
FROM EMISSION REDUCTION TO MARKET EXCHANGE: AN INTEGRATED ANALYSIS OF CARBON CREDIT GENERATION, VERIFICATION, TRADING, AND REGULATION IN INDIA

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ABSTRACT

Carbon emissions remain one of the most serious environmental issues facing the world in the twenty-first century, as they are responsible for climate change, global warming, ecological destruction and public health hazards. As India is the third largest emitter of carbon dioxide globally, there arises the need for sustainable economic development and meeting international obligations on climate change at the same time. This research paper analyses the issue of carbon emissions, industrial pollution in India and the use of carbon credits as a tool of emission reduction. International legal principles of carbon trade have been discussed in detail through the Kyoto protocol and Paris agreement while the incorporation of carbon credits under the national legislation of India through acts like Environment (Protection) Act, 1986, Air (Prevention and Control of Pollution) Act, 1981 and Energy Conservation Act, 2001 have been discussed.

I. Introduction

Carbon emission refers to the release of carbon dioxide and other greenhouse gases into the atmosphere primarily through activities like industrial production, burning of fossil fuels. The constant and unchecked rise in carbon emissions led to various environmental problems including global warming, climate change, air pollution and human health hazards. India emerged as the third largest carbon producer in the world.¹ India's annual carbon emissions stand at approximately 3.2 billion tonnes along with the United States and China producing 4.9 billion tonnes and 12 billion tonnes respectively.² Although India's per capita emissions remain lower than those of developed nations, its total emissions continue to rise due to heavy dependence on coal, expansion of manufacturing industries, and growth in transport infrastructure.

The industrial sector remains a major contributor to carbon emissions in India. For regulatory purposes industries are categorised by the Central pollution control board as red, orange, green and white industries on the basis of capital investment of the industry which reflects their pollution potential and environmental impact.³ Red industries including hazardous chemical producers, dyes & dye intermediates, pesticides etc. These industries generate high levels of air, water, and hazardous waste pollution. Orange industries producing dairy products, fermentation industries, coal washeries etc. Green industries include aluminium, ayurvedic & homeopathic, chilling plants, ice making without ammonia etc. Lastly white industries being assembly of air coolers, baby carriages, bicycles, leather cutting without dyeing and bleaching operation. Industries need environment clearance as per pollution laws which includes consent to establish and consent to operate.⁴ White industries do not require environmental clearance.

In response to this rising climate crisis, governments, international institutions, and private stakeholders have adopted a combination of regulatory frameworks and market-based instruments aimed at reducing carbon emissions and promoting environmentally sustainable

¹ Ministry of Env't, Forest & Climate Change, Gov't of India, India: Third Biennial Update Report to the UNFCCC (2021).

² Int'l Energy Agency, CO₂ Emissions in 2024 (2025).

³ Cent. Pollution Control Bd., Revised Classification of Industrial Sectors Under Red, Orange, Green and White Categories (2016).

⁴ Environment (Protection) Act, No. 29 of 1986, §§ 3–5 (India); Air (Prevention and Control of Pollution) Act, No. 14 of 1981 (India); Water (Prevention and Control of Pollution) Act, No. 6 of 1974 (India). Environment (Protection) Act, No. 29 of 1986, §§ 3–5 (India); Air (Prevention and Control of Pollution) Act, No. 14 of 1981 (India); Water (Prevention and Control of Pollution) Act, No. 6 of 1974 (India).

development. Among these Carbon credits are one of the ways to fight pollution through giving incentives to enterprises for reducing carbon emissions.⁵ When enterprises decrease pollution, they receive credits which they may sell in exchange for profit, thus encouraging enterprises to utilize clean technologies.

Carbon credits operate under a variety of international environmental conventions and domestic climate legislations, such as the Kyoto Protocol and the Paris Agreement, providing emission reduction targets and legal framework for carbon trading.⁶ There are different mechanisms employed in different nations in order to fulfill climate targets of nations: cap-and-trade, baseline-and-credits, and participation in voluntary carbon markets.

Increasing connection between carbon credits and environmental regulations indicates the intersection of economic strategy and environmental regulation and technological development. Key legal frameworks including the Environment (Protection) Act, 1986, the Air (Prevention and Control of Pollution) Act, 1981, the Energy Conservation Act, 2001, along with newly evolving climate-focused regulations ensures this interaction goes well.

