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Public Transportation in Developing Countries

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ABSTRACT

Public transportation in developing countries is faced with myriad of problems and challenges such as low quality services, high costs, and insufficient coverage; but is very crucial for mobility, accessibility, and sustainability, most especially with increasing urbanization, population, and environmental concerns. Transportation is crucial for both economic and social development of nations. It is also a major contributor to greenhouse gas (GHG) emissions, for which there is the urgent need for a paradigm shift towards a holistic approach that integrates transport with economic and social considerations, particularly for low- and middle-income countries (LMICs). Developing countries must support the pursuit of green and resilient transport by starting with the importance of setting climate goals, and develop their own path to Paris Align transport. The paper looks into the challenges to public transportation in developing countries faced by commuters, government, and private investors, with an attempt to proffer viable solutions.

KEYWORDS: *Public transport, developing countries, greenhouse gas (GHG) emissions, climate goals, bus rapid transit (BRT), mobile/digital ticketing, intelligent transport system (ITS), corruption, infrastructure*

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INTRODUCTION

Public transportation in developing countries faces unique challenges like low quality, high costs, insufficient coverage, poor integration, and lack of safety and reliability, but also offers opportunities for sustainable and equitable urban development. It is known to play a crucial role in the economic growth, social development/inclusion, and improving the quality of life of the people in a nation. In developing nations, efficient public transportation systems are essential for improving mobility, reducing congestion, and fostering economic growth, creating jobs and connecting people to essential services like healthcare and education. In many developing countries, these benefits are not being realized, as one billion people still live more than 2km away from an all-weather road, where lack of access is inextricably linked to poverty [1]. Due to fear of harassment in transit, one out of six women globally do not seek for jobs. Furthermore, road crashes claim over 1.19 million lives every year, 93% of them in developing countries [1]. This is coupled with some significant challenges in maintaining and expanding their transportation networks – with corruption at the centerpiece. Efficient public transportation is crucial for economic growth and social mobility, requiring innovative solutions and tailored strategies for improvement.

HISTORICAL BACKGROUND

The fascinating history of transportation spans from 4000 BC to the present day, when man makes use of animals for transport and the invention of the wheel to the first roads, trains and aeroplanes. The use of horses to the earliest invention of the wheel, to the first flight of the space shuttle, transport has a 5,000-year history as follows [2]:

- 4000 BC – Horses and camels were domesticated and used for transport.
- 3500 BC – Fixed wheels on carts were invented.
- 3500 BC – River boats were invented.
- 2000 BC – First chariots were built.
- 312 BC – Paved roads were built by the Romans.
- 1044 AD – The compass was invented in China.

- 1662 – The first horse-drawn public bus was invented.
- 1783 – First hot air balloon launched.
- 1801 – First steam "road locomotive" was run.
- 1814 – First steam-powered railway train was built by George Stephenson.
- 1816 – The earliest bicycle was made.
- 1900 – First successful airship was built by Ferdinand von Zeppelin.
- 1904 – Wright Brothers fly the first motor-driven aeroplane.
- 1908 – First Ford cars were manufactured.
- 1942 – V2 rocket travelled 200 km.
- 1947 – First supersonic flight took place.
- 1957 – First man-made satellite, Sputnik 1, was launched into orbit.
- 1981 – First flight of the space shuttle lifts off, 20 years after the first manned space flight,

The three modes of transport: The three main modes of transport are – air, land and water. The majority of transport fit into these three categories, and all experienced significant changes throughout the history of transportation, as shown in Figure 1.

First form of transport: The earliest and first form of transport was walking. Before humans learnt how to domesticate animals like horses and donkeys, the only mode of travel by man was by walking [2]. In cities in developing countries, most people walk, bike, or take public transport – formal or informal – and only a minority travel by car. Motorization levels – private cars per 1,000 residents – are still moderate or low, and motorization by motorcycle is often the first step towards private vehicle travel. Developing countries have at least four to eight times lower motorization rates than developed countries, which leads to the essential role of public transport – a low-carbon mode. However, public transport coverage and quality of service are often inadequate, resulting in many people walking long distances to access opportunities, abstaining altogether from participating in the labor market, accessing education or health care services, or sharing in other activities [3].

