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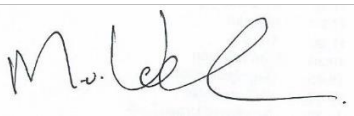
2	Production	M van Veelen		February 2022

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This report was produced with financial aid provided by the Royal Academy of Engineers as part of a larger project called the Global Challenges Research Fund Africa Catalyst Phase 3, funded by the UK Government Department for Business, Energy and Industrial Strategy (BEIS). The objective of the funding is to to support capacity building activities that create strong professional engineering bodies in sub-Saharan Africa.

This objective was achieved as four countries (Rwanda, Kenya, the DRC and Zimbabwe were trained to produce their first infrastructure reports, while Nigeria completed their third infrastructure report. South Africa is in the process of developing their fourth report.

It is hoped that this is not the end of the project, but that funding can be obtained to repeat the process in five or six other countries. Many valuable lessons were learned in producing this report, even in overcoming the challenges posed by a pandemic.

The report was a collaborative exercise between the participating countries, the Federation of African Engineering Organisations, the Commonwealth Engineering Council and the South African Institution of Civil Engineering.

As part of the project an application was developed that allows the real time assessment of infrastructure. Unfortunately, due to the regulations issued by the different governments to combat the covid pandemic, this could not be deployed as part of this project. The system exists, is functional and the countries received training on how to use it.

FOREWORD

This report represents the result of a collaborative effort that was started during the term of my predecessor, Martin Manuhwa. It brought together six members of the Federation of African Engineering Organisations who together produced a professional and honest appraisal of the state of infrastructure in Africa to support the achievement of the United Nations' Sustainable Development Goals.

The report was completed under difficult circumstances relating to the effects of the COVID-19 pandemic. The perseverance of the project team to complete the work despite the restrictions that were placed on travel is gratefully acknowledged. I thank the teams from our member countries that worked so hard to prepare this report. The Project Team was ably led by Dr. Martin van Veelen. It is my hope t that this project be expanded to cover the rest of Africa, and be done periodically in five year phases.

I recognise the contribution from our partners, the Commonwealth Engineering Council and the South African Institution of Civil Engineering. Their guidance and especially the training that they provided was key to the success of the project.

It is foreseen that this will be the first in a series of reports, firstly in Africa, but also in the rest of the world and that this will lead to a change in the operation and management of existing infrastructure.

The report will be circulated to FAEO and WFEO National Members, our Governments, Development Partners, the UN system, the AU , AfCFTA, AfDB , all RECs in Africa and other stakeholders. The aim being to seek more resources to expand this noble project.

FINALLY I would like to thank the RAENG who financed this project through the Africa Catalyst Grand.

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EXECUTIVE SUMMARY

Introduction

The FAEO is recognized by International Organisations as the overall leader of the Engineering Profession in Africa and sets out to apply Engineering for the benefit of mankind. FAEO's Mission is to serve humanity through the use of best practiced technology and to represent the engineering profession in Africa internationally. The Objective of the Federation is to develop, in the spirit of African unity, direct relationship between its several member organizations on a basis of mutual understanding.

The UK Partner on the project is the Commonwealth Engineering Council (CEC). The CEC is an umbrella body representing the professional engineering institutions throughout the Commonwealth. It operates largely as a virtual organisation, and its headquarters and nominal operating budget are provided by the Institution of Civil Engineers in London. Its major activities are focused on its role within WFEO; CEC was one of WFEO's founding international members. CEC is a Commonwealth Accredited Organisation within the Commonwealth Secretariat and together with cognate disciplines (architecture, planning, surveying and land economy) across the Commonwealth is a member of BEPIC (Built Environment Professions in the Commonwealth).

The South African Institution of Civil Engineering (SAICE) was responsible for training on the project and some administrative support. SAICE is a well-established organization with a history stretching back to 1902 when it was first constituted. It has an office in Midrand, South Africa with a staff complement of 30 permanent employees and a strong financial control system. SAICE has to date produced three Infrastructure Report Cards and understands the management and administrative requirements for such a project very well. SAICE has produced a Guide on how to organise and execute an infrastructure report card project.

Scope

The United Nations' Sustainable Development Goals (SDGs) are international development goals that all 193 member states have adopted at the UN Sustainable Development Summit September 25–27, 2015, in New York, USA, and agreed to achieve by the year 2030. 17 Sustainable Development Goals with 169 associated targets are integrated and indivisible, global in nature and universally applicable, taking into account different national realities, capacities and levels of development, and respecting national policies and priorities. Targets are defined as aspirational and global, with each government setting its own national targets guided by the global level of ambition, but taking into account national circumstances. Each government will also decide how these aspirational and global targets should be incorporated in national planning processes, policies and strategies.

Achieving the SDGs is almost entirely dependent on the presence of effective and fully operational infrastructure. Infrastructure is the assets that society develops, owns and utilizes in order to improve the standard of living and the quality of life. It enables economic development and keeps society healthy. Infrastructure can only be an asset if it is maintained in optimum working condition. Governments have to report to what degree they achieve their set goals in terms of the SDGs, but they seldom report on the state of the infrastructure that is required to achieve these goals.

Infrastructure report cards have been used in various countries to report on the state of infrastructure. As long as this is done unemotionally, objectively and based on solid data, it serves the purpose of informing society whether or not they have the necessary infrastructure to achieve their aspirations. Engineering organizations are in the perfect position to produce infrastructure report cards, as they have access to a vast pool of knowledge and expertise and can play the role of an honest broker between civil society and government.

Purpose

There is generally inadequate knowledge of the condition of infrastructure amongst the public and decision-makers, which leads to poor maintenance of existing infrastructure and insufficient maintenance planning for new infrastructure.

There is also a lack of knowledge of the role of engineering and built environment professions in the provision and maintenance of infrastructure. This offers the opportunity for an engineering organisation to establish a profile as an independent learned society and fair arbiter of infrastructure evaluation.

The development of an infrastructure report card (IRC) has therefore two objectives, namely (i) to increase awareness of the importance of economic and social infrastructure and the associated role of engineering and built environment professionals, and (ii) to promote the professions and built environment as a career destination.

Lastly the IRC should provide assistance to decision-makers and their support teams in the built and natural environments.

This report considers the availability and state of infrastructure in six countries in Africa South of the Sahara as being representative of the region. The countries are (from North to South):

- Nigeria,
- Rwanda,
- Kenya,
- The Democratic Republic of the Congo,
- Zimbabwe, and
- South Africa.

Discussion

General

From the United Nations Reports it is clear that Africa South of the Sahara lags far behind in achieving the Sustainable Development Goals. But even those reports do not tell the full story. The United Nations reports focus on the availability of infrastructure and report on aspects such as access to water. There is no consideration how reliable the service is. There is not much use of having a tap when there is no water coming from it.

In general the main problem in Africa South of the Sahara is the dilapidated condition of infrastructure and the fact that a major portion is getting old and approaching the end of its design life. In South Africa there are still many water supply systems in smaller towns that were constructed of asbestos-cement pipes. Although not a direct threat to human health (asbestos becomes a problem when breathed in and not consumed), the pipes are brittle and subject to frequent failures. In very few cases is any money allocated to replace old and failing infrastructure.

Much of the infrastructure dates from colonial times and is not always compatible with modern equipment while spares are becoming difficult to obtain. This is especially true for the electricity generating, transmission and distribution systems where frequent unplanned interruptions are experienced.

A significant challenge is presented by vested interest. When a water supply system fails, water bowsers are deployed to provide water to communities. The owners of the water bowsers are sometimes suspected of sabotaging the supply system in order to create work for their bowsers. In South Africa the regulations that were implemented to combat the covid epidemic saw a sharp reduction in the demand for public transportation. This led to trains being set alight in order to create more demand for mini-bus taxis. Mini-bus taxis are the public transportation most used in the major cities. The taxi industry has great political influence and they vigorously oppose alternative forms of transportation in order to protect their interest. Most cities in Africa therefore suffer from congestion during peak traffic times, exposing the population to polluted air.

The individual country reports provide some insight on what is important in that particular country. No two countries are the same, but there are some commonalities.

Power Supply

This is probably one of the most pressing problems in Africa. Even in South Africa where a considerable portion of the electricity on the continent is generated and consumed, lack of electricity is stifling economic growth. Most businesses have resorted to installing generators to supply power during black-out periods. This is expensive and in the long run not sustainable.

All countries that rely on hydro power to some extent are subject to the vagaries of the weather. In drought periods power supply to domestic areas is severely curtailed and it is not unusual to find that households only receive power for a few hours per day.

The power that is supplied is expensive and most households do not use it for cooking but rely on other sources of energy such as charcoal. This again leads to air pollution and also deforestation.

The ageing and dilapidated state of the distribution systems lead to frequent interruptions in supply. Households are often left in the dark. It also creates challenges with communication. Most of Africa skipped the land-line era and jumped to the mobile phone technology. During long lasting power interruptions mobile phones cannot be charged and people use much time to shop around for phone-charging facilities. This is productive time lost .

Most of the power utilities resort to some form of load-shedding by cutting off power supply to areas where payment for electricity is low or where there is a high incidence of illegal connections.

Water

Water supply infrastructure is well developed in the major urban areas, but still provides a challenge in the rural areas. It is not unusual for people to have to walk up to a kilometer to fetch water for domestic purposes. Under those conditions the daily per person water use remains close to what the WHO considers the minimum for healthy living.

Carrying a full jerrycan of water (20 litres) over a long distance places a heavy strain on the human body and causes long-term damage. In most cases women take their business to the water (washing is done where the water is) rather than carrying water to their business.

Water supply is also not always reliable. It is not unusual that water is only available for a few hours per day, as the supply authorities do not have sufficient capacity to keep the full system supplied. In the more affluent places people have resorted to installing tanks to store sufficient water to overcome the dry periods. This then places an additional demand on the system.

