International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 9 Issue 2, Mar-Apr 2025 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Green Transportation: An Overview

Matthew N. O. Sadiku[1], Matthias Oteniya[2], Janet O. Sadiku[3], Benedict A Oteniya[4]

[1,2,4]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA
[3]Juliana King University, Houston, TX, USA

ABSTRACT

Transportation has a significant economic, social, and environmental impact on society. It accounts for major impact on the environment. Green transportation, also known as sustainable transportation, encompasses all environmentally friendly modes of transportation. It involves efficient and effective use of resources, modification of the transport infrastructure, and making healthier travel choices. Energy-efficient transportation system helps to achieve the goal of smart and green cities. Green transportation systems are introduced worldwide to reduce carbon emissions. This paper presents the concept, characteristics, modes, strategies, benefits, and challenges of green transportation.

KEYWORDS: *green transportation, sustainable transportation, sustainable mobility, transportation industry*

How to cite this paper: Matthew N. O. Sadiku | Matthias Oteniya | Janet O. Sadiku | Benedict A Oteniya "Green Transportation: An Overview" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-9 | Issue-2, April 2025, pp.495-505, URL: www.ijtsrd.com/papers/ijtsrd78365.pdf

IJTSRD78365

INTRODUCTION

We cannot do without transportation in this modern age. Transport systems provide social and economic connections. It is transportation that allows us to enjoy fresh fruits every day, receive packages overnight, and have Christmas presents delivered to our door just in time [1]. However, the current transportation infrastructure (roads, railways, airways, waterways, canals and terminals) has a lot of problems including global warming, environmental degradation, emission of greenhouse gases, traffic congestion, health complications, and pollution of air and surface and ground water. Transportation is now one of the major contributors to the destruction of the environment. It is one of the biggest hurdles with regard to social and economic development. The current modes of transportation require enormous amounts of energy, for example, fossil fuels (natural gas, coal, oil) to power vehicles on the roads. Many nations that have invested heavily in car-based transport systems are now the least environmentally sustainable [2].

The primary goal of transportation is to mobilize people and goods in an efficient manner from their origin to destination. The transportation sector has made its essential contributions to our lives, from food and transport of goods to personal mobility. The direct impacts of modern transportation activities include personal mobility, economic productivity, and traffic congestion. The infrastructure, vehicles, operations, and service characteristics of transportation can have long-lasting implications and near-term and direct impact on the environment. The transportation sector is energy intensive and has high direct emissions. For example. airport terminals are large public buildings, making significant demands on energy [3,4].

CONCEPT OF GREEN TRANSPORTATION

The idea of "green transportation system" was introduced in 1994 by a Canadian named Chris Bradshaw. The objective is to solve transportation problems by developing the traffic tools to decrease traffic jam, to reduce environmental pollution, to boost social fairness, to reduce energy consumption, and to save construction expenses [5]. To solve the air pollution problem and to achieve an environment-friendly transport system, automobile and power generation companies proposed a wide variety of products and solutions.

Green transportation is a highly interdisciplinary area with researchers from different disciplines including automotive engineers, policy makers, urban planners, and chemical engineers. It seeks to link transportation and environmental concerns. It may be regarded as consisting of the following four components [6]:

