Nitrous oxide (N ₂ O)	Most of the nitrous oxide comes when we apply nitrogen fertilizers to the soil. Soil microbes convert nitrogen to N ₂ O. It is also produced when we use organic fertilizers like animal manure.
4.	Hydro-fluorocarbons (HFCs)	Refrigeration and air conditioning equipment Manufacturing of polyurethane foams Manufacturing of inhalers such as asthma puffers Building insulation Manufacturing of extinguishing systems and fixed flooding systems
5.	Perfluorocarbons (PFCs)	Aluminum industry Electronic industry for the production of semiconductors PFC gases are earlier used for soundproofing in windows
6.	Sulfur hexafluoride (SF ₆)	SF ₆ is used in: As an insulating gas in power systems for electrical insulation Arc quenching in the transmission and distribution of electricity Manufacturing of semiconductors Production of magnesium

Source: Annex A, Conference of The Parties, Third session Kyoto, 1-10 December 1997 Agenda item 5

Efforts to mitigate GHG emissions involve implementing cleaner technologies, transitioning to renewable sources of energy, improving the efficiency of energy consumption, and implementing policies to regulate emissions. Additionally, initiatives such as carbon pricing, reforestation projects, and international cooperation play crucial roles in combating climate change. Internationally a goal has been established, to reduce global warming to less than 2 °C by the 21st century (Paris Agreement), and to pursue hard work to limit the rise of the average global temperature to 1.5 °C. IPCC advised modeling to realize the later goal, observing that a significant amount of CO₂ reduction will be obligatory by the year 2030 (IPCC, 2018).

requires a concerted global effort involving governments, industries, communities, and individuals. By applying the principle of sustainability in developmental practices and reducing our carbon footprint, we can strive towards a sustainable future that is more in tune and harmony with the environment while continuing to support steady growth in the economy and equitable development.

MAJOR OUTCOMES OF THE KYOTO PROTOCOL

This approach recognized the historical responsibility of developed nations for the bulk of historical emissions and aimed to promote equity in addressing climate change. The Kyoto Protocol was adopted on December 11, 1997, and came into effect on the 16th of February, 2005. The primary motto of the Kyoto Protocol is to stabilize the concentration of greenhouse gases in

the atmosphere, which is the main cause of global warming, and to spread the knowledge about the urgency to control GHG emissions. At this conference, many countries agreed to reduce CO₂ emissions and other greenhouse gases. The novel concept known as carbon credits was introduced as a key strategy during the Kyoto Protocol discussions.

To summarize, the Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change (UNFCCC) by making the developed and developing nations commit to limiting as well as reducing greenhouse gas emissions as per the targets envisioned by the protocol itself. While the Convention encourages those countries to adopt suitable measures and policies for the mitigation and to report the steps thus taken, periodically. The Kyoto Protocol listed emission targets that were legally binding for developing nations. To attain these goals, the nations must limit the emission of carbon dioxide. The salient features of the Kyoto Protocol are as:

1. **Number of countries:** The Kyoto Protocol was ratified by 192 parties. It is worth mentioning that all the countries that are parties to the Kyoto Protocol, do not necessarily have legally binding emission targets. The emission targets that are legally binding are primarily for developed countries, known as Annex I Parties, while developing countries, known as Non-Annex I Parties, have voluntary commitments under the protocol.
2. **Emission targets for developing nations:** Developing nations do not have any legally binding emission reduction targets under the Kyoto Protocol. The protocol focuses on setting binding targets exclusively for developed countries to reduce their greenhouse gas emissions.
3. **Enforcement:** While the Kyoto Protocol came into effect on February 16, 2005, it's essential to note that enforcement mechanisms under the protocol primarily involve reporting and compliance procedures rather than punitive measures for non-compliance.

This annex-based agreement focuses on "Annex I Parties," comprising primarily developed countries responsible for the current high levels of GHG emissions in the atmosphere. By targeting these nations, the Protocol aims to assist them in managing their emissions and implementing climate policies at the national level. The crux of this commitment lies in limiting carbon dioxide emissions. Annex I countries, of the Kyoto Protocol, pledged an average reduction of 5.2% of their GHG emissions during the period 2008-2012. Notably, the United States, despite being a significant emitter accounting for approximately one-third of global GHG emissions, did not ratify the treaty.