Water quality is not always considered or monitored. Although the chemical quality of the water is mostly known, the biological quality is seldomly measured. In rural areas there are two problems: The one is the quality of the water that comes from the tap, borehole or spring, while the other is the cleanliness of the vessel in which it is collected. Jerrycans are sometimes rinsed with clean water before they are filled, but not always as it uses valuable water as well as time while someone else is waiting his/her turn.

People are generally reluctant to pay for water as they believe that it falls for free from the sky. Water supply authorities face endless challenges in collecting payments for water, which again leads to a lack of funds for operation and maintenance. Controversially in some areas there is a thriving business for water vendors who will deliver full jerrycans to the doorstep for a fee. People seem to understand that it is a service to be paid for, but not if the water comes from a tap.

It should however be recognised that all persons have access to water in some way or another, but that it is the level of service and the quality that is in question.

Sanitation

Sanitation always was and remains a problem in most areas in Africa. Even large cities such as Lagos in Nigeria remain without a sewer system, relying on on-site sanitation in the form of pit latrines or conservation tanks. This has led to a significant industry to empty the pits and tanks (honeysuckers) who sometimes dispose their load indiscriminately to avoid paying the fees at designated disposal points.

Most countries have adopted the ventilated improved pit latrine (VIP) as the minimum standard for sanitation, but in the rural areas open defecation is still common. In South Africa the bucket system has still not been completely eradicated, despite the Government's stated objective to have done so some time ago.

As a result environmental contamination is common, although it is an open question on whether a thousand pit latrines pose a more significant problem than a badly operated wastewater treatment works where untreated sewage is discharged to a receiving water body.

Roads

Most countries face two challenges. The first is the lack of roads that render some rural areas virtually inaccessible, while the second is the condition of the roads. In some instances what is a line on a map indicating a road, in reality is a track that becomes impossible to navigate under wet conditions. The opposite is also true in sandy areas where it becomes impossible to drive when the sand is dry.

Paved roads pose their own challenges when not properly maintained. A gravel road is preferable to a tarred road where potholes pose very dangerous driving conditions. In countries

where long distance buses are the only mode of transport between cities, this leads to frequent accidents and loss of life.

Railways

Railways are mostly a remnant of the past and not well maintained. For instance the railway in the DRC that runs from the copper producing area to the Atlantic coast is defunct, forcing the export of copper by road to the port of Durban in South Africa. Although it is good business for Durban Harbour, the trucks that transport the copper put a heavy load on the road network.

Apart from the generally bad condition of the rail system, a problem that has to be overcome is that not all rail gauges are the same. A train can therefore not seamlessly drive from one country to the next. Another issue is that some railways are custom built to accommodate specific rolling stock. A case in point is the railway that was constructed from Mombasa to Nairobi in Kenya that was constructed according to Chinese standards.

Health

There is a significant difference between private health facilities and public health facilities. The latter suffer from underfunding and bad governance. Public facilities are not always properly equipped.

In contrast the DRC reports that the rural population have better access to health facilities than the urban population.

Education

As with health facilities, there is a significant gap between private schools that provide education to international standards and public schools. Public schools are generally not well equipped and the student to teacher ratio is very high. An exception is Rwanda that is clearly investing in the education system.

Prisons

Prisons are as a rule overcrowded and not conducive to any form of rehabilitation.

Summary

Although there are some areas that are cause for optimism, in general the availability and state of infrastructure in Africa South of the Sahara does not support achieving the Sustainable development goals.

What is required is a different way of thinking from politicians who have to acknowledge that accepting donor funding for infrastructure creation creates a downstream obligation to budget for operation and maintenance costs. Objectives have to be long term to provide a service that stimulates sustainable economic growth and creates jobs that add value.

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SECTION 1: INTRODUCTION

1 BACKGROUND

The FAEO is recognized by International Organisations as the overall leader of the Engineering Profession in Africa and sets out to apply Engineering for the benefit of mankind. FAEO's Mission is to serve humanity through the use of best practiced technology and to represent the engineering profession in Africa internationally. The Objective of the Federation is to develop, in the spirit of African unity, direct relationship between its several member organizations on a basis of mutual understanding, so that their activities may be fostered and directed to the greater public good and, in particular:

A. To establish appropriate standards of engineering education.

B. To support the advancement of knowledge in critical areas required for development.

C. To build engineering resource capacity in every country.

D. To promote the development of standards of professional engineering practice appropriate for the continent and share knowledge on best practice.

E. To promote the adoption of appropriate regulatory framework in each country to ensure that only qualified practitioners operate.

F. To promote the adoption of high standards of ethical behaviour.

G. To promote the advancement of engineering science and practice and their applications for the benefit of mankind.

The FAEO is well established and accepted as the lead organization for the Engineering Profession in Africa by the World Federation of Engineering Organisations, the African Union, the African Development Bank, the United Nations Economic Commission on Africa, the United Nations Educational, Scientific and Cultural Organisation, the Royal Academy of Engineering, and most important, its member organisations. Through its member oganisations it has a very good understanding of what the challenges are in order to improve the quality of engineering in Africa.

The FAEO has, through its members, access to the various national engineering organisations that are functioning at different levels of efficiency and authority, and through association with professional engineers in countries where no organization is in place yet, also to these countries. The FAEO is therefore in an excellent position to engage with engineers in the different countries, and thereby gain valuable grass roots input and support to bring about institutional change.

The FAEO has established a firm working relationship with the African Union Science, Technology and Innovation Commission and signed a Memorandum of Co-operation. Through the AU, the necessity of institutional change can be introduced at the highest political level in AU member countries. The support of the African Development Bank will also go a long way to ensure that the developing countries in Africa establish a competent engineering corps to manage and maintain the infrastructure that has been put in place.

The UK Partner on the project is the Commonwealth Engineering Council (CEC). The CEC is an umbrella body representing the professional engineering institutions throughout the Commonwealth. It operates largely as a virtual organisation, and its headquarters and nominal

operating budget are provided by the Institution of Civil Engineers in London. Its major activities are focused on its role within WFEO; CEC was one of WFEO's founding international members. CEC is a Commonwealth Accredited Organisation within the Commonwealth Secretariat and together with cognate disciplines (architecture, planning, surveying and land economy) across the Commonwealth is a member of BEPIC (Built Environment Professions in the Commonwealth).

The South African Institution of Civil Engineering (SAICE) was responsible for training on the project and some administrative support. SAICE is a well-established organization with a history stretching back to 1902 when it was first constituted. It has an office in Midrand, South Africa with a staff complement of 30 permanent employees and a strong financial control system. SAICE has to date produced three Infrastructure Report Cards and understands the management and administrative requirements for such a project very well. SAICE has produced a Guide on how to organise and execute an infrastructure report card project.

2 SCOPE OF WORK

The United Nations' Sustainable Development Goals (SDGs) are international development goals that all 193 member states have adopted at the UN Sustainable Development Summit September 25–27, 2015, in New York, USA, and agreed to achieve by the year 2030. 17 Sustainable Development Goals with 169 associated targets are integrated and indivisible, global in nature and universally applicable, taking into account different national realities, capacities and levels of development, and respecting national policies and priorities. Targets are defined as aspirational and global, with each government setting its own national targets guided by the global level of ambition, but taking into account national circumstances. Each government will also decide how these aspirational and global targets should be incorporated in national planning processes, policies and strategies.

Achieving the SDGs is almost entirely dependent on the presence of effective and fully operational infrastructure. Infrastructure is the assets that society develops, owns and utilizes in order to improve the standard of living and the quality of life. It enables economic development and keeps society healthy. Infrastructure can only be an asset if it is maintained in optimum working condition. Governments have to report to what degree they achieve their set goals in terms of the SDGs, but they seldom report on the state of the infrastructure that is required to achieve these goals.

Infrastructure report cards have been used in various countries to report on the state of infrastructure. As long as this is done unemotionally, objectively and based on solid data, it serves the purpose of informing society whether or not they have the necessary infrastructure to achieve their aspirations. Engineering organizations are in the perfect position to produce infrastructure report cards, as they have access to a vast pool of knowledge and expertise and can play the role of an honest broker between civil society and government.

At the WFEO UN Relations Committee (WURC) meeting in Kyoto in 2015, the possibility of producing a comprehensive global infrastructure overview report that can be submitted to the UN via the High Level Political Forum was discussed. The first step would be to produce a guide on how to prepare an infrastructure report card at national level. The manual was prepared and tabled at the World Federation of Engineering Organisations United Nations Relation Committee (WURC) meeting in Rome in November 2017.

The guide was produced as a guideline for individual engineering organizations to produce their own infrastructure report cards. It is a guideline with suggested minimum requirements but is not intended to be prescriptive. At the same time, if the minimum requirements are adhered to, it becomes possible to combine individual scorecards into a regional, continental and even global scorecard that can be submitted to the UN General Assembly through the High-Level Political Forum. In this way engineering organizations can make a real contribution in achieving the SDGs by focusing attention on where infrastructure is lacking or dysfunctional.

3 PURPOSE OF THE REPORT

Infrastructure enables economic development and keeps society healthy. Infrastructure can only be an asset if it is maintained in optimum working condition. If it is not worthwhile to maintain, it was not worthwhile in the first instance to allocate resources to establish it.

Infrastructure only remains an asset if it is fit for the purpose that it was built for. If it can no longer fulfil its function, it becomes a liability. Infrastructure can only remain functional if it is properly operated and maintained. This does not refer to infrastructure that has reached the end of its economic or functional life and is deliberately decommissioned.

Maintenance is often neglected because insufficient resources are allocated for this purpose. There is a general lack of understanding amongst the public and decision-makers of the value of maintaining infrastructure in good working order. Resealing a road in time is far less costly and disruptive than to have to repair potholes.

There is generally inadequate knowledge of the condition of infrastructure amongst the public and decision-makers, which leads to poor maintenance of existing infrastructure and insufficient maintenance planning for new infrastructure.

