

DECARBONIZING THE TRANSPORTATION SYSTEM IN BANGLADESH: AN OVERVIEW OF GLOBAL BEST PRACTICES

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Abstract

The article presents an overview of Bangladesh's current transportation system and investigates the key sources of carbon emissions from various modes of transportation, such as road, rail, water, and air. The purpose of this article is to identify best practices for facilitating the transition to a low-carbon transportation system. The study used a secondary research approach, analyzing recent academic literature, government papers, and international publications to identify transportation decarbonization difficulties and global best practices. Carbon emissions and air pollution have increased in Bangladesh due to the country's rapid transportation demand growth, significant reliance on fossil fuels, and antiquated automobiles. The findings highlight various challenges to lowering emissions, including technical limits, insufficient infrastructure, budgetary constraints, a lack of governmental support, and low stakeholder awareness. The research also discusses prospective emission-reduction initiatives, such as promoting electric vehicles, extending rail and water transport, enhancing public transportation systems, supporting renewable energy integration, and strengthening policy frameworks. The study highlights the significance of concerted efforts between the public and private sectors in order to move toward a low-carbon transportation system, drawing on global experiences from nations like Sweden and Norway. The study suggests that implementing sustainable transportation policies and technologies in Bangladesh can dramatically cut carbon emissions while also enhancing environmental quality and long-term economic sustainability.

Keywords: decarbonization, transportation sector, carbon emissions, sustainable transport, Bangladesh.

Introduction

Efficient transportation is essential for a country's overall and sectoral growth. Additionally, this sector ensures economic growth and controls demographic mobility. In Bangladesh, transportation plays a significant role in the country's economy. Since the country's liberation, infrastructure development has advanced at a rapid pace, and there are now a broad range of modes of transportation by road, railway, air, and water that are widely used to transport both passengers and cargo (Islam, Hoque, & Statistics, 2020). Mobility, economic growth, environmental quality, government funding, and living quality can all be significantly impacted by transportation (Islam et al., 2020). In order to improve economic activity and provide high-quality transportation infrastructure and services at a reasonable cost with low environmental impact, careful planning is required (Mikwa & Management, 2014). Over 90% of all traffic in the nation is carried by roads and inland waterways, which are the most common modes of transportation in Bangladesh (Hasan et al., 2023).

However, starting in the twenty-first century, climate change has grown to be a major global and national concern (Srinivasu, Rao, & research, 2013). Transportation is a responsible sector as it consumes fossil fuels and releases significant CO₂ into the environment (Saha, Sabur, & Saif, 2023). The primary source of GHG gas is this CO₂. Greenhouse gases (GHGs) are a mixture of many gases, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) (Hasan et al., 2023). To minimize CO₂ emissions and mitigate climate change, it is important to prioritize this transportation sector (Saha et al., 2023). The article delves into the various forms of transportation include inland waterways, rail, planes, and road. And described that various modes of transportation produce CO₂ emissions. Analyzing current situation, it seek to shed light to some different approaches to lower the rate of CO₂ emissions as well as to develop clean transportation for Bangladesh.

Research aim: to identify the best practices that can support the transition toward a low-carbon transportation system.

The following **objectives** have been set to achieve the aim:

1. To understand the major sources of carbon emissions in the transport;
2. To find out the challenges in reducing transport-related emissions in Bangladesh;
3. To suggest effective measures for reducing carbon emissions in the transportation system in Bangladesh.

Research object and methods

The object of the research: decarbonizing the transportation system in Bangladesh.

In this article, a secondary research methodology is employed. Reputable academic database sources including Google Scholar, Science Direct and other sources such as research papers, government reports, industry reports, international publications, case studies, mostly journal articles are used to get a broad and diverse perspective on decarbonizing and practicing green transportation system in Bangladesh. The gathered data is examined through comprehensive descriptive analysis, allowing for an in-depth analysis of qualitative research. The data collection method is guided by a keyword searching approach in specified parameters, with a primary emphasis on terms such as