A critical look at public transportation versus private vehicles ownership shows that public transportation is much better than owning private vehicles considering the following factors that it is [4]:

1. **More cost effective than driving:** The cost of commuting by cars are much higher than that of using public transportation, since driving a car typically comes with some additional expenses that go beyond the initial purchase, such as the costs of fuel which fluctuate depending on oil prices and distance traveled, can take a significant toll on any household budget. In addition is car insurance premiums, which could be substantial, as well as congestion charges and regular check-ups, making commuting by car a rather costly choice. On the other hand, public transportation absolves passengers of the responsibilities associated with fuel costs, vehicle purchase, and maintenance while riders or commuters can use the services they require for a fixed fare, based on travel distance or zone. This helps in cost savings for citizens, making public transit an even more cost-effective option and affordable, most especially for the elderly, students, and low-income residents, as shown in Figures 2 and 3.
2. **Reduces traffic congestion:** City traffic and congestion have a far reaching impact than most people realize as just mere daily inconvenience in the lives of citizens or commuters. This is actually a global issue as the implications relate to environmental, economical, health and the well-being of populations. It was reported that for 2022, the typical U. S. driver spent over 51 hours in congestion, which is about an hour each week. This was 15 more hours lost to congestion than in 2021, and the time wasted in traffic jams costs Americans over $869 in lost time as well as increased levels of pollution, according to the 2022 Global Traffic Scorecard by the mobility analytics firm Inrix. Moreover, drivers paid around $134 more for fuel in 2022 than they did in 2021. The overall costs associated with delays and traffic congestion for the U.S. economy amount to over $120 billion annually.

   The pollutants from cars are linked to a variety of health conditions, from allergies and skin irritation to heart disease and respiratory problems such as asthma. Other atmospheric pollutants apart from exhaust fumes, are also fragments of particulate matter such as dust released into the air from brake and tire wear, as well as from the surface of roads, causing a damaging effect on people's health. Therefore, the use of public transportation not only reduces the number of cars on the road but also contributes to less pollution in cities, as shown in Figures 4 and 5.
3. **More energy efficient compared to private vehicles:** Public transport systems are designed to operate in a more efficient and planned manner, reducing the overall use of fuel and emissions produced. Since public vehicles travel along

designated routes, this limits the amount of fuel needed to transport a large number of passengers which is why it is effective in reducing air pollution. Current estimate showed that about 85% of greenhouse gas emissions from the transportation sector are related to the surface transportation system. The use of public transportation is the most effective option individuals can take to reduce or conserve energy, and as well as the saving of over 37 million metric tons of carbon dioxide, for example as in the U.S., as shown in Figures 6, 7, and 8.

4. **Reduction of CO2 emissions:** Personal vehicles are said to be among the largest contributors of carbon dioxide (CO2) emissions in a typical American household. An average household with two cars is estimated to consist of three main areas of CO2 emissions: electricity, natural gas and private vehicles. Electricity accounts for around 25% of the total emissions, natural gas for about 20%, and the remaining 55% is all contributed by cars. Public transportation is part of the solution to mitigating the effects of climate change, improving the quality of air in cities, and reducing the CO2 emission levels generated by the sector.
5. **Enhances accessibility and community mobility:** Inasmuch as public transportation creates social and economic opportunities for members of communities, it remains a vital part of the society. The lack of public transportation systems in any community, will lead to no mobility and therefore high dependence on cars which may either create a financial burden on families and individuals or exclude disadvantaged community members from being able to access essential services. The most affected groups would be children, people with disabilities, elderly citizens, low-income residents, and high-risk people/drivers going out to parties. Unlike cars, public transit systems are designed to work for all residents regardless of their race, income, social status, or where they live, functioning as an important tool for promoting equity.
6. **Safer than driving a car:** It has been proved that riding public transportation contributes to the reduction of traffic-related fatalities and other road incidents since it limits the number of cars on the road. Buses and subways are used to transport larger groups or number of people as more passengers can travel per public transit vehicle compared to a single car, leading to less chance of accidents, takes high-risk drivers off the road, aside reducing traffic in cities (i. e. traffic congestions) – as it Is estimated that over 100 people die every day on U.S. roads and motorways, hence the need for improving safety for everyone on the roads.
7. **Reduces pollution in cities:** The excessive number of cars on the road every day portends serious and harmful effect on the environment as well as human health, due to emission of harmful particles into the atmosphere. According to the World Health Organization, air pollution is one of the greatest environmental risks to health, and caused over 4.2 million premature deaths worldwide in 2019. This has caused governments around the world to introduce various initiatives to encourage the frequent use of public transport by citizens so as to improve air quality in cities and mitigate the effects of climate change, i. e. by way of promoting greener, more eco-friendly mode of transport such as walking, cycling, and the development of more efficient and sustainable public transport systems, as shown in Figure 9. Less burning of fuel means better air quality for cities as about 85% of greenhouse gas emissions are from daily transport commuting. In addition, modern public transport vehicles e. g. buses and trains now use alternative fuel sources like electricity and hydrogen to further reduce emissions.
8. **Makes communities healthier**: Walking from our houses to nearby transit stop and back, increases physical activity and helps to address modern obesity epidermic. The regular use of public transit by people has been proved to help achieve the 30 minutes of daily activity recommended by physicians as this allows them to walk more. One can bike or walk to work, or even combine public transit with biking or walking to get those extra steps.