There is also a lack of knowledge of the role of engineering and built environment professions in the provision and maintenance of infrastructure. This offers the opportunity for an engineering organisation to establish a profile as an independent learned society and fair arbiter of infrastructure evaluation.

The development of an infrastructure report card (IRC) has therefore two objectives, namely (i) to increase awareness of the importance of economic and social infrastructure and the associated role of engineering and built environment professionals, and (ii) to promote the professions and built environment as a career destination.

Lastly the IRC should provide assistance to decision-makers and their support teams in the built and natural environments.

This report considers the availability and state of infrastructure in six countries in Africa South of the Sahara as being representative of the region. The countries are (from North to South):

- Nigeria,
- Rwanda,
- Kenya,
- The Democratic Republic of the Congo,
- Zimbabwe, and
- South Africa.

4 REPORT FORMAT

This report is divided into four sections:

Section 1: Introduction (this section)

This section provides the background to the project.

Section 2: United Nations Sustainable Development Goals

This section examines the relevant United Nations Sustainable Development Goals and discusses the African context.

Section 3: Individual Country reports

This section contains the assessments as provided by the participating countries.

Section 4: Discussion and Summary

This section summarises the most serious problems that are experienced by African countries and draws some parallels.

SECTION 2: UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

5 UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

This section has been selectively copied from The Sustainable Development Goals Report 2020 and The Sustainable Development Goals Report 2019 as published by the United Nations.

5.1 SUSTAINABLE DEVELOPMENT GOALS

The United Nations has adopted 17 Sustainable Development Goals (SDGs). These goals are set to achieve a certain world view for all societies. The SDGs are as follows:

- 1 No Poverty
- 2 Zero Hunger
- 3 Good health and well-being
- 4 Quality educationGender equality
- 5 Gender equality
- 6 Clean water and sanitation
- 7 Affordable and clean energy
- 8 Decent work and economic growth
- 9 Industry, innovation and infrastructure
- 10 Reduced inequalities
- 11 Sustainable cities and communities
- 12Responsible consumption and production
- 13 Climate action
- 14 Life below water
- 15 Life on land
- 16 Peace, justice and strong institutions
- 17Partnerships for the Goals
- Leaving No-One Behind

5.2 TARGETS

Each SDG is in essence a desire and does not represent a measurable outcome. For this reason the UN has developed Targets and Indicators. The Targets (there are 169 in total) are still descriptive in nature, as for example the targets for SDG 6:

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Two more goals were added later:

6.A By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.B Support and strengthen the participation of local communities in improving water and sanitation management.

5.3 INDICATORS

In order to arrive at measurable outcomes a suite of 232 indicators was developed. This is how the achievement of the SDGs is measured and reported on. Some of these indicators are discussed below as they are affected by infrastructure.

Over the years, good progress has been made in increasing the availability of internationally comparable data for SDG monitoring. However, huge data gaps still exist in terms of geographic coverage, timeliness and the level of disaggregation required. Moreover, challenges remain in compiling and disseminating metadata to document the data quality of SDG indicators at local and national levels.

An analysis of the indicators in the Global SDG Indicators Database (https://unstats.un.org/sdgs/indicators/database) reveals that for 4 of the 17 goals, less than half of 194 countries or areas have internationally comparable data. This lack of country-level data is particularly worrisome for Goal 5 (gender equality), where on average only about 4 in 10 countries have data available. Country-level data deficits are also significant in areas related to sustainable production and consumption (Goal 12) and to climate action (Goal 13). What's more, even countries with available data have only a small number of observations over time, making it difficult for policymakers to monitor progress and identify trends.

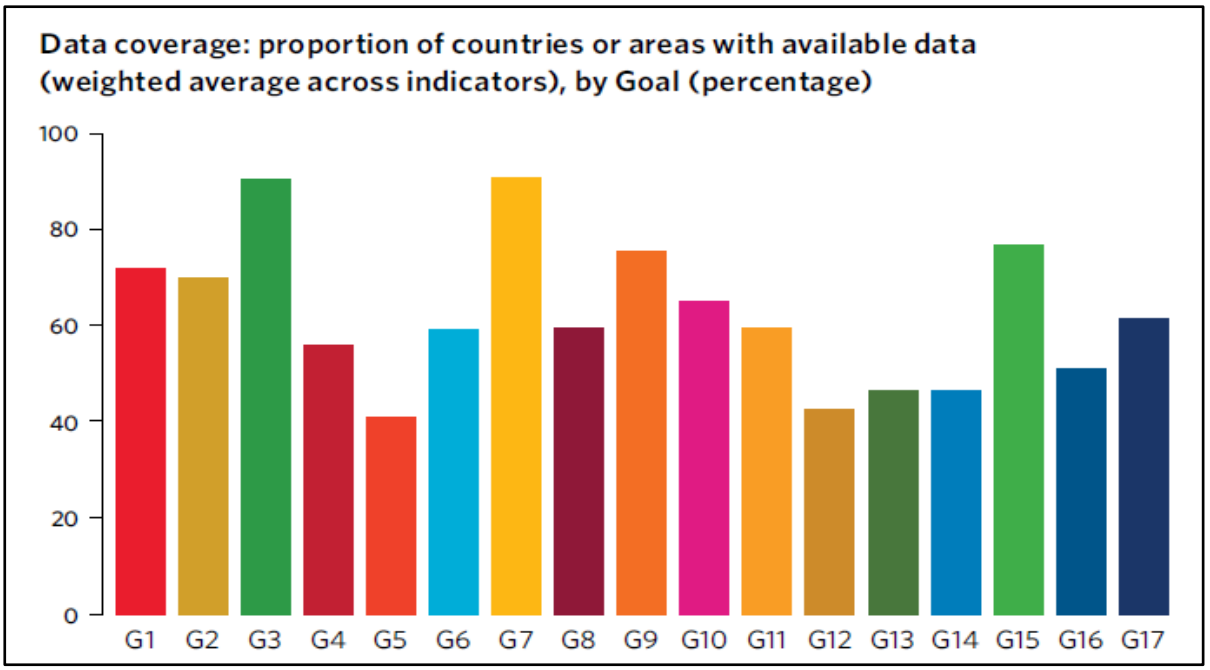

Figure 5-1: Data coverage for SDG Indicators

In addition, a large number of SDG indicators are available only with a significant time lag. For instance, in at least half of countries or areas in the database, the latest data point available for poverty-related indicators (Goal 1) is for 2016 or earlier. A similar situation is found for indicators on gender equality (Goal 5), sustainable cities (Goal 11) and peace, justice, and strong institutions (Goal 16).

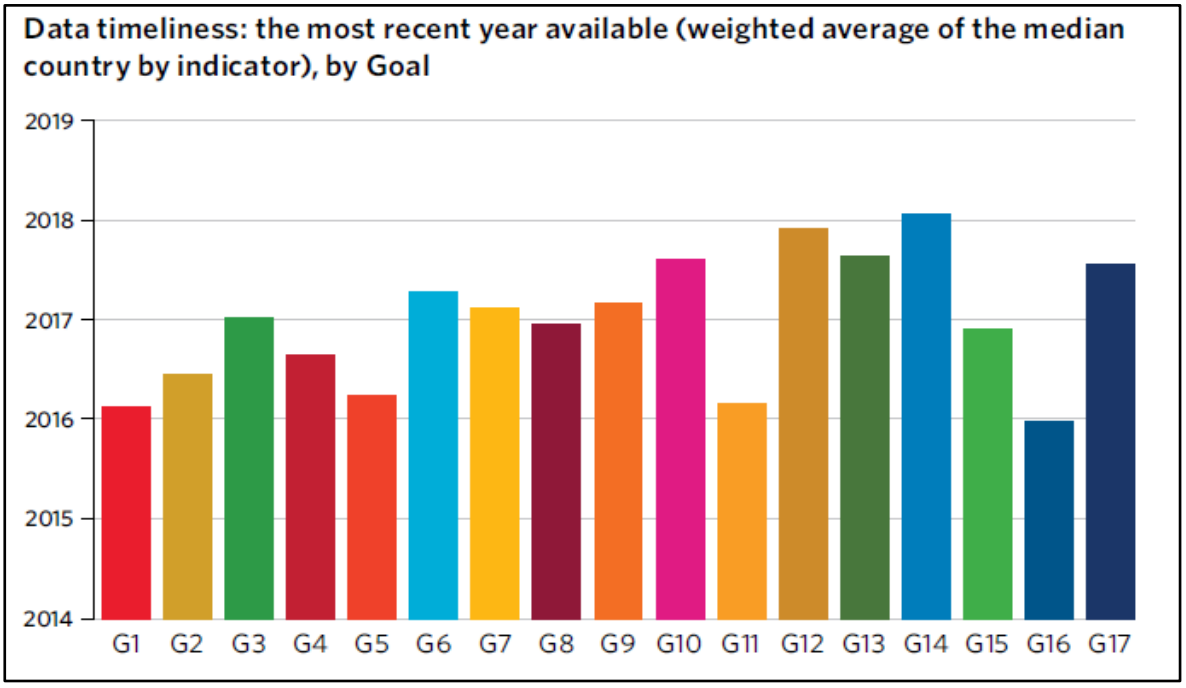

Figure 5-2: Data timelines for the SDG Indicators

It is clear from the above that real-time data is not available. We know what happened, but we are not sure what is happening.

