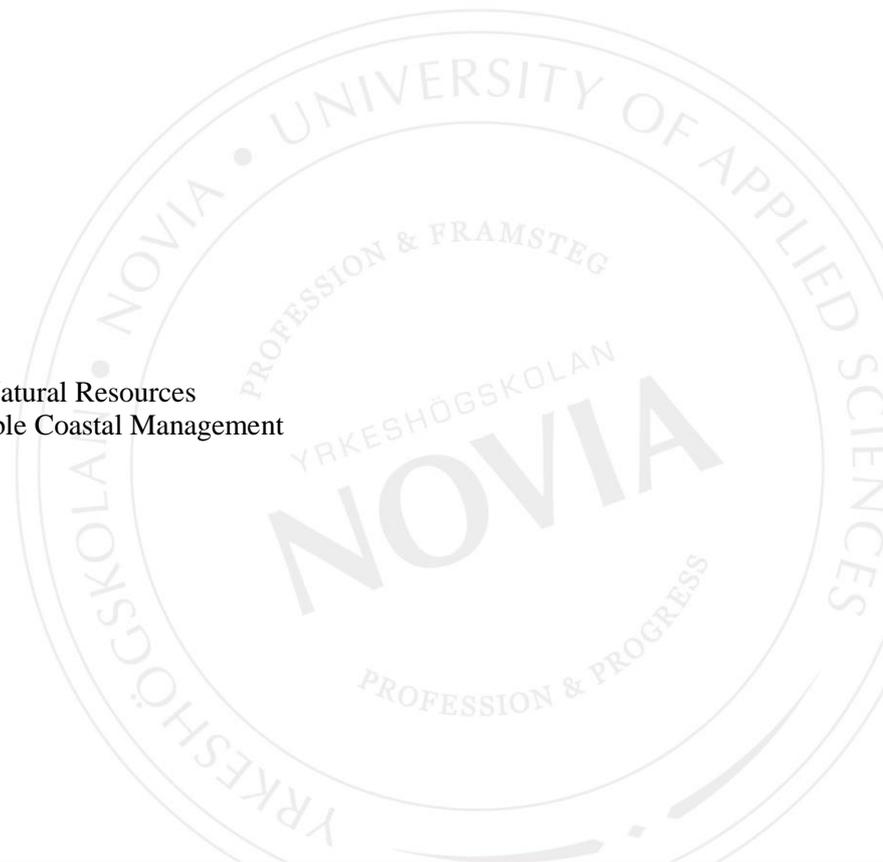


Poor Public Transport Infrastructure in Lagos Nigeria, How Sustainable Improvement could enhance well-being of the people and provide environmental benefits.

Edema James Etim

Degree thesis for Bachelor of Natural Resources
Degree programme in Sustainable Coastal Management
Ekenäs, 2019



BACHELOR'S THESIS

Author: James Edema Etim

Degree Programme: Natural Resources and Environment

Specialization: Sustainable Coastal Management

Supervisor: Jonna Engström-Ös and Stefan Heinänen

Title: Poor Public Transport Infrastructure in Lagos Nigeria, How Sustainable Improvement could enhance well-being of the people and provide environmental benefits.

Date: May 2019

Number of pages: 26

Abstract

The urbanization of cities has been a more deliberated issue for decades, with visible implementation stipulated by countries towards sustainable implementation of policy and infrastructures that suits the environment at present and for future developments. The effect of these implementations has also seen more research on effective ways to reducing environmental pollutions, and better healthy standard for humanity.

Greater appreciation goes to this new era of technology advancement which has aid faster movement in cities restructuring, ranging from town planning and road designs, housing and transportation. This thesis focuses on the Poor Public Transportation infrastructure in Lagos Nigeria, and the sustainable ways for improvement. The first part covers the challenges by pointing out major issues with the present system.

The second part of my thesis explains alternatives sustainable measures to improve the public transport in Lagos, by looking at how public transportation works in Helsinki Finland and sustainable implementations.

Finally, in the conclusion and discussion, I have answered the research questions in this thesis and then, explained why it is important to have a high quality and sustainable public transport in Lagos, the benefit to the people, clean environment and boost to the nation economy.

Language: English **Keywords:** Sustainability, challenges, public transportation, roads network, environmental impact, policy, implementation, inhabitants, health issues

Table of contents

1	Introduction	1
2	Background.....	2
2.1	The Lagos state transport sector.....	2
3	Purpose and Research Questions.....	3
3.1	Purpose	3
3.2	Research Questions	3
4	Structure of research report / Methodology	3
5	What Is Sustainability.....	4
6	Challenges of the Lagos state public transport.....	4
6.1	Poor roads maintenance.....	4
6.2	Congestion due to urbanisation and increase in population.....	5
6.3	Environmental Pollution	6
6.4	Privately owned commercial vehicles.....	6
7	How public transportation work in Helsinki Finland considering their policies and sustainable projects	6
7.1	Helsinki Finland.....	6
7.1.1	Finland Transport and communications policy with the ministry aim.....	7
7.1.2	Transport and communications policy in the Government Programme ..	7
7.1.3	Helsinki region transport authority	7
7.2	Environmental Sustainability.....	9
7.3	Social Sustainability	9
7.4	Economic Sustainability	10
8	How sustainable improvement could enhance well-being of the people, and provide environmental benefits in Lagos.....	10
8.1	Drainage systems and road management.....	11
8.2	Traffic lights, CCTV and speed limit monitors.....	11
8.3	Collaboration and Transparent Investment in Transport Infrastructure.....	11
8.4	Electric Vehicles Powered by Solar	13
8.5	Bicycle Lanes and City Bike	13
8.6	Towards Sustainability	15
	Table: 1 The sustainable way forward for Lagos state transportation.....	15
8.7	Benefits of sustainable transport system in Lagos.....	16
9	Discussion	17
10	Conclusion	18

11	Recommendation.....	19
	Reference List.....	19

1 Introduction

For decades, cities in Africa have seen extreme population increases. This is mainly due to scamper in urbanization and heavy rural migration. It is estimated that by 2020, according to reports 55% of the African population will be living in urban areas (African Association of Public Transport 2010). The rapid increase at these cities faces extensive challenges in terms of infrastructure provision and the need to meet with the demand for transport.

This is a heartbreaking fact because most of the existing infrastructure in cities across Africa are far from being suitable for the present transport demand. Furthermore, nearly all publicly owned and managed transport enterprises in African cities have come to a standstill since the 1990s, mostly due to consequence of structural adjustment and policies required for compliancy in accordance with aid programmes associated with international agencies.

Therefore, the public transport sector has suffered more than 20 years of neglect, combined with escalating urban populations, which has resulted in chaotic, unsustainable, time- and money-wasting transport systems in most African cities (African Association of Public Transport 2010).

Generally, across Africa, public transport is overshadowed by the operations of unorganized informal sector (which is market-based, unregulated, low-capacity service offers). And the dominance of these services has propelled economy development and reduced the quality of life for citizens, as the large number of vehicles required to meet demand are causing congestion and parking issues, while citizens suffer with high levels of locally associated pollution and low levels of security and safety (African Association of Public Transport 2010).

