

Pathways to Carbon Neutrality through Carbon Credits and Carbon Markets: Indian and Global Frameworks

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Abstract

Carbon neutrality has emerged as one of the major global objectives for reducing greenhouse gas emissions and supporting the achievement of net-zero targets. Carbon credits and carbon markets play an important role in supporting emission reduction by providing economic benefits for industries, institutions and countries to adopt low-carbon practices. The present paper discusses the concept of carbon neutrality and examines the role of carbon credits, carbon trading and carbon markets in climate change mitigation. The study reviews important emission reduction strategies such as carbon pricing and energy efficiency improvement. It also highlights major international carbon market systems, including the EU-ETS, China ETS and Korea ETS, along with Indian mechanisms such as PAT, REC, CDM and the proposed Indian carbon market (ICM). The study highlights that strong policies, transparent rules, reliable monitoring and prevention of double counting are essential for successful carbon markets. Overall, the study suggests that the transition towards carbon neutrality requires a balanced combination of innovation, policy action and market-driven climate solutions. Strengthening carbon credit systems and carbon markets can significantly support India and the international community in meeting climate targets and promoting a sustainable low-carbon future.

Keywords:

Carbon neutrality, Carbon credits, Carbon markets, Indian carbon market (ICM), Emission trading system (ETS), Carbon pricing, Carbon credit trading scheme (CCTS).

1. Introduction

Carbon neutrality means achieving a net-zero carbon state by balancing the amount of carbon dioxide (CO₂) emitted into the atmosphere with an equivalent amount removed [1]. Carbon neutrality is the state in which carbon emissions are balanced by carbon removal or offsetting, resulting in net-zero carbon dioxide emissions. Carbon neutrality has become an important goal for educational institutes, industries, business organizations and governments that want to reduce their environmental impact and help control climate change. It can be achieved by reducing emissions, improving energy efficiency, using renewable energy and increasing carbon sequestration. In educational institutes, industries, business organizations and governments, carbon neutrality can be achieved by properly measuring greenhouse gas emissions and taking suitable steps to reduce them.

Carbon credit is a tradable certificate representing the removal of one metric tonne of carbon dioxide (or equivalent greenhouse gas) from the atmosphere.

These credits act as financial incentives for climate projects (like renewable energy or reforestation) and allow companies to offset their emissions to meet compliance or voluntary net-zero goals [2]. A carbon credit is a tradable unit equal to one tonne of carbon dioxide or the equivalent amount of another greenhouse gas that is reduced, sequestered or avoided. According to United Nations development programme (UNDP), carbon credits are traded in carbon markets and represent greenhouse gas emission reductions or removals generated by activities such as renewable energy, forest protection and energy efficiency improvements. [3].

Carbon trading is a market-based system that allows countries or companies to buy and sell credits for emitting greenhouse gases [4]. Carbon trading is defined as for balancing your emissions, company can buy carbon credits. Carbon trading helps to reduce emissions in a cost-effective way. It encourages industries and companies to adopt cleaner technologies. It also provides financial support for low-carbon and renewable energy projects. Carbon trading

is an important part of carbon markets and climate mitigation strategies. It supports towards low-carbon and sustainable development.

Carbon neutrality is important because it helps to reduce the harmful effects of climate change by balancing carbon emissions with carbon removal. It supports sustainable development by encouraging the use of clean energy, efficient resource management, waste reduction and environmentally friendly practices. It supports a low-carbon future and better environmental health.

The objective of this paper is to understand the concept of carbon neutrality, study the methods used for carbon footprint assessment and review the strategies that can help reduce emissions and support the achievement of carbon neutrality.

A review is needed to collect and summarize existing knowledge on carbon neutrality from different studies. It helps in understanding assessment methods, reduction strategies and challenges related to achieving carbon neutrality. It also helps in identifying key methods, important findings, major challenges and possible solutions related to achieving carbon neutrality. In addition, it provides a basis for future studies and policy development. It also identifies research gaps and provides a clear direction for future studies.

2. Literature review

2.1 Imran Khan, Mohammad Farooq, Arshe Azam (2023) ^[5]

In this research paper, the study is related to environmental accounting, carbon accounting, carbon credits and corporate climate practices. The paper explains that previous researchers examined how environmental accounting supports sustainable corporate development in India and internationally. It also mentions studies on the use of global reporting initiative (GRI) standards for greenhouse gas reporting, the connection between corporate emissions and natural climate solutions, the use of digital platforms for carbon accounting and carbon offsetting, and the role of voluntary carbon credits in corporate climate claims. In addition, the paper highlights that carbon accounting has become an important and growing research area for supporting climate goals under the

Paris Agreement. Overall, the literature review shows that earlier studies focused more on accounting practices, reporting systems, carbon credits, and climate claims, which provides the background for this paper's discussion on carbon credit markets and accounting implications in India.