1. *Energy Consumption*: Transportation agencies in various countries, along with several standardization organizations, have proposed different types of energy sources (such as hydrogen, biodiesel, electric, and hybrid technologies) as alternatives to fossil fuel to achieve a more ecofriendly and sustainable environment.
2. *Electric Vehicles* (EVs): These are a key to future clean, green transportation system. A green vehicle (or eco-friendly vehicle) is_the_vehicle that produces less harmful impact on the environment than conventional vehicles running on gasoline or diesel. Green vehicles can be powered by renewable sources of energy such as wind, solar, biofuels and hydroelectricity. EV charging is a major issue for the massive production of EVs. Electric cars come with a new type of charging station. Major automobile industries worldwide are developing their strategies for wireless charging technologies. The high costs of electric vehicles, charging stations, and associated infrastructure are challenging.
3. *Smart Parking*: Parking is often difficult in a large city. Smart solutions optimize the use of parking lots by equipping each parking space with a sensor which detects whether a car is parked there or not. Smart parking in smart cities helps to avoid idle cruising and integrates crowdsourcing with the traditional road navigation system to collect and share real-time information about parking availability.
4. *Society*: The modern society relies heavily on efficient modes of transportation. It is the public thinking and acceptance that always determine the implementation of an idea. Education on green transportation can have significant impacts. Public education campaigns can raise awareness of the benefits of green transportation infrastructure technologies. Governments or private industry have not done much to implement green transportation infrastructure because of technical, regulatory, and social barriers involved. Government policy and commitment are critical in achieving green transportation. However, some lawmakers in California have considered charging green transportation taxes and fees in order to raise additional revenues for transportation [7].

MODES OF GREEN TRANSPORTATION

Green transportation refers to environmentally friendly modes of travel methods that lower emissions, conserve energy, and reduce the environmental footprint of transporting people and goods. It includes electric vehicles (EVs), public transit, cycling, walking, and other sustainable options aimed at decreasing dependence on fossil fuels. Walking, as a mode of transport, is the most sustainable. Besides walking, there are various modes of green transportation available. Typical average travelling share ratio for the modes of transportation is shown in Figure 1 [8]. Typical ones include the following [9].

1. *Bicycle*: Riding a bicycle to work instead of driving a car is great mode of green transportation. People should walk or use bicycles more often. Electric bikes are excellent green modes of transportation because they do not release harmful emissions like carbon dioxide and carbon monoxide. Riding a bicycle is shown in Figure 2 [10].
2. *Electric Vehicles*: Common electric vehicles include electric bikes, cars, trucks, motorcycles, trains, boats, and scooters. They do not emit any dangerous gasses since they are powered by electricity or renewable technologies like hydroelectric, solar power, and wind turbines. Bus is the dominant motorized vehicle in most big cities. Multiple occupant vehicles (or carpools) reduce the number of vehicles on roads and are favorable mode of green transportation. Car sharing has been going on in the developing world, where traffic and urban density is worse. Green vehicles are more fuel-efficient and should have less environmental impact than equivalent standard vehicles. Sustainability in Internet of vehicles can be achieved by the use of pollution-free vehicular systems and by maintaining road traffic safety or prevention of accidents. Figure 3 shows different kinds of electric vehicles [11].
3. *Hybrid Vehicles:* Unlike EVs that rely entirely on electric power, hybrid vehicles have an electric motor and an internal combustion engine. This gives electric vehicles the ability to run either on fuel or electricity, which is one of their advantages. Hybrid vehicles boast of an innovative feature – regenerative braking. This technology harnesses the wasted energy coming from the process of slowing down a car and uses it to recharge the batteries. Electric hybrid buses, like hybrid EVs, combine two power sources, fuel

and electricity. They, too, have a diesel engine and an electric motor. Figure 4 shows an example of hybrid electric vehicle [10].

4. *Green Trains*: Trains are getting increasingly greener with innovative green technologies. These electric trains travel at tops speeds of more than 200 mph. Trains are becoming more environmentally friendly, with hybrid locomotives and other innovative green technologies. A typical green train is shown in Figure 5 [11].
5. *Carpooling:* If you and others are going to the same location, you can share the ride. It reduces the number of cars running on the road significantly, lowering harmful emissions and traffic. Carpooling platforms such as Ola, Uber, and BluSmart are promoting ride-sharing and electric vehicle (EV) fleets. Companies like Zoom in India, eHi in China, and Carrot in Mexico, are bringing car-sharing to developing countries in an effort to reduce car-related pollution, ameliorate traffic, and expand the number of people who have access to cars.
6. *Public Transport:* Generally, public transportation follows the same model as carpooling. Many countries are focusing on developing public transportation such as electric buses or metro in the cities to fight congestion and pollution. Many cities in India and other places are adopting electric buses or buses powered by compressed natural gas for public transit. These vehicles significantly reduce pollution and offer a more sustainable solution for mass transportation.
7. *Walking:* Walking contributes to zero emission of any greenhouse gas. You can save money by walking to your local destinations. Get your legs moving with family, friends, or solo stroll to help the environment. One should prefer to walk to school, to work and to grocery shopping. etc. since walking involves zero emission in addition to the health benefits of exercising. Figure 6 shows some pedestrians [11].