During the conception phase of the Kyoto Protocol, participating countries recognized the urgent need to address the growing threat of global warming caused by the accumulation of greenhouse gases in the Earth's atmosphere. Under the Kyoto Protocol, the developed nations agreed to collectively reduce greenhouse gas emissions, with a set target specific for each country. However, it was acknowledged that achieving these targets for emission reduction would be challenging for some countries due to various technological and economic constraints. The protocol directed 37 industrialized countries to diminution of their emissions.

Nevertheless, the Protocol introduces mechanisms to aid Annex I Parties in meeting their reduction targets. The Kyoto mechanisms include the Clean Development Mechanism (CDM), trading of Emissions, and Joint implementation. Through these mechanisms, the Kyoto Protocol offers a framework for cooperative action, encouraging developed countries to take care of the emissions nationally while facilitating global endeavors to combat climate change.

Emissions trading enables the buying and selling of emission allowances by developed nations, fostering a market-driven approach to emission reductions. CDM allows investment in the projects being carried out or envisioned by the developing countries for emission reduction, allowing Annex I countries to support such initiatives in countries with lesser economic as well as technological capabilities, as a tool to offset their emissions. Similarly, JI permits Annex I Parties to undertake projects for the reduction of emissions in other Annex I countries, generating credits towards their reduction targets.

This conference pioneered the concept of a cap-and-trade system leading up to a carbon credit market. It was realized that carbon credit may be a good way of reducing greenhouse gases. By this conference, it is concluded that a tradable permit mechanism is an efficient policy instrument that has proven to be effective environmentally in the industrial sector, and consequently introduced and popularized the idea of carbon credit for regulating the emission of GHGs. This means the concept of carbon credit was conceptualized due to the increasing consciousness and the necessity for the control of pollution. Moreover, the protocol's introduction of carbon credit as tradable certificates for emissions reductions incentivized investment in emission reduction projects and provided a market-based mechanism for achieving climate goals. This concept of carbon credit has since become a cornerstone of international climate finance and mitigation efforts, facilitating emissions trading and promoting collaboration between developed and developing countries.

To provide flexibility in meeting emission reduction targets, a concept was introduced known as the cap-and-trade system. This system allowed countries or industries that were able to reduce the amount of emissions well below their given targets to earn carbon credit, which could then be traded or sold to other entities that were struggling to meet their targeted levels of emission. This mechanism incentivized emission reductions by creating a carbon credits market, thereby promoting cost-effective solutions to put a check on the amount of GHG emissions. The idea of carbon credit gained traction as a practical and effective tool for keeping greenhouse gas emissions within set limits while allowing for economic growth. By introducing market-based incentives for emission reductions, carbon credit offered a mechanism to harness the forces of supply and demand to achieve environmental objectives. Today, carbon credit remains an important tool for various countries to jointly curb emissions and synergistically act against climate change, with various emission trading schemes and carbon emission reduction projects implemented worldwide. The concept continues to evolve as countries seek innovative ways to reduce the amount of emissions and move towards a more sustainable and low-carbon future.

In 2008, developed countries devised various norms to reduce the amount of greenhouse gas (GHG) emissions within their companies and factories. Industries were mainly given two options for achieving carbon reduction targets. The first involved directly decreasing GHG emissions through the incorporation of new technologies or the improvement of existing ones. The second option allowed industries to collaborate with developing nations, assisting them in implementing eco-friendly technologies and initiatives. This collaboration enabled developing countries or their companies to earn credits for their efforts. A prominent mechanism facilitating this collaboration is the Clean Development Mechanism (CDM). The CDM enables a developed country to sponsor a developing country (Non-Annex I Country) for a GHG reduction project. Typically, the estimated cost incurred for implementing projects that reduce GHG emissions in developing countries is lower compared to developed ones, while its impact on the environment is globally significant. In such scenarios, the developed country sponsoring the project earns carbon credits for meeting its targets for emission reduction, whereas the country that is being sponsored, benefits from capital investment and the transfer of clean technology.