5.4 REGIONAL CONTEXT

The United Nations publishes a report on the Sustainable Development Goals every year since 2016. The reporting is done on a regional basis where Sub-Saharan Africa is one of the regions as can be seen from **Figure 5-3.**

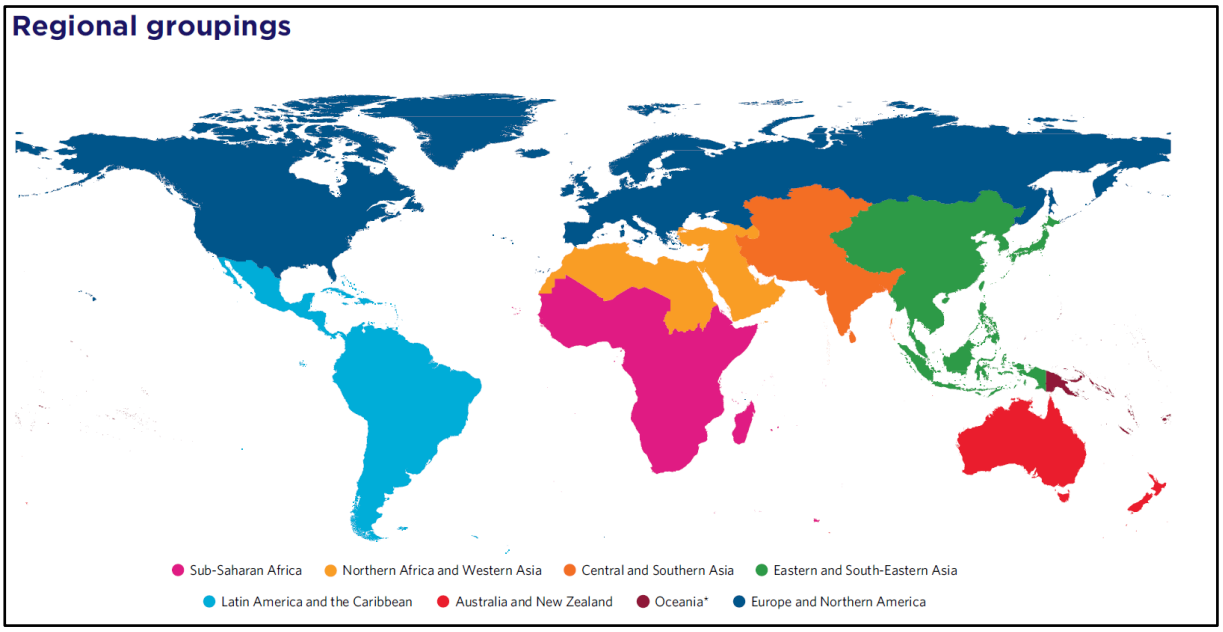

Figure 5-3 : UN Regions for SDG reporting

This report considers Africa south of the Sahara.

Not all of the SDGs are considered. The focus is on those SDGs that are directly affected by infrastructure:

4. Education
6 Clean water and sanitation
7 Affordable and clean energy
9 Industry, innovation and infrastructure
11 Sustainable cities and communities
12 Sustainable consumption
16 Peaceful societies.

This does not mean that the other SDGs are not affected in some way or another by infrastructure or that they are not important, but it was not possible to address all issues in one report.

The available information regarding the indicators is provided below.

5.5 SDG 4: ENSURE INCLUSIVE AND EQUITABLE QUALITY EDUCATION AND PROMOTE LIFELONG LEARNING OPPORTUNITIES FOR ALL

Despite progress, the world is not on track to meet 2030 education targets. Before the coronavirus crisis, projections showed that more than 200 million children would be out of school, and only 60 per cent of young people would be completing upper secondary education in 2030. Education systems worldwide have been hit hard and abruptly by the pandemic. School closures to stop the spread of COVID-19 have affected the vast majority of the world's student population. Disrupted education is adversely affecting learning outcomes and social and behavioural development of children and youth. Children and youth in vulnerable and disadvantaged communities are particularly at risk of educational exclusion. The pandemic is deepening the education crisis and widening existing educational inequalities.