The above-mentioned situation across Africa cities is not by any means different from the system in Lagos, the largest city in Sub-Saharan Africa. Lagos is considered as the commercial and economic capital of Nigeria and Africa at large, with estimated population of 21, 305,971. It has a total area of 3, 577.28 square kilometres of which about 22% is wetland with a population density of 6, 515 persons/km² (Lagos State Government 2013). With over 20 million inhabitants, Lagos state is one of the largest cities in the world, and its population is growing swiftly at the rate of 3.2% per annum. (Lagos State Government 2018).

The poor and unpleasant condition of the road network for transport, automatically affects numerous developments in the city. Nevertheless, the working and living conditions of Lagosian is not excluded, especially the most vulnerable citizens. Increase in private owned vehicles, combined with dependence on commercial vehicles which include motorcycles has resulted in extreme traffic congestion and pollution throughout the city, which has brought about low-quality of public transport. In 2007 when LAMATA law as regulator was amended, the implementation of their front-runner project BRT-Lite commenced, public transport saw no difference in Lagos, and could be best described as not controlled, inefficient and ineffective, chaotic, expensive, poor in quality and dangerous, which include risk of life in terms of road traffic accidents and personal safety. There are about 2,600 km of roads in Lagos that are frequently congested, with over 1 million vehicles plying the roads daily. (LAMATA 2014).

LAMATA which means (Lagos Metropolitan Area Transport Authority) was jointly established by the Lagos state government and the World Bank in 2002. The aim was to provide consistency in urban planning, efficient implementation of policies and effectiveness in sustainable implementation of infrastructure, also to address issues previously mentioned above. The Lagos Urban Transport Project (LUTP) in the other hand was established in 1994 to enhance public transportation building capacity and to effectively manage the system by identifying the priority actions, measures for high level improvement and implementation, investment and innovation of public transportation sector. For the fact that improvement in the public transport sector in Lagos has been cared for by LAMATA and LUTP, the entire public transport system efficiency and effectiveness is still yet to meet the modern design and alternatives.

2 Background

Lagos state which is also known as Èkó is in southwestern geopolitical zone of Nigeria. With a population of 17,552,940 as at 2006 census, nevertheless it is the smallest in area of Nigeria thirty-six states and the most commercial and economically important state of the country, which shares boundary with the Republic of Benin in the west. The layout of developing an effective and efficient public transport started back in 1980's, the late Alhaji Lateef Kayode Jakande who was then a journalist, and later became a governor of Lagos state in 1979 to 1983 introduced the Metro line Project. (Lookman O. 2016).

In the mid 70's, there existed only a Transportation Unit in the planning division of the old Lagos state Ministry of Works and Planning. Under the administration of Alhaji Lateef Jakande, the Lagos state governor 1979, the increasing growth of traffic in the metropolis posed transport challenges that could no longer be served by sub-division of the Ministry. This led to the establishment of a full-fledged Ministry of Transportation in Lagos State with two objectives.

- 1) To set up a centralized transit system within the metropolis
- 2) To tackle the chaotic transportation problems in the state.

In 1984, under the administration of Governor Gbolahan Mudasiru, the Ministry of Transportation was merged with the Ministry of Works and became the Ministry of Works and Transport. In 1994, it was separated under the Administration of Colonel Olagunsoye Oyinlola and named Ministry of Public Transportation (LAMATA 2018)

2.1 The Lagos state transport sector

The late Alhaji Lateef Kayode Jakande envision that the population of Lagos was going to increase drastically in the future, and the need for effective and efficient public transport will primarily depend on the functionality and accessibility of a good system, and to solve these future problems he then proposed a bill for the Metro line project, which was later rejected in 1985 by ruling president Muhammadu Buhari. The reason for the rejection came as a result of loss of over 78 million dollars of the Lagos state taxpayer funds, and the

transportation sector became disorganized and gave access to individually owned buses and cars used for the services needed by the public. (Agbola, T. & Agunbiade, E.M. 2009) The Lagos Metropolitan Area Transport Authority (LAMATA) was introduced on January 13, 2002 by Bola Hammed Tinubu the Lagos state governor. Bola Hammed Tinubu saw the need for a swift public transport and invested 135 million dollars for the light rail network in 2003, and the project was done by LAMATA.

LAMATA continued to make progress. In September 2011 an acquisition was made for the purchase of H5-series subway trains previously used by the Toronto transit commission (TTC), The H5-series subway trains were to be refurbished in the United states, by converting them into track gauge before sent to Lagos and to be put into use of the blue and red line according to (Michael Schabas), an English based transport analyst who work as partner with the Eko-rail company, and record shows that the H5- series have been around since 1977 and 1980 while the H6-series are since 1986 and 1990, which were built by the urban transportation development corporation in Thunder Bay.

The transition was spectacular following the areas that was covered during the introduction of the BRT bus network, how progressive it has been since then is still yet to be uncovered.

3 Purpose and Research Questions

3.1 Purpose

The objective of my thesis is to suggest the sustainable ways for improvement of the public transportation infrastructure in Lagos Nigeria. This paper will explain the effective outcome of good integration and implementation of innovative transportation system which will meet the growing demand in Lagos state.

3.2 Research Questions

- Why should Lagos invest in sustainable public transport infrastructure?
- Should Lagos State adopt the Helsinki style of sustainable transport?
- Will Lagos state public transport get better with the introduction of sustainable transportation system?

4 Structure of research report / Methodology

The entire paper is structured into three parts based on information collected online from various publication and journals, official statistics of the government and thesis works. The data comprises of schematics representation of sustainable transport system. In the first part I explained the challengers of Lagos state public transport and policy. In the second part, I briefly write on sustainable transport implementation, policy and investment in Helsinki Finland. And finally, in the third part I suggest how to accomplish a sustainable

transportation in Lagos, with a recommendation of positive outcome of exploring and integrating alternative means for transport in Lagos.

5 What Is Sustainability

Sustainability is define as meeting the needs of the present without compromising the ability of the future generations to meet their own needs. (United Nations Brundtland commission 1987)

That is why environmental sustainability for transport is mainly interested in total removal of negative outputs in public transportation services, including reductions in greenhouse gas emissions, air pollution (i.e., NO_x, PM, SO_x, O₃), noise pollution and waste, by encouraging the use of renewable resources, recyclable materials and energy use (Linda E.& Sirkku Juhola 2019)

6 Challenges of the Lagos state public transport

Transportation is one of the essential parts to economic development and growth of nation, because it connects people with places, that is why road transport in big cities around the world is made easy and accessible for everyone regardless of culture, race, religion or language differences. Lagos state faces a tremendous burden to meet the demand for public transport due to the following reason.

6.1 Poor roads maintenance

Poor road maintenance is a major problem in the country and not just in Lagos state. Most of these roads were constructed within early 1980's and late 1990's, which at this time need a total renewal or proper fixing since they are already wearing out, and the government are very slow to attend to them on time. The reason for these bad roads is mostly due to low quality of materials used for maintenance and lack of supervision of repair projects, mostly repairs are carried out when there is serious damage to the surface and yearly accident rate. The resident of Lagos and motorists have protested, calling on local governments and the state government to rescue them by fixing the bad roads, which have caused persistent vehicle damage, accident and longer hours spent during travels from a location to another. Therefore, Lagos state governor Akinwunmi Ambode, recently granted a budget for immediate fixing of all damaged major roads starting from August 1, 2019, while the deteriorated inner roads that leads to the main ones are still neglected (Vanguard Nigeria 2018).



Figure: 1 Bad road in Lagos
Source: Vanguard Ngr.

