

Carbon Credits as a Key Tool in Enhancing Environmental Sustainability in Automobile Industry in India

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Abstract

Sustainable development is crucial for overall prosperity of the world. Climate change and the automobile industry have an interesting relationship. Long years of environmental policies have been committed to upgrading natural sustainability through accomplishing carbon neutrality or energy utilization effectiveness. This article examines the role of carbon credits as a vital tool in promoting environmental sustainability within the automobile industry. This article researches into the specific applications of carbon credits within the automobile industry, exploring how manufacturers can leverage these credits to incentivize the development and adoption of low-carbon technologies, such as electric vehicles, hybrid systems, and fuel-efficient engines. It also discusses the potential challenges and opportunities associated with implementing carbon credit schemes in the automobile sector, including issues related to supply chain emissions, lifecycle analysis, and consumer awareness. Sustainability is more and more important to automobile industry in India due to the factors, for example, the design, development and manufacturing of motor vehicles and CO₂ emission reduction, recycling targets, which is the central point of contention. Still, carbon credits play an important role in advancing environmental sustainability. Carbon credits, likewise, called carbon offsets, assume a pivotal part in environmental change by giving a means to compensate for greenhouse gas emissions and promote sustainability. They offer various advantages, including the execution of cleaner advancements, investment in sustainable practices, and change to a low-carbon economy. Notwithstanding, carbon credits hold enormous potential in enabling emission reductions and adding to a sustainable future. Carbon credits help as an intense market-driven motivating force, effectively and efficiently catalyzing the reduction of greenhouse gases and carbon dioxide. These credits work inside the structure of international agreements like the Kyoto protocol and Paris agreement, flourishing inside carbon markets where activities intended to restrict outflows yield tradeable credits. These credits, thus, can be bought by entities looking to adjust their own emissions, in this manner

exhibiting their strong obligation to fostering sustainability of the environment. This present descriptive study provides insights into how this innovative approach can contribute to achieving environmental sustainability goals while ensuring continued growth and competitiveness in the automotive sector.

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INTRODUCTION

The automobile sector is one of the main drivers of the advancement of the Indian economy. India is

a well-known automobile manufacturing hub in the world because of its low production cost, low cost of labor, low cost of raw material, and easy availability of raw materials and labor. These are the elements driving the manufacturing business. India is the fourth largest producer of automobiles in the world with a typical yearly creation of multiple million engine vehicles. The report of Indian auto industry investigation is partitioned by vehicle types (bicycles, voyager vehicles, business vehicles, and three-wheelers), by fuel type (diesel, petroleum/gas, electric, compressed natural gas/liquefied petroleum gas [CNG/LPG], and others), and by district (north India, east India, west India, and south India). The vehicle industry in Indian market is expected to register a compound annual growth rate (CAGR) of 8.10% during the estimated period. India's automobile business was regarded at USD 100 billion in 2021 and supposed to be at USD 160 billion by 2027.

The major players in the automobile sector are as follows:

- *Tata Motors*: Asia's biggest and 17th biggest auto making organization on the globe.
- *Mahindra & Mahindra Ltd*: A USD 19 billion global federation of companies.
- *Maruti Suzuki*: A subsidiary of the Japanese automobile and motorcycle manufacturer Suzuki Motor Corporation.
- *Hero MotoCorp Ltd*: Constitutes 39% of the market share in India.
- *Bajaj Auto Limited*: Constitutes 27% of the market share in India.
- *Honda Motors*: Constitutes 14% of the market share in India.