CHALLENGES FACING PUBLIC TRANSPORTATION

There are challenges facing public transportation systems in developing countries, some of which are [5 - 9]:

1. **Environmental impact/concerns:** Many traditional and historic public transport systems are still using old technology, and this is a high contributor to worldwide contamination. According to the United Nations (UN), the transport system (which includes public transport, individual cars, and more) is responsible for approximately a quarter of all greenhouse gas emissions.

   The solution is the adoption of more sustainable transport options to reduce the environmental

impact caused via carbon and air quality emissions, noise levels, and climate change. The changes should be implemented, as some cities are already making a move. For example, Edinburgh is already making transport more sustainable by increasing the number of electric, hybrid, and lower emissions buses. Locals are also encouraged to walk and cycle more, with the city council investing 10% of their transport budget towards cycling provisions.

Germany has rolled out its world's first zero emission trains in the cities of Cuxhaven, Bremerhaven, Bremervoerde, and Buxtehude, which are entirely powered by hydrogen and are to serve about 2 million people.

2. **Urbanization, traffic congestion and delays:** Rapid urbanization in developing countries is the cause of an explosion in the demand for public transportation. Increase in urban population often outpaces the development of adequate public transport infrastructure, leading to severe traffic congestion and longer travel times. The increase of traffic on roads reduces the efficiency of public transport services, leading to delays and decreased reliability. As a result of this, public transport can become less attractive to commuters, which may lead to people relaying more on private vehicles, thereby exacerbating congestion. In order to solve this problem, there would be the urgent need for smart traffic management systems, prioritizing public transport routes, and investing massively in infrastructure development and upgrades
3. **Financial constraints:** Funding challenges has always faced public transport systems, making it hard and difficult to invest in upgrade of infrastructure, maintain vehicles, purchase new vehicles, hire qualified staff, and implement new technologies. The impact leads to aging infrastructure, unreliable services, decline in the overall quality of public transport, and insufficient coverage in urban and rural areas. Solving this problem would require the creation of financial models like public-private partnerships, and as well as the increased government investment needed in order to ensure the long-term sustainability of public transport.
4. **Cybersecurity concerns:** The increasing reliance on technology by public transport systems, now makes the systems more vulnerable to cyberattacks. In this case, hackers could potentially disrupt traffic systems, compromise passenger data, or even hijack and take control of vehicles endangering the lives of commuters. Robust cybersecurity measures must be implemented, such as encryption and firewalls, and investing in cybersecurity training for staff are crucial to protect public transport systems from cyber threats.
5. **Infrastructure development and maintenance:** The reliance of many public transport systems on aging or archaic infrastructure that requires significant investment for maintenance and upgrades. This is also coupled with inadequate infrastructure, poor road conditions, insufficient bus fleets, and limited rail networks. The impacts of this are delays, breakdowns, and decline in the overall quality of service delivery. Required is the massive investment in new infrastructure, like the bus rapid transit (BRT) systems and light rail lines, while maintaining existing infrastructure are also essential for ensuring the reliability and efficiency of public transport. To keep up with this, engineers are developing tougher materials that can withstand heavy use and hash weather. Smart sensors are being deployed to catch problems early before they become major issues.
6. **Technological advancements/innovation and integration:** The integration of different modes of public transport and incorporation of new technologies are challenging. The lack of integration can lead to inefficiencies, reduced convenience, and a fragmented user experience. The solution is by developing interoperable ticketing systems (mobile ticketing), implementing real-time information systems/analysis, bike sharing, and promoting the use of mobile apps. New tech is now transforming the transportation and logistics industry. More common now are electric vehicles on our roads. Smart logistics systems are also making shipping faster and more efficient.
7. **Customer experience and customer satisfaction:** The need to focus on improving the customer experience to attract and retain riders. The impact of this is poor customer service, long wait times, and unreliable service which can result to dissatisfaction and a decline in ridership. The solution is in providing comfortable and clean vehicles, offering reliable and frequent services, and ensuring good customer service.
8. **Declining performance of urban transportation:** Urbanization and increasing reliance on private vehicles can lead to a decline in the performance of public transport systems. The impact is that it will lead to congestion, pollution, and reduced quality of life. The solution lies in promoting public transport,