6.2 Congestion due to urbanisation and increase in population

The present population of city is estimated to be over 21 million people, the growing population due to urbanisation is over the supplies and amenities Lagos state could provide. The road transportation amount to eighty-seven percent of both passenger and freight transport. The increase in population comes with a great price to pay, congestion is always at it peak on major roads daily which is bad for the environment and human health. Forty percent of Nigeria vehicles are registered and driven in Lagos. Vehicles are parked on street and most of the road are one lane (Landlagos February 2019).



Figure: 2 public transport in Lagos state
Source: Punchng

6.3 Environmental Pollution

Lagos state is public transportation is associated with noise and air pollution. The air pollution which are result of carbon monoxide, hydrocarbons, nitrogen emission from vehicle exhausted pipes are threat to the people of Lagos and the environment. The noise from vehicles horns, bad vehicle engines and motorist calling next destination contributes to unpleasant environment. In 2016, Nigeria was listed among West African countries that imports dirty fuel, which are used for vehicles and individually power generator. The World Health Organisation ranks sulphur particles from vehicles engines and generators as one of the top global risk causing heart disease, lung cancer and respiratory problems (BBC 2016)

6.4 Privately owned commercial vehicles

The public transportation sector is an open market in Nigeria, therefore over fifty percent of Lagosian are into it with their personal cars registered with Uber the company which is aggressively taking control of new markets. The introduction of Uber will probably sink the development of state own public transport. (CNN News 2019)

7 How public transportation work in Helsinki Finland considering their policies and sustainable projects

Advanced countries are constantly developing and building sustainable cities for the future, the endeavours are towards enhancing a lasting environmental solution for pressing challenges which bring about climate change. The urbanization of cities and developments are meant to meet the triple bottom line which are economy stability, social and environmental development in every ramification all together. (The Economist 2009)

Preliminarily before getting into practice, many advanced countries have either jointly enhanced and published applicable policies on transportation project execution. Helsinki Finland will be focused on in this thesis. This city is known for it top implementation of sustainable transport which aim towards a cleaner environment, especially in terms of carbon emission reduction. (The European Commission 28 November 2018)

They are also good illustration for sustainable environmental development for its inhabitants. And Finland was recognized for its outstanding effort as the world leading country for cleantech which is also applied to the general community daily life. (Business Finland 2018)

7.1 Helsinki Finland

Finland population is estimated to be 5.4 million. Helsinki, the capital city is the largest with the population of over 1.4 million people as at 2015, and the demand for public transport is at its peak within the city which is of importance for Liikenne- ja viestintäministeriö (Ministry of Transport and Communication) established in 1892.

The ministry has prioritized it key aim alongside with the government policy to create an effective and efficient system which enhance quality of transportation, the environment, well-being of the people and economy development in every part of Finland. Productive networks are essential for growth, Effectiveness and employability. These is the data and

platform that gives accessibility and freedom with the big question of how to reduce emission. (LVM 2014)

The core role of the Finnish ministry of transportation is to create an avenue for new ideas and enforces ratification to make possible changes, knowing that digital technology and approaches are becoming part of everyday life including changes in services, behaviour and habits. business in future will be easy but access to information is essential. (LVM 2016)

7.1.1 Finland Transport and communications policy with the ministry aim

The ministry target at developing unique services through better ratification which improves the present situation of transportation and protects the future. By so doing they will support well-being of the people and that of the environment and create sustainable growth and national competitive edge, through its innovative products and services across the nation. A framework for the development and renewal of the society which is the key elements on which Finnish society is founded. (LVM 2017).

7.1.2 Transport and communications policy in the Government Programme

Digitalisation is a cross-cutting theme in Prime Minister Juha Sipilä's Government Programme. For the administrative branch of the Ministry of Transport and Communications the most important key projects relate to reinforcing the requirements for digitalisation (LVM 2018).

The ministry strongly believes that everyday activity and well-being of people in Finland is affected by digital revolution, the government scheme for transport ratification, the ministry endeavour to move into a useful way of performances in the service delivery and respond to the structural changes of the society, with a view to promote prosperity and welfare of the people.

The objective is that transport and communications services are provided on market terms and easy-to-use basis. Services need to be mutually compatible and form a well-functioning system. (LVM 2018).

7.1.3 Helsinki region transport authority

The Helsinki Region Transport authority (HSL) coordinates and management public transport within 14 municipalities. The safety of the people and the environment is their top priority, "Environmental responsibility is one of HSL top values.

They encourage everyone in the city to use public transport and other sustainable modes of transport, and they work towards improving competitiveness and reduce transport emissions (HSL 2016).

The ambition is to support the development of sustainable transportation. A smart transport solution is in cooperation with stakeholders which includes the public and private sectors, local institutions and the bus operator. The reason for these integrations is to "create more efficient travel, and logistics chains and also overview of the status of the transportation in real-time. (VTT 2014) A smart transport solution solely based on traveller's choice and acceptance and aim at efficiency, quality and comfort, the experience that comes with numerous service options such as commercial buses, foot paths, bicycle, private car, taxi, car and shared transport, tram, metro and trains. It is regarded as an integrated transportation

system. The environmental policy for reducing carbon emissions from traffic in the Helsinki region remain as apex key target in HSL strategy (HSL 2016).

To reduce emissions from public transport, HSL are increasing the share of rail services and favour low-emissions vehicles. With the share of public transport helps reduce the amount of private own cars. The sustainable transport development is a long term project, the Liikenne- ja viestintäministeriö (LVM 2018) has set out Finland's transport policy lines for 2012-2022, which is different from that of other European countries, based on the “Society development” (LVM 2014), not because transport is of greater importance to the economy or profit-making avenue, rather it is aim at meeting the growing demand.