ENVIRONMENTAL IMPACT

The impact of the automobile sector on the Indian economy is significant, whether in emerging or developed nations. However, one of the primary environmental concerns in the 21st century includes climate pollution and its effects on human health, global warming, and ozone layer depletion, along with the growing scarcity of freshwater resources. Automobiles contribute to air pollution, and with rapidly increasing population and urbanization, the number of automobiles is also increasing. Figure 1 shows the greenhouse gas emissions in India from 2010 to 2021, measured in million metric tons of CO₂ equivalent (MtCO₂eq). Automobiles such as motors, scooters, cars, buses, trucks, taxis, and so on discharge huge measure of gases. These automobiles run using internal combustion engines which operate by burning of fossils fusels. The main pollutants emitted by vehicles are CO, hydrocarbons (HCs), NO_x, SO_x, volatile organic compounds (VOC)s, and suspended particulate matter (SPM). Heavy duty diesel engine emits more NO_x and suspended particulates matter emissions while light duty petrol driven vehicles and two wheelers are the major source of CO and HC emission. The vehicle sector consumes the greater part of the world's petroleum and is one of the biggest sources of worldwide ozone harming substance emanations.

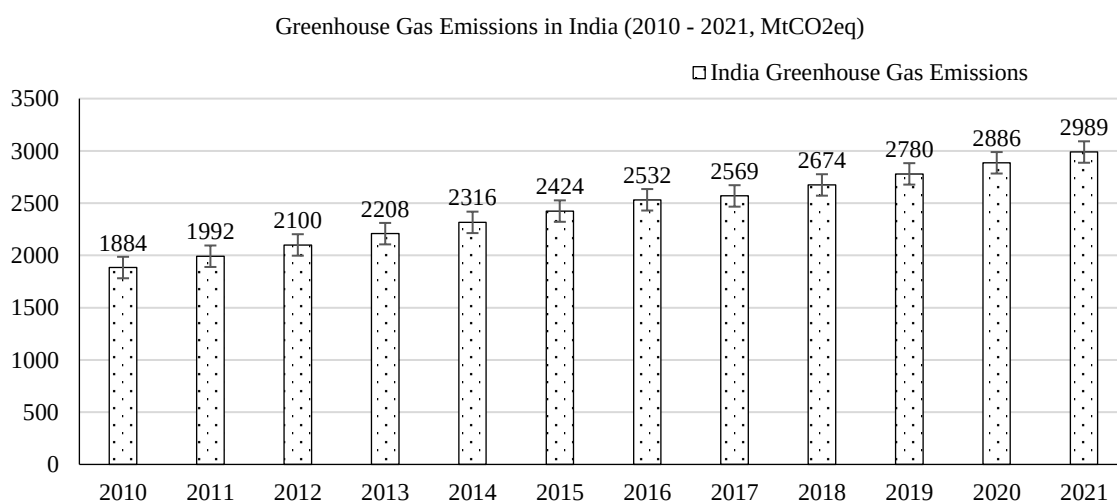


Figure 1. Greenhouse gas emissions in India (2010–2021).

It is additionally heavy live contamination. Vehicles are a significant contributor to air contamination creating huge measures of NO_x, CO, and particulate matter. However, natural change has turned into a constant worldwide issue nowadays and the automobile, automotive, and other manufacturing industries are the critical producer of carbon dioxide (CO₂). Most of the activities of the automobile sector have substantial impacts on the environment.

India Greenhouse Gas Emission

Objectives

- To investigate the existing carbon credit mechanisms in promoting environmental sustainability.
- To analyze the carbon credit initiatives of automobile sector in India.

METHODOLOGY

The study aims at understanding the impact of carbon credit on the sustainability of the environment for this purpose the data and information of automobile industry were collected and analyzed as this sector contributes to the climate change and environmental pollution. The study focuses on the mechanism of carbon market in India and how it helps auto industry in reducing their carbon emissions and protect environment for sustainable development in India. The descriptive method has been applied for this present study.

REVIEW OF LITERATURE

A study by Prajapati et al. [1] found the role of carbon credit and its significant role in moderating climate change. Similarly, research by Chanda et al. [2] assessed the overview of the world carbon market, and they adopted the econometric model to find the effect of carbon trading on the other stock market variables.

Khan et al. [3] focused on Indian carbon market with accounting standards and their implications. For this they have used secondary data from national and international sources with an interpretive approach. They found that many of the developed countries face the lack of carbon credits and India has the immense potential to create carbon credits.