STRATEGIES ON GREEN TRANSPORTATION

These strategies are all based on the principle of sustainable development [12].

1. Call for using public transport vehicles instead of private cars.
2. Improve new energy vehicles and give priority to rail, electric or hybrid vehicles
3. Construct walking and bicycle systems.
4. Develop intelligent transport system.
5. Strengthen enforcement on green transport and education systems.
6. The government should made efforts to establish an efficient public transportation system.

APLICATIONS OF GREEN TRANSPORTATION

Green transportation is any means of travel that does not negatively impact the environment. The common denominator among green transportation everywhere is that it is sustainable. Efforts to promote green transportation are increasingly important as the world grapples with climate change and the negative impacts of traditional transportation methods. Examples and case studies provide tangible evidence of the effectiveness of global efforts to promote green transportation. Common areas of applications of green transportation include the following:

- *Smart Cities:* Urban planning shapes how cities are designed and developed, and can promote sustainable mobility. Effective urban planning can play a vital role in decreasing transport-related emissions, improving air quality, and creating more livable, sustainable cities. Sustainable transportation is a key component of smart cities, which use technology and data to optimize urban living. Efficient public transit, bike-sharing programs, and pedestrian-friendly infrastructure help reduce urban sprawl and encourage more sustainable land-use planning. Sustainable transportation not only reduces emissions and pollution, benefiting the environment, but also enhances public health and quality of life. Cities around the world are doing their best to harness the environmental benefits of bus ridership by making them more attractive to ride.
- *Smart Mobility:* Smart mobility solutions are innovative approaches that integrate advanced technologies, data analytics, and intelligent systems to create more efficient, sustainable, and user-friendly transportation networks. By leveraging technologies like IoT, AI, and big data, smart mobility solutions optimize traffic flow, reduce congestion, and lower emissions. These solutions support sustainable transport by improving energy efficiency, reducing reliance on fossil fuels and encouraging more environmentally friendly travel choices. Figure 7 shows urban mobility [13].
- *Public Transportation*: Efficient and accessible public transportation systems, such as buses, trams, and trains, encourage mass transit and reduce individual carbon footprints. The benefits

of public transportation directly make a positive impact on the environment by saving fuel, lowering an individual's carbon footprint, and reducing vehicle congestion on area roadways. Public transportation makes a positive impact on the environment and the climate by helping reduce pollution, creating healthier communities, and reducing the number of cars on the road. Every vehicle on the road releases an average of one pound of CO2 per mile driven. The US has a bad habit of treating public transportation like a social welfare program, which has discouraged many people from using these systems.