In this way it allows developing countries like India to grow economically along with reducing its carbon footprint. It will help India meet its climate commitments under global agreements and ensure fulfilment of the environment's major principle namely inter generational equity.

II. CARBON EMISSIONS AND INDUSTRIAL POLLUTION IN INDIA

With the increasing economic growth in India led by rapid industrialisation there is also a constant rise in carbon emissions. While this growth has boosted employment generation and GDP growth, it has simultaneously intensified environmental degradation, particularly in the form of carbon emissions. Industrial pollution, coupled with energy-intensive production processes and fossil-fuel dependence, has made the industrial sector one of the largest sources of greenhouse gas emissions.⁷ In this way, emissions from industries not only accelerate climate change but also cause localised environmental harm such as acid rain, soil contamination, smog formation and respiratory illnesses. Consequently, the regulation of

⁵ U.N. Env't Programme, Introduction to Carbon Markets (2022).

⁶ Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 3, Dec. 11, 1997, 2303 U.N.T.S. 162; Paris Agreement art. 6, Dec. 12, 2015, T.I.A.S. No. 16-1104.

⁷ M.C. Mehta v. Union of India, (1987) 1 S.C.C. 395 (India).

industrial emissions has become a key component of India's environmental protection strategy.

2.1 Sources of Carbon Emissions

Major contributors of carbon emissions in this sector includes Power generation (coal-based thermal plants), Industrial manufacturing, Transportation sector, Construction and urbanisation, Agricultural residue burning etc. The central pollution control board has categorised 17 industrial sectors as highly polluting industries mainly thermal power plants, tanneries, fertilisers, zinc smelters etc.⁸

2.2 Industrial Classification by CPCB

The Central Pollution Control Board (CPCB) classifies industries based on pollution potential:

a) Red Category Industries

Red industries represent a high pollution risk and are subject to more stringent rules and compliances. These industries generate high levels of carbon emissions, hazardous solid waste and toxic effluents.

Red industries includes

- Hazardous chemical manufacturing
- Pulp and paper
- Dyes and dye intermediates
- Nuclear power plants etc.

These industries are subject to regulatory obligations such as Mandatory Environmental Impact Assessment and Installation of continuous emission monitoring systems.⁹ Strict compliance with emission standards such as periodic environmental audits.

Non-compliance can result in closure orders, monetary penalties, and criminal liability under

⁸ Cent. Pollution Control Bd., Comprehensive Environmental Pollution Index Guidelines (India).

⁹ Environmental Impact Assessment Notification, S.O. 1533(E), Gazette of India, Sept. 14, 2006.

the Environment (Protection) Act, 1986.¹⁰

b) Orange Category Industries

Orange category industries possess moderate pollution potential and are regulated through a balanced compliance mechanism. Examples of orange industries include

- Bakery and confectionery
- Dairy products
- Fragmentation industries such as beer and alcohol.
- Coal washeries etc

These industries are required to comply with prescribed emission limits and clean implement pollution control technologies. Although their level of regulation may not be as strict compared to red category industries, non-compliance will result in legal actions.

c) Green Category Industries

Green industries are classified by CPCB as low polluting industries which, if operated with prescribed safeguards, have minimal impact on the environment. The rationale behind creating the green category lies in encouraging environmentally favourable industrial activities while reducing unnecessary regulatory burden. These industries generally employ cleaner production methods, rely on non-hazardous raw materials, and produce emissions within permissible limits. Examples of green industries are:

- Aluminium fabrication
- Ayurvedic and homeopathic medicine units
- Ice making without ammonia
- Chilling plants etc.

¹⁰ Indian Council for Enviro-Legal Action v. Union of India, (1996) 3 S.C.C. 212 (India).

Although classified as low-polluting, green category industries are not exempt from environmental regulation. They are governed by The Environment (Protection) Act, 1986, The Air (Prevention and Control of Pollution) Act, 1981 and The Water (Prevention and Control of Pollution) Act, 1974.¹¹ Failure to comply may lead to re-categorisation into orange or red category industries.

d) White Category Industries

White category industries are classified as practically non-polluting. They pose negligible risk to the environment. The white category was introduced to reduce regulatory burden on non-polluting units and promote ease of doing business. It allows regulators to focus on high-polluting industries more. Examples of white industries are

- Bicycle, air cooler assembly units
- Leather cutting (without dying & bleaching operation)
- Biogas
- Book binding etc.

