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Decarbonisation of the Transport Sector in Nigeria

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ABSTRACT: We reviewed the various sub-sectors of the Nigerian transport sector with their corresponding energy consumption rates. Results show that all the sub-sectors are solely dependent on fossil fuels to meet their energy demands and requirements, thus making the transport sector the highest consumer of fossil fuels, and consequently, the highest contributor to carbon footprint. This necessitates the need for gradual decarbonisation of the sector, but not at the expense of the nation's economy, since the transport sector contributes about 3% of the nation's GDP. We have therefore outlined measures to decarbonise the sector. These include revitalisation of the rail and water transport; encouragement of mass transit; improving the state of security on Nigerian roads; employment of low-carbon fuels (biodiesels); and use of electric vehicles.

KEYWORDS: Fossil fuels, transport sector, GHG emission and decarbonisation

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Introduction

An Overview of the Nigerian Transportation Sector

The word transport was derived from 2 Latin words 'trans' which means across and 'portare' which means carry. There are many definitions to the term transportation, but Good and Jebbin[1] defined transportation as a system for carrying passengers, raw materials, and goods from one place to another, both internally and internationally, often through power driven machines. According to history, transportation in Nigeria dates to the colonial era when the colonial masters used the road network, rails, inland and sea waterways for the exportation of cash crops like cocoa, cotton, and palm produce; while importing cheap mass produced consumption goods.[2] The transport sector then was known for sub-standard railways and road networks, hence, it was not adequate for a competent and rewarding economic activity within the country. However, the introduction of the national development plan – a post independence initiative, made the transport sector became a tool for social and economic development.[3] Today, Nigeria's transport sector is the gateway to the economy of the nation, and the backbone that facilitates trade, supply chain, and economic progress. This involves the movement of people, goods, and information; through cars, trucks, trains, ships, airplanes, and other vehicles, across the nation. The major subsectors of the Nigerian transportation sector are the road, railway, airway, waterway, and pipeline subsectors; contributing about 3% to the nation's GDP, and consequently to greenhouse gas emission.[4]

Road transport is the dominant mode of transportation in Nigeria, moving over 90% of internal goods and passengers across the country; hence it is the highest contributor to the nation's GDP amongst other sub-sectors. Known as the giant of Africa, Nigeria lies along the western coast of the second largest continent in the world, with a land mass of 910 768 km^2 and water body of 13 000 km^2, totalling an area of 923 766 km^2, with a population of about 211 400 708[5]; this whole population is both directly and indirectly served by the road transport subsector. Nigeria has about 195 000 km road network; 36 182 km of this network is federal,[6] while the rest are state and local roads. However, road transportation is not energy efficient, hence the major source of GHGs emission in the sector; this is not same with the rail transport.

Before independence, railway construction started with a private sector, but later, the then colonial administration took over with the driving motive of linking the northern part of the country with the southern part (the coast), for ease movement of minerals and agricultural resources for the development of the Great Britain.[7] It started in 1898 with the construction of 32 km railway that ran from Iddo (Lagos) to Otta (Ogun). In 1901, this was extended to Ibadan constituting a 193 km rail network. It was later extended to Illorin and finally to Kano in 1912; this was the first rail line. Construction of the second rail line was initiated a year later, after the completion of the first rail line. It ran from Port Harcourt, passing through Aba, Enugu, Jos, Kafanchan, and terminated at Kaduna in 1923. In 1958, this particular track was later made to pass from Kanfanchan through Bauchi and then terminated at Maidugiri.[8] These single-track narrow-gauge rail lines were basically used to carry agricultural products like groundnuts from the trans-Saharan routes to the coast, for costal trade at the ports.[9] Improvement on the then railway sector also encouraged cocoa transportation from the west, and palm oil transportation from the east to the seaports. This was responsible for a booming Nigerian economy before the discovery of fossil fuel deposits in the country. As at 2012, the Nigerian railway was made up of

3505 km/1.067 m gauge lines – the narrow gauge, and 479 km/1.435 m gauge line – the standard gauge. In 2016, a new 187 km standard gauge line that runs from Abuja to Kaduna was officially opened for services; the 327 km Itakpe – Ajaokuta – Warri standard gauge railway project was completed and commissioned for passenger traffic in 2020; in 2021, the new 181 km Lagos – Ibadan standard railway project was opened for service.