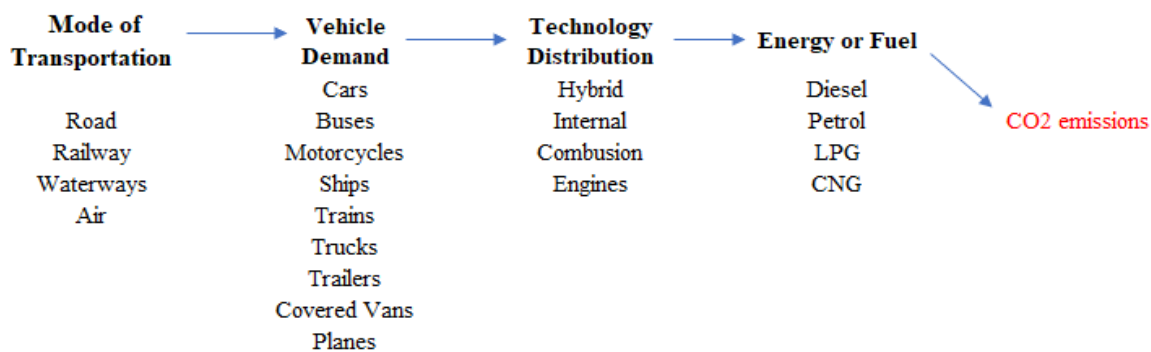
‘decarbonizing’, ‘carbon emission’, ‘transportation in Bangladesh’, ‘green transport strategies’, ‘mode of transportation in Bangladesh’, ‘environmental sustainability’ and ‘global transport practice’. Analytically, qualitative methodologies such as content analysis are used to allow for a more nuanced study of the acquired secondary data. Content analysis acts as an important method for analysing and interpreting obtained data, allowing for the identification of patterns, themes, and critical results.

Research results and discussion

Transportation modes and major sources of carbon emissions

Bangladesh’s transportation system is highly intricate. Road transportation makes up almost 75% of all traffic in Bangladesh, making it a major component of the country’s transportation network (Saha et al., 2023). However, there is still need for development in the road network, particularly with regard to quality and safety (Mikwa & Management, 2014). Many of the roads are in poor condition, and they are congested and narrow (2023). In addition, most road transportation vehicles are outdated and very polluting and in Bangladesh, these cars’ emissions are a major cause of air pollution (Islam et al., 2020). Road transportation adds to soil erosion and water contamination and also to air pollution (2014). Poorly maintained roadways cause sediment flow into neighbouring rivers and streams, which worsens water quality and increases river bank erosion in Bangladesh (2023).

Another essential part of Bangladesh’s transportation network is waterway transportation and the nation boasts a vast network of channels, rivers, and canals that are useful for moving cargo (Ahmed, Rafiq, & Jahan, 2025). But the waterways need to be maintained and are frequently plugged (Saha et al., 2023). Another crucial part of the transportation system is rail transit. A combination of narrow and broad-gauge lines make up the railway network, which has to be expanded and modernized (2023). The least advanced part of Bangladesh’s transportation network is air travel and there aren’t many airports in the nation, only two international and eight domestic airports (Islam et al., 2020). The potential mode of transportation systems in Bangladesh poses a considerable source of carbon emission.



Source: made by author according to Islam et al. (2020), Saha et al. (2023).

Fig. 1. Sources of carbon emissions

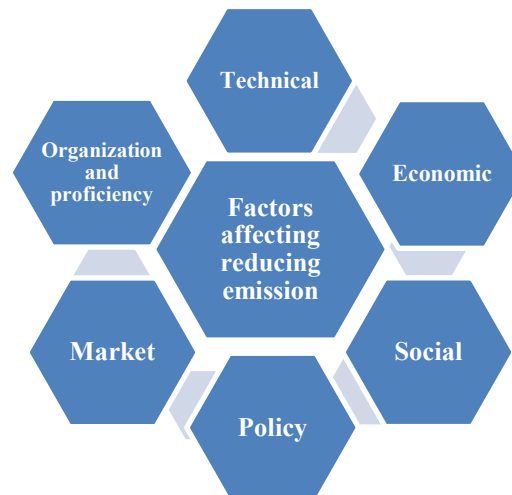
One of the biggest issues facing the transportation sector today is CO₂ emissions. In particular, transportation specialist looked at and computed the CO₂ emissions from moving chemicals in various ways, with deep-sea tankers and pipelines being the most effective and having the lowest emissions (Saha et al., 2023). Road transport is one of the biggest polluters, followed by intermodal road/barge and intermodal road/rail, with emissions of 62, 31, and 34 gCO₂/tone-km (2023). However, with emissions of 622 gCO₂/tone-km, air freight holds the top spot and intermodal transport road/short sea produces 21 gCO₂/tone-km, while rail transportation only emits 22 gCO₂/tone-km. Conversely, the Short Sea is responsible for 16 gCO₂/tone-km of emissions (Alam et al., 2025). Pipelines, deep-sea tankers, and deep-containers are additional nonsignificant emitters with emissions of 5,8,5 gCO₂/ton-km (2023).