2.2 Ashim Paul (2011) ^[6]

The research paper shows that the study is based on the greenhouse gas control, Kyoto Protocol mechanisms, carbon credits and carbon trading in India. The paper explains that increasing industrialization has raised greenhouse gas emissions and made climate control measures necessary. It then connects this background to the Kyoto Protocol, especially its flexible mechanisms such as international emissions trading (IET), joint implementation (JI) and the clean development mechanism (CDM), which created the basis for carbon credits and carbon trading. The paper further discusses how carbon credits are treated as tradable certificates linked to emission reduction and how developing countries like India can benefit from carbon trading through renewable energy projects, energy-saving initiatives and low-carbon industrial development. Overall, the research paper builds the foundation for understanding the emergence, present scenario, and future prospects of carbon credit and carbon trading in India.

2.3 Shaon Kumar Das, E. K. Bhujel, Ramgopal Laha, Vinay Kumar Mishra (2022) ^[7]

The research paper explains the concept, benefits and practical importance of carbon neutrality under changing climate conditions. It describes carbon neutrality as a balance between carbon emissions and carbon removal through sinks or offsetting, and links this idea to carbon footprint reduction and climate action. The paper also discusses the broader climate change context, including rising CO₂ concentration, global emissions and the need for net-zero balance through emission control and carbon sequestration. In addition, it highlights the role of agriculture in carbon neutrality by explaining soil carbon sequestration, sustainable farming practices, reduced tillage, residue management, organic farming and bioenergy crops as important methods for storing carbon and reducing greenhouse gas emissions. Overall, the paper shows that carbon neutrality is important not only for reducing environmental pollution and climate change impacts,

but also for improving health, food security, biodiversity and long-term sustainability.

2.4 Israa Al Khaffaf, Adil Tamimi, Vian Ahmed (2024) [8]

The research paper explains that carbon neutrality has become an important global objective for reducing greenhouse gas emissions and addressing climate change. The paper reviews previous studies across major sectors such as energy, buildings, transportation, industry and agriculture, and discusses the strategies and technologies used to achieve carbon neutrality. It highlights renewable energy, energy efficiency, electrification, carbon capture, circular economy practices and sustainable agriculture as the main approaches found in earlier studies. The paper also shows that most existing research has focused more on the energy and industrial sectors, while agriculture and forestry remain less studied despite their strong carbon sequestration potential. Overall, the paper provides a broad and systematic understanding of current carbon neutrality pathways and identifies the need for more integrated and cross-sectoral research.

2.5 Ranuji B. Zodge, B. M. Kamble, D. H. Phalke, S. S. Bachhav, Samiksha G. Ahire, Nikita B. Mayuri. M. Jagtap (2025) [9]

The research paper explains that agriculture is both a major source of greenhouse gas emissions and an important sector for carbon sequestration and climate resilience. The paper's study showing that agricultural emissions mainly arise from methane, nitrous oxide and carbon dioxide generated through activities such as rice cultivation, enteric fermentation, manure management, fertilizer use, land-use change, residue burning and energy use. It further discusses previous research on soil organic carbon, the global carbon cycle, conservation agriculture, reduced tillage, crop diversification, renewable energy use and climate-resilient farming practices as important strategies for reducing emissions and enhancing carbon storage. It also highlights that sustainable agricultural management can improve soil health, increase input efficiency and support long-term climate mitigation. Overall, the paper presents carbon-neutral agriculture as an evolving approach that combines emission reduction, carbon sequestration and resilience-building measures to address climate change.

2.6 Insung Hwang, Woojun Jung, Keuntae Cho (2025) [10]

The research paper explains that carbon neutrality research has changed significantly before and after the 2016 Paris Agreement. The paper shows that earlier studies mainly focused on technological pathways, renewable energy, carbon capture and storage, industrial efficiency, and policy support for reducing emissions. It also discusses that many previous bibliometric studies were limited because they focused on only a few countries or specific technologies and often did not compare broader research trends across G20 nations. In addition, the review highlights that G20 countries are very important in carbon neutrality research because they contribute a major share of the global economy and greenhouse gas emissions and their policies strongly influence global climate action. Overall, the study showing existing research trends, major themes and gaps, especially the need for a broader comparative analysis of carbon neutrality research in G20 countries before and after the Paris Agreement.