In favour of road transportation however, the railway sector was abandoned by the administration, this seriously affected its contribution to the nation's GDP. Statistics showed that in 1982, road transport contributed N5085.2 million to the nation's GDP, while railway transport contributed N211.1 million. But, in 2009, road transportation contributed N17 551.4 million, whereas the railway sector contributed N2.1 million; what a decrement! Statistics also has it that before the independence year, the railway sector carried over 60% of freight tonnage compared to its current share of less than 5%.[9] The pain is not only that the contribution of railway transport to the nation's GDP vehemently decreased, but, the extreme encouragement of road transport over railway transport implies an increment in the sector's GHG emissions; this is indeed a threat to our environment. Rail transport is of-course more energy efficient, hence limiting the nation's carbon footprint.

Despite the shift of attention from rail transport, the present day road networks are poorly maintained, contributing to further energy inefficiency, as duration of journeys has been extended owing to the bad state of roads. Thus, these days people are opting for air transportation owing to the wastage of time and the much insecurity when land transportation is engaged.

Just as the British colonist was pivotal in railway development in Nigeria, so they were in the development of the Nigerian airways. The Nigerian airways was initiated in 1945 after the second world war, when Nigeria, Ghana, Sierraleone, and the Gambia – the 4 British colonies in West Africa, collaborated to form the West African Airways Corporation (WAAC). This was possible because, during the World War II, the flights of the British Royal Airforce were handled by the British and their West African colonies.[10] The corporation's headquarters was situated in Lagos before its disbandment due to the independence of member countries; hence the establishment of the Nigerian Airways in 1960 by the Federal government of Nigeria, which was fully controlled by the Nigerian government until the 1980s when increase in air traffic and apathy for poor services of the Nigeria Airways by the public drew the attention of the Federal government to deregulation of the nation's aviation sector, thus allowing private sectors to get involved in domestic air transportation[11,12]; this was formalised by the Nigerian Civil Aviation Policy (NCAP) in 2001.[13] Between 2001 and 2007, domestic air services in Nigeria witnessed a traffic boom as traffic increased from 5.2 million to 8.4 million air passengers. Nigeria has 32 airports, and approximately 78 airfields of which 30 are already privatised.[9] Poor road infrastructure, insecurity, and the speed of the aircrafts (fastest among all transportation means) kept encouraging the use of the air transport sector. The growth rate of air transportation in the country is seriously alarming even with plans of further expansion.

This increased usage of domestic air services is indeed another serious threat to our environment, because aircrafts do not just consume more fuel than other means of transportation owing to their very high speed, but also use relatively high-carbon fuel (ATK & DPK) as energy source, which are extremely polluting. Amongst all these means of transportation, water transportation is the most energy efficient (least polluting), and can actually handle many of the tasks carried out by the land and air transport; if our water bodies are properly dredged and put in good condition.

Water transportation in Nigeria has been in existence since the pre-colonial era.[14] Canoes were then used on local water bodies like Anambara river, Ulasi river, Mamu river etc., for commercial and transport activities. People from Ijaw, Itsekiri, Ukwani, Bini, and Urhobo used the waterways as the major means of trade with the Portuguese, Dutch, and British merchants: the major trade then was the slave trade before the colonists captured Nigeria and diverted trade to agricultural produce. Nigeria has 870 km coastline and 3000 km inland waterways; this is made up of 6 major ports and some crude oil terminals. The ports include Tincan Island, Apapa, Delta port, Rivers Port, Onne, and Calabar Port; inland waterways can be found at Onitsha, Oguta, Opobo, Lokoja, Baro, Jebba etc. Compared to other modes of freight transport, ships have an immense capacity that makes them more economical and suitable for transporting large, heavy and bulky items, while producing a relatively small amount of emission.

The common thing among these sub-sectors is that all use fossil fuels as the sole energy source, and there has not been a remarkable diversification of energy source, as this would help ameliorate Nigeria's GHG emission; rather, there has been a continuous shift from the more energy efficient sub-sectors (rail and water transport) to the less energy efficient ones (road and air transport); this has really increased the threat of GHG emission in Nigeria.