CONCEPT OF CARBON CREDIT AND CARBON OFFSETS

Energy is necessary for human growth, but because of our excessive reliance on fossil fuels, which raise greenhouse gas emissions and carbon footprints worldwide, energy has also played a major role in climate change. Reducing carbon emissions is critical for both combating climate breakdown and fostering a sustainable ecosystem, as highlighted by several international agreements. Established as a tradeable commodity under the United Nations Kyoto Protocol in 1997 and confirmed in 2005, the notion of carbon credits enables nations or businesses to purchase or sell emission permits to promote the reduction of greenhouse gas emissions [4].

The 2015 Paris Climate Agreement [5], which sought to keep global warming to well below 2°C over pre-industrial levels while pursuing efforts to keep it to 1.5°C, further strengthened this framework. To meet its obligations, each nation has set a self-imposed goal of obtaining carbon credits. Anything created far beyond this expected limit, is allowed to be sold in global market, where the purchasers and sellers are government or ventures that need to produce or secure more carbon credits to discharge its greenhouse gases and accomplish its environment objectives. Carbon exchanging is done through decentralized market where worldwide private parties can trade carbon credit authentications. Carbon credit is relinquished and cannot be sold or used again after it has been purchased and weighed against carbon emission. Since 2010–2022, India has issued 35.94 million carbon credits and traded such credits on international global market.

Meaning of Carbon Credit

Carbon credits were developed as a mechanism to reduce greenhouse gas emission. Carbon credit represents the right to produce ozone harming substances identical to one ton of carbon dioxide or its

comparable in other ozone harming substances. Carbon credits cause quantifiable, certain emission reductions from guaranteed environment activity projects. These ventures either decrease, eliminate, or avoid greenhouse gases. If an organization reduces its emanations, it can offer its excess remittances to other organizations. Nations or organizations are distributed a certain no. of credits and may exchange them to assist with adjusting balancing all universal emissions. The authoritative objective of carbon credit is to decrease the discharge of greenhouse gases into the air.

Carbon Credit Trading

Carbon trading is the most common way of trading licenses and credits that permit the grant holder to discharge carbon dioxide. It has served as a keystone for European Union (EU) efforts to mitigate climate change.

- Exchanges or specialized platforms that make the purchasing and selling of credits easier are available for trading carbon credits.
- Bilateral agreements between two parties, such as businesses or organizations, can be used to exchange carbon credits.
- Carbon credits are usually traded for immediate delivery and settlement, generally at the common market cost.
- Some carbon markets offer future and option contracts, permitting entities to exchange carbon credits for a future date.
- Government authorities control the consistency market and expect organizations to comply with the emission reduction targets or commitments.
- The cost of the carbon is entirely determined by the market influences, including administrative costs, demand and supply elements, market feelings, economic situations, and so forth.
- Credits that are exchanged on the market should go through verification and certification processes.
- Carbon credits can be exchanged universally. Worldwide exchanges can encourage worldwide collaboration and facilitate emission and greenhouse gas emissions reduction efforts where they are financially cost effective.

It plays a major role in driving emission reduction strategies, facilitating the investment in low carbon technologies and initiations. and making economic incentives for economical practices.

By allowing businesses and investors to exchange carbon offsets and credits, a carbon market helps to both mitigate environmental problems and generate new business opportunities. The emergence of new regional markets has led to a rise in investment in these markets, which have been in place since the Kyoto Protocol of 1997. By effectively giving CO₂ emissions a price, carbon markets encourage the reduction of greenhouse gas emissions through market-based processes. These emissions can be categorized as one of two classes: carbon credits and carbon offsets which work on various systems.

Carbon credits are also known as remittances, and they work like consent slips for emissions. An organization obtains permission to release one ton of CO₂ when it acquires carbon credits, usually from the government.

By selling carbon money between businesses, carbon offsets flow horizontally. One can produce a carbon offset now when their regular business operations remove one unit of carbon from the atmosphere. Afterwards, other organizations can purchase that carbon offset to lessen their own carbon footprint.