Profits generated from the selling of carbon credits incentivize projects that focus on renewable energy in developing countries. For instance, renewable energy electricity projects such as hydroelectric power plants are eligible to generate carbon credits through the CDM. Along with the reduced GHG emissions, it also allows developing countries to earn additional revenue by selling these credits in the global carbon market.

Overall, while the Kyoto Protocol had limitations and challenges, its role in shaping international climate policy and promoting the use of carbon credits as a tool for mitigation of greenhouse gas release cannot be overstated. The Protocol represents a significant step toward international cooperation in handling the urgent issue of climate change.

CONCEPT OF CARBON CREDIT

Indeed, carbon credit plays an important role in environmental economics, functioning as a tradeable certificate that represents permission to emit a given amount of GHGs. Each carbon credit typically corresponds to the mitigation or removal of a unit tonne of carbon dioxide or the equivalent mass of another greenhouse gas. Carbon credit plays a key role in incentivizing emission reductions and promoting climate action by providing a market-based mechanism for valuing and trading emission reductions. They contribute to efforts to mitigate climate change by encouraging investments in sustainable practices and technologies while facilitating the emergence of a low-carbon economy.

Essentially, carbon credits embody the entitlement to emit a predetermined quantity of GHGs. By holding these credits, businesses or individuals demonstrate their commitment to offsetting their emissions of greenhouse gases. This certification serves as evidence that the entity in possession of the credits is taking fruitful steps of counterbalance by investing in emission reduction projects or supporting initiatives that sequester carbon from the atmosphere. These are uniquely issued, tracked, and cancelled using an electronic registry.

A carbon credit entails:

1. **Emissions Unit:** A carbon credit is an emission unit issued by a carbon crediting program, representing a quantified reduction or removal of greenhouse gases (GHGs). These credits are meticulously tracked and managed through electronic registries, ensuring transparency and accountability in their usage.
2. **Tradable Certificate:** Carbon credits serve as tradeable certificates that confer entitlement to emit a unit ton of carbon dioxide or an equivalent amount of some other greenhouse gases. This tradeable nature allows for flexibility in the means to achieve emission reductions, as entities can either reduce emissions internally or procure credits by investing in emission reduction projects elsewhere.
3. **Payment for Emission Reduction:** The issuance of carbon credits typically involves a payment mechanism, where governments or companies pay for the removal or reduction of a specific quantity of carbon dioxide from the environment. This payment reflects an allegiance to the cause of mitigating climate change by offsetting emissions through investments in emission reduction projects or initiatives that sequester carbon from the atmosphere.
4. **Value Assignment:** Carbon credits allot a tangible value to the offset or reduction of greenhouse gas emissions, generally measured in terms of carbon dioxide equivalent (CO₂-e). Each credit represents the avoidance, removal, or reduction of one tonne of CO₂-e, providing a standardized unit for quantifying and trading emission reductions.

Overall, carbon credits present a tangible way to quantify and address the undesirable outcomes of anthropogenic activities, offering a pathway towards achieving targets of emission reduction and fostering the progress to a low-carbon economy. By assigning a tangible value to emissions reductions and providing a mechanism for trading these reductions, carbon credits encourage businesses, industries, and governments to invest in sustainable practices and technologies. This market-based approach fosters innovation and incentivizes the adoption of cleaner energy sources, measures that utilize energy more efficiently, and other initiatives that aim to reduce greenhouse gas emissions. It empowers organizations to take proactive steps to mitigate their environmental impact while promoting economic growth simultaneously and competitiveness in a low-carbon economy.

Furthermore, carbon credits play an important role in facilitating a collaborative international effort to address climate change. Through mechanisms like the Clean Development Mechanism (CDM) and emissions trading, developed countries can support emission reduction projects in developing nations, driving investment in clean energy and sustainable development while enabling developed nation-states to meet their targets for emission reduction more cost-effectively. It serves as a powerful tool in the global fight against climate change, incentivizing emission reductions, promoting sustainable development, and accelerating the transition to a future that is greener and more resilient.