Globally, the transport sector is a major source of CO_2 pollution in the atmosphere, with a global contribution of about 7.3 billion metric tons of carbon dioxide emission in 2020. About 20% of the global CO_2 emission is contributed by Surface transport. However, from all we could glean, road transport is predominant in the Nigerian transport sector. This entails an excessive use of internal combustion engine vehicles (ICEs), hence, an immense contribution to CO_2 emission through the combustion of petroleum-based products like PMS, AGO and ATK; relatively small amounts of methane (CH_4) and nitrous oxide (N_2O) are emitted during fuel combustion, though. In addition, a small amount of

hydrofluorocarbon (HFC) are emitted by the transportation sector, as a result of the usage of mobile air conditioners and refrigerations in transport.[15] Nigeria was the world's 17th biggest emitter of greenhouse gases in 2015, and the second highest in Africa after South Africa.[16] From 1971 to 2014, the Nigerian transport sector contributed an annual average of 48% to her total CO_2 emission from fuel combustion.

According to data from National Bureau of Statistics, there existed about 11.8 million vehicles in Nigeria in 2018; this was made up of commercial (57.70%), private (40.98%), and Government and diplomatic (1.32%) vehicles.[6] The number increased to 13 million by April 2021.[17] Under the business as usual (BAU) economic activities scenario, Nigeria was projected to be emitting about 453 $MtCO_2eq$ by 2030. Recently, the Nigerian government projected that by 2035, GHG emissions from the transport sector could increase by up to 50%, and by almost 100% by 2050; under the business as usual (BAU) scenario.[18] From world bank's analysis, the average person in Nigeria emits less than 0.7 metric tons of CO_2, compared to 6.4 and 15.3 metric tons per capita emissions by the European union and North America respectively,[19] yet we are more vulnerable to climate change, because we have the least technology and ability to adapt to the impact of climate change.

The production process of transport fuels has also contributed immensely to the nation's carbon footprint. Gas venting and gas flaring during the production of these transport fuels by the oil and gas sector is also a key driver of methane and CO_2 emissions in Nigeria. Methane as a greenhouse gas is around 28 to 34 times more powerful than CO_2 over a period of 100 years; this is largely emitted by gas venting. Gas flaring helps to burn off methane, thus decreasing its emission; however, inefficient flaring still causes substantial methane emissions. In 2018, it was estimated that about 7.4bn cubic feet of gas was flared in Nigeria, making it the world's seventh largest gas flarer. Under the national gas policy, Nigeria had earlier pledged to end gas flaring by 2020; this target is obviously far from attainment.

Perspectives on greenhouse gas emission

Greenhouse gases are those gases that have the property of absorbing infrared radiation emitted from the Earth's surface and reradiating them back to the earth's surface, thus contributing to greenhouse effect.[20] They are also known as heat-trapping gases with its examples including CO_2, CH_4, $H_2O_{(g)}$, N_2O, CFC, HFC etc. However, CO_2, CH_4 and $H_2O_{(g)}$ have the predominant concentration among other GHGs in the atmosphere; owing to the activities of man on earth, starting from the advent of industrial revolution.[21] Fossil fuel combustion, being one of the human activities on earth, has the highest contribution to the evident constant increase in the atmospheric concentration of these greenhouse gases. Based on Global Carbon Project report, global emission, due to anthropogenic activities has experienced an increment from 22 Gt CO_2-eq in 1990 to 36.2 Gt CO_2-eq in 2016.[22] Since the onset of industrial revolution, emission of carbon dioxide and other GHGs into the atmosphere due to human activities has been on the increase; from about 278 ppm (pre-industrial level) to 418 ppm in March 2021.[23]

Greenhouse gases are rated according to their effect at making the earth warmer and thickening the earth's blanket; this is known as global warming potential. Global warming potential has been calculated to be how long the gas remains in the atmosphere, on average, and how strongly it absorbs energy.[24] Since the industrial revolution, gases with higher GWP has been on the increase in the atmosphere's composition, thus pushing up the earth's temperature to about 1.1°C above the pre-industrial age levels. By October 2021, global warming had reached 1.2° above pre-industrial levels.[25] Inter-governmental Policy on Climate Change (IPCC) experts project that in the coming decades climate changes will increase in all regions, and for a 1.5°C rise in the earth's temperature, there will be increasing hot waves, longer warm seasons, and shorter cold seasons. They also warned that global warming of 2°C will be exceeded in this 21st century if the world do not ensure rapid and deep reductions in CO_2 and other GHG emissions in the coming decades. Climate models project that if global warming increases up to 2°C above pre-industrial level, alterations in the climate system could become irreversible.