- *Green Logistics:* Logistics is a critical factor in promoting globalization and international flows of commerce. It constitutes the heart of the operation of modern transport systems. Modern economy depends on logistics to support the flow of goods. Logistics and transport activities are well known to have a major impact on the environment. Green logistics refers to the systematic measurement, analysis, and mitigation of the environmental impact of logistics activities. It combines the environmental concern with logistic and transport activities. It is gaining importance throughout logistics and supply chain management [14]. Efficient logistics refers to the optimized management of resources, transportation and distribution processes to minimize waste, reduce costs and improve overall supply chain performance.
- *Green Transportation Infrastructure:* Cities are shaped by their transportation infrastructure. Components for evaluating sustainability include the particular vehicles used for road, water or air transport; the source of energy; and the infrastructure used to accommodate the transport. Creating green transportation infrastructure demands a holistic approach that merges modern technology, renewable energy, and intelligent urban planning. By prioritizing these strategies, cities and nations can lower environmental impacts, boost air quality, promote public health, and develop more sustainable transportation systems for future generations. To some people, thinking about green transportation infrastructure in isolation is misguided. Instead, they insist that a better approach is to figure out how to configure entire communities in such a way that greener modes of transportation are simply the most obvious and easiest choices. By providing dedicated bike lanes, secure parking, and safe crossings, cities encourage more people to choose cycling over motorized transport. If cities did more to create safer bike lanes, more people would start choosing to commute that way.
- *Electric Vehicles*: Electric vehicle technology significantly reduces transport CO_2 emissions when comparing battery electric vehicles (BEVs) with equivalent internal combustion engine vehicles. Electric vehicles have lower lifecycle emissions than other vehicle types. Tesla has been at the forefront of the electric vehicle revolution, not only producing popular electric cars but also developing a comprehensive charging infrastructure to support them. Establishing a robust charging infrastructure is pivotal for widespread electric vehicle adoption. Addressing this challenge accelerates the transition to green transport, ensuring reliable charging accessibility. A typical electric car is shown in Figure 8 [10].
- *Maritime Shipping:* In maritime shipping, wind-assisted propulsion systems like rotor sails and wing sails are being implemented on cargo vessels, reducing fuel consumption. Sustainable fuel is revolutionizing cargo transport, making it more sustainable across various modes. Electric and hybrid models of ferries are being introduced for short sea routes, significantly cutting emissions in coastal areas. A typical maritime shipping is shown in Figure 9 [10].

GLOBAL INITIATIVES ON GREEN TRANSPORTATION

The benefits of green transportation include reduced emissions, lower fuel costs, and less noise pollution, helping to create a more sustainable future. Green transportation is gaining traction globally, with stakeholders from various sectors converging to promote greener vehicles. Through collaborative networks, these alliances are crafting frameworks that aim to significantly reduce carbon emissions. For example, international agreements like the Paris Agreement have spurred a wave of innovation in electric vehicle technology. Such initiatives highlight the importance of sustainable transportation as an integral tool to improve upon traditional practices for a greener planet. The cities and nations that have invested most heavily in car-based transport systems are now the least environmentally sustainable. Here we consider how some countries adopt green transportation [15].

- *United States:* Since many Western countries are highly automobile-oriented, the main transit that people use is personal vehicles. About 80% of their travel involves cars. The emergence of the car in the post-war era led to major changes in the structure and function of cities. In 1939, the New York World's Fair included a model of an

imagined city, built around a car-based transport system. In this "greater and better world of tomorrow", residential, commercial, and industrial areas were separated, and skyscrapers loomed over a network of urban motorways. It has been calculated that New York residents save $19 billion each year simply by owning fewer cars and driving less than the average American. A less car intensive means of urban transport is carsharing, which is becoming popular in North America and Europe. There are major differences in transport energy consumption between cities; an average U.S. urban dweller uses 24 times more energy annually for private transport than a Chinese urban resident, and almost four times as much as a European urban dweller. There are plenty of greenways to get around in the nation's capital, Washington DC. There is the Metrorail, which is the local train system, and there is the Metrobus.