2.7 Yuan Zhang, Chung-Lien Pan, Han-Teng Liao (2021) [11]

The paper shows that carbon neutrality is not only a technical issue but also a social, economic, political and behavioral issue. The paper explains that previous studies discussed topics such as climate policy, investment, communication, behaviour change and sustainable transition but a systematic review of social science research on carbon neutrality was still lacking. Therefore, this paper reviews the existing literature to understand how social science knowledge contributes to carbon neutrality policies and technologies.

3. Methodology and research methods

3.1 Carbon neutrality

Carbon neutrality means balancing carbon emissions with an equal amount of carbon removal or absorption so that there is no net increase in carbon dioxide in the atmosphere. This can be achieved by reducing emissions at the source and balancing the remaining emissions through carbon offsetting or carbon sequestration. Carbon neutrality supports climate change control and helps in the transition to a low-carbon economy. It usually includes not only carbon dioxide but also other greenhouse gases

expressed as carbon dioxide equivalent (CO₂e). To achieve carbon neutrality, it is important to reduce emissions, use renewable energy, improve energy efficiency and increase carbon storage through natural or technological methods. Carbon neutrality also provides environmental, social and economic benefits. It helps reduce pollution, improve public health, create green jobs, support economic growth, reduce climate change impacts and improve food security and ecosystem stability. Carbon sequestration is an important part of carbon neutrality because it captures carbon dioxide from the atmosphere and stores it in places such as soil, plants, oceans and rocks. In agriculture, soil carbon sequestration is especially useful because it not only helps reduce greenhouse gases but also improves soil quality, increases carbon storage, supports better crop productivity and provides long-term environmental and economic benefits [1].

The timeline for achieving net zero begins with measuring total greenhouse gas emissions and identifying the main emission sources. The next stage involves reducing emissions through renewable energy use, energy efficiency, electrification, fuel switching and cleaner technologies. This is followed by deeper decarbonization so that only a small number of unavoidable emissions remains. In the final stage, these residual emissions are neutralized through carbon removal and long-term storage. Net zero is achieved when the remaining emissions are fully balanced by removals [12].

India's carbon neutrality approach is reflected in its updated NDC targets, which include a 45% reduction in emissions intensity of GDP from 2005 levels by 2030, about 50% cumulative installed electric power capacity from non-fossil-fuel sources by 2030 and a net-zero target for 2070. Internationally, carbon neutrality is viewed as a key climate goal under the Paris Agreement, where countries use NDCs to reduce emissions and move gradually toward net-zero emissions [13].

3.2 Carbon credit, carbon trading and carbon offset

A carbon credit is a certificate that represents one metric tonne of carbon dioxide equivalent (tCO₂e) reduced, avoided or allowed under a carbon system. In carbon trading, organizations that emit less than their allowed limit can sell extra carbon credits, while those that emit more than their limit can buy these credits [3].

In this way, carbon trading helps control greenhouse gas emissions and encourages cleaner and more energy-efficient technologies. For developing countries like India, it can also attract investment in renewable energy, support energy-saving measures and create jobs in low-carbon sectors. Carbon trading takes place in two main forms: compliance and voluntary. Compliance carbon trading is mandatory and is used by regulated entities to meet legal emission targets. Voluntary carbon trading is optional and is used by companies or individuals who want to compensate for their emissions or support environmental projects. In simple words, compliance trading follows government rules, while voluntary trading is based on self-chosen climate action [14] [15].

Carbon offset means balancing carbon emissions by supporting activities or projects that reduce, avoid or remove an equal amount of carbon dioxide from the atmosphere. It is used when a person, company or institution cannot completely eliminate its own emissions. Examples of carbon offset projects include tree plantation, renewable energy generation, methane capture and energy efficiency improvements. In simple words, carbon offset helps compensate for emissions by creating environmental benefits elsewhere [3].

Carbon credit, carbon trading and carbon offset are related but not the same. A carbon credit is a certificate that represents one tonne of carbon dioxide reduced or removed. Carbon trading is the process of buying and selling these credits in a market. Carbon offset means using those credits or supporting reduction projects to compensate for one's own emissions. In simple words, carbon credit is the unit, carbon trading is the exchange and carbon offset is the balancing of emissions [3] [15].