Figure: 3 HSL city bike
Source: Yle

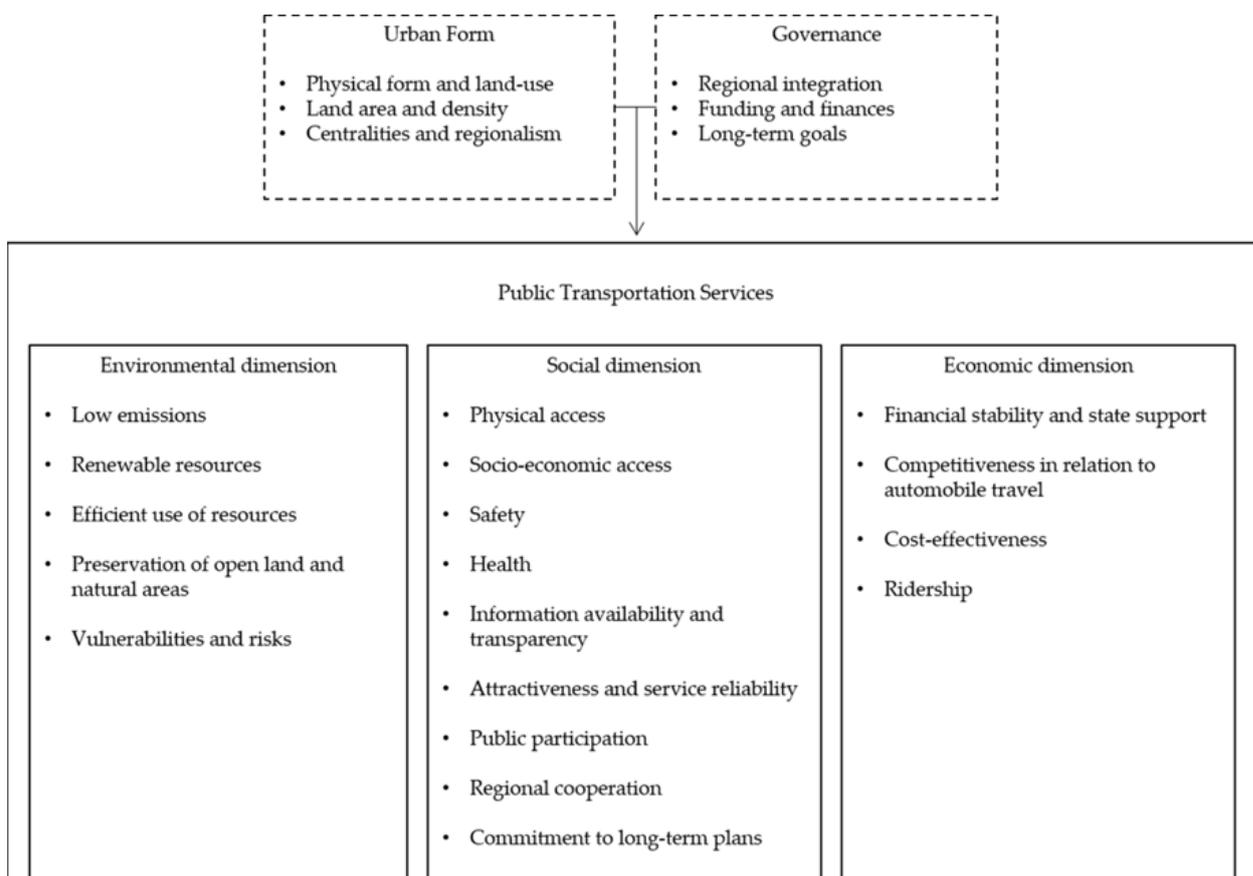


Figure: 4 Analytical framework for Helsinki public transportation

Source: Linda E.& Sirkku Juhola

Linda and Sirkku analytical framework explore the three key indicators in which Helsinki region public transportation is based on. Environmental sustainability, Social sustainability and Economic sustainability. In relevance to the effort of reducing emission, technological innovations and improvements are also seen as effective pathway of increasing sustainability and awareness, using renewable resources alongside with eco-vehicles (Schiller & Kenworthy 2010).

7.2 Environmental Sustainability

The Helsinki Region Transport authority (HSL) has an inclusive policy, that is strictly focus on elimination of vulnerabilities and possible environmental risk, mostly on issues that concerns climate change. The issues are to be stated clearly with a risk assessment, by so doing the policy-makers can preserve the environment and provide solution for ecological disturbance which are recognized (Linda E.& Sirkku Juhola 2019)

7.3 Social Sustainability

This aspect of sustainability is regarded as the most challenging part of it all, since it covers total transparency and accessibility to information, safety, attractiveness, health, coordination and management of the entire transportation system. The government goal is

to continually improve the quality of life and provide transportations that gives opportunities to all regardless of society status. The elderly, the disabled, the young, and people with low income are fully integrated into the system. (Litman, T. & Burwell 2006)

7.4 Economic Sustainability

Essential elements of economic sustainability are volume of transportation, passengers, costs to service provider, fare revenue, and financial stability (Linda E. & Sirkku Juhola 2019) The stability in the cost for public transportation enables the regulatory body of the Helsinki public transport to provide high quality infrastructure, services, capacity which are cost-effective and a well structure implementation for the benefit of people and the state government. Long term plans are made based on cost per passengers, the number of yearly subsidies, revenue from investments (Cervero R. 1990)

8 How sustainable improvement could enhance well-being of the people, and provide environmental benefits in Lagos

To have a sustainable city requires smart and sustainable implementation of environmental policies, good infrastructure and accessibility to facilities. This is the dream of every Nigerian; how do we achieve them remain questionable due to lack of vision and enthusiasm for accomplishments by the government. Environmental consciousness alongside with a fight against climate change, poor air quality and congestion have prompted several cities in the world to invest in cleaner public transport.

The solar energy and electric vehicles are not new ideas, rather there have been greater improvement in the effort towards making them sustainable and environmentally friendly. The climate change we face today is as a result of human negligence and some of daily activities. One of these consequences is the failure to implement the right measures and control that are required for the safety of our society. Taking a broader view on how to sustainably improve the public transportation in Lagos, entails eliminating the setback factors of present system on our environment.

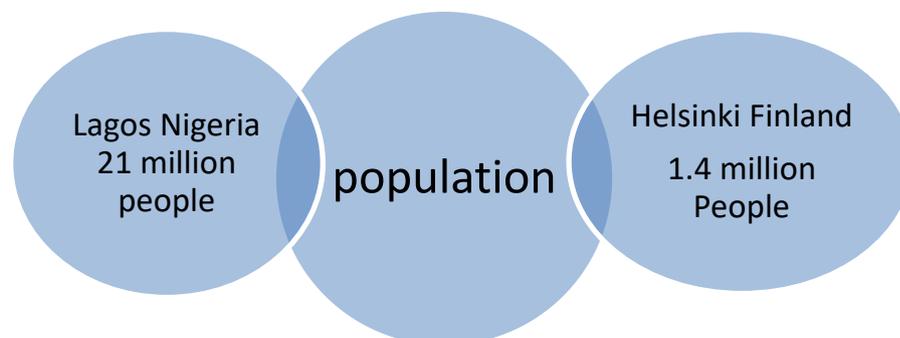


Figure: 5 2017 Population diagram for Lagos and Helsinki

The above diagram shows the total population of Lagos state Nigeria and Helsinki Finland as at 2017 respectively. What these cities have in common is people, and the differences between them is the amount people living in them. could this growing population be the reason why transportation will never get better in Lagos? I simply disagree, because there are numerous alternatives for transportation which are yet to be taking advantage of in Lagos.

The Lagos state government need to invest in renewable energy and transportation. Lagos state stand at the advantage of integrating solar energy into electric vehicles. An investment in renewable energy and lower emission infrastructures are smarter movement, affordable, secure and profitable steps taken by most cities in the world. Having transportation running on renewables, automatically transforms sectors and give room for technological improvement and advancement. Renewables are now cost-competitive with conventional fuels in many contexts, by 2025 France will have nine million electric vehicles on the road (Frederic Busin, Senior VP Development Customers and Services).

8.1 Drainage systems and road management

Road management includes having a proper drainage facility along road networks, for the fact that low quality materials are used for roads repair, these roads are mostly damaged by flood during heavy rain fall. Side ditches drainage system should be constructed properly, when road is in cut it is important to have a side ditches on Lagos roads because, it collects road water and lead it onward to outlet ditches. These side ditches should be at least 30 cm below the bottom of the pavement structure 25 cm is the minimum depth in Finland. (Roadex Network 2019)

8.2 Traffic lights, CCTV and speed limit monitors

Observation from traffic management around the world have proven that drivers are more careful when there is a CCTV camera and speed limit monitors on road. Having these technologies will not only improve the Lagos state driver's road attitudes, but it will improve safety, reduce accident (Smart Cambridge transport 2019). The CCTV will also allow traffic managers in Lagos state road control accidents and other causes of traffic congestion within the city. Combine with good communication system with the police and emergency unit it will prepare the traffic managers in Lagos ahead of unseen situations. The Helsinki traffic laws and regulation are very strict, and it bring about 0.01 percent chance of accident

8.3 Collaboration and Transparent Investment in Transport Infrastructure

To traverse the vast transport infrastructure gap in Lagos, it is crucial that the government considered collaboration and transparency on enormous investment in infrastructure.