Extreme weather events has been recorded to be increasingly severe and frequent, globally, owing to global warming. According to recent reports from World Meteorological Organisation, 79% of worldwide disasters are related to weather, climate, and water. These have contributed to 56% of deaths and 75% of economic losses from natural disaster. It was also reported by WMO that there were 11 700 reported weather-related disasters from 1970 to 2019; this amounts to an average of 234 disasters per year. These disasters contributed to 2 064 929 deaths and about $3.6 trillion dollars worth of economic losses. Also, 9.8 million displacements were recorded in the first half of 2020, owing largely to hydro-meteorological hazards and disasters. Global warming was the major driver of these disasters. Thus, it has been clearly stated by IPCC that if global warming continues to increase, weather related disasters will be catastrophic and threaten human existence on earth.

On 12th December, 2015, an agreement was reached on issues bordering climate change, by 196 parties at the 21st Conference of Parties (COP21) held in Paris; this is known as the 'Paris Agreement'. This agreement though adopted on 12th December, 2015, was entered into force on 4th December, 2016, with the goal of limiting global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial age levels. The agreement works on a 5-year cycle of collectively and increasingly determined climate action known as the Nationally Determined Contributions (NDCs). Each country in its NDC, is to affirm the actions they will take to reduce their GHG

Table 1. 10 -Year average daily petroleum products distribution (million litres).[29]

YEAR / PRODUCT	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
PMS	15.58	13.75	43.55	47.67	48.71	47.56	47.64	50.16	56.39	60.00
HHK	2.47	1.73	7.30	7.90	5.72	2.51	3.94	2.55	14.13	14.13
AGO	2.68	1.85	8.82	7.76	8.90	10.66	10.68	13.01	0.74	0.73
ATK									2.88	3.00

emission and to build resilience, so as to adapt to the impacts of the globe's rising temperature. All concerned countries were mandated to submit theirs by 2020 (ie, COP26).

Nigeria, Madagascar, and Barbados were mentioned to be part of the climate-vulnerable countries in COP26 talks, held in November 2021, at Glasgow. This assertion by experts is however tue, as the impacts of climate change in Nigeria can be seen in terms of desertification and degraded landscape in the north; changes to precipitation; drought in the centre; pollution in the coast; and increase in extreme heat waves. The nation's transport sector has the highest share in contributing to the above menace. Hence, there is need for energy transition and management in the sector, if the globe's 2050 net zero emission mandate will be possible for the country. Of course, decarbonisation is the key issue in energy transition.

Energy Consumption in the Nigerian Transport Sector

Both freight and passenger transportation aim at solving the problem of spatial inequality across the globe, hence huge amount of energy is expended in trying to achieve this in a growing economic society like Nigeria. Energy is therefore the major driver of the transportation sector, since the growth and development of the transportation sector has strong correlation with energy consumption. Almost 20% of the world's total delivered energy is used in the transport sector where liquid fuels are the dominant source.[26] Transportation alone accounts for more than 50% of world consumption of liquid fuels, and its share is likely to increase over years in the future. IEA's projection shows that from 2007 to 2035, growth in transportation energy use accounts for 87% of the total increase in the world's liquid consumption.[27]

Data from the National Bureau of Statistics show that there has been an increment in the contribution of the transport sector to the nation's Gross Domestic Product (GDP); especially the road and the air transport sub-sectors.[28] *This persistent increase in the transport sector's contribution to Nigeria's GDP is directly proportional to national energy consumption rate, and has a strong implication on the environmental pollution and energy balance of the society; depending on the type of energy source used in the sector, which is fossil fuel, in Nigeria's case.* This does not speak good of the safety of our environment, as we have always known that the combustion of these fuels by automobile engines is the major contributing factor to the increment in our environment's warming, hence the threat of disrupted climatic patterns.