investing in infrastructure, and implementing policies that discourage private vehicle use to help improve urban transportation performance.

9. **Citizen engagement in transport planning:** The non-engagement of citizens in transport planning could lead to policies and measures that are not well-suited to the needs of the community. To ensure that transport plans are responsive to community needs, citizens must be involved in decision-making processes, and the soliciting for feedback.
10. **Inefficient operators:** The operators of public transportation in developing countries are often inefficient, and with routes and schedules that are not well planned, leading to delays, overcrowding, and cancellations.
11. **Informal transport systems:** This is very common in many urban areas of developing countries e. g. minivans, shared taxis, or "boda-bodas" (motorcycle taxis) playing significant role. Since they often operate without regulation, these leads to safety issues and unfair pricing practices (compounded by touts on the roads). While these systems can be more flexible and accessible, they can be chaotic and lack the reliability and consistency required for effective urban transport [10].
12. **Accidents and safety:** The growth in the intensity of circulation in urban areas is linked to a growing number of accidents and fatalities, especially in developing countries. It accounts for a significant share of recurring delays from congestion. Portable devices cause distractions which can be linked with rise in accidents for drivers, commuters, and pedestrians alike [11, 12].

OPPORTUNITIES FOR IMPROVING PUBLIC TRANSPORTATION

Some of the opportunities/solutions for improving public transportation in developing countries are as follows [13]:

1. **Sustainable transportation:** Developing countries can adopt sustainable transportation solutions, such as electric or hybrid buses – as shown in Figures 10 and 11, the promoting of non-motorized transportation, like cycling and walking.
2. **Public-private partnership:** Public-private partnerships can provide the needed financing and expertise for public transportation project such as the bus rapid transit (BRT) systems and rail networks.
3. **Innovative and smart transport technologies:** Innovative technologies, such as mobile apps and intelligent transportation systems (ITS), real-time tracking, digital ticketing can improve public transportation services, thereby making them more efficient, reliable, safer, and user-friendly – for example, as used in Nairobi, Kenya where apps provide live bus tracking and real-time information about routes have helped reduce waiting times and improve the reliability of services. These technologies also help transit authorities optimize routes and schedules based on demand.
4. **Capacity building:** Capacity building programs can assist public transportation agencies in developing countries develop needed skills and expertise to manage and operate efficient and effective public transportation systems.
5. **International cooperation:** International cooperation and knowledge sharing can provide the needed valuable lessons and best practices for improving public transportation in developing countries.
6. **Integration of informal and formal transport:** Rather than banning or ignoring informal transportation, they should be integrated into the formal public transportation network. This will involve improving safety standards, regulating fares, and providing better routes for informal transport providers. This line of approach will help to increase the overall coverage of the public transport system and provides a safer environment for commuters.
7. **Policy reform and public awareness:** Stronger regulation, improved safety standards, with better enforcement of laws can help enhance the safety and efficiency of public transport systems. Governments should also focus on public awareness campaigns that educate the public/passengers about the importance of maintaining order and safety on public transport. Need for comprehensive planning that integrates transportation policies with urban development plans is also essential to create a transportation network that will meet the needs of growing populations.

Some developing countries as examples of successful public transportation include:

1. **Medellin, Colombia:** The Medellin's Metrocable system is said to provide affordable and efficient transportation to hillside communities, hence reducing travel times and improving access to employment and education.