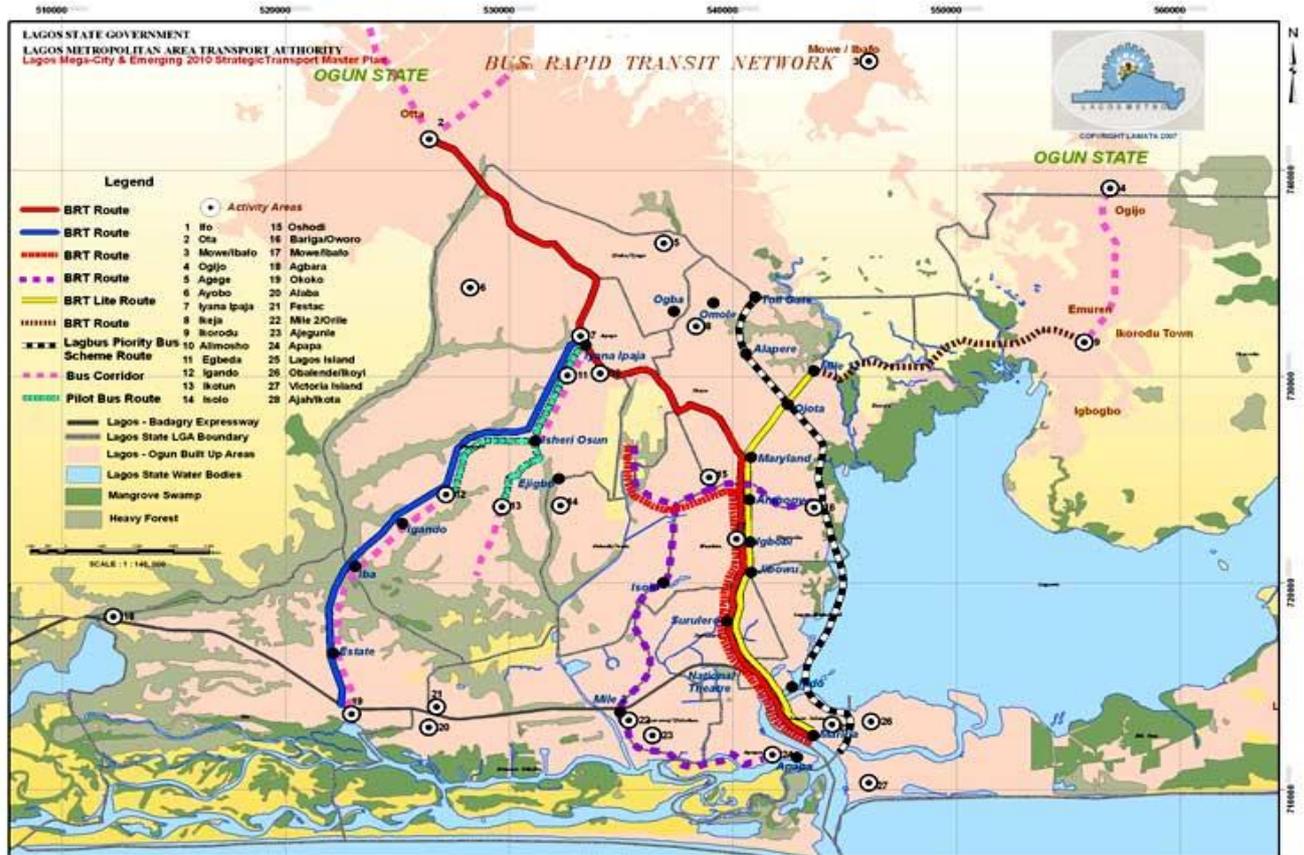


Figure: 6 Major roads and connections in Lagos state
Source: skyscrapercity.com

The roads network in figure 6 shows that there are huge ways on how the alternative mode of transport could be integrated into the present for effective and efficient public transportation. It will be poor judgement to draw a conclusion that LAMATA can single-handedly provide transport infrastructure in Lagos state of over 23 million people where the large-scale transport infrastructure are undersupply. Therefore, it will be meaningful to consider collaboration with local and international stakeholders, particularly the local administrations, private infrastructure investors, to execute an accountable, sustainable and transparent Public Private Partnership alongside with development partners, while setting up an organized private transport operator sector to effectively and efficiently carry out the responsibility of covering the major route in the city. Meanwhile, focussing strongly on the affordability of public transport mostly does not work in its approbation; setting and keeping fares at meaningfully low levels and not giving operators full compensation for concessionary fares do not help to make them commercially practicable entities. Evidently, transport fare increases could be sensitively political and Lagosian that are not able to pay high fare should still be able to be mobile. Keeping fares low might prevent the willingness towards effectiveness and efficiency, which then leads to less service in general.

Subsidising and any kinds of compensation could help the Lagos public transport system, but an integrated framework and realistic strategy are needed for all types of transport to prosper. Financial mechanisms should be put in place to support the system, integrating the different types of collective transport rather than allowing profits to be taken up by the private commercial body with no regard for the burden of costs they might place on commuters. Trust funds, better credit and loan facilities with other sources of revenues that

can be used to enhance building sustainable low-carbon transport systems, that will allow Lagos state to prosper and reach its development potentials and economically.

8.4 Electric Vehicles Powered by Solar

Carbon emissions from transport are a big contributor to global warming, introducing electric vehicles powered by solar in Lagos state will significantly curb carbon emissions and reduce the number of gas-powered vehicles on the road. Given the weather condition in Nigeria which is over 18°C on daily basis, the solar energy is what we should embrace as the best source for power. Therefore, the integration of the solar into the electric vehicle will automatically eradicate the need for building recharge centres for the vehicles. Considerably, all trips in the city are within an electric vehicle's range, and it is the battery for these electric vehicles that turns out to be the most cost effective over four years. (ICCT 12 February 2019). Hence, the battery costs are dropping rapidly yearly, that means the initial price of the vehicles will drop as well. Depending on solar energy as the main source of energy will enhance greater load balancing of the energy system and higher energy supremacy, by installing solar panels on vehicles roof, that will deliver energy to the grid during day which are used and stored in the vehicles batteries.

The consumption and demand for fossil fuel vehicles across major cities in the world is significantly becoming dent by the introduction of cleaner, and environmentally friendly alternatives. Electric vehicles have a greater and direct impact on that as well, because for every 1000 battery powered vehicles on the road, about 500 barrels a day of diesel fuel are displaced from the market.

Ford motors have already introduced this new technology of solar integration in their latest electrification vehicles with sun energy which is free of charge. (BBC 2018). This implementation can be reference to the environmental and economic sustainability dimension of the Helsinki public transportation analytical framework. Having high quality and innovative technology for the improvement of public transportation in Lagos, should be an effective way to promote use renewable resources which are environmentally friendly and sustainable. nevertheless, the Lagos state government and ministry of transport should not focus mainly on economic revenue, because it is always difficult to balance profitability with sustainability, rather the cost for service provision should be parallel and attractive to user of the public transport.