Table 2. Nigerian balance of final fossil fuel consumption by sectors.[27]

ECONOMIC SECTOR	FOSSIL FUEL (10^3 TOE)	PERCENTAGE (%)
Manufacturing	744.4	8.39
Agriculture	15.6	0.18
Construction	67.2	0.76
Mining	3.8	0.04
Transportation	6154.4	69.36
Household	1320.2	14.88
Services	567.2	6.39
Total	8872.9	100

The 2020 annual statistical bulletin by the Nigerian National Petroleum Commission (NNPC) showed a persistent increase in the daily consumption of petroleum products, with PMS being the most consumed (see Table 1). The expansion of the nation's road transport sub-sector and its sole dependence on fossil fuels is pivotal to such increment, hence a major contributor to the nation's carbon footprint (see Table 2).

Furthermore, Chukwu et al[27] – a team of the Energy Commission of Nigeria (ECN), projected that the transport sector being the highest consumer of fossil fuels, was responsible for about 70% of fossil fuels consumed by all the economic sectors.

'What about data on certain hybrid vehicles in Nigeria'?

From Table 3 above, it can be inferred that about 77% of fossil fuels used in the sector was used for passenger transportation, while 18% was used for freight transportation; this is indeed a great expense of energy cum GHG emissions. Deplorably, the railway and waterway sector used only 0.0088% of the total fossil fuels, this shows that almost zero attention is given to these

Table 3. Structure of energy consumption in the transport sector by mode and by source (source: Energy commission of Nigeria, MAED[30]).

TYPE	MODE	FOSSIL FUEL AS A MOTOR FUEL(10^3 TOE)	STEAM COAL	ELECTRICITY	TOTAL
Passenger Urban	Car	2219.65	0	0	2220.0
	Public (bus)	515.49	0	0	515.5
	Others (motor bikes, etc.)	180.24	0	0	180.2
	Subtotal	2915.47	0	0	2915.5
Passenger intercity	Car	1158.09	0	0	1158.1
	Bus	558.52	0	0	558.5
	Train (diesel)	0.156	0	0	0.156
	Train (electric)	0.00	0	0	0
	Plane	149.68	0	0	149.68
	Subtotal	1866.44	0	0	1866.4
Freight	Truck local	336.96	0	0	3337.0
	Truck long distance	770.21	0	0	770.2
	Train (diesel)	0.38867	0	0	0.38867
	Train (steam)	0.00	0	0	0.0
	Train (electrical)	0.00	0	0	0.0
	Ship	0.00	0	0	0.0
	Pipeline	7.70	0	0	7.70
	Subtotal	1115.26	0	0	1115.26
Miscellaneous		295.00	0	0	295.0
Grand total		6192.18			6192.8

sub-sectors which are more energy efficient than the dominant road transport. Passenger transportation which consumes the highest amount of fossil fuels is predominantly replete with cars of which a greater number are private owned vehicles, while some are also used in commercial transportation. This simply shows that cars or private owned vehicles (invariably) have actually caused more harm than good to our environment, as it is the highest emitter of GHGs in the transport sector.

Challenges and Potentials for the Decarbonisation of Nigerian Transport Sector

According to the updated Nationally Determined Contribution submitted by the Nigerian government in July 2021, Nigeria pledged an unconditional target of reducing emissions by 20% below 'business as usual' by 2030, without international aids; and a conditional target of reducing emissions by 47% below 'business as usual' by 2030, provided that foreign aids are made available – putting an end to gas flaring by 2030, is one of the means to achieving this. However, according to the speech by the President in Glasgow's COP26, he stated that the country would not be able to meet up with the global 2050 'net zero emission' commitment, hence the extension of such commitment to 2060. The President's speech is not arguable since **petroleum remains the rock on which the Nigerian economy stands**. Hence, Nigeria should be actively involved in low-carbon emission (for now), while gradually transiting to zero-carbon emission by 2060. Gradual transition is paramount at this time, as she cannot abruptly do away with petroleum, owing to a **poorly diversified economy** – this is the major challenge with decarbonisation in Nigeria. Other challenges include **poor awareness/education** on the applicability of renewable energy sources in the transport sector; inadequate infrastructure and technological capacity that supports the renewable energy idea; and the high cost of zero emission vehicles (ZEVs). But most importantly, there are yet no active policy frameworks and integrated planning that can instil the urgency of decarbonisation in the transport sector. Thus, policy incentives that can expedite the adoption of zero emission vehicles by the Nigerian community are non-existent.