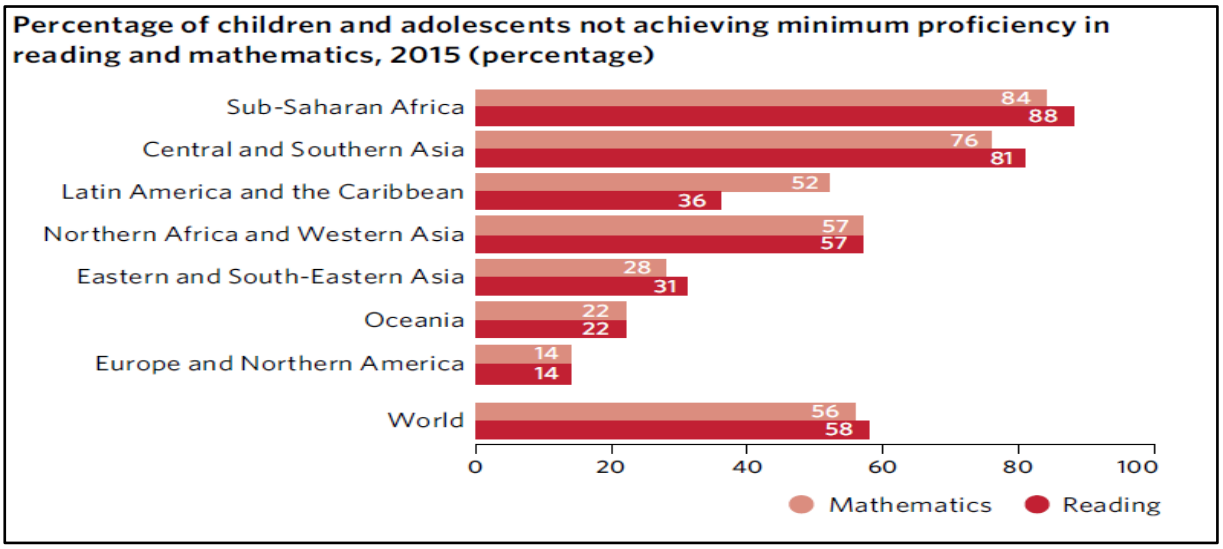

Figure 5-4: Reading and Mathematics proficiency

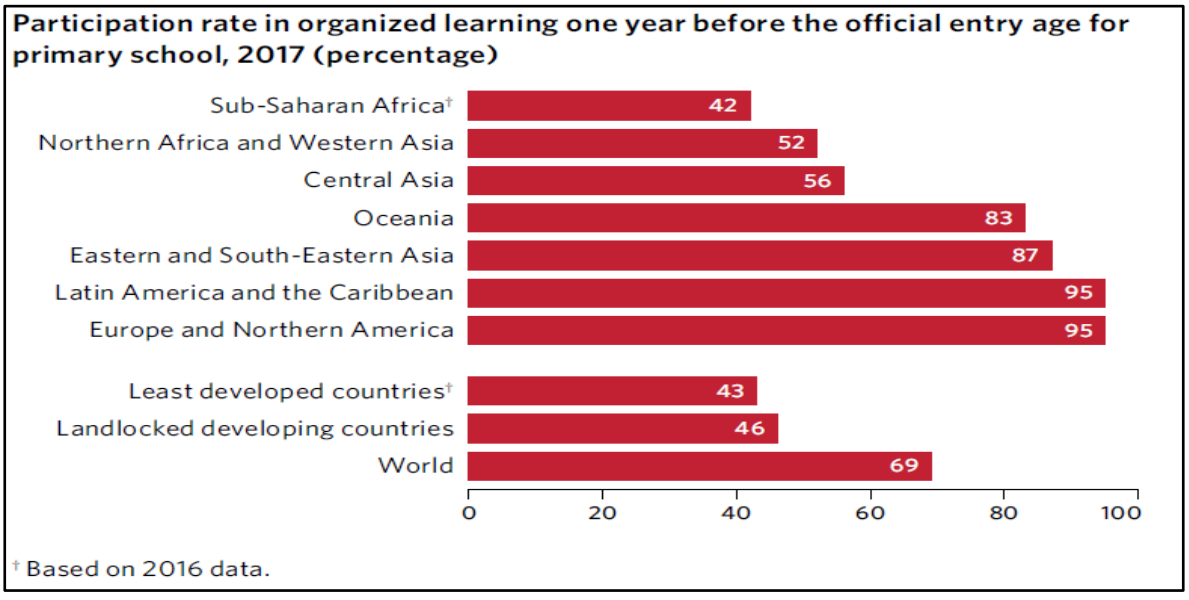

Figure 5-5: Preschool learning

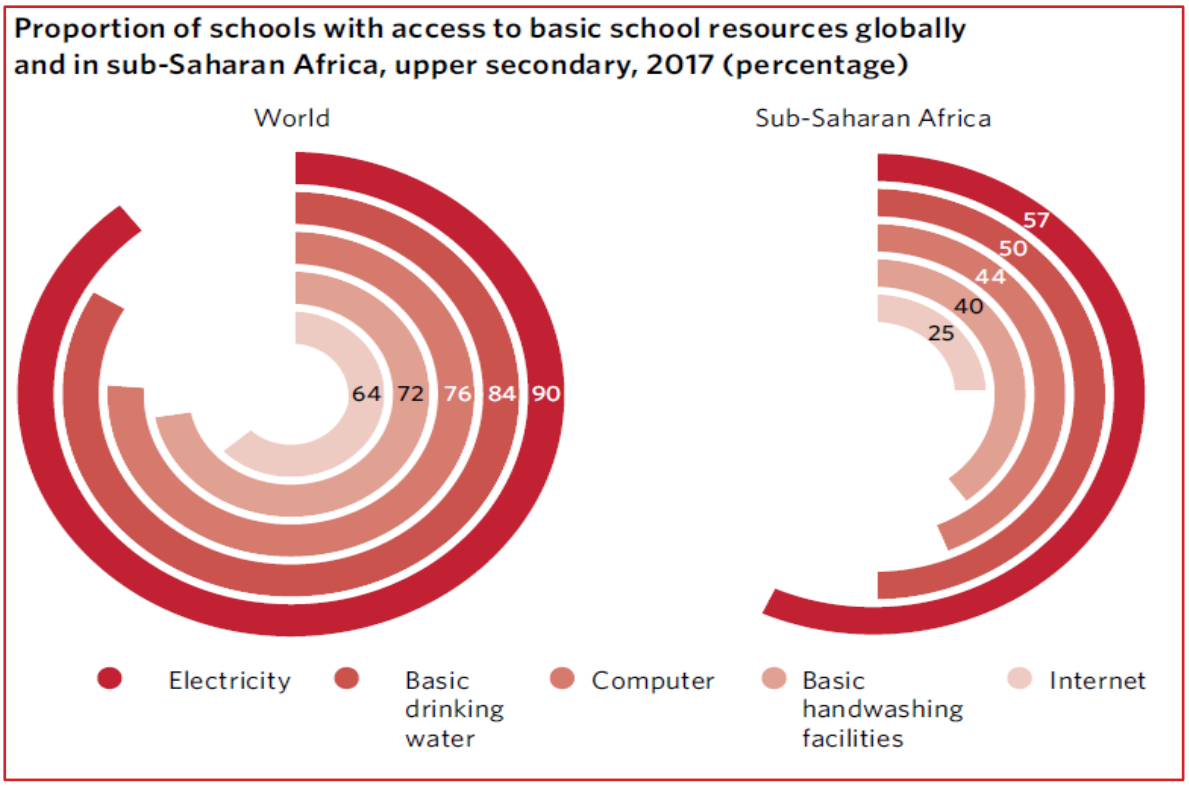

Figure 5-6: Access to basic school resources

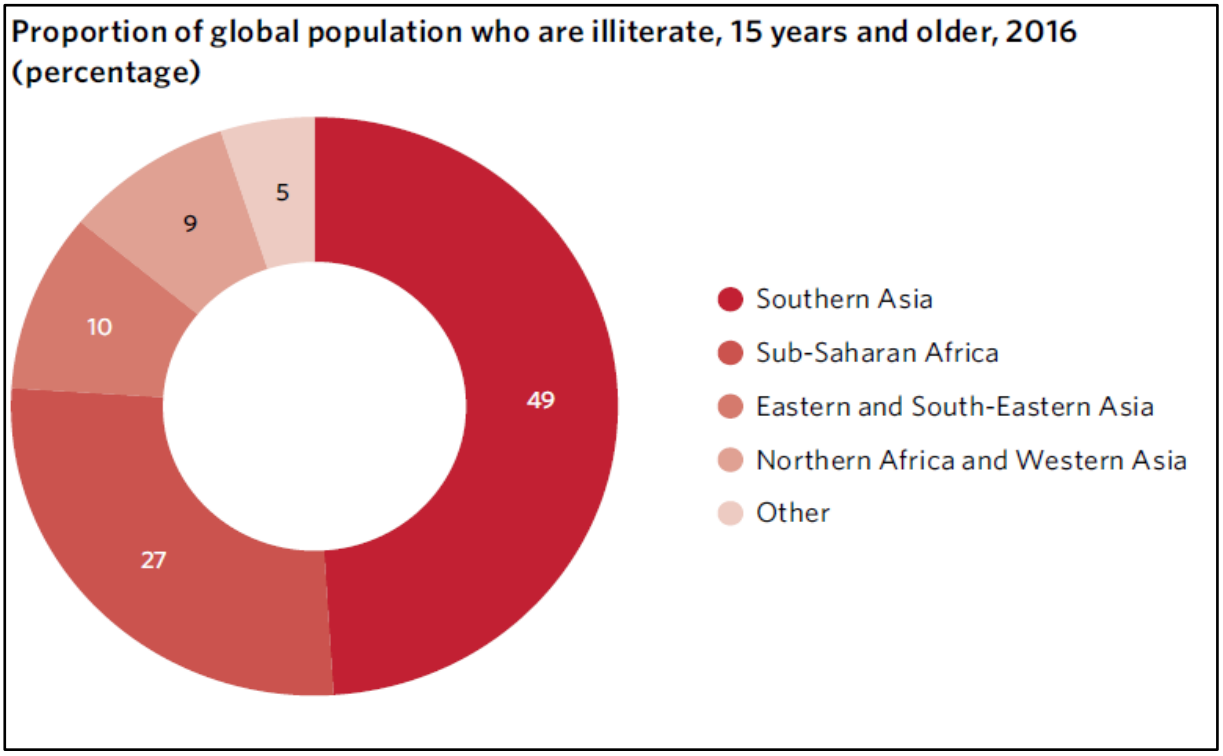

Figure 5-7: Illiteracy

5.6 SDG 6: ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

5.6.1 PUBLIC HEALTH AND WATER

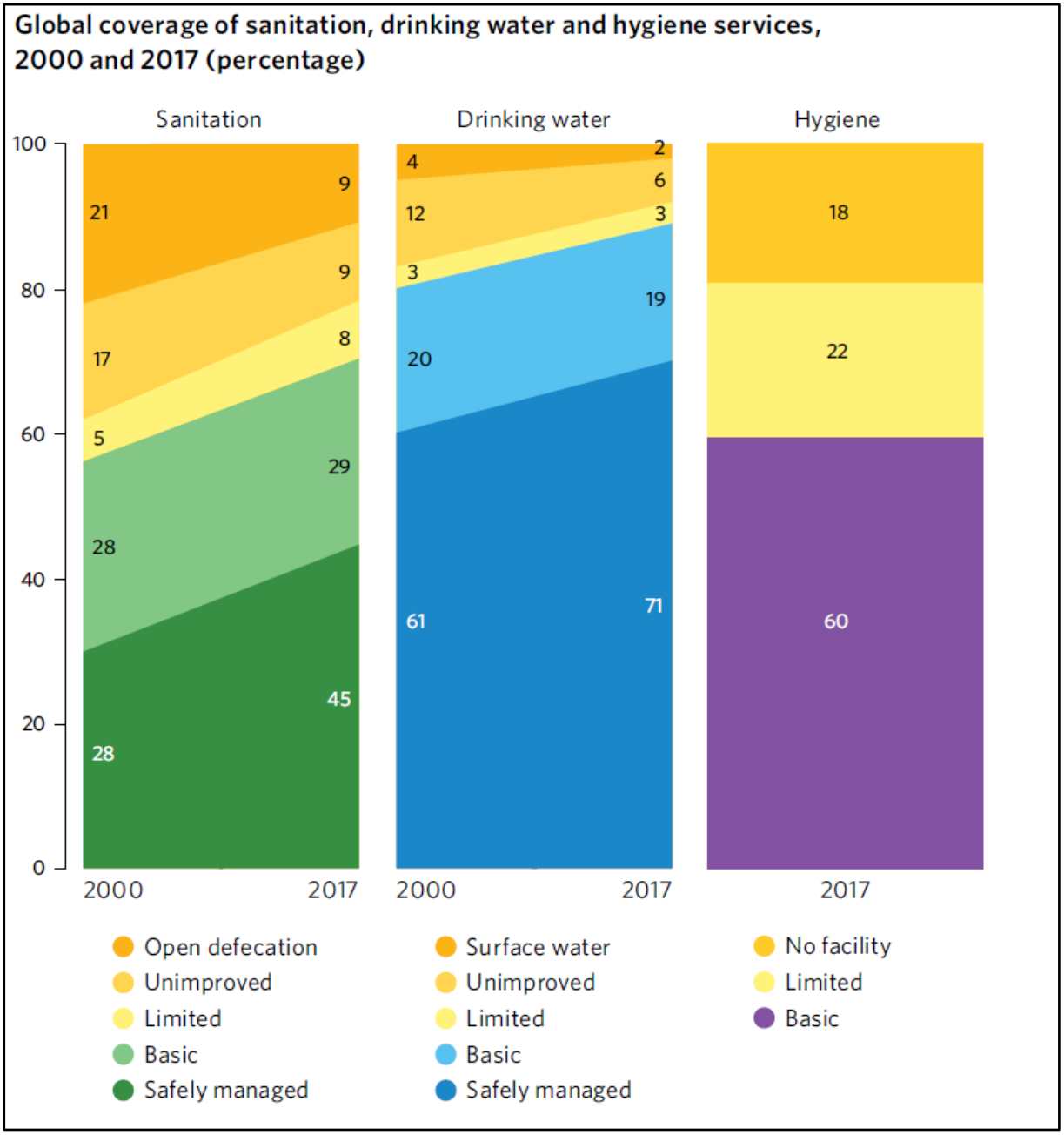

Figure 5-8: Sanitation, drinking water and hygiene

Handwashing is one of the cheapest, easiest and most effective ways to prevent the spread of the coronavirus. But in 2017, only 60 per cent of people had a basic hand-washing facility with soap and water at home. In LDCs, the share was 28 per cent. This means that, in 2017, an estimated 3 billion people worldwide lacked the ability to safely wash their hands at home. The regional disparities are stark: in sub-Saharan Africa, 75 per cent of the population (767 million people) lacked basic hand-washing facilities, followed by Central and Southern Asia at

42 per cent (807 million people), and Northern Africa and Western Asia at 23 per cent (116 million people).

As can be seen from Error! Reference source not found. Sub-Saharan Africa has a low p roportion of handwashing facility with soap and water. This does not necessarily mean that people do not clean their hands before eating, but that soap in rural Africa is a rare commodity. People wash their hands using ash instead of soap (authors personal experience in rural Zambia).