8.5 Bicycle Lanes and City Bike

Cycling, as a zero-emission vehicle, is a relevant transport mode concerning sustainable development. Bicycle use is increasing as development of cycling infrastructures and introduction of bicycle sharing system are made through cities. (Chastenet De Castaing Ludovic 2016/2017)

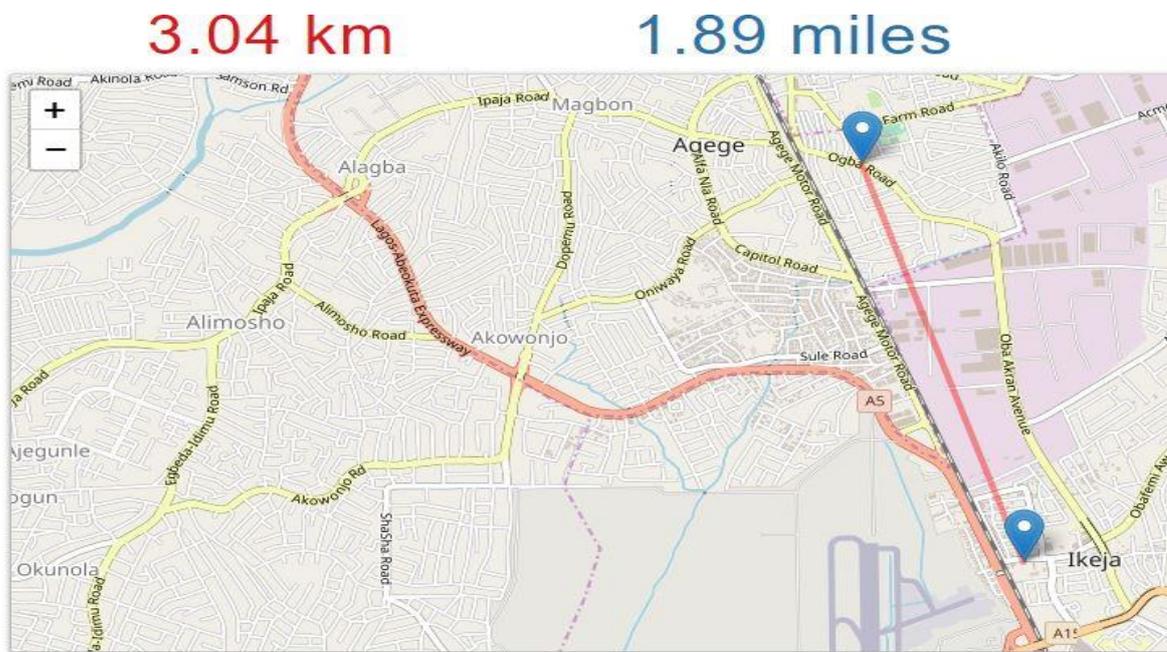


Figure: 7 Distance Calculator
Source: distancecalculator.net

Bicycle Lanes should not be an option rather it should be a well acceptable means of transportation within the city of Lagos. Lagos state road network does not have bicycles lanes, and that makes the people stick only to personal cars or commercial buses as alternative means of transport. If nine out of ten Lagosian should cycle 3.04km which is 1.89miles a day on average from Ogba to Ikeja according to figure 7 above, that will account for a quarter of all personal transport in Lagos for distances of less than five kilometres.

Cycling is also both space efficient in densely built-up areas as well as flexible for individual mobility. The space requests for parking bicycle is rather marginal compared to other types of vehicles. Bicycle would require only about 8% of parking space needed for a car (Kurt 2008). Cycling is also a flexible mean of transport since it can be integrated with other public transportation modes, and it can be used for an individual mobility need the same way as for private cars, as each person may have its own (or rented) bike.

The implementation of personal cycling within short distances will be the fastest, easiest, most healthy and environmentally friendly way to get around the city of Lagos. moreover, cyclist will reduce CO2 emissions by 20,000 tons a year on average and 20 % less traffic congestion in the city.

The routes covered by BRT are limited and the entire coverage of major routes are still yet to be reached. Since Lagos BRT is still ongoing project, now is the appropriate time for LAMATA to add to bicycles lane, metro, short distances electric shared cars to the infrastructures. The shorter distances cars are not to replace taxis in the city, but it will encourage private cars owners and Uber users to navigate within the city using these alternative electric vehicles or other alternatives. This is also related to the Helsinki Social sustainability. Personal journey planners and accessibility to alternative means of transportation, will be beneficial to the people of Lagos state while it will contribute towards healthy living and attractiveness of public transportation with the city

8.6 Towards Sustainability

Table: 1 The sustainable way forward for Lagos state transportation

Traffic Noise Reduction	The commercial vehicles and personal cars should all undergo road worthiness check, and environmental compliance for its purpose
Enabling accessibility	LAMATA strategy should include development and contribution towards poverty reduction, climate change and wealth creation
Promote cycling	All road should have cycling path, Increase the use of renewable energy in city transport
Control system	Digital boards and signs for all terminal and stops should be considered to eradicate the current system of bus conductors
Fixed transportation cost	The routes should be categorized in region or locality, the transportation cost should be fixed based on that for convenience and affordability
Tax on used and fossil fuel vehicles	Higher tax should be placed on used cars and fossil fuel vehicles to encourage the usage of alternative transport mode

In table 1 above I have highlighted sustainable ways to eliminate unnecessary and unwanted activities that are hindering development in the public transportation sector. The Lagos state traffic law enforcement agency have a lot of work to do, they should make it mandatory for all drivers to follow speed limits according to the nature of the road and the environment, huge fine for jumping red light and driving through restricted areas. The implementation of this basic principles will contribute towards better sustainable transport system in the city.