Exactly, carbon credits are indeed tradable certificates that represent the right to emit a specific quantity of greenhouse

gases, typically measured in terms of carbon dioxide equivalent (CO₂-e). Each carbon credit corresponds to the mitigation or removal of a unit tonne of carbon dioxide or an equivalent amount (CO₂-e) of another greenhouse gas. This equivalence allows for a standardized unit of measurement, facilitating the trading and valuation of cross-sectoral emission reductions and regions. By representing emissions reductions in terms of carbon credits, businesses, governments, and individuals can easily quantify and account for their environmental impact, while also providing a means to incentivize and finance emission reduction projects. In essence, one carbon credit, or carbon offset, signifies the avoidance, reduction, or removal of one tonne of carbon dioxide or its equivalent in other greenhouse gases. This standardized unit serves as a worthwhile tool in the global effort to fight climate change, enabling stakeholders to quantify, track, and trade emissions reductions while contributing towards the conception of a low-carbon economy.

So, carbon credit works as a compensation technique, assuring a balance between the GHG emission and the respective quantities of certified mitigations. In other words, carbon credits are exchanged in a carbon market, commonly referred to as the cap-and-trade market, where businesses can sell each other's rights to pollute. Companies are issued carbon credits for reducing their greenhouse gas emissions. Then, these credits are traded with businesses that are unable to fulfill the standards of the protocol. It serves as an intangible commodity that can be traded on the commodities market. So, it helps develop clean technologies.

Carbon trading is a promising field with relation to development, that involves effort and time to be escalated as a mature market. In the year 2006, carbon trading had a projected market value of roughly \$ 30 billion U.S. dollars.

CARBON EMISSION REDUCTION (CER)

Carbon Emission Reduction (CER) is another way that is used in the trading of Carbon. A CER is specified by the executive board of the Clean Development Mechanism (CDM), through certified projects in developing countries to verify whether they have brought down the emission of greenhouse gases by one ton of carbon dioxide each year (Höhne et al. 2020).

A CER certifies a reduction in the amount of greenhouse gas emissions equivalent to one ton of carbon dioxide (CO₂) per year. These reductions are achieved through various types of projects that are carried out by developing countries, such as renewable energy projects, energy efficiency initiatives, methane capture from landfills or agriculture, afforestation and reforestation projects, and others. The CDM executive board oversees the validation and registration of CDM projects and issues CERs to projects that meet the required criteria. These CERs can then be traded on carbon markets or used by developed countries to meet their targets for emission reduction under the Kyoto Protocol or other international agreements. By generating CERs, CDM projects not only help reduce greenhouse gas emissions but also contribute to sustainable development in the host countries by promoting clean energy, creating employment opportunities, improving air quality, and supporting local communities. Overall, CERs play a crucial role in carbon trading markets, providing a standardized unit for quantifying emissions reductions and facilitating international cooperation in addressing climate change while promoting sustainable development in developing countries.

CARBON REDUCTION CREDITS (CRC'S)

The terms Carbon Reduction Credits, Carbon Offset, and Carbon Credits are used interchangeably but have a slight difference. Carbon Reduction Credits (CRC) are gained by renewable energy production. These are earned by GHG-free fuels which comprise clean ways of energy production, for example solar, wind, hydro or biofuels. Therefore, these are useful in the reduction or removal of CO₂/ GHGs that compensate for CO₂ emissions.

Carbon Reduction Credits consist of the accumulation and storage of excess carbon from the atmosphere by processes like bio-sequestration (reforestation, forestation) and also efforts done for its capture and storage from ocean and soil. Both procedures are recognized as efficient means to lessen the Worldwide Carbon Emission "crises". Credits have to be purchased from the market, by companies that surpass their limits. This process of selling and buying carbon credits is known as carbon trading. This method