To control industrial pollution, the consent mechanism is considered one of the most important tools under environmental laws. No industry should start or operate unless it proves that it will not harm the environment. This mechanism is mainly governed by the water act 1974, the air act 1981 and the environment protection act 1986 and is implemented by state pollution control boards.¹²

Consent to Establish (CTE) is required at the initial stage before an industry is set up. It ensures that environmental safeguards are planned at the very beginning.¹³ Authorities examine the location of the unit, the technology to be used, and the pollution control measures proposed. In this way, possible environmental damage is prevented even before operations begin.

Consent to Operate (CTO) is required before the industry actually starts functioning. It ensures

¹¹ Environment (Protection) Act, No. 29 of 1986; Air (Prevention and Control of Pollution) Act, No. 14 of 1981; Water (Prevention and Control of Pollution) Act, No. 6 of 1974 (India).

¹² Cent. Pollution Control Bd., Guidelines for Consent Management Under Water Act and Air Act.

¹³ Environmental Impact Assessment Notification, S.O. 1533(E), Gazette of India, Sept. 14, 2006.

that pollution control equipment has been installed and is working properly.¹⁴ The consent of CTO is valid only for a specified period and is subject to renewal, thus assuring continued adherence to environmental norms.

Collectively, both CTE and CTO function as measures for prevention and remediation. They contribute towards cutting down emissions, using cleaner technology, ensuring public welfare and that industrialization proceeds in an environmentally sustainable way. Through this connection between industry and the environment, the mechanism of consent serves Indian interests regarding climate change and intergenerational equity.

III. CONCEPT AND MECHANISM OF CARBON CREDITS

Carbon credits are basically a tradeable permit that permits a company to release some amount of carbon dioxide into the environment. This is a market based approach that aims at cutting down greenhouse gas emissions without stopping economic activities.

A carbon credit is basically a certificate of the removal of one metric tonne of carbon dioxide and/or the equivalent quantity of greenhouse gases from the atmosphere.¹⁵ This system tries to encourage companies that pollute less than others and penalize those that pollute more.

If a company manages to cut down their emissions by making technological advances or using renewable sources of energy, then the company earns carbon credits. They can trade these carbon credits to other industries that are not able to meet their emission limits.¹⁶

Thus carbon credits make environmental consciousness an economic factor for industries.

3.1 Objectives of Carbon Credits

The carbon credits play an important role in the reduction of emissions because they incentivize industries by giving them financial incentives. They promote clean and green technology use such as renewable energy sources and energy-saving machines. In addition, they facilitate sustainable development since they enable economies to progress without damaging the environment irreparably. Carbon credits ensure that the price of pollution is put into

¹⁴ Air (Prevention and Control of Pollution) Act, No. 14 of 1981 (India).

¹⁵ World Bank, State and Trends of Carbon Pricing 2024 (2024).

¹⁶ David Freestone & Charlotte Streck eds., Legal Aspects of Carbon Trading (Oxford Univ. Press 2009).

consideration by businesses through the polluter pays policy where those who pollute the environment must pay for their damages.¹⁷ The scheme ensures that the two go hand in hand whereby industries can progress without unrestricted pollution. For economies like India, the carbon credit offers them a practical way to develop while minimizing their carbon emissions.

3.2 Types of Carbon Markets

Carbon credits work via different markets, which serve different regulatory or voluntary functions.

- a) Compliance carbon markets - There is a legally mandated cap on emissions that industries should not pollute beyond the limit. The industries that remain within the mandate can trade their extra credits, but those that go beyond their limit will either purchase extra credits or face punishment.
- b) Baseline and credits- The system rewards industries by encouraging them to perform above a certain benchmark. In such cases, the industry or a certain project is assigned a baseline level of emissions. When the industries reduce their emissions below the set baseline level, they earn credits. Such carbon trading is beneficial in developing countries, whereby setting tough caps on emissions could limit their growth.
- c) Voluntary carbon markets- These markets function without legal mandates. They include individuals, companies or organizations buying carbon credits for offsetting their emissions, to meet ESG requirements, or for any other reason.