3.3 Carbon pricing

Carbon pricing means putting a price on carbon emissions so that polluters pay for the greenhouse gases they release into the atmosphere. Its main purpose is to encourage industries, companies and other sectors to reduce emissions, improve energy efficiency and shift toward cleaner technologies. In simple words, carbon pricing makes pollution more costly and clean energy more attractive. It can be applied through tools such as carbon tax or carbon markets, where emission reductions and carbon credits are traded [16].

3.4 Indian carbon market

The Indian carbon market (ICM) is a carbon market planned for India to help the country achieve its climate goals, such as the 2030 NDC target and the 2070 net-zero target. Its main aim is to support emission reduction by encouraging the use of finance, technology and market-based systems. ICM is designed as a single unified carbon market for India. It brings together the experience of existing systems like PAT and REC instead of having separate and disconnected markets. In this market, carbon credits will be measured in tCO₂e (tonnes of carbon dioxide equivalent) so that emissions can be compared easily and linked with international carbon systems. The ICM has two main parts. One is a compliance market for sectors that are required to reduce emissions. The second is an offset market for sectors that are not directly obligated. In phase I, the present PAT and REC systems will continue and extra ESCerts and RECs may be converted into carbon credit certificates under certain rules. In phase II, the present energy-efficiency market is expected to change into a carbon compliance market, where entities will meet emission reduction targets by trading carbon credits. A very important part of ICM is MRV, which means Monitoring, Reporting and Verification. This is needed to ensure correct emission accounting, transparency and to avoid double counting. The market will also need proper infrastructure such as a registry, digital systems and a trading platform for issuing, transferring and tracking carbon credits. It will include regulatory bodies and institutions such as administrators, regulators, registries, exchanges and verifiers. Overall, ICM is expected to help India reduce emissions, support climate action, encourage clean energy and contribute to sustainable development [17].

3.5 Carbon market in Paris Agreement

The Paris Agreement allows countries to cooperate through carbon markets to reduce emissions in a cost-effective way. Article 6 provides the rules for transferring carbon credits and emission reductions to help countries achieve their climate targets [17].

3.6 Regional carbon markets

Regional carbon markets are carbon trading systems developed by a group of countries or within a specific region to control greenhouse gas emissions. In these markets, industries or companies are given

emission limits and those that reduce emissions below the limit can sell extra carbon credits, while those that exceed the limit must buy credits. Such markets help reduce emissions in a cost-effective way and encourage the use of cleaner technologies. Examples include the European union emissions trading system (EU-ETS) and other regional or national trading schemes [17].

3.7 International emissions trading system (ETS)

International emissions trading systems (ETS) are market-based mechanisms used by different countries to reduce greenhouse gas emissions. In an ETS, governments set an emission limit for industries or companies and entities that emit less than their allowed limit can sell extra allowances, while those that emit more must buy them. This system helps control emissions in a cost-effective way and encourages industries to adopt cleaner and more efficient technologies. Examples of major emissions trading system (ETS) frameworks include the European union emissions trading system (EU-ETS), China ETS and Korea ETS. The EU-ETS is one of the oldest and most developed carbon markets and mainly covers sectors such as power, industry and aviation. The China ETS is currently the world's largest ETS in terms of emissions coverage and initially focuses mainly on the power sector, with plans for expansion into other industries. The Korea ETS is a national carbon market that covers several sectors, including power, industry, buildings, transport and waste. These ETS frameworks help countries control emissions by setting limits and allowing regulated entities to trade emission allowances in a structured carbon market [17].

3.8 Science mapping approach

Science mapping approach is a research method used to study and visualize the overall structure of a research field. It helps researchers understand how a topic has developed over time, which subjects are most important, which areas are emerging and how different studies are connected. In simple words, it gives a big picture of the knowledge available on a topic [11].

3.9 Indian market-based instruments

PAT (Perform, achieve and trade) is an Indian market-based scheme used to improve energy efficiency in large energy-consuming industries. Under this scheme, designated consumers are given energy-saving targets. If they save more energy than the target,

they receive energy saving certificates (ESCs), which can be traded. If they fail to meet the target, they must buy ESCs from others [18] [19].

REC (Renewable energy certificate) is a market mechanism used in India to promote renewable energy. It helps electricity distribution companies and other obligated entities meet their renewable purchase obligations. If a renewable energy generator produces eligible green power, it can receive RECs, which can then be sold to entities that need them for compliance [20] [21].