Meanwhile, irrespective of the apparent low response to decarbonisation of the Nigerian transport sector, there abound a great potential for decarbonisation to thrive in Nigeria owing

to the plethoric presence of renewable energy resources in the country. Research on global energy potential shows that regions closer the equator tend to have greater annual solar potential than those further north or south. Nigeria being one of those countries situated very close the equator (7.6219°N, 6.9743°E) has greater annual solar potential. With an average sunshine duration of 6.5 hours daily, Nigeria receives an average flux of 5.55 kWh/m^{2}day; this implies that Nigeria receives 4.851×1012 kWh of energy per day. This high irradiation means that if only 1% of Nigeria's land mass is covered with crystalline PV modules, it can generate up to 207 GWh/year, which is about 10 times the total electricity currently generated in Nigeria[31]; this can help ensure a green transport sector by facilitating mobile charging facilities for electric vehicles, amidst the poor grid electricity generation in Nigeria. The presence of lithium-ore deposits in Nigeria and other proximal African countries like Zimbabwe, Namibia, Ghana, Democratic Republic of Congo and Mali, can situate Nigeria on the world's map of energy storage systems.[32] Cobalt which is another important component of lithium-ion battery has a very large deposit in D.R. Congo - about half of the world's cobalt reserves; Zambia also has a substantial reserve of cobalt. With maximum cooperation with these countries, Lithium and cobalt processing factories can be established in Africa, thus helping to further bring down the prices of these batteries, thereby promoting Nigeria's share in the EV market. For now, the private sectors are fronting the zero emission vehicle idea. For example, the stallion motors, Lagos, has successfully assembled the first indigenous electric vehicle – the Hyundai Kona car. Apart from this Nigerian assembled EV, there also exist other non-indigenous electric vehicles on the streets of Nigeria. This includes Tesla, BMW i3s, BMW i8, Honda clarities, Chevrolet Volts and Nissan leaf. Presently, GIG Logistics (GIGL) – a courier and logistics company – has partnered with JET motor company to launch its first electric vehicles for deliveries in Lagos. However, the Federal Government has put in some effort to encourage the use of EVs in Nigeria. Such efforts include initiating the development of the National Automotive Industry Development Plan (NAIDP) in 2014, and the subsequent submission of the NAIDP bill to the national assembly. The NAIDP bill contains provisions for EVs technology, standards and manufacturing. Also, as part of the NAIDP programme, the Federal Government commenced the Electric vehicle pilot programme in Nigerian universities. This programme is aimed at promoting local production of vehicles. Under the EV pilot programme, a 100% solar-powered EV charging stations were commissioned at Usman Danfodio University, Sokoto and the University of Lagos.

Nigeria also has great potentials for relatively clean fuels like compressed natural gas (CNG)[33-35] and biofuels/biodesiel[36-38]; this is also a plus to the decarbonisation agenda. Investment into research and development can help Nigeria exploit her renewable energy potentials.

Low Carbon Roadmap for the Nigerian Transport Sector

To ensure a low-carbon economy in a developing country like Nigeria, a lot of work has to be done, which spans across enabling policies, financing, research and development, and behavioural changes. However, there is need for participation by all members of the Nigerian community; public-private partnerships is inevitable.

According to Agbo[39], annually, over 60 000 vehicles are imported into Nigeria, with 85% of them being used vehicles. Udeozor and Nzeako[40], opined that some of these imported vehicles have exceeded their economic life span, with low energy efficiency; high emission of GHGs is simply the repercussion. Of-course there are no emission standards for Nigerian vehicles. Hence there is need for active policies on vehicle importation and emission standards.