1.	Reforestation	Reforestation projects involve planting large numbers of trees to counteract deforestation and absorb carbon dioxide present in the atmosphere. These projects, often implemented in developing countries, aim to restore forest ecosystems and sequester carbon through tree growth.
2.	REDD	REDD (Reducing Emissions from Deforestation and Forest Degradation) financially incentivizes the reduction of deforestation, and forest degradation, and the promotion of sustainable forest management. Companies or private sectors pay countries to preserve their forests, thereby preventing emissions from deforestation and earning carbon credits in return.
3.	Clean water access	Projects focused on providing clean water access in rural areas can reduce emissions associated with traditional methods of water treatment, such as boiling water using wood stoves. By improving access to clean water, these projects reduce reliance on wood fuel, thereby mitigating emissions from deforestation and air pollution.
4.	Wind Energy	Wind turbine projects displace the generation of fossil fuels and present a great alternative to carbon-emitting energy resources. These projects generate carbon credits based on emission reductions, which can be used as offset to balance emissions from other sources.
5.	Investing in renewable energy	Direct investment in renewable energy sources, such as solar, wind, or hydroelectric power, is considered one of the most effective ways to offset carbon emissions. Renewable energy projects reduce our over-dependency on fossil fuels and produce clean energy with minimal greenhouse gas emissions, making a substantial contribution to emission reductions over their lifetime.

boosts market forces to cut down overall GHG emissions. The concept of emissions trading through carbon credits significantly depends upon the capability of polluters to decline their emissions gradually but with conviction annually.

CARBON CREDIT/ CARBON ALLOWANCE

Carbon credit/ Carbon allowance is a tradeable permit that lets the firm release a fixed quantity (a unit tonne) of carbon dioxide or an equivalent amount of a different greenhouse gas.

Carbon Credit, Carbon allowance, emissions trading schemes, or cap and trade terms used for a certificate or permission slips given by the government or governmental agency that provides an entitlement to emit a unit tonne of carbon dioxide or equivalent greenhouse gas in the atmosphere. Such allowances or permits are officially sanctioned or issued to companies and organizations that are actively trading in the carbon market. If these allotted credits are not used by any company/organization/country, they can be put up for auction, or allocated to another company on 'cap and trade' carbon markets free of charge based on forecast carbon emissions. Extra carbon credits can be bought if a company thinks it will exceed its targets, thus making a market for carbon allowances.

Carbon credit/ Carbon allowance is not issued by projects planned to cut the emission of greenhouse gases. These are issued by an organization or industry that is way below its emissions targets. So, these carbon credits can be transferred to other countries or to be sold in the carbon credit market internationally.

CARBON OFFSET

The application of carbon offset as a significant tool to deal with climate change and global warming is increasing fast due to the alarming rate of carbon emissions throughout the world. It reduces greenhouse gas emissions via an increase in carbon fixation through land restoration or planting of trees or any sustainable way by which to compensate for the greenhouse gas emissions. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), represents a significant step in addressing the environmental impact of international aviation and predicts the demand from 1.6 to 3.7 billion offset credits between 2021 and 2035 (Warnecke et al. 2019). Carbon offset resulting from a third-party certified project usually generates a carbon credit.

A carbon offset represents a unit tonne of carbon dioxide or an equivalent amount of some other greenhouse gas, which is generated by reducing the amount of emissions by an intended project planned solely for this particular purpose. Therefore, carbon offsets have a great potential in reducing the amount of greenhouse gas emissions more efficiently than carbon credits.

Carbon offsets are gained with clearly defined objectives and by the project's design. These can be achieved by the installation of wind turbines or solar panels, the use of CNG and battery

vehicles, and trees plantation or preserving forests (Alexeew et al. 2010; Ruthner et al. 2011; Haya and Parekh 2011; Gillenwater and Seres 2011; Lazarus et al. 2012; Spalding-Fecher et al. 2012; Kollmuss et al. 2015; Cames et al. 2016). These can also be achieved by involvement in a mandatory process or by regulatory obedience. During this process, each project undergoes a thorough review and check before the offsets are certified as genuine.

Like carbon credit, carbon offsets can be measured by a tonne of CO₂-equivalent. Carbon credits are gained when an industry releases less carbon than its limit, while carbon offsets are generated when a business or a company chooses to invest in any project that intends to reduce the amount of greenhouse gas emissions. This means carbon offsets denote the generation of a certain quantity of sustainable energy to stabilize the excess usage of fossil fuels.