- *Europe:* Mainstream transport planning in Europe has never been based on assumptions that the private car was the best or only solution for urban mobility. For example, the Dutch Transport Structure Scheme has since the 1970s required that demand for additional vehicle capacity only be met "if the contribution to societal welfare is positive," and since 1990 has included an explicit target to halve the rate of growth in vehicle traffic. In 2007, 72% of the European population lived in urban areas, which are key to growth and employment. Cities need efficient transport systems to support their economy and the welfare of their inhabitants. In 2021 the Institute for Public Policy Research issued a statement saying that car use in the United Kingdom must shrink while active transport and public transport should be used more. The city of Freiburg, Germany has implemented extensive methods of public transportation, cycling, and walking, along with large areas where cars are not allowed.
- *Brazil:* Brazil met 17% of its transport fuel needs from bioethanol in 2007, but the OECD has warned that the success of biofuels in Brazil is due to specific local circumstances. Internationally, first-generation biofuels are forecast to have little or no impact on greenhouse emissions, at significantly higher cost than energy efficiency measures. The later generation biofuels however (2nd to 4th generation) do have significant environmental benefit, as they are no driving force for deforestation or struggle with the food vs fuel issue.
- *City Level:* Green transportation policies have their greatest impact at the city level. Some of the biggest cities in Western Europe have a relatively sustainable transport. Many other cities throughout the world have recognized the need to link sustainability and transport policies. Some major cities support green, clean transportation. The PATH (Port Authority Trans-Hudson) train makes it easy to commute from New York City to nearby cities. There are also lots of room for bikers and walkers in this bustling metropolis. Being part of the Southeastern Pennsylvania Transportation Authority (SEPTA), Philadelphia offers many advantages to commuters. Residents of this city can choose among various transport modes like trains, trolleys, buses, and subways.

BENEFITS

There are several benefits of green transportation which will enhance healthier lifestyle, improve quality of human life, and allow sustainable mobility. Green modes of transportation have produced zero emissions. They play an important role in achieving a green city. Green transportation can also enhance quality of life and certain economic activity. Going green will increase the efficiency and productivity of your business. Other benefits include the following [16]:

- *Pollution Reduction*: Green transportation reduces air pollution and greenhouse gas emissions, conserves fuel, lowers the risk of respiratory issues and heart disease, helps build healthier communities, and declines the need for fossil fuels. Enhancing electric vehicle use by expanding charging infrastructure and adopting uniform charging connectors can significantly reduce carbon emissions.
- *Sustainability:* Transportation is the biggest contributor to greenhouse gas emissions. Sustainability is critical, and green transportation is one way to reduce environmental impact. Green transportation or sustainable transportation refers to the practice of ensuring that vehicles and other modes of transportation are environmentally friendly. It reduces carbon emissions and air pollution in businesses by reducing the use of fossil fuels. It will save you thousands of dollars are they work on renewable resources like electricity which are way cheaper than gasoline.
- *Promotes Health:* Improved air quality in a community means greater health benefits for the people who live there. Green transportation promotes community health by lowering emissions and air pollution. If more people use public transportation or green vehicles to

commute, pollution levels will plummet, allowing people to breathe easier and live longer.

- *Cost Savings*: Using green transportation modes such as bicycles, multiple-occupant cars, and electric motorcycles will save you a lot of money on out-of-pocket expenses associated with purchasing gas at the pump. Green transportation can save you money on gas and maintenance costs in addition to being good for the environment.
- *Energy Conservation:* Green transportation encourages the use of more energy-efficient cars and renewable energy sources, such as wind or solar power, to cut down on the usage of fossil fuels like gas and oil. This helps conserve nonrenewable energy resources and decreases dependency on oil, which can enhance energy security for nations.
- *Reduced Traffic Congestion*: Green transportation systems, including well-designed public transportation and shared mobility options, help reduce the number of vehicles on the road. This leads to less traffic congestion, reduced commuting times, and improved urban mobility, making cities more livable and efficient.

CHALLENGES

In spite of the progress made in promoting green transportation, several challenges and controversies remain. There may be some downsides depending on how you handle green transportation at your company. Green vehicles, for example, may have limited mileage. The materials used in manufacturing electric batteries are scarce and costly. There is lack of global standards and regulations for electric vehicles. Home charging capacities are limited to one or two cars at most [17]. Other challenges include the following [17]:

- *Government Support:* Governments may play a significant part in supporting green transportation by certain rules and incentives and through the implementation of policies and regulations. They can incentivize the adoption of sustainable transportation methods by offering tax credits, subsidies, and infrastructure development. Governments also have the power to enforce regulations that limit emissions and promote the use of alternative fuels. Successful examples of government initiatives include the electric vehicle subsidies in Norway and the implementation of congestion pricing schemes in cities such as London and Singapore.
- *Public Awareness:* Public awareness and education are crucial in promoting green transportation. Educating people on how to travel more sustainably is a key part of an effective sustainable transportation strategy. By educating the public about the benefits of sustainable transportation options, individuals can make informed choices that positively impact the environment. Various campaigns, programs, and initiatives have been launched to raise awareness about the advantages of using public transportation, cycling, and walking. Public awareness and education also play a significant role in influencing policymakers and driving the implementation of green transportation initiatives.
- *International Collaboration:* International collaboration and partnerships are essential for the successful promotion of green transportation on a global scale. Organizations such as the United Nations and the International Energy Agency have spearheaded efforts to address climate change and promote sustainable transportation. Global initiatives like the Paris Agreement have set targets for reducing greenhouse gas emissions, leading to increased collaboration between countries to develop and implement sustainable transportation policies.
- *High Cost:* Green technology is an expensive upfront investment and may not be a viable option for small businesses with limited budgets. The high cost of electric vehicles and limited charging infrastructure pose barriers to widespread adoption. The social costs of transport include road crashes, air pollution, physical inactivity, time taken away from the family while commuting, and vulnerability to fuel price increases.
- *Lack of Chargers*: A big problem in the growth of electric vehicles is the lack of chargers available - the equivalent today of having just a handful of gas stations. Some nations are developing highways with built-in charging capabilities for electric vehicles (dynamic charging), allowing EVs to charge while in motion.

CONCLUSION

Transportation is one of the most indispensable means of life. It plays a major role in people's everyday lives and is a decisive factor in economic competitiveness. Green transportation is a low-carbon and environmental friendly mode. It involves various practices, including effective utilization of resources, adapting transportation structure, and making healthier commuting choices. Green transportation modes include walking, bicycle, public transport, and rail transport [19].

Many cities worldwide have realized the need to link sustainability and transport policies. Green transport is now becoming a strategic choice for most countries. Unfortunately, the US is far behind other nations when it comes to making changes in transportation modes. There has also been little investment in public transportation compared to other countries. More information on green transportation can be found in books in [3,19-31] and the following related journals:

- *International Journal of Sustainable Transportation Journal of Advanced Journal of Transportation,*
- *Transportation Research Part D*
- *Sustainability Magazine*

REFERENCES

[1] P. J. Katsioloudis and M. V. Jones, "Green transportation for a green earth," *Technology and Engineering Teacher*, April 2012, pp. 19-25.

[2] "Sustainable transport," *Wikipedia*, the free encyclopedia https://en.wikipedia.org/wiki/Sustainable_transport

[3] M. Kutz (ed.), *Environmentally Conscious Transportation*. Hoboken, NJ: John Wiley & Sons, 2008.

[4] M. N. O. Sadiku, *Emerging Green Technologies*. Boca Raton, FL: CRC Press, 2020, pp. 182-187.

[5] D. Zhang and A. Fei, "Green transportation: The essential way for transportation in the future," *Applied Mechanics and Materials*, vol. 97-98, 2011, pp. 1135-1140.

[6] M. N. O. Sadiku, A. E. Shadare, and S. M. Musa, "Green transportation," *International Journal of Trend in Research and Development*, vol. 6, no. 1, Jan. – Feb. 2019, pp. 213-214.

[7] A. Weinstein, J. Dill, and H. Nixon, "Green transportation taxes and fees: A survey of public preferences in California," *Transportation Research Part D*, vol. 15, 2010, pp. 189-196.

[8] J. Froehlic et al., "UbiGreen: Investigating a mobile tool for tracking and supporting green transportation habits," *Proceedings of the SIGHI Conference on Human Factors in Computing Systems,* Boston, MA, April 2009, pp. 1043-1-52.