2. **Lagos, Nigeria:** Lagos' Bus Rapid Transit (BRT) system is helping in reducing travel times – via the use of dedicated lanes, and improved air quality, providing a reliable and efficient public transportation service to millions of commuters.
3. **Bangkok, Thailand:** Bangkok's Skytrain and Metro systems provide efficient and reliable transportation, reducing congestion and pollution, as well as improving access to employment, education, and healthcare.
4. **Cape Town, South Africa:** Cape Town's MyCiTi bus system is said to provide affordable and efficient transportation, providing social equity and sustainability, and improving access to employment, education, and healthcare.

CORRUPTION AND PUBLIC TRANSPORT

Transportation is one of the more corruption-prone sectors, since this sector allows public officials discretion, attracts rent-seeking activities, and conceals malfeasance through secretive transactions. Public corruption diminishes the quality of transportation infrastructure through misappropriation of funds, rent-seeking, and lack of accountability. Bribery, embezzlement, policy capture, influence peddling, and abuse of functions are among the more common corrupt acts associated with government-financed infrastructure projects. All of which negatively affects the quality of state roads, bridges, and on traffic congestion associated with traffic fatalities [14]. For these reasons, there is the need to strengthen good governance as a critical means to improve public infrastructure performance.

CONCLUSION

Public transportation in the developing countries is facing a myriad of numerous and complex challenges, including corruption, which are surmountable and with inherent opportunities for improvements. At the forefront, is the great challenge of massive/monumental levels of corruption that developing countries have found themselves, which must be fought and won if developing countries are to make or have any meaningful progress in the area of public transportation systems that would be effective, efficient, sustainable, and eco-friendly. The developing countries therefore must adopt sustainable transportation solutions, leverage on public-private partnerships (PPP), and utilizing innovative technologies (such as electric or hybrid buses, maglev trains, etc) to provide efficient, reliable, and affordable public transportation services that will improve the quality of life for millions of people. More information about public transportation in developing countries can be obtained in [15 – 18].

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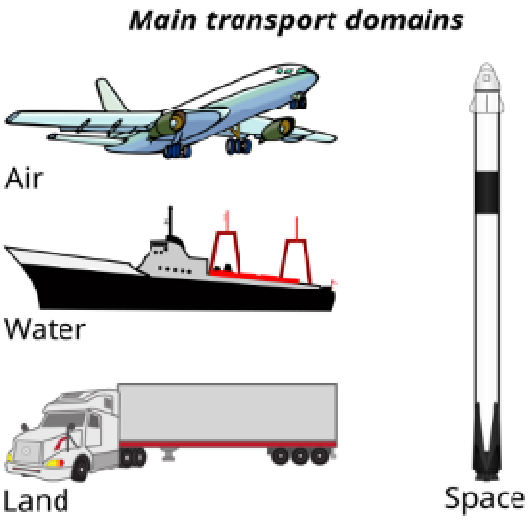

Figure 1. Main transport domains

Source:https://www.google.com/search?q=images+on+water+transport+by+wikipedia&sca_esv=3f2e39702a0b213c&udm=2&biw=1036&bih=539&sxsrf=AHTn8zof108FtG0oDy6G5FgzhjLMFYm4UQ%3A1741852750565&ei=TpDSZ-2iIsqHwbkP4_SrwAo&ved=0ahUKEwjtgcuTy4aMAxXKQzABHWP6CqgQ4dUDCBE&oq=images+on+water+transport+by+wikipedia&gs_lp=EgNpbWciJmltYWdlcyBvbiB3YXRlciB0cmFuc3BvcnQgYnkgd2lraXBlZGlhSMyUAVCtCViVYnABeACQAQGYAasVoAHAdqoBFDAuNi4xOC4zLjAuMS4xLjIuMC4yuAEMyAEA-AEBmAIAoAIAmAMAiAYBkgcAoAfNCw&sclient=img#vhid=v91g9FS-xCtOvM&vssid=mosaic

Figure 2. Public transport

Source:https://www.google.com/search?sca_esv=e6cbb193bcbd8d96&sxsrf=AHTn8zqD68qfbmdvfPBZdFGnr8rRWjw3xw:1741781131374&q=images+on+public+transportation+in+developing+countries+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpAdk4wpBWOGsoR7DG5zJBpcx8kZB4NRoUjdgt8WwoMuWnuS7DI2S6srcfL0KzJZNRasn6Cq3KUYuprxiyJLyIg0jLgL2PszFrSOyyGhhWLk8BVlBIfJenYp2kcj1gYGkd_2dLHTyD9El2IgmpjC3BDu9g05rxtyKajWlRIHaDpv7vPqZvJH5gl1se1kQbnLAmmQ&sa=X&ved=2ahUKEwizvPKswISMAxWMUkEAHWaKKIgQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=hmskWeE7ocXjzM&vssid=mosaic