Transportation system has been found to be the biggest source of carbon emissions worldwide, mostly as a result of the burning of fossil fuels (Alam et al., 2025). A large amount of the world’s energy consumption and CO₂ emissions are caused by transport industry (2025). For example, in 2021, it was responsible for 37% of CO₂ emissions from end-use sectors (2025). In order to meet the 2050 Net Zero target, the International Energy Agency (IEA) has mandated a 20% decrease in transportation-related emissions by 2030 (2025).

The challenges in reducing transport-related emissions

Reducing CO₂ emissions is a major problem for Bangladesh, especially from its transportation sector (Hossain, Hasan, Hasanuzzaman, Khan, & Ahsan Habib, 2022). According to Bangladesh Road Transport Authority 2020, over 80% of the 5,982,765 registered vehicles in the nation by January 2024 were producing excessive amounts of black smoke, mostly from gasoline and diesel engines (Alam et al., 2025). In actuality, transportation accounted for 9.92% of Bangladesh’s GHG emissions, which are predicted to increase to 36.28 million metric tons by 2030 (2025). In response, the nation has made an ironclad commitment to cut its transportation sector’s greenhouse gas emissions by 3.39 million metric tons by 2030 (2025). Therefore, in order to significantly cut carbon emissions and enhance air quality, public

health, and overall environmental sustainability, a shift in favour of transportation decarbonization is imperative (Ahmed et al., 2025). For the potential sustainable transport system gains poses a considerable factor of challenges.



Source: made by author according to Ahmed et al. (2025); Alam et al. (2025); Solaymani & Botero (2025); Srinivasu et al. (2013).

Fig. 2. Factors affecting reducing transport-related emissions

Decarbonizing system not only depend on single modification, within this full process different type of factors are included and every factor needed to prioritize properly to reduce emission of carbon.

Technical factor, absence of biofuel station, free charging facilities of EV, lack of professional experts with the skills and expertise needed to deploy and manage decarbonization technologies, limited utilization of established, effective decarbonization technology in the transportation industry, unreliable alternatives, poor service quality and the inefficient infrastructure impede the transition to low-carbon solutions (Alam et al., 2025). Poor technological system not only affect the decarbonization process, but the overall development.

Economic factors, investments in decarbonization carry financial risks because of erratic market conditions, restricted availability of funds specifically designed for decarbonization projects, unable to guarantee funding availability, unpredictable costs associated with decarbonization technology maintenance, insufficient financial initiatives for promote investment and consumers' and the high costs while switching to low-carbon modes of transportation (Ahmed et al., 2025). Economic sustainability is highly needed in the developing countries like Bangladesh, then sustainable infrastructure is possible.

Social Factors, inadequate understanding of the potential benefits of implementing clean technologies and decarbonization programs, absence of support or initiative from policymakers to push decarbonization programs, stakeholders and customers are hesitant to switch from existing practices to new alternatives and the differences between rural and urban communities' and the lack of ability to implement decarbonization initiatives (Srinivasu et al., 2013). Social change can bring or open a new opportunity toward the developed sustainable system.

Policies, decarbonization initiatives are hampered by complex laws and regulations, lack of economic laws or policies that encourage investments, lack of a well-defined legislative framework for environmentally friendly transportation, complicated administrative procedures make decarbonization activities more difficult or take longer time and governmental agendas less prioritization on decarbonization (Solaymani & Botero, 2025). Government policies can turn the situation to development but the economics and geographic location have an impact on the formulation and execution of policies.