8.7 Benefits of sustainable transport system in Lagos

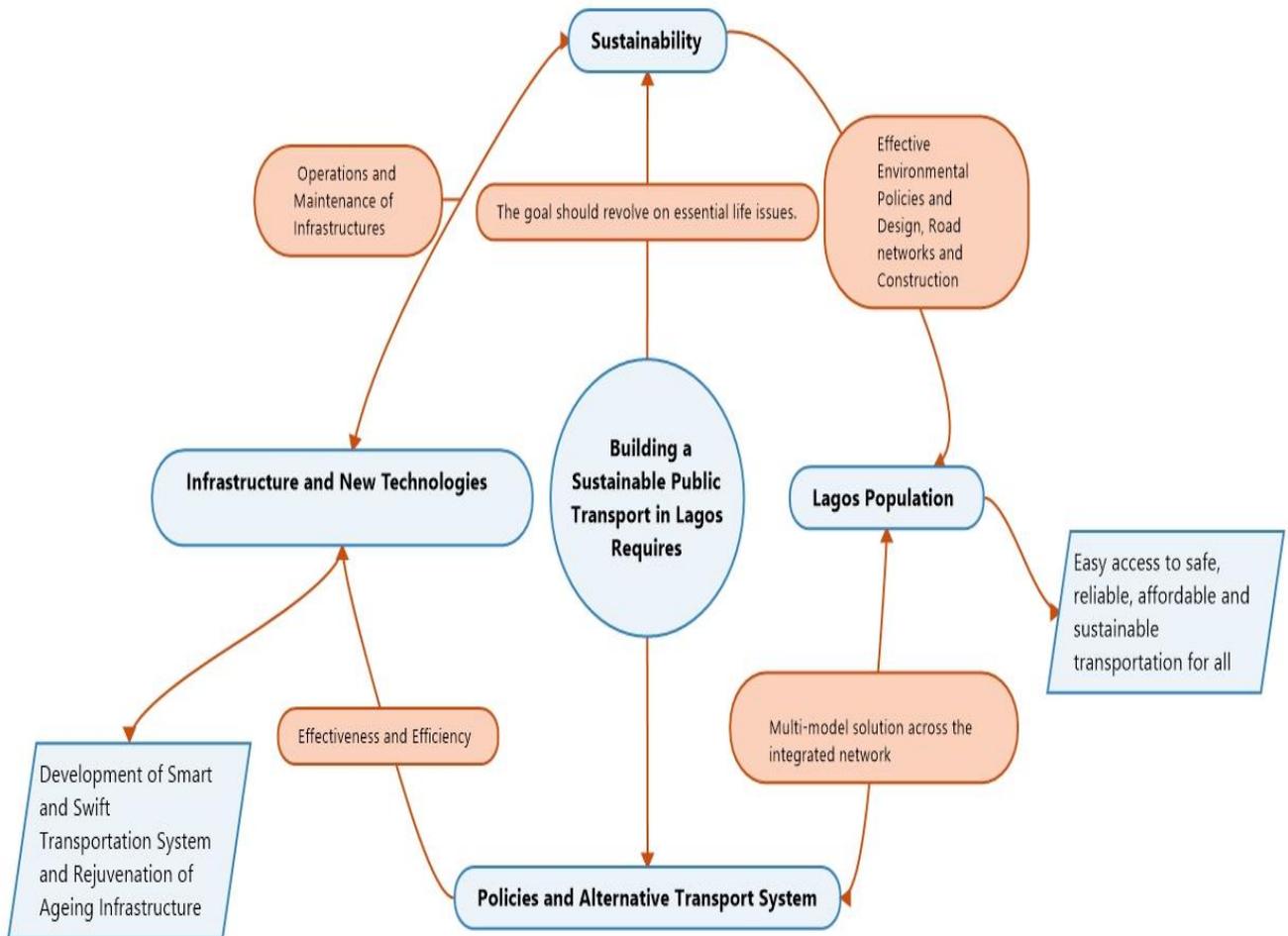


Figure: 8 Sustainable transport system benefits for Lagos state and how they are interconnected. Blue coloured boxes with bold letters are the main subjects, while the orange coloured, and square boxes are the outcome of implementing the blue

The information from the diagram in figure 8 does not only indicate the relationship and policies need for Lagos transportation system, but it also highlights the flow and outcome if it considered and integrated into the current transportation system. The fact is that the population will keep increasing, and a negligence on put the right measures and implementation of realistic policy in place, will put the entire system and other sectors in jeopardy economically. The sustainable implementation will create more jobs and resilience.

9 Discussion

This part of my thesis answers my research questions and cite examples different angels with the application of Helsinki analytical framework

• Why should Lagos invest in sustainable public transport infrastructure?

Infrastructure upgrade is very much needed in the public transport sector of Lagos state. With climate change, traffic congestion, growing population and toxics emission from fossil vehicles posing huge environmental challenges, it is never too late to investment in a sustainable infrastructure. “Climate change automatically impacts everything, Cities must work with others on climate action to promote public transport and to secure networks. (UITP 2018).

Chile can compared to Lagos in term of population and 2022 mission is to increase the electric buses used for public transportation by 80 percent, the effort build a sustainable environment is at it apex, therefore to accomplish the set goal, the ministry of public transportation signed an agreement and partnership with a Chinese electric vehicle maker BYD for supply of electric vehicles for public transport use (The Santiago Times 2019)

Norway is almost same size as Finland in terms of population. The new implementation for sustainable and effective transportation system in Norway is the most deliberated topic on BBC recently. Norway ministry of transportation is currently working on a set vision of 2018-2029 sustainably transportation development. During the 12-year plan the government has decided to invest 1064 billion kroner in the modernisation of the nation’s infrastructure and the development of safe and efficient transport solutions. This implementation of the Nasjonal Transport Plan (NTP 2018-2029) the government has decided to develop mobility solutions for the future. A safe and secure transport system that promotes wealth creation, while making all necessary preparations for the transition to a low-emission society.

The Norway minister for transportation stated that the record investments is to the benefit of the whole nation, and will result in the improvement of everyday travel, safer transport and increased mobility. The potential for growth and employment is inextricably linked to good transport solutions. 2018 is the first budget year of the NTP 2018-2029. (Solvik-Olsen)

As a fast-growing city, Oslo has gone through massive changes in its recent history. Early city planners had the idea of “Big-Oslo” already in the 1930s (Gjellebæk, 2015, p. 26). The substance of this idea was that the greater city regions should be designated for different purposes to escape the industrial city problems (Gjellebæk, 2015). A city with specialized regions meant that the main transport goal should be to connect these different pieces together. This view has greatly changed. Today the goal is to densify sub-urban city centres to reduce traffic to the city centre (Oslo City Council, 2015; Akershus County Council & Oslo Municipality, 2015).

These countries are good example of how active the world is on the fight to overcome climate change; therefore, Lagos state should not be an exceptional. The outcome of all these sustainable implementations mentioned can be categorized as Environmental sustainability

• Should Lagos State adopt the Helsinki style of sustainable transport?

The answer to this question is yes because Linda E.& Sirkku Juhola analytical framework explains how diverse sustainability aspects are of relevance to the public transportation

services, it helps to identify key indicators which are very necessary during public transportation planning and urban development. Helsinki regional transport authority merged their key aim with that of the government to create the three-dimensional factors which are considered during provision and implementation of the sustainable public transportation. Lagos state be become a role model for other African cities, if similar strategy used in Helsinki public transportation are adopted

• **Will Lagos state public transport get better with the introduction of sustainable transportation system?**

In figure 5 I used a diagram to explain how sustainable improvement are inter-connected. To enhance well-being of the people, it is important for Lagos state ministry of transportation to have an all-inclusive policy with a visible implementation given the fact that the population is growing rapidly, also an infrastructure design, good road networks and maintenance just like Helsinki. This policy should be centred on essential life issues by providing reliable, affordable and easy public transport access for everyone regardless of their physical challenges.

Infrastructure and new technology will not only bring about access to information, efficiency and effectiveness in the public transportation system, but the development will contribute towards environmental sustainability. Sustainable implementation will eradicate the major challenges the Lagos state public transport is having.

10 Conclusion

This thesis has covered major factors affecting the public transportation in Lagos. To achieve sustainability in the public transportation system in Lagos requires transitioning process carried out gradually from the use of fossil fuel to zero emission alternative. government is under great pressure to create a sustainable transport planning. Therefore, starting now will guarantees the possibility to identify risks and weaknesses. The vision of making Lagos state a mega city can be accomplished, if the government focuses more on safer environment and wellbeing of the people. The Strategy should be based on planning and execution of a sustainable transportation system in Lagos for the busiest routes, which will likely give a positive experience to the users while the government focus on developing areas suffering from poor roads and infrastructures, bad air quality and higher accident rate. Nevertheless, the climate change crisis can only be overcome with a collective effort and a stipulated rules and regulations. It is time to go out of the comfort zone and traditional ways of running public transport in Lagos. However, to reduce CO₂ emission and building a sustainable system in the transport sector, implies engaging in a new tendering structure, doing away with fossil fuel and accepting electric vehicle, encourage biking and integration of solar energy as the source of power, where the buses and the infrastructure need to be rolled out simultaneously.