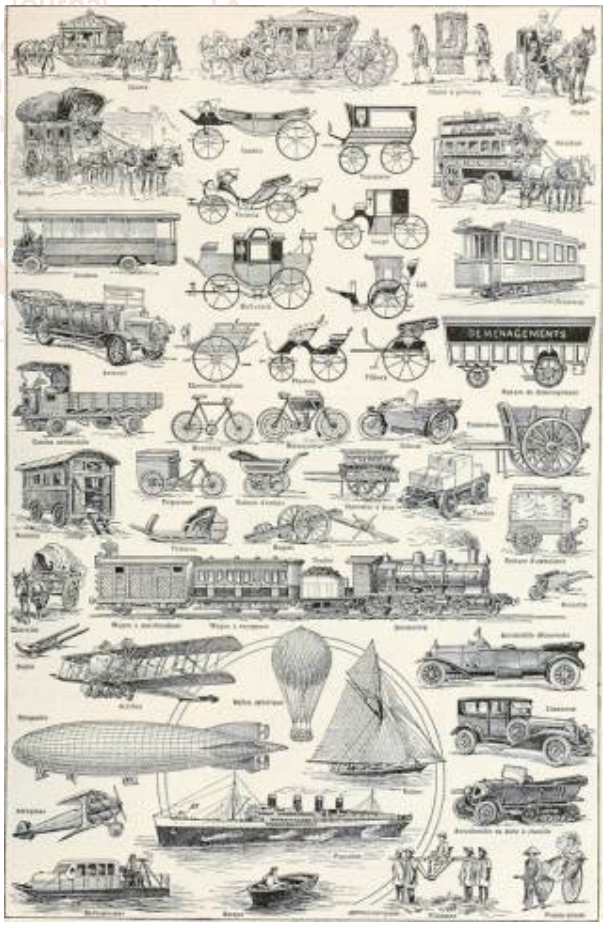

Figure 3. Land transport

Source:https://www.google.com/search?sca_esv=e6cbb193bcbd8d96&sxsrf=AHTn8zqx4xIStJfZl_DvF

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Figure 4. Sustainable transport

Source:https://www.google.com/search?sca_esv=e6cbb193bcbd8d96&sxsrf=AHTn8zqx4xIStJfZl_DvFXjrMVCfvU8gYg:1741781671971&q=images+on+public+transportation+in+developing+countries+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpAdk4wpBWOGsoR7DG5zJBpcx8kZB4NRoUjdgt8WwoMuWnuS7DI2S6srcfL0KzJZNRasn6Cq3KUYuprxiyJLyIg0jLgL2PszFrSOyyGhhWLk8BVlBIfJenYp2kcj1gYGkd_2dLHTyD9El2IgmpjC3BDu9g05rxtyKajWlRIHaDpv7vPqZvJH5gl1se1kQbnLAmmQ&sa=X&ved=2ahUKEwi58dWuwoSMAxXhQkEAHfSvB2QQtKgLegQIExAB&biw=1036&bih=539&dpr=1#vhid=5UJf15RmjqyhXM&vssid=mosaic

Figure 5. The Big Green Bus

Source:https://www.google.com/search?sa=N&sca_esv=e6cbb193bcbd8d96&udm=2&cs=0&sxsrf=AHTn8zqdKWAio5pUkJ8Vv4sw5PMcUUVCw:1741783777963&q=green+public+transportation&stick=H4sIAAAAAAAAAFvEKp1elJqap1BQmpSTmaxQUpSYV1yQX1SSWJKZnwcAktAUzR4AAAA&source=univ&ved=2ahUKEwil_vCayoSMAxUtWUEAHdW8NjE4ChCs3AJ6BAgEEAA&biw=1036&bih=539&dpr=1#vhid=E2iiEmJxSNma0M&vssid=mosaic