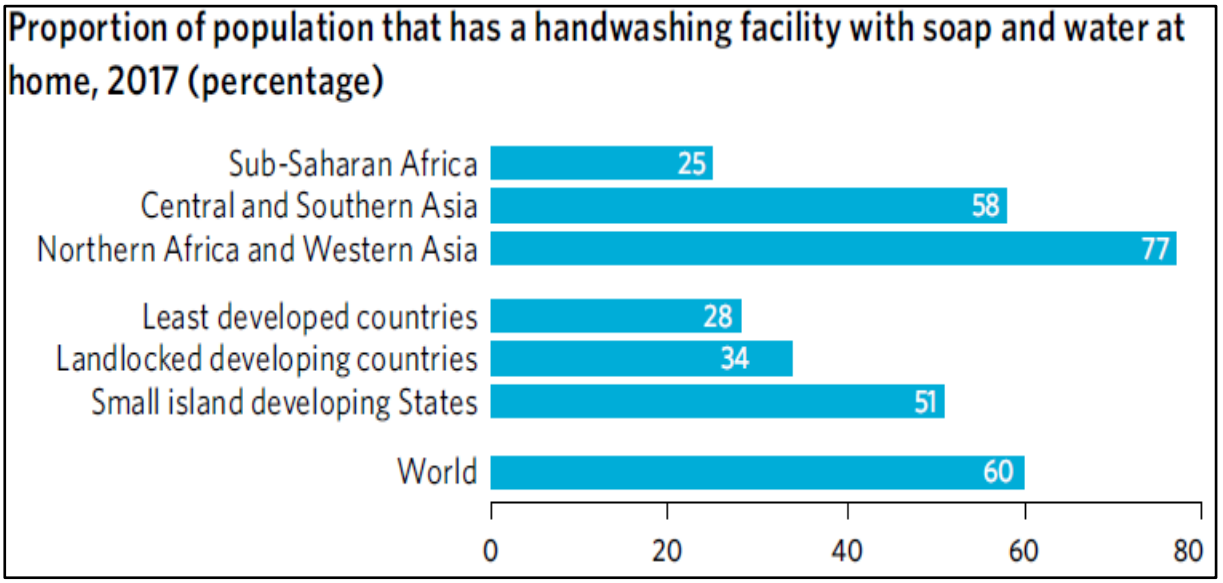

Figure 5-9: Handwashing Facilities

Water, sanitation and hygiene services are not always available in places where people seek medical care: in 2016, one in four health-care facilities around the world lacked basic water supplies, one in five had no sanitation services, and two in five had no soap and water or alcohol-based hand rub, at points of care. Moreover, 47 per cent of schools worldwide lacked hand-washing facilities with soap and water. Closing these gaps will be critical to providing effective health care and to containing the spread of COVID-19.

It should be recognised that the very low figure for Sub-Saharan Africa does not mean that people do not wash their hands. It means that in many instances there is no home or yard connection and that water has to be collected from a communal standpipe or a source such as a borehole. In some instances (in the remote rural areas) soap is not an available commodity and people use other means such as ash to clean their hands. Measurement of this indicator deserves some reconsideration.

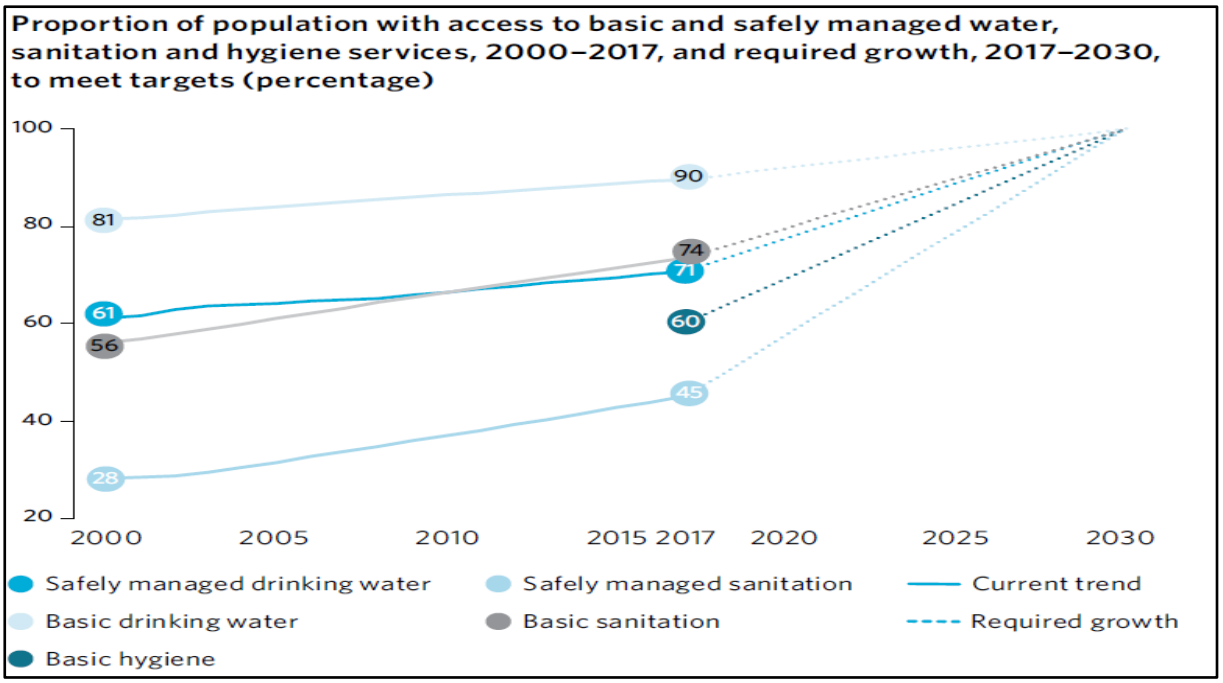

Figure 5-10: Basic and Safely Managed Water

This indicator is directly related to infrastructure. However, it does not indicate if the available infrastructure is in good working order and what the level of service is. To put it bluntly: A tap without water is not of much use. This indicator should consider service delivery and not installed infrastructure.

5.6.2 FRESH WATER RESOURCES

More than 60 per cent of global freshwater flow comes from basins that cross national borders. Transboundary cooperation is a prerequisite for ecologically sound management of freshwater resources and for peaceful regional integration. According to data from 67 out of 153 countries sharing transboundary waters, the average share of national transboundary basins covered by an operational arrangement was 59 per cent over the period 2017–2018. Only 17 countries reported that all their transboundary basins were covered by such arrangements. A major effort is needed to ensure that cooperation is operational in all transboundary basins.

High water stress – the withdrawal of too much fresh water from natural sources compared with the fresh water available – can have devastating consequences for the environment and can constrain or reverse sustainable development. If unmitigated, water stress can lead to water scarcity, which could displace an estimated 700 million people by 2030. Globally, water stress remains at a safe 17 per cent; however, this overall value masks huge regional variations. Northern Africa and Central and Southern Asia register water stress levels above 70 per cent. Western Asia and Eastern Asia follow, with water stress levels between 45 per cent and 55 per cent, respectively.

Increasing water-use efficiency reduces the risk of water stress, reinforcing both economic and environmental resilience. Globally, water-use efficiency stands at $18.20 per cubic metre in 2017. Estimates ranged from as little as $0.20 per cubic metre in countries whose economies depend largely on agriculture, to $1,197 in highly industrialized, service-based

economies. Increasing agricultural water productivity is a key intervention for improving water-use efficiency.

Freshwater ecosystems provide natural sites for human settlements, bringing benefits such as transportation, natural purification, irrigation, flood protection and habitats for biodiversity. However, population growth, agricultural intensification, urbanization and industrial production degrade freshwater bodies worldwide, threatening ecosystems and the livelihoods of people everywhere. Globally, slightly more than 2.1 per cent of land is covered by freshwater bodies, but they are unevenly distributed. In developed countries, 3.5 per cent of land is covered by fresh water, compared with 1.4 per cent in developing countries. Least developed countries and small island developing States have a significantly lower coverage of freshwater bodies, at 1.2 per cent and 1 per cent, respectively, which increases their vulnerability to climate change and water scarcity.

Integrated water resources management is a global framework covering policies, institutions, management instruments and financing for the comprehensive and collaborative management of water resources. Of the 172 countries that reported in 2018, 60 per cent stated very low, low or medium-low levels of implementation. These countries are unlikely to meet the target of implementing integrated water resources management by 2030. In 2018, the average global score for integrated water resources management implementation was 49 out of 100. Implementation is particularly slow (very low to medium-low) in around 90 per cent of countries across Latin America and the Caribbean, Central and Southern Asia, and Oceania (excluding Australia and New Zealand), and in 50 per cent to 70 per cent of countries in sub-Saharan Africa, Eastern and South-Eastern Asia, and Northern Africa and Western Asia. An acceleration of progress is needed in these countries.