[9] "What is green transportation?" https://www.conserve-energy-future.com/modes-and-benefits-of-green-transportation.php

[10] C. King, "Top 10: Green transport solutions," November 2024, https://sustainabilitymag.com/top10/top-10-green-transport-solutions

[11] J. Hanis, "#SaveEarth: Modes of green transportation," June 2022, https://kancilscience.my/2022/06/introduction-to-green-fundamentals-modes-of-green-transportation/

[12] Z. Liu et al., "Green transport practice in Beijing," *The Fifth Advanced Forum on Transportation of China,* Beijing, China, Oct. 2009, pp. 80-84.

[13] S. Olwan, " Green transportation challenge: Crafting the next wave of sustainable vehicles," November 2024, https://learningmole.com/green-transportation-challenge-designing-eco/

[14] M. N. O. Sadiku, S. R. Nelatury, and S.M. Musa, "Green logistics: A primer," *Journal of Scientific and Engineering Research,* vol. 6, no. 3, 2019, pp. 11-14.

[15] "Sustainable transport," *Wikipedia*, the free encyclopedia https://en.wikipedia.org/wiki/Sustainable_transport

[16] R. Patel, "Understanding green transportation and its significance," October 2024, https://www.upperinc.com/guides/green-transportation/

[17] S. Mehar et al., "Sustainable transportation management system for a fleet of electric vehicles," *IEEE Transactions on Intelligent Transportation Systems*, vol. 16, no. 3, June 2015, pp. 1401-1414.

[18] H. Li, "Study on green transportation system of international metropolises," *Procedia Engineering*, vol. 137, 2016, pp. 762 – 771.

[19] H. N. Psaraftis (ed.), *Green Transportation Logistics: The Quest for Win-Win Solutions*. Springer, 2015.

[20] B. Fahimnia et al. (eds.), *Green Logistics and Transportation: A Sustainable Supply Chain Perspective*. Springer, 2015.

[21] K. Furgang and A. Furgang, *On the move: Green transportation*. Rosen Publishing Group, 2009.

[22] P. Lamichhane, *Green Transportation (A True Book: A Green Future)*. Children's Press, 2024.

[23] M. Abrahamsson, *Green Transportation: Making Smarter Choices For A Cleaner Environment*. Independently Published, 2024.

[24] D. Charis, *Green Transportation Basics: A Green Energy Guide*. New Society Publishers, 2010.

[25] R. Bergqvist and J. Monios, *Green Ports: Inland and Seaside Sustainable Transportation Strategies*. Elsevier, 2018.

[26] B. Jarboui, H. Derbel, and P. Siarry (eds.), *Green Transportation and New Advances in Vehicle Routing Problems*. Springer, 2021.

[27] H. Lu, *Eco-Cities and Green Transport*. Elsevier, 2020.

[28] A. Juan et al. (eds.), *Sustainable Transportation and Smart Logistics Decision-Making Models and Solutions*. Elsevier, 2018.

[29] J. Chakwizira, J. O. Odiyo, and P. B. Bikam (eds.), *Green Economy in the Transport Sector: A Case Study of Limpopo Province, South Africa*. Springer, 2021.

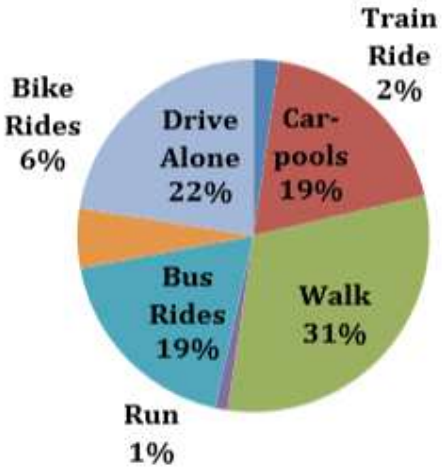

Figure 1 Typical average travelling share ratio [8].

Figure 2 Riding a bicycle [10].

Figure 3 Different kinds of electric vehicles [11].

Figure 4 A hybrid electric vehicle [10].

Figure 5 A typical green train [11].

Figure 6 Some pedestrians [11].

Figure 7 Urban mobility [13].

Figure 8 A typical electric car [10].

Figure 9 A typical maritime shipping [10].