11 Recommendation

Our environment of today has experience great damage compared to early years due to industrialization, unwanted inventions. I recommend that research should be done on town planning and housing in Lagos. One of the problems in Lagos is improper houses structure closer to roads, and recently there have been cases of demolitions of houses that were built on future roads. To have the Lagos of our dream it is time to get thing done the right ways and appropriately. The government should stop create portfolios rather there should be transparency and accountability in the exiting sectors.

Reference List

Agbola, T. & Agunbiade, E.M., 2009, 'Urbanization, slum development and security of tenure:The challenges of meeting millennium development goal 7 in Metropolitan Lagos, Nigeria', in A.A. de Sherbiniin, A. Rahman, J.C. Barbieri & Y. Zhu (eds.), *Urban population-environment dynamics in the developing world: Case studies and lessons learned*, Committee for International Cooperation in National Research in Demography (CICRED),Paris,pp.77106.(Viewed 3 September 2018) available at: <http://www.Populationenvironmentresearch.org/workshops.jsp#W2007>

BBC News 2017 (Viewed November 4 2018) available at: <https://www.bbc.com/news/world-africa-39209279>

Business Finland (Viewed December 14 2018) available at: <https://www.businessfinland.fi/en/do-business-with-finland/explore-finland/cleantech/>

CNET 2018 (viewed 2 April 2019) available at: <https://www.cnet.com/roadshow/news/electric-bus-2040-study/>

Chastenet De Castaing Ludovic 2016/2017. Cycling as a part of sustainable urban transport in Helsinki: Assessing the influence of weather on cycling activity, University of Helsinki (Viewed May 1 2019) available at https://blogs.helsinki.fi/accessibility/files/2017/10/TFE_Chastenet_Final.pdf

CNN News 2019 Uber wants to compete with public transit. These experts are horrified (Viewed on April 27 2019) available at: <https://edition.cnn.com/2019/04/25/tech/uber-public-transportation/index.html>

Cervero, R. Transit pricing research: A review and synthesis. *Transportation* 1990, 17, 117–139. [Google Scholar] [CrossRef]

CNN 2019 (viwed 3 April 2019) available at: https://edition.cnn.com/2019/04/04/world/norway-zero-emission-vehicles-trnd/index.html?utm_term=link&utm_content=2019-04-05T00%3A00%3A35&utm_medium=social&utm_source=fbCNN&fbclid=IwAR3sEh-mwdn1HltEXtrJPnVd2n0Yt-NYLnjcl49DN7ONsc6Tbbh2t3MWk7nw

David Williams 2015 Social Practice Theory and Sustainable Transport: An Analysis of English Local Transport Planning as a System of Provision
University of the West of England, Bristol (viewed April 2 2019) available at: http://eprints.uwe.ac.uk/24486/22/Thesis%20David%20Williams_For%20Repository.pdf

International Union of Public Transport (UITP) 2018 (Viewed May 25 2019) available at: <https://www.uitp.org/>

Janssens, M., Pinelli, D, Reymen, D.C., Wallman, S. 2009. Sustainable cities: diversity, economic growth and social cohesion. Edward Elgar Publishing Limited, UK.

Linda E. Karjalainen & and Sirku Juhola Framework for Assessing Public Transportation Sustainability in Planning and Policy-Making (Viewed May 24 2019) available at: <https://www.mdpi.com/2071-1050/11/4/1028/htm>

Lagos Metropolitan Area Transport Authority (LAMATA) (viewed 3 September 2018) available at: <https://lamata-ng.com/#>

Lookman., O, (2016). Bus Rapid Transit, Lagos Urban Rail Network, LAMATA, Smart City, Strategic Transport Master Plan

Litman, T.; Burwell, D. Issues in Sustainable Transportation. *Int. J. Glob. Environ. Issues* 2006, 6, 331–347. [Google Scholar] [CrossRef]

MTC. 2014. [viewed 3 September 2018]. Available at: https://www.lvm.fi/en/publications_series

Marius Sandvoll Weschke On the Road to Sustainability. Exploring transition and transport planning in Oslo, Norway. (Viewed May 1 2019) available at <http://lup.lub.lu.se/luur/download?func=downloadFile&recordId=8878196&fileId=8878258>

Oresanya, O. (2015). *The Lagos megacity project: the way forward*: Lagos State Publishing.

Report on statistical indicators of Public transport performance in Africa (African Association of Public Transport, 2010)

Roadex Network for better rural roads (Viewed May 13 2019) available at: www.roadex.org/e-learning/lessons/drainage-of-low-volume-roads/components-of-road-drainage-system/

Salama, A. M., & Ashukaikhat, M. (2013). A trans-disciplinary approach for a comprehensive understanding of sustainable affordable housing. *Global Built Environment Review*, 5(3), 35-50.

Schiller, P.L.; Bruun, E.C.; Kenworthy, J.R. An Introduction to Sustainable Transportation: Policy, Planning, and Implementation; Earthscan Ltd.: London, UK, 2010. [Google Scholar] (Viewed 24 May 2019) available at: https://scholar.google.com/scholar_lookup?title=An+Introduction+to+Sustainable+Transportation:+Policy,+Planning,+and+Implementation&author=Schiller,+P.L.&author=Bruun,+E.C.&author=Kenworthy,+J.R.&publication_year=2010

Smart Sustainable Mobility - A user-friendly transport system is a combination of intelligence, low carbon energy, and adaptable services. 2014. Authors: Raine Hautala, Veikko Karvonen, Jukka Laitinen, Juhani Laurikko, Nils-Olof Nylund, Mikko Pihlatie, Karri Rantasila, Anu Tuominen. VTT. Vision 5. [accessed 16 December 2018]. Available at: <https://www.vtt.fi/inf/pdf/visions/2014/V5.pdf>

The Economist 2009 (viewed 22 February 2019) available at: <https://www.economist.com/news/2009/11/17/triple-bottom-line>

The European Commission 28 NOVEMBER 2018 CALLS FOR A CLIMATE-NEUTRAL EUROPE BY 2050. (viewed January 2019) available at: https://ec.europa.eu/clima/policies/strategies/2050_en

The Santiago Times 2019 (Viewed April 2 2019) available at: <https://santiagotimes.cl/2019/03/28/chile-doubles-santiagos-electric-bus-fleet/>

The Norwegian National Transport Plan 2018-2029 (viewed 1 February 2019) available at: <https://www.ntp.dep.no/Forside/plangrunnlag-nasjonal-transportplan-2018-2029>

Ujoh, F., Kwabe, I. D., & Ifatimehin, O. O. (2010). The role of government towards sustainable transportation system in Nigeria. *Journal of Geography and Regional Planning*, 4(16), 55-67.

Ujoh, F., Kwabe, I. D., & Ifatimehin, O. O. (2010). Understanding urban sprawl in the federal capital city, Abuja: towards sustainable urbanization in Nigeria. *Journal of Geography and Regional Planning*, 3(5), 106-113.

Vanguard Nigeria 2018 (Viewed January 13 2019) available at: <https://www.vanguardngr.com/2018/12/motorists-residents-groan-over-bad-roads-in-lagos/>

YLE News 2018 (viewed January 20 2019) available at: https://yle.fi/uutiset/osasto/news/helsinki_pulls_electric_buses_from_traffic_over_steering_defect/10580530