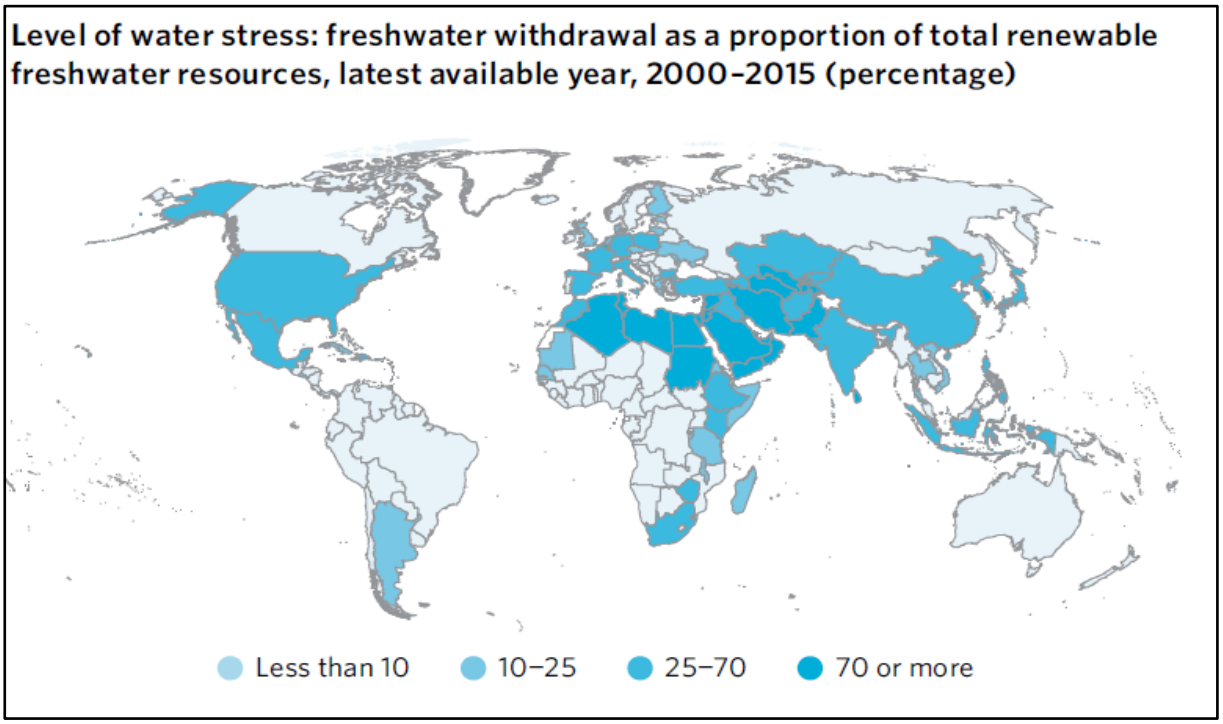

Figure 5-11: Water stress

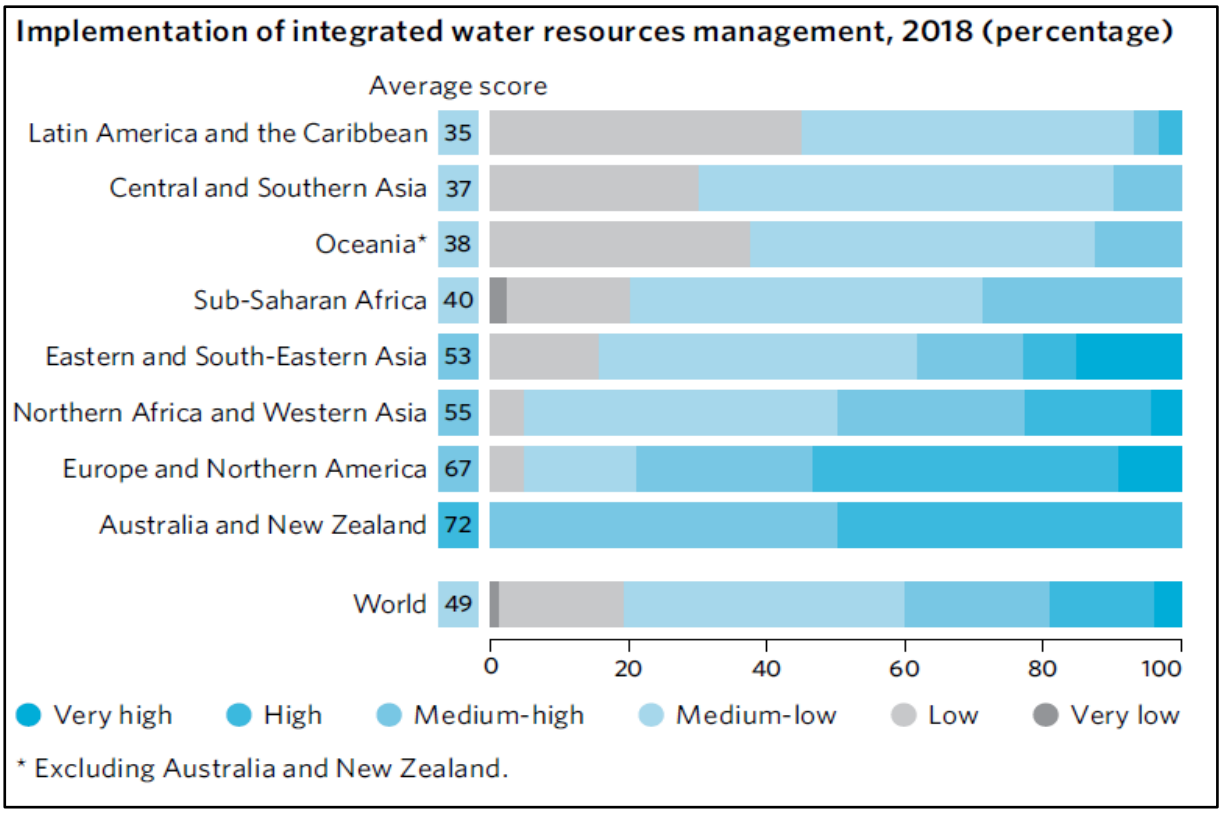

Figure 5-12: Integrated water resource management

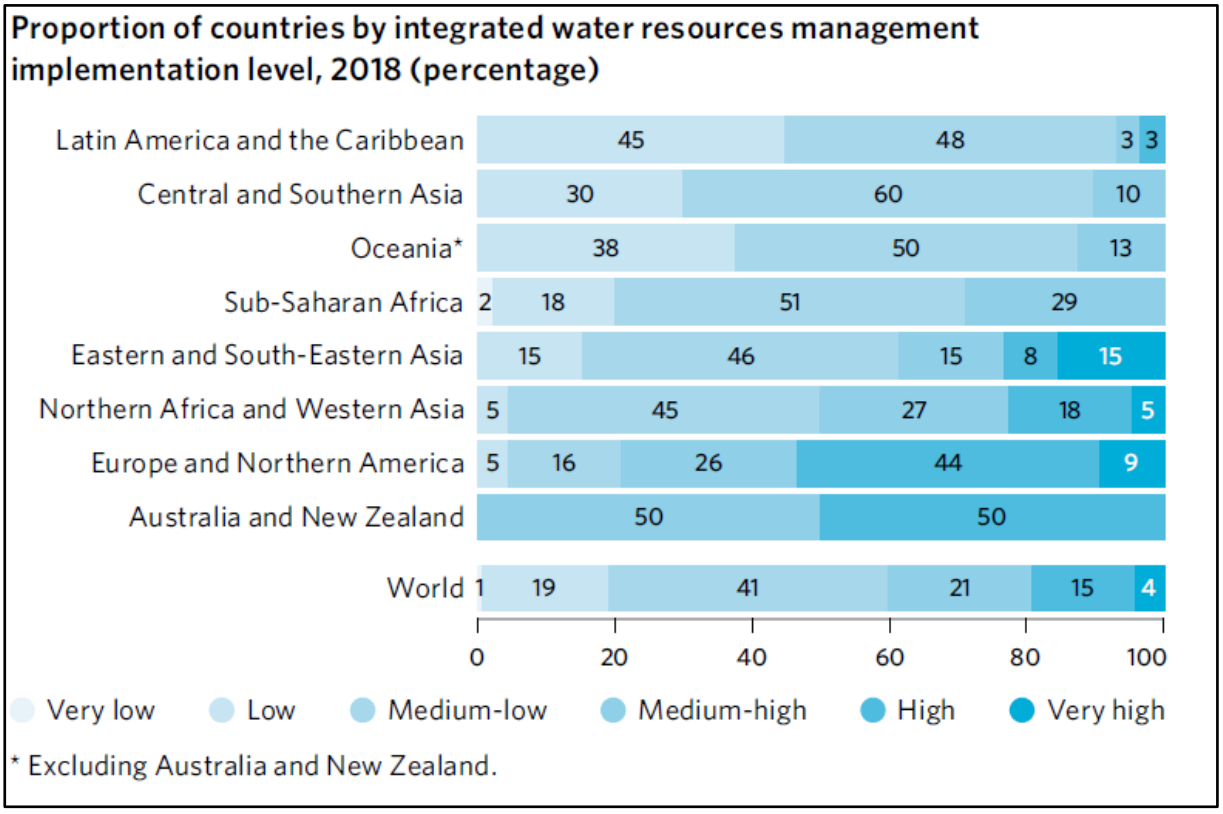

Figure 5-13: Integrated water resource management

5.7 SDG 7: ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

The proportion of the global population with access to electricity increased from 83 per cent in 2010 to 90 per cent in 2018, meaning that over 1 billion people acquired this essential service. Still, 789 million people – 85 per cent in rural areas – lacked electricity in 2018. Latin America and the Caribbean and Eastern and South-Eastern Asia maintained strong progress, exceeding 98 per cent access by 2018. The deficit is increasingly concentrated in sub-Saharan Africa, affecting about 548 million people, or 53 per cent of the population.

The COVID-19 pandemic spotlights the need for reliable and affordable electricity. A 2018 survey conducted in six African and Asian countries showed that one quarter of health facilities surveyed were not electrified, and another quarter experienced unscheduled outages, which affected their capacity for essential health services. Damage to equipment caused by poor connections and voltage fluctuations impacted 28 per cent of health centres. These deficits further weaken the response of health systems to the coronavirus crisis.

To meet the target of universal access to electricity by 2030, the annual rate of electrification has to rise from the current 0.82 percentage points to 0.87 for 2019 to 2030. At the current rate of progress, a projected 620 million people would still lack access to electricity in 2030. This estimate does not, however, take into account the disruptions caused by COVID-19.