Dynamic carbon credit assists top management in the auto business with settling on momentous and successful choices that produce benefit, yet in addition add to the battle against environmental change using carbon credits. The organization's expertise in reconciliations can assist with lessening the carbon impression and work with the procuring of carbon credits, which can then be sold on the carbon market.

Indian government has passed a revision to the Energy Protection Act, 2001, which prompts groundwork of a carbon credit market in India (The Energy Conservation (Amendment) Bill, 2022). The revision gives a legitimate structure to a carbon market with the target of boosting activities for emission reduction. Organizations can register as "Registered Entities" under the carbon credit trading plan under the Indian carbon credit market. Carbon markets have been successful in diminishing greenhouse gas discharges by putting down a boundary on emission and empowering their trading. Trading empowers the nations or organizations that can lessen carbon outflows at lower cost to be paid to do as such by higher-cost emitters, in this manner bringing down the economic cost of reducing emission [6, 7].

Benefits of Carbon Credits

Carbon credits contribute to reduced emissions and climate change mitigation while supporting environmental preservation and restoration. They offer financial incentives and investment opportunities, enhance corporate social responsibility and reputation, and provide access to carbon markets with compliance flexibility. Additionally, they foster international cooperation and facilitate the transfer of green technologies.

How to Produce Carbon Credits

Businesses can create and sell carbon credits by reducing, capturing, and storing emissions through different methods. Some of the most popular types of carbon offsetting projects are:

- Renewable energy projects
- Improving energy efficiency
- Carbon and methane capture and sequestration
- Land use and reforestation

Methods for Offsetting Carbon Emissions

Businesses have numerous ways to offset their carbon emissions. Some popular practices include the following:

- Investing in renewable energy sources such as wind, hydro, geothermal, and solar power to boost global energy efficiency.
- Capturing carbon from the atmosphere and repurposing it.
- Returning biomass to the soil post-harvest to enhance carbon sequestration.
- Supporting afforestation and reforestation projects to restore and expand forest areas.
- Transitioning to alternatives like lower-carbon biofuels.

These strategies not only help reduce carbon footprints but also contribute to a more sustainable future.

SECTOR-WISE CONTRIBUTIONS AND INITIATIVES

Transport sector: Outflows from transport are still on the ascent, addressing 12% of India's energy-related CO₂ emanations in 2021. In India, industry-related direct and indirect emissions account for 12.4% and 0.7% of CO₂ emissions related to energy, respectively. Beginning about 1990, these emissions increased substantially, and since India's metropolitan population is predicted to quadruple by 2050, it is likely that these emissions will continue to rise.

Despite being a significant source of CO₂ emissions, the transportation industry is making immediate measures to lessen its negative environmental effects:

- Vehicle fuel efficiency programs
- Energy efficiency in railways
- Electric vehicles
- Labeling program for vehicles
- Encouraging the use of different technologies, such as, hydrogen fuel cell

Automobile Industry – Towards Sustainability

India has encountered a critical surge in its carbon impression throughout the past 10 years, securing itself as one of the main worldwide producers of carbon dioxide. A tendency of fluctuations can be seen in the carbon emissions from 2000 and 2021. After beginning at 27.15 million tons in 2000, emissions climbed dramatically to 60.41 million tons by 2005 and then continued to rise steadily until reaching 83.42 million tons in 2015. The COVID-19 pandemic is probably to blame for the year 2020, with an unexpected decline to –181.45 million tons. But in 2021, emissions increased and peaked at 264.67 million tons.

In the emerging carbon emission journey, there are likewise different moderating procedures in progress to diminish its intensity and space out clean climate. Most organizations in the automobile business are treating "supportability" as the key objective in both their product strategy and activities to expand their worldwide competitiveness. The automotive industry is essential to achieving net-zero global emissions by 2050, which lays the foundation for the roadmap to limit global warming to 1.5°C over preindustrial levels [7].

Numerous original equipment makers (OEMs) are thus setting violent decarbonization focuses to address this difficulty. The industry has understandably focused on energizing powertrains because tailpipe emissions account for 65% to 80% of an automobile's outflows, while fuel supply accounts for equal indirect emissions.