1CO₂ Carbon offset = 1 metric tons CO₂ reduction

Purchasing a carbon allowance/ credit gives the right to emit greenhouse gases, while carbon offset supports a prior reduction of greenhouse gases. Carbon offset schemes can take place throughout the world. These have great potential to reduce the amount of greenhouse gas emissions more economically than carbon credits/ allowances. Transferable credits of carbon offset are issued and certified by some independent certification organization or by governments, which epitomize an emission lessening of one metric tonne of CO₂, or an equivalent amount of other GHGs.

The carbon offset is indeed going on in developed nations and is usually represented as:

THE CLEAN DEVELOPMENT MECHANISM (CDM)

The CDM indeed offers an effective tool for high greenhouse gas emitting countries, primarily developed nations, to fulfill their targets for emission reduction pledged under the Kyoto Protocol by financing developing countries in their carbon emission reduction projects. These projects, known as CDM projects, are aimed at promoting sustainable development while reducing emissions.

The CDM plays a critical role in setting standards, verifying projects, and ensuring that emission reduction activities adhere to rigorous environmental and social criteria. Once a CDM project is successfully implemented and verified, it generates emission credits known as Certified Emission Reductions (CERs). These CERs represent quantified reductions in the amount of greenhouse gas emissions and can be bought and traded on international carbon markets. By providing a means for developed countries to invest in projects for emission reduction in developing nations, the CDM not only helps meet emission reduction targets but also contributes to sustainable development goals in host countries. These projects often involve renewable energy, energy

efficiency, waste management, and other activities that promote economic growth, improve livelihoods, and enhance environmental quality.

The initiation of the Clean Development Mechanism (CDM) marked an important landmark in international climate policy, with the first project being registered in Russia in 2004. This project registration represented the beginning of a new era in emissions trading and carbon finance. As the CDM gained momentum, it quickly became a leading player in the offset market, providing a platform for emission reduction projects around the world to generate Certified Emission Reductions (CERs). These CERs could then be traded on international carbon markets, enabling countries to meet their targets for emission reduction under the Kyoto Protocol and other international agreements.

One notable aspect of the CDM's evolution is its transition to self-financing since 2007. Initially, the CDM's regulatory functions were supported by contributions from donor countries and international organizations. However, as the CDM matured and the number of projects grew, the cost of administering the mechanism was increasingly covered through fees charged to project proposers. CDM's growth and self-financing reflect its success in mobilizing private investment for emission reduction projects and giving a robust framework for international cooperation in addressing climate change. As the world transitions to more ambitious climate targets, the CDM remains a valuable tool for promoting sustainable development and reducing greenhouse gas emissions on a global scale.

The CDM indeed aims to support sustainable development by facilitating the implementation of climate change and greenhouse gas (GHG) mitigation projects being carried out by developing countries. These projects typically focus on utilizing clean energy sources, improving the efficient use of energy, and promoting waste utilization and management practices. By investing in CDM projects, countries and companies can achieve several long-term benefits. First and foremost, they contribute to reducing greenhouse gas emissions, thereby combating climate change and its associated impacts. Additionally, CDM projects help countries transition to greener energy sources, reducing over-dependency on fossil fuels and ensuring sustainable energy systems. Furthermore, CDM projects often lead to a reduction in pollution and environmental degradation, particularly in sectors such as manufacturing and waste management. By implementing cleaner technologies and practices, these projects help to minimize harmful emissions and pollutants, leading to improved quality air and water and better overall environmental health.

One of the key incentives for participating in CDM projects is the opportunity to generate additional revenue in the form of carbon credits. These credits represent the emission reductions achieved by CDM projects and can be traded on international carbon markets. This creates a financial incentive for investing in emission reduction activities and helps to mobilize private sector funding for sustainable development initiatives in developing countries.

Overall, the CDM plays a vital role in promoting sustainable development, reducing greenhouse gas emissions, and fostering international cooperation in addressing climate change. By incentivizing investments in clean energy and emission reduction projects, the CDM contributes to building a more sustainable and resilient future for all.