CDM (Clean development mechanism) is an international carbon market mechanism created under the Kyoto Protocol. It allows developing countries to implement emission reduction projects and generate Certified emission reductions (CERs). Each CER represents one tonne of CO₂ equivalent reduced and these credits can be used by developed countries to help meet their emission reduction commitments [22] [23].

3.10 Overview of carbon credit trading scheme (CCTS)

The carbon credit trading scheme (CCTS) is India's domestic carbon market mechanism. It aims to reduce greenhouse gas emissions by assigning carbon value to emission reductions and allowing carbon credit certificates to be traded. Under this system, entities that perform better in reducing emissions can earn carbon credits, while entities that exceed limits may need to buy them. The scheme is part of India's broader effort to meet its climate goals and strengthen the Indian carbon market. It supports the Indian carbon market (ICM). It uses carbon credit certificates (CCCs) as the tradable unit. It is overseen by the national steering committee for Indian carbon market (NSICM), with implementation support from the bureau of energy efficiency (BEE). It is intended to help India move toward its NDC targets and longer-term low-carbon transition [24].

3.11 Gold standard and verra standards

Gold standard and verra are two well-known carbon credit standards used in the voluntary carbon market. Both are used to check whether a carbon project is real, measurable and properly verified before carbon credits are issued. Gold standard says its standard is designed to certify climate and sustainable development impacts with safeguards and stakeholder

engagement, while verra says its Verified Carbon Standard is the world's most widely used greenhouse gas crediting program [25] [26].

Gold standard gives strong importance to both carbon reduction and sustainable development benefits. It focuses not only on emission reduction, but also on social and environmental impacts such as community benefits, safeguards and contribution to the Sustainable Development Goals [27] [28].

Verra is a non-profit organization that develops and manages standards for sustainable development, climate action and responsible business practices. Verra, through its verified carbon standard (VCS), mainly provides a framework for quantifying, monitoring, verifying and issuing carbon credits from projects that reduce or remove greenhouse gases. Its methodologies define how projects calculate emission reductions and how Verified Carbon Units are issued [26] [29] [30].

3.12 Case study: Apple and carbon neutrality

Apple is a widely discussed example of a company working toward carbon neutrality. The company announced that it became carbon neutral for its global corporate operations in 2020 and set a broader Apple 2030 goal to become carbon neutral across its entire value chain, including manufacturing and product life cycle, by 2030. Apple says this plan is based mainly on cutting emissions by 75% from its 2015 baseline, with the remaining emissions to be addressed through high-quality carbon removal projects [31].

Apple's carbon-neutrality strategy includes using more recycled and renewable materials, increasing renewable electricity in manufacturing, improving energy efficiency and shifting to lower-carbon transportation. Apple also reports working with suppliers to transition production to cleaner electricity and has used product-level environmental reports to show how emissions are reduced in devices through recycled content and low-carbon electricity [32] [33].

The company has also reported measurable progress. In 2024 Apple said it had reduced its overall greenhouse gas emissions by more than 55% since 2015 and in 2025 it reported this had increased to over 60%. Apple presents this as progress toward its 2030 carbon-neutral goal [34] [35].

Apple has additionally introduced some carbon neutral products, starting with selected Apple Watch models announced in 2023. This is used by Apple as a product-level example of how carbon neutrality can be pursued through material changes, clean electricity, shipping improvements and residual carbon removal [36].

3.13 Reduce carbon emissions

Carbon emissions can be reduced by using more renewable energy and depending less on fossil fuels such as coal, petrol and diesel. Cleaner energy sources like solar, wind, hydrogen and nuclear power help lower carbon dioxide emissions. Reducing coal use, improving fuel efficiency, using cleaner fuels such as biodiesel and treating natural gas as a temporary transition fuel can also help control emissions. In addition, increasing solar and wind power, carefully developing nuclear energy and promoting green hydrogen can support carbon neutrality and reduce greenhouse gas emissions in many sectors [37].

3.14 Challenges of carbon neutrality, carbon credits and carbon markets

3.14.1 Risk of double counting in carbon credits and carbon markets

Double counting happens when the same emission reduction is claimed by more than one country, company or system. This reduces the credibility and environmental integrity of carbon markets [38] [39].

3.14.2 Lack of transparency in some carbon trading systems

Some carbon markets do not clearly show how credits are generated, verified and traded. This can create confusion and reduce trust among stakeholders [40] [41].