In any case, to arrive at maximum capacity of automobile decarbonization — and achieve the zero-carbon vehicle — industry players at present ought to coordinate their concentration toward material emissions as well.

The initiatives listed below can be used to summarize industrial decarbonization:

- Resource efficiency
- Infrastructure improvement
- Decarbonization roadmap
- Creative business models

According to the Intergovernmental Panel on Climate Change (IPCC), the transportation sector globally is responsible for 14% of greenhouse gas emissions, or 7 billion tons. The automotive industry should respond to this global mandate as governments, cultures, and economies around the world strive towards decarbonization to mitigate the most horrifying effects of climate change [10]. Keys to this industry's ongoing reaction are: Power Purchase Arrangements (PPAs) – vehicle manufacturers guarantee the utilization of sustainable power through PPAs with their utilities. Energy Reduction and Reuse – Modern internet of things (IoT) innovations help upgrades tasks to lessen energy use and misfortune and reduce the down time. Worldwide automobile makers, including GM, Honda, Nissan, Portage, Volkswagen, and Toyota, have made significant steps towards PPAs and energy decrease and reuse. Effectively sending drives towards decarbonization, notwithstanding, requires an affirmation and embrace of intricacies and difficulties inside the present status of the industry. Worldwide Emission Reduction Targets: The auto business has encountered severe natural pressures through rigid guidelines to diminish emissions and waste all throughout vehicle production. Alongside this rising worldwide awareness, OEMs should follow new environmental norms, while guaranteeing fruitful long-term execution. Growing Adoption of Renewable Energy: Using energy sources that are not harmful to the environment at automotive manufacturing facilities is a crucial carbon reduction technique. OEMs are buying significant amounts of renewable energy from suppliers directly to power their factories or to sell back to the grid to offset emissions from the production of vehicles, in addition to installing solar panels and wind turbines at their facilities.

Impact of computerized change: Because of long lifetimes, upgrading/supplanting equipment & facilities to bring down emissions requires long-term planning and investment. Digital technologies IoT

solutions have increasingly enabled the implementation of green services for OEMs, providing necessary solutions to monitor and control sustainability related initiatives with relatively lower cost and faster implementations.

Electric vehicle (EV) production to overwhelm Internal Combustion Engine (ICE) by 2040: EV deals are supposed to outperform ICE deals by 2030. The EV business involves two techniques for producing carbon credits:

1. Clean development mechanism (CDM), and
2. Voluntary carbon standards (VCS).

While the procedure accessible in CDM is utilized for activity as well as charging of electric and hybrid vehicles for giving travelers or cargo transportation services; existing philosophy in VCS is utilized for project exercises like charging station establishment and related framework.

Carbon Credits Can Foster Electric Vehicle Growth

Charging systems get carbon credits for giving environmentally friendly energy to drive electronic vehicles. Charging station proprietors can, subsequently, produce extra revenues from carbon credits, accomplishing a more prominent return on investment. This thought is to some degree new and there is nonappearance of clarity on the process and pricing; charging station owners should guide climate experts who can help them register and endorse their charging stations for credit generation and transformation.

While this will straightforwardly decrease the effect of the utilization of petroleum derivatives on the climate, it will offer circuitous opportunities for expanded environment activity by attracting investment and scalability in the EV business. Adaptation of carbon credits will empower extra income inflow into the business while additionally uplifting more organizations to enter the market. As the deployment of charging stations extends, it will enable the adoption of a greater number of EVs. Expanded carbon credits from the EV environment can assist India with trading more credits and draw in more foreign direct investment (FDI) in its journey towards novel innovation electrification of the vehicle sector [2, 8, 9].

Market for Carbon Credits: Tesla's Role

With its renewable energy initiatives, Tesla has positioned itself as a leader in both the EV and carbon credit markets. It installs solar panels and offers energy storage systems that reduce greenhouse gas emissions and generate carbon offset credits. Its record-breaking carbon credit sales have made it stand out as extremely noteworthy, and 2022 is no exception. It revealed that sales of carbon credits to various automakers brought in \$1.78 billion. Additionally, the value of Tesla's renewable energy activities increased by 47% in the fourth quarter of the year.