There is this financing gap with funding decarbonisation initiatives in developing countries like Nigeria, owing to the already existing extremely capital intensive investment needs for conventional transport infrastructure investment such as roads and improving connectivity. Apart from connectivity needs, other reasons behind financing gap in transport decarbonisation are low market demand and focus of attention on green energy generation (Both grid-tied and stand-alone). Actions towards a more enabling environment that would create funding opportunities include:

- Removing distortive explicit or implicit subsidies to ensure that cars pay the true social cost of using roads,
- Internalising social costs for private motorised users,
- Recycling tax revenues from transport externality pricing and carbon pricing,
- Pricing into green investments/infrastructure,
- Optimising tax bases by anticipating a reduction in fuel tax collection,
- Reviewing construction codes, land use regulations, and parking policies,
- Improving quality/efficiency of public spending, and
- Identifying new ways to mobilise commercial finance.

(IAP-NASAC).[41]

Nigeria's huge deposit of Natural gas makes the incorporation of CNG-fuelled vehicles into the transport sector feasible. Many countries in the Europe, South America, and Asia are really incorporating CNG fuelled vehicles. For example, India and Pakistan have successfully implemented the use of CNG vehicles.[42] The Nigerian Gas Company built a CNG fuelling station in Warri and converted some of the company's cars to a CNG fuelled cars.[27] This implies the possibility of having CNG vehicles in the country, hence de-carbonising the transport sector; incorporation of biodiesel and ethanols from agricultural feedstocks is also a clean and feasible fossil fuel alternative. According to Belincanta et al[43], above 80% of all

licenced vehicles in Brazil are biofuel driven. Brazil is also a developing country, so, if they can, then Nigeria can too.

In the area of electrifying the transport sector, the presence of Nigerian governance system should be conspicuous in the promotion of sustainable transport policies, as lack of policies on electric vehicles, inadequate infrastructure and energy sources, poor contact with technology, and lack of flexible financing, has been the major setback to the electrification of the transport sector. Enforcement of emission standards and tax subsidies should be part of the policies that can help kick-start electrification of the Nigerian transport sector; but most importantly, partnering with the private sectors and research based institutions can help fast-track the implementation of these policies. Further constraints like the large gap between the cost of conventional vehicle and electric vehicle can be drastically mitigated by implementing incentive policies like cutting down the cost of import duties on electric vehicles to encourage the importation of electric vehicles, thus increasing availability in the nation; they can actually start with electric motorcycles and tricycles, which may be relatively affordable. This will help measure adaptability of zero emission vehicles in the Nigerian environment. In Nigeria, the transport sector is dominated by the private sector, hence, public-private-partnerships need to be maximised, so as to explore the potential role of the private sector as it concerns sustainable transport system. New technologies and service models can be easily mainstreamed in the transport industry by the private sector, and they can also provide sponsorship to testing and scaling of new ideas, when government resources are narrow.

In the absence of a stably electrified transport sector, a shift towards a more energy-efficient means of transportation can the easiest means of transiting to a low-carbon economy. Revitalising Nigeria's railway transport for passenger and freight transportation can seriously cut down the nation's carbon footprint. The bad state of the rail transport sub-sector has encouraged the use of trucks – a heavy emitter of greenhouse gases – as the major means of freight transportation; this is too bad. Good railway is indeed a powerful and a more energy efficient means of freight transportation. A train can use same amount of energy used by a truck to transport more freights and passengers than a truck; this way, emission is being reduced. Mass transit should also be encouraged for both intra- and inter-city transportation, as this is a serious means of improving the energy efficiency of the Nigerian transport sector.

Conclusion

Although fossil combustion is the chief driver of global warming, and the Nigerian transport sector being solely dependent on fossil fuels to meeting its energy demands. However, we still need fossil fuels for survival, as it is a major contributor to the nation's GDP (about 9%), while also serving other economic sectors, as its bye products are inevitable raw materials to industries; in fact, it is one of the major drivers of the nation's economic activities. But, the global 2050 net zero emission target, which is invariably suggesting the total abandonment of fossil fuel is still not a bad idea, as climate change is everybody's business. Hence, there is need we start now to prepare ourselves towards having a good share in the EV market, while still exploiting our fossil fuel deposit till 2060 – as pointed out by the president. Changing our climate-unfriendly attitude towards transportation and investing in research and development to exploit our renewable energy potentials, can serve as a good means to achieving decarbonisation.

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