Carbon credits provide environmental accountability as an opportunity. The reason for this is that they create a balance between the issue of pollution and economic motivation. In this regard, carbon credits do not punish industries but give them the motivation to be accountable environmentally.

IV. DOMESTIC LEGAL FRAMEWORK IN INDIA

In place of having an environmental law alone, India adopts the multilevel approach involving both old-style and new-age market-based environmental laws. The objectives of such

¹⁷ Vellore Citizens Welfare Forum v. Union of India, (1996) 5 S.C.C. 647 (India).

environmental laws include regulating pollution, fostering energy conservation, and moving towards a low carbon economy in India. This legal regime has been put in place to address the challenges that arise from being a developing nation with its unique requirements.

4.1. Environment (Protection) Act, 1986

The Environment (Protection) Act, 1986 (EPA), passed in response to the Bhopal gas tragedy, is the cornerstone of India's environmental governance system.¹⁸ It recognised the urgent need for a strong central law to protect the environment and public health. The Act gives the Central Government wide-ranging powers to deal with environmental problems, including pollution from industries. Unlike sector-specific laws, the EPA acts as an umbrella legislation, covering air, water, land, and overall environmental quality. Under this act, the government can set emission and discharge standards for industries. It prescribes penalties for environmental violations. Many environmental rules and notifications related to climate protection derive their authority from this Act.

Although the Act does not explicitly mention "carbon emissions", its broad definition of pollutants allows greenhouse gases to be regulated under its scope. In practice, the EPA allows the government to set the baseline emission standards, against which carbon reductions can be measured providing the statutory foundation on which carbon credit schemes are built. Without such statutory emission limits, carbon credits would have no legal reference point.

4.2 Air (Prevention and Control of Pollution) Act, 1981

The Air Act, 1981 is directly linked to carbon credits because it regulates industrial air emissions, which are the primary source of carbon dioxide.¹⁹ It plays a crucial role in the functioning of carbon credit mechanisms because carbon dioxide is emitted mainly through the burning of fossil fuels, especially in industrial and power sectors. The Act was enacted to address the growing problem of air pollution caused by industrialisation and urbanisation. It established the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs), which are responsible for setting emission standards and enforcing compliance. Consent is one of the key features of the Air Act, according to which industries need to get permission to establish and operate the unit that is going to emit air pollutants. It ensures the

¹⁸ Environment (Protection) Act, No. 29 of 1986 (India).

¹⁹ Air (Prevention and Control of Pollution) Act, No. 14 of 1981 (India).

fact that pollution control is not voluntary but compulsory, and only those industries that adhere to the emission norms will be able to take part in the carbon markets because carbon credits are designed to reward the reduction of emissions in excess of what is required under the law.

Monitoring and verification is another crucial contribution of the Air Act to the functioning of carbon credit mechanisms. It ensures regular monitoring of emission levels by Pollution Control Boards through inspections and enforcement of the emission standards. The collected information is important for carbon credits because carbon credit systems presuppose the collection and verification of information regarding reduction in emissions. Another feature of the Air Act that coincides with the philosophy of carbon credits is the polluter pays principle. The idea of carbon market is based on the financial cost of excess emissions when industries need to purchase credits.

4.3 Energy Conservation Act, 2001

This act marks a radical departure in India's policy on environmental protection.²⁰ While previous legislations concentrated solely on pollution after its occurrence, this act tries to curb energy consumption before pollution takes place. This act is preventive in nature. The Act created the Bureau of Energy Efficiency (BEE).²¹ It promotes the efficient use of energy in industries, building sectors, and appliances. Energy efficiency is related to carbon emission because most of India's energy comes from fossil fuels. Hence, any reduction in energy usage leads to reduced carbon emissions. The main contribution of this act towards carbon credit systems is the Performance, Achievement and Trade (PAT) system. Under the PAT system, energy-intensive industries have set targets for energy saving. Those who exceed the targets earn energy-saving certificates, while those who do not meet them need to purchase certificates.

4.4 Carbon Credit Trading Scheme (India)

The Carbon Credit Trading Scheme (CTS) can be considered the most practical attempt by India to construct an organized and credible carbon market within the country.²² The scheme entails shifting from a traditional and inflexible environmental regulation towards a more flexible approach to managing carbon emissions that involves incentivizing industries to cut

²⁰ Energy Conservation Act, No. 52 of 2001 (India).