The United States and China are the two countries that create the most greenhouse gases, with India coming in third [9].

- India opposes environmental change as well, primarily because of the changing patterns of rainfall and the thawing of the Himalayan glaciers.
- The nation has pledged a 33% to 35% decrease in the "emanations force" of its economy by 2030, contrasted with 2005 levels.
- India as of now has the world's fifth biggest car sales. These are supposed to develop with rising incomes and fast urbanization, with solid implications for worldwide oil demand.
- The government promotes the uptake up of EVs, although so far India has just 260,000 – including bikes and hybrids – and, overall, only 0.6% of sales are EVs. The rollout of charging stations stays low.
- It also boasts about 1.5 million electric rickshaws, though they are usually only used for short trips.

- India established the National Mission for Electric Mobility in 2011 with the goal of enhancing the production of hybrid and EVs. In 2017, the then power minister Piyush Goyal said petroleum and diesel vehicle sales ought to end by 2030. Be that as it may, the government has since scaled back on this aim, presently focusing on a 30% portion of sales for EVs by 2030. It also stipulates that by 2030, all new urban buses must be electric.

FINDINGS AND DISCUSSION

The present research uses secondary data from different sources and the suggestions were made based on outcomes founded by researchers through the study of many reports and articles which are of national and international origin.

It has been found that the automobile industry is the major contributor to the Indian economy and at the same time they are the major contributor to the environmental change. There is rapidly increasing temperature due to the high raising of carbon dioxide and greenhouse gas emission. As per statistics, India is the ^{third} largest emitter of greenhouse gases and carbon dioxide. By 2050, these emissions are predicted to quadruple as India's urban population grows.

India has also suffered high pollution, but studies have found that India has many opportunities to develop carbon markets to mitigate the climate change and to encourage the businesses to reduce their carbon footprint through environmental programs.

Worldwide automobile makers, including GM, Honda, Nissan, Portage, Volkswagen, and Toyota, have made significant steps towards PPAs and energy decrease and reuse. Many companies in the auto-industry have adopted various strategies like decarbonization, renewable energy, digital transformation, clean development mechanism, energy efficiency and so on to promote environmental sustainability. They are also trading their carbon credits with other companies to mitigate the carbon risks.

It has been found that the Indian government has many plans to promote EVs that aims at reducing environmental pollution. India is striving for the development of the carbon markets to enable Indian companies to reduce their carbon footprint and create the investment opportunities to grow. Since 2010–2022, India has issued 35.94 million carbon credits and traded such credits on international global market.

Carbon credits and offsets are the two major mechanisms enabling the industries to achieve the goal of in net zero carbon economy. Carbon market playing the major role in India to reduce its effect on the environmental complications which is the pressing issue in the world.

CONCLUSION

Floods, fire, and earthquakes keep on destroying the world, and environment observers cry foul, urging us to notice the nature around us. The Indian Prime Minister Narendra Modi has proudly reported that India is on target to meeting its guarantee to adhere to the Paris Agreement. He has said that the nation will accomplish its environmental objectives certainly before 2030. This implies that India ought to totally switch over to sustainable power, energy effectiveness, creating energy from waste, in the following 10 years.

Execution of different carbon credits and carbon offsets techniques contributed a lot for auto-industry in emissions reduction, environmental change moderation, ecological protection and restoration and sustainable carbon credits are essential in accomplishing environmental sustainability by boosting the emissions reductions. They give a lot of advantages, including the adoption of cleaner innovations, investment in sustainable projects and change to a low carbon economy. The possibilities for carbon credits are promising with expanding global awareness ecological security driving the demand for the emission offsets. However, ensuring environmental integrity and monitoring and strengthening system must be addressed by automobile industries to maintain sustainability in the future. However, carbon credits have enormous potential to help reduce emissions and support a sustainable future.

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