3.14.3 Difficulty in measuring total greenhouse gas emissions accurately

It is often difficult to calculate total emissions correctly because emissions come from many direct and indirect sources. Inaccurate measurement can affect carbon accounting and reduction planning [42] [43].

3.14.4 Limited availability of reliable activity data from institutions, companies and sectors

Many organizations do not maintain complete and reliable records of electricity use, fuel use, transport and waste generation. Without proper data, carbon footprint assessment becomes weak and uncertain [41] [42].

3.14.5 Lack of standard emission factors, especially for some sectors and developing countries

In some sectors, suitable emission factors are not easily available, especially for local or country-specific conditions. This creates difficulty in preparing accurate and comparable emission calculations [17] [41].

3.14.6 Challenges in carbon credit verification and certification

Carbon credits must be carefully checked to ensure that the claimed emission reduction is real and measurable. Weak verification can lead to low-quality credits and reduce confidence in carbon markets [38] [44].

3.14.7 Price fluctuations in carbon markets affecting market stability

Carbon credit prices can change frequently depending on supply, demand and policy changes. This makes market planning difficult for industries and project developers [43] [45].

3.14.8 Overdependence on offsetting instead of direct emission reduction

If organizations depend too much on offsets, they may avoid taking real steps to reduce emissions at the source. Carbon neutrality should focus first on direct reduction and then on balancing the remaining emissions [38] [44].

3.14.9 Limited participation of small institutions and organizations in carbon markets

Small institutions and companies often face technical, financial and administrative barriers in entering carbon markets. As a result, the benefits of carbon trading may remain limited to larger organizations [41].

3.14.10 Need for strong Monitoring, Reporting and Verification (MRV) systems

A strong MRV system is necessary to ensure accurate emission reporting and proper credit issuance. Without effective MRV, transparency and trust in the carbon market cannot be maintained [18] [42].

3.14.11 Differences between Indian and international policy frameworks

Indian carbon market systems and international carbon market mechanisms may follow different rules, standards and priorities. These differences can make integration and comparison more difficult [17] [38] [45].

3.14.12 Challenge of balancing economic growth with climate goals

Developing countries need economic growth, industrial development and energy access but these often increase emissions. Therefore, it is a major challenge to achieve climate goals while also supporting development [43] [46].

4. Findings and suggestions

The study indicates that increasing carbon emissions are contributing significantly to global warming, making carbon credit accounting and carbon markets important tools for emission management and climate mitigation. The reviewed literature shows that many countries still do not have adequate legal frameworks, accounting standards and well-structured market systems for carbon credits. This limits the effective implementation of carbon trading and reduces the overall efficiency of climate action. Therefore, the study suggests the need for stronger policy frameworks, improved accounting standards, simplified market procedures and greater investment in renewable energy, especially in developing countries such as India.

The reviewed studies further show that achieving carbon neutrality requires an integrated approach that combines renewable energy adoption, energy efficiency improvement, carbon sequestration, carbon pricing and market-based mechanisms. At the international level, carbon markets and emission trading systems such as the EU-ETS, China ETS and Korea ETS demonstrate that emission trading can support cost-effective emission reduction when backed by strong monitoring, reporting and verification systems, transparent registries and strict compliance mechanisms. From the Indian perspective, existing mechanisms such as PAT, REC and CDM provide a useful foundation for the development of the Indian carbon market (ICM), which can contribute to India's NDC targets and long-term net-zero goals. However, Both Indian and international studies show that carbon markets work better when there are clear rules, proper

accounting, transparency, simple procedures and strong policy support.

5. Conclusion

Carbon neutrality is an important pathway for reducing greenhouse gas emissions and supporting sustainable development at both national and international levels. The review shows that carbon credits, carbon markets and emission trading systems can play a valuable role in promoting cost-effective climate action when supported by strong policies, proper accounting systems, transparency and environmental integrity. From the Indian perspective, existing mechanisms such as PAT, REC and CDM provide a strong foundation for the development of the Indian carbon market, which can contribute significantly to India's NDC targets and long-term net-zero goals. From the international perspective, carbon markets and emission trading systems such as the EU-ETS, China ETS and Korea ETS show that well-designed market mechanisms can support effective emission reduction and global climate action. Overall, with growing policy support, renewable energy expansion, improved monitoring systems and active stakeholder participation, carbon neutrality can become an achievable and effective strategy for building a cleaner, low-carbon and sustainable future.

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