The three global CDM criteria as outlined in Paragraph 5, Article 12 of the Kyoto Protocol are:

1. The voluntary involvement of governments of respective partner countries in the CDM.
2. The outcome of projects related to mitigation of climate change must be real, measurable, and with long-term benefits.
3. The reduction in GHG emissions from the CDM project must be additional to any that would occur in the absence of the CDM.

The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. The Kyoto Protocol has three mechanisms that are Clean Development Mechanism (CDM), Joint Implementation (JI) (article 6), and Emission trading (article 17).

The mechanism of Emission trading allows a party with emission reduction commitments listed in Annex B of the Kyoto Protocol to implement carbon reduction projects in a developing nation and, after verification, to obtain certified emission reductions (CERs). The CDM Executive Board (EB) oversees the operation and administration of the CDM. The EB is eventually answerable to the governing body of the Kyoto Protocol, which comprises representatives from all the nations that have ratified the treaty. It ensures that CDM projects adhere to the rules and guidelines set forth by the Kyoto Protocol and the CDM. The EB is supported by expert panels that focus on specific tasks linked to the implementation of the CDM. These panels may include technical experts, environmental specialists, and representatives from relevant stakeholders. Some of the key expert panels include:

1. **Methodologies Panel:** This panel is responsible for reviewing and approving methodologies for quantifying emission reductions from CDM projects. It ensures that projects use scientifically sound and robust methodologies to calculate their emission reductions accurately.
2. **Registration and Issuance Panel:** This panel handles the registration of CDM projects and the distribution of Certified Emission Reductions (CERs) once a project has been successfully implemented and verified. It ensures that projects meet all the requirements for registration and issuance.
3. **Accreditation Panel:** This panel is responsible for accrediting Designated Operational Entities (DOEs), which are independent entities responsible for validating and verifying CDM projects. The accreditation panel ensures that DOEs have the necessary expertise and competence to perform their roles effectively.

By overseeing the work of these expert panels and ensuring compliance with CDM rules and procedures, the CDM Executive Board plays a crucial role in maintaining the integrity and effectiveness of the CDM. It helps to uphold the credibility of CDM projects and ensures that they contribute to meaningful emissions reductions and sustainable development outcomes. Overall, mechanisms like the CDM promote international cooperation in tackling climate change by facilitating technology transfer, investment, and emissions reduction efforts between developed and developing nations. This collaboration not only assists developed countries in meeting their emission reduction targets but also supports sustainable development and clean energy initiatives in developing regions.

CONCLUSION

The Kyoto Protocol can be considered as a milestone in international efforts to substantially mitigate climate change, setting emission reduction targets that are legally binding for developed countries while encouraging voluntary commitments from developing nations. It has a crucial role in shaping international climate policy and introducing the idea of carbon credits as an instrument for mitigating greenhouse gas emissions. A carbon credit is a tradeable certificate that represents the right to emit one tonne of carbon dioxide (or the equivalent mass of other greenhouse gases). It is a unit of measurement used in emission trading schemes to quantify and manage greenhouse gas emissions. Carbon credits are typically generated through emission reduction or removal projects, and they can be traded on carbon markets. A carbon offset is a practical tool that allows a party to compensate for the release of carbon dioxide or other GHGs by making investments in projects that help reduce equivalent emissions elsewhere. Carbon offset projects can include activities such as renewable energy projects, reforestation initiatives, methane capture from landfills, and energy efficiency programs. By purchasing carbon offsets, individuals, companies, or governments can neutralize their carbon footprint and contribute to global efforts to mitigate climate change. The Clean Development Mechanism, established under the Kyoto Protocol, permits developed nations to finance schemes related to emission reduction in developing countries serving as a means to fulfill their individual emission reduction goals. CDM projects promote sustainability in the developmental activities of developing countries by implementing clean energy, energy efficiency, and waste management projects. These projects generate Certified Emission Reductions (CERs), which can be traded and sold as carbon credits on the international market. This means carbon credits and carbon offsets are instruments used

to incentivize and finance emission reduction activities, while the Clean Development Mechanism facilitates international cooperation and sustainable development by supporting emission reduction projects in developing countries.

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