²¹ Bureau of Energy Efficiency, Perform Achieve and Trade (PAT) Scheme, Gov't of India.

²² Carbon Credit Trading Scheme, 2023, G.S.R. 702(E), Gazette of India, June 28, 2023.

carbon emissions as part of their ongoing growth. Rather than perceiving environmental protection as a constraint, CTS views it as an opportunity to foster innovation and responsible industrial development.

At the heart of CTS lies a simple principle – pollution has a price. For many years, industries have been emitting greenhouse gases into the atmosphere without incurring any direct costs. The aim of the CTS is to address this problem by introducing economic incentives. According to the scheme, industries which are able to cut their carbon emissions to below prescribed amounts receive carbon credits, whereas industries which emit more greenhouse gases have to buy carbon credits in order to remain operational.

The scheme will be formulated and regulated by the Ministry of Power with the help of the Bureau of Energy Efficiency (BEE).²³ The rationale for choosing the mentioned institutions stems from the peculiarities of the Indian economy, which shows that carbon emissions are directly associated with the consumption of energy produced by coal-fired electricity production and by energy-intensive industries. By placing the Carbon Trading Scheme in the sphere of energy regulation, India seeks to resolve the issue from the root.

Among the main advantages of the Indian CTS is its gradual and inclusive approach. In contrast to strict cap-and-trade policies introduced in certain developed states, the CTS of India takes into account the developmental requirements of the country. There will be no abrupt emission restrictions that might hinder the development of industry. On the contrary, the scheme provides an opportunity for enterprises to enhance the efficiency of production, to switch to environmentally-friendly technologies, and to cut down emissions.

Further, the Carbon Trading Scheme is based on India's previous experience of the Perform, Achieve and Trade (PAT) Scheme that was introduced under the Energy Conservation Act, 2001. The PAT scheme was helpful in making the industries acquainted with the concept of tradable environmental certificates. The CTS uses the previous experience of the PAT scheme in relation to trading in the area of carbon emissions reduction rather than energy conservation.

V. Conclusion

The growing problem of carbon emissions has made it clear that environmental protection is a

²³ Bureau of Energy Efficiency, Carbon Credit Trading Scheme Framework (2023).

primary concern in the process of economic development. In a country like India, where industrial growth is essential for employment and infrastructure, the challenge lies not in choosing between development and the environment, but in ensuring that both progress together. This research has shown that unchecked industrial pollution not only harms the climate but also affects public health, ecological balance, and long-term economic stability.

Carbon credit mechanisms emerge as an important tool in addressing this concern because they move beyond traditional rules and regulation by attaching economic value to emission reductions. Carbon credits encourage industries to take responsibility for their environmental impact while still allowing room for growth and innovation. When industries are rewarded for adopting cleaner technologies and efficient practices, environmental compliance becomes a matter of opportunity rather than mere obligation.

The integration of carbon credit systems with India's domestic environmental laws strengthens their effectiveness and credibility. Laws such as the Environment (Protection) Act, 1986, the Air (Prevention and Control of Pollution) Act, 1981, and the Energy Conservation Act, 2001 provide the legal foundation for monitoring emissions, enforcing standards, and verifying reductions. Together, these laws ensure that carbon trading operates within a regulated framework and does not undermine environmental accountability.

India's approach to carbon markets reflects a balanced and realistic understanding of its developmental needs. Instead of imposing sudden and rigid emission limits, the focus remains on gradual transition, capacity building, and inclusive participation by industries. Initiatives like the Carbon Credit Trading Scheme demonstrate India's willingness to align climate action with economic policy, while also fulfilling its international commitments and constitutional duty to protect the environment.²⁴

Ultimately, carbon credits acts as a supportive mechanism for environmental regulation and enhances its effectiveness. Their success depends on reliable monitoring systems, transparent governance and strict enforcement of environmental laws. If implemented with integrity and consistency, carbon credit mechanisms can play a meaningful role in reducing emissions, promoting sustainable industrial practices, and upholding the principle of intergenerational equity.²⁵ In this way, India can move towards a future where economic development and

²⁴ Kyoto Protocol, *supra* note 9; Paris Agreement, *supra* note 10.

²⁵ A.P. Pollution Control Board v. Prof. M.V. Nayudu, (1999) 2 S.C.C. 718 (India).

environmental responsibility are not in conflict, but work together for the common good.