Figure 6 Energy Efficiency of different Transport

Source:https://www.google.com/search?q=images+on+sustainable+transport+by+wikipedia&sca_esv=3f2e39702a0b213c&udm=2&biw=1036&bih=539&sxsrf=AHTn8zpHmCqsYfLNKRFuqJXpzP9coIBL5g%3A1741850991025&ei=b4nSZ5lAeqTwbkP68S8qAk&ved=0ahUKEwjfmMnMxIaMAxXqSTABHWsiD5UQ4dUDCBE&oq=images+on+sustainable+transport+by+wikipedia&gs_lp=EgNpbWciLGltYWdlcyBvbiBzdXN0YWluYWJsZSB0cmFuc3BvcnQgYnkgd2lraXBlZGlhSI6SAlDbCFjvW3ABeACQAQCYAYkioAHJgQGqAQc3LTEuMC40uAEMyAEAAEBmAIAoAIAmAMAiAYBkgcAoAfhAQ&sclient=img#vhid=ELLtOxgyhDBgiM&vssid=mosaic

Figure 7. Environmental impact of aviation

Source:https://www.google.com/search?q=images+on+sustainable+aviation+by+wikipedia&sca_esv=3f2e39702a0b213c&udm=2&biw=1036&bih=539&sxsrf=AHTn8zpLbFwRyOs54GUoTb1sS2JhAsaIag%3A1741851153417&ei=EYrSZ_qWGenRwbkPtfySOA&ved=0ahUKEwi644CaxYaMAxXpaDABHTWBAcQ4dUDCBE&oq=images+on+sustainable+aviation+by+wikipedia&gs_lp=EgNpbWciK2ltYWdlcyBvbiBzdXN0YWluYWJsZSBhdmlhdGlvbiBieSB3aWtpcGVkaWFIIoBUIARWOVqcAF4AJABA5gB30CgAYL_AaoBETItMS4xLjAuMS4wLjQuMC40uAEMyAEAAEBmAIAoAIAmAMAiAYBkgcAoAfvAw&sclient=img#vhid=Pcf6RLnaikX1HM&vssid=mosaic

Figure 8. Aviation biofuel

Source:https://www.google.com/search?q=images+on+sustainable+aviation+by+wikipedia&sca_esv=3f2e39702a0b213c&udm=2&biw=1036&bih=539&sxsrf=AHTn8zpLbFwRyOs54GUoTb1sS2JhAsaIag%3A1741851153417&ei=EYrSZ_qWGenRwbkPtfySOA&ved=0ahUKEwi644CaxYaMAxXpaDABHTWBAcQ4dUDCBE&oq=images+on+sustainable+aviation+by+wikipedia&gs_lp=EgNpbWciK2ltYWdlcyBvbiBzdXN0YWluYWJsZSBhdmlhdGlvbiBieSB3aWtpcGVkaWFIIoBUIARWOVqcAF4AJABA5gB30CgAYL_AaoBETItMS4xLjAuMS4wLjQuMC40uAEMyAEAAEBmAIAoAIAmAMAiAYBkgcAoAfvAw&sclient=img#vhid=BDrmyXcvAyOX_M&vssid=mosaic

Figure 9. Sustainable transport

Source: https://www.google.com/search?q=eco+friendly+transportation+clipart+by+wikipedia&sca_esv=e6cbb193bcbd8d96&udm=2&cs=0&biw=1036&bih=539&sxsrf=AHTn8zrQC07l-NFZ68dXkVkLxFySn0-Ggg%3A1741784864738&ei=IIfRZ5boLP7Ap84Pr7L8GA&ved=0ahUKEwiW-IyhzoSMAxV-4MkDHS8ZHwMQ4dUDCBE&oq=eco+friendly+transportation+clipart+by+wikipedia&gs_lp=EgNpbWciMGVjbyBmcmllbmRseSB0cmFuc3BvcnRhdGlvbiBjbGlwYXJ0IGJ5IHdpa2lwZWRpYUiEflCaB1jKW3ACeACQAQGYAfIJoAGfMqoBDTItNy4xLjIuMi4xLjG4AQzIAQD4AQGYAgKgAq4CwgIEEAAYHpgDAIgGAZIHBTEuMC4xoAekBQ&sclient=img#vhid=L0QrZqBCkNo1uM&vssid=mosaic

Figure 10. Hybrid Electric bus

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Figure 11. SmartBus

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