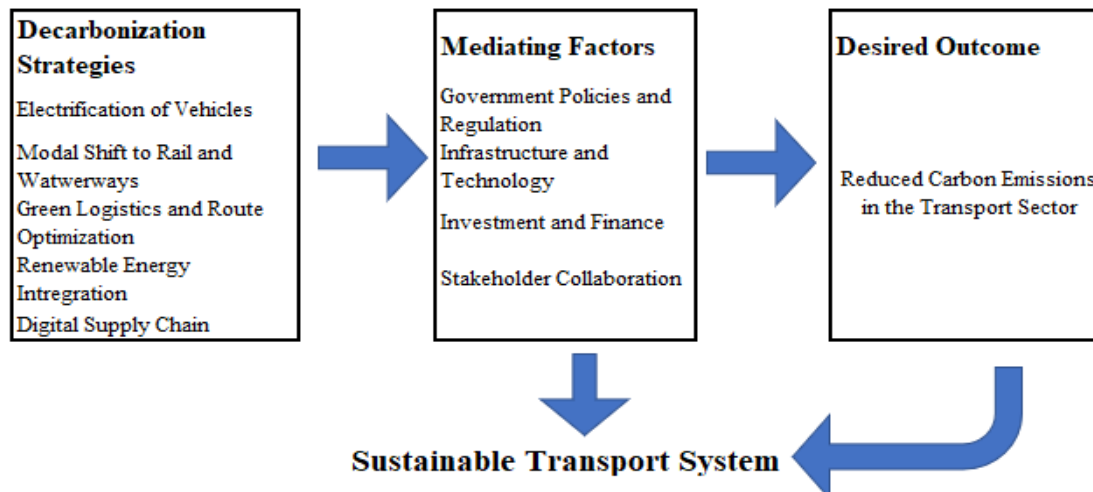
Concerning Market economy, underdeveloped market with little access to cutting-edge or environmentally friendly automobiles, fuel market volatility has an impact on the availability and demand of alternative fuel sources, minimal participation in global carbon markets or trading, the difficulty of competing with conventional fossil fuel-based systems for renewable transportation solutions and for the private sector who made few contributions or investments in decarbonization activities (Alam et al., 2025; Solaymani & Botero, 2025). Market economy consider internal and international situations and the capacity of adaptability and political system put strong impact on market economy.

Organization and proficiency, insufficient progress in study and research of decarbonization technology and methods for transportation, absence of a coordinated or cooperative platform for transportation decarbonization stakeholders, there is little experience in adopting decarbonization initiatives within enterprises and the inadequacy of cooperation parties to involved in decarbonization initiatives (Saha et al., 2023). Organization can make progress and implement new technologies but insufficient collaboration works as a main barrier.

Effective measures for reducing carbon emissions in the transportation system in Bangladesh

To reducing carbon emissions, the adoption of sustainable transportation systems is strongly associated with other environmental advantages (Alam et al., 2025). The use of electric vehicles can lower carbon emissions, especially if the electricity is generated by renewable energy sources like solar or wind (Funk, 2015). Additionally, converting roads to

autonomous vehicles (AVs) can increase road capacity and the percent of moving vehicles by reducing inter-vehicle distances, traffic signal delays, braking frequency, and speed changes, mainly higher speeds (up to 30 mph) that result will increase fuel efficiency and reduce carbon emissions (Hossain et al., 2022). Increase the capacity and modernize rail transportation, and shift carrying loads from underutilized road to river modes (Hasan et al., 2023). Collaboration among parties is vital, including transport firms, shippers, and logistics providers (Saha et al., 2023). Decarbonization helps to get a sustainable transportation system after implementing some effective strategies and successful collaboration with mediating factors.



Source: made by author according to Funk (2015); Hasan et al. (2023); Saha et al. (2023); Solaymani & Botero (2025).

Fig. 3. Process of decarbonization

It is worth emphasizing that government support for renewable energy production has a higher impact than price rises in transportation fuels to reduce CO₂ (Solaymani & Botero, 2025). Transportation-related carbon emissions have significantly decreased as a result of the implementation of carbon pricing, emissions regulations, and vehicle taxes in nations like Sweden and Norway (Alam et al., 2025). Similarly, emphasizing investments in public transportation, bike lanes, and EV charging networks has aided decarbonization efforts in these countries (2025). Additionally, non-motorized, shared, and collective transportation in urban areas and the use of e-mobility as major facilitators of decarbonization (Solaymani & Botero, 2025). The decarbonization process and development sustainable transportation in Bangladesh necessitates a multifaceted and collaborative approach. By addressing infrastructure and technical limitations, fostering strategic development, promoting green practices, and leveraging public-private partnerships, Bangladesh can get a sustainable transportation system.

Conclusions

1. By understanding the importance of decarbonization in transport, the article highlighted the primary sources of emissions across several modes of transportation and found that road transportation continues to be the most significant source of emissions, while rail and water transport emit considerably less carbon.
2. By analysing the available literature, it is identified that mitigating the challenges can enhance the decarbonization. The identified challenges are technological constraints, inadequate infrastructure, lack of funding, shoddy policy frameworks, restricted market growth for clean technology, poor stakeholder coordination and lack of social awareness and institutional
3. The effective solutions for enhancing decarbonization process are encouraging electric mobility, updating and growing rail networks, utilizing inland waterways more frequently, enhancing public transit systems, and funding infrastructure for renewable energy. Additionally, strong government regulations, financial incentives, and international collaboration are required to promote the change to sustainable transportation.

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