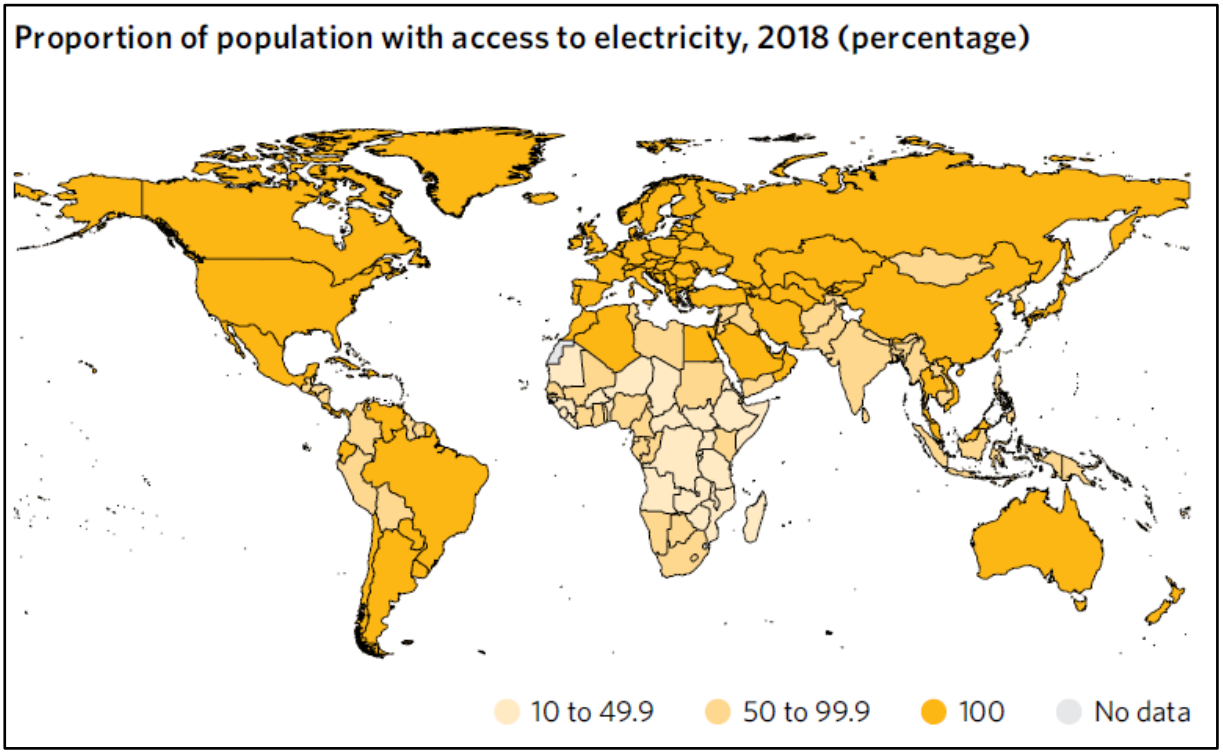

Figure 5-14: Access to electricity

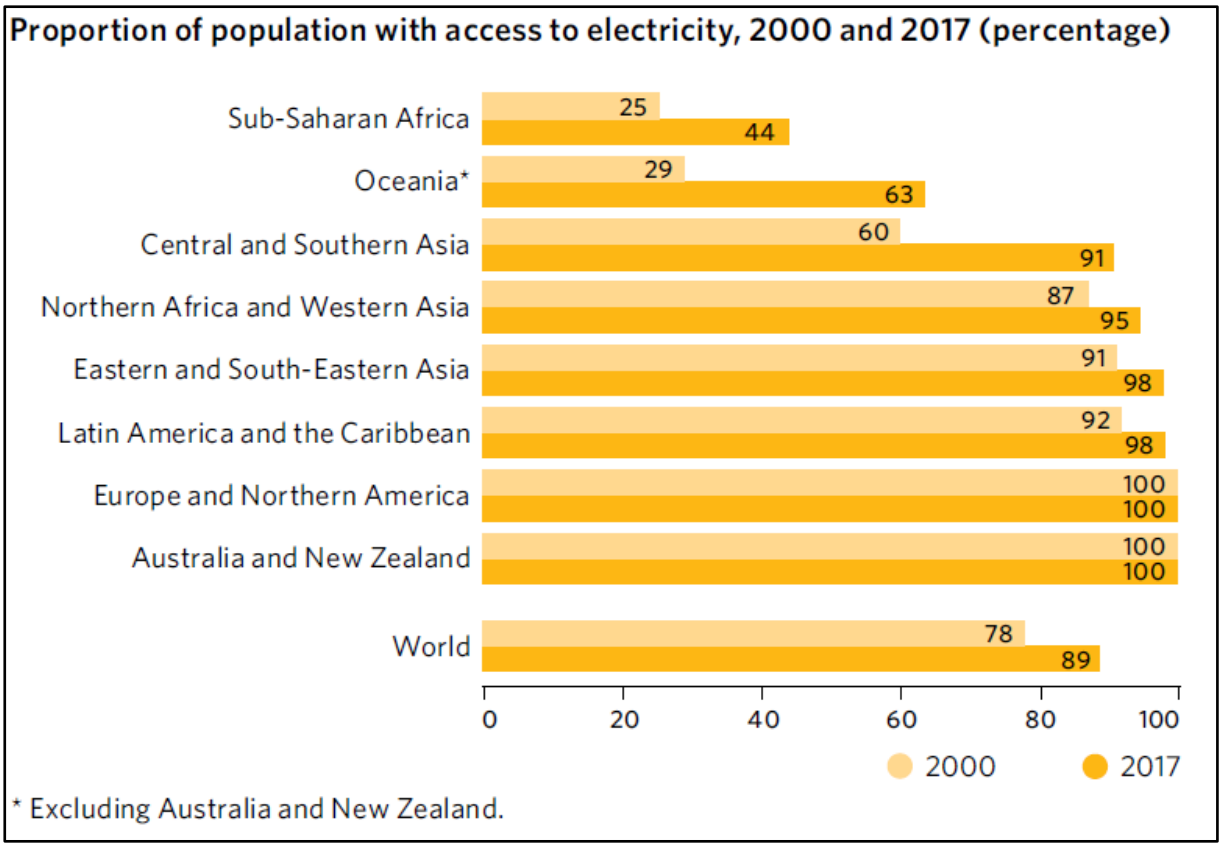

Figure 5-15: Access to electricity percentage

Access to clean cooking fuels and technologies increased from 56 per cent of the global population in 2010 to 60 per cent in 2015 and 63 per cent in 2018. Approximately 2.8 billion people remain without access, a number that has stayed roughly the same over the past two decades. Promising improvements have been made in various Asian regions. However, in sub-Saharan Africa, population growth between 2014 and 2018 outstripped growth in access by an average of 18 million people each year. Slow progress towards clean cooking solutions is of grave global concern, affecting both human health and the environment. Under current and planned policies, 2.3 billion people would still be deprived of access to clean cooking fuels and technologies by 2030. This means that nearly one third of the world's population, mostly women and children, will continue to be exposed to harmful household air pollution.

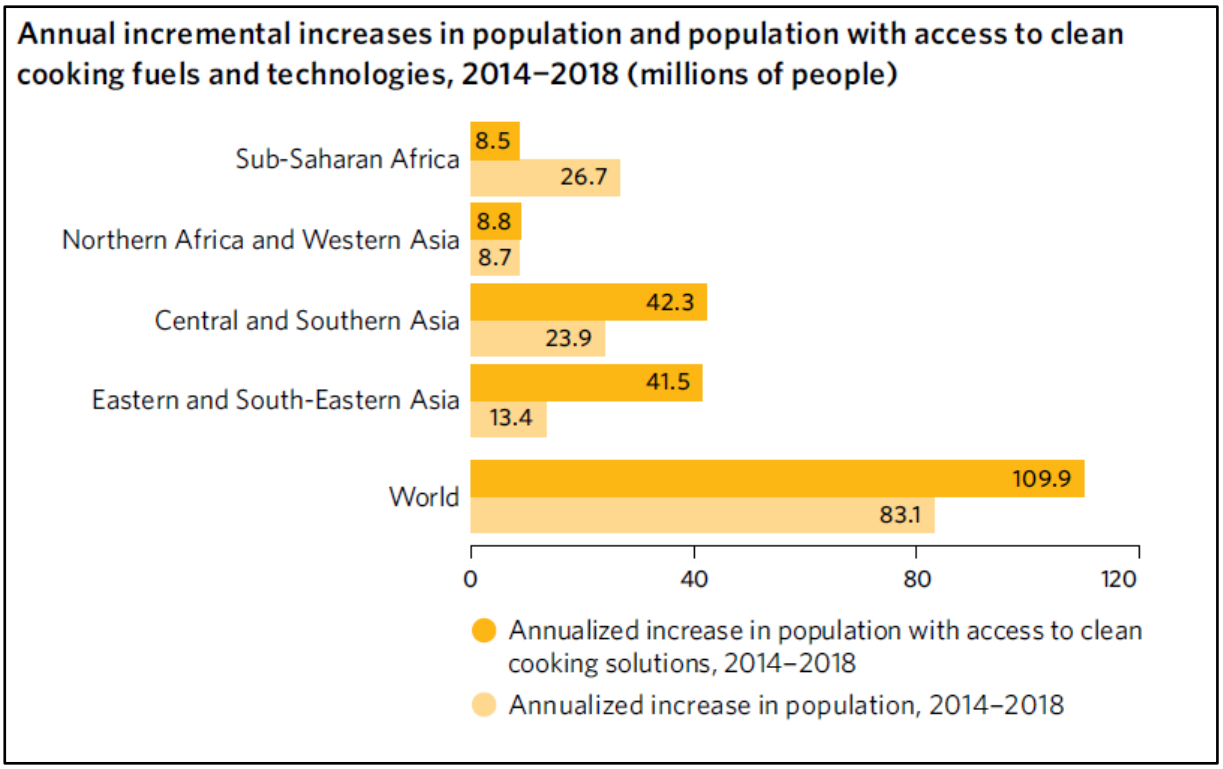

Figure 5-16: Access to clean cooking fuels

The share of renewable energy in total final energy consumption reached 17.3 per cent in 2017, up from 17.0 per cent in 2015 and 16.3 per cent in 2010. This growth was driven primarily by increased consumption of modern renewables, which rose from 8.6 per cent in 2010 to 10.5 per cent in 2017.

The largest increase in the use of renewables has come from the electricity sector, driven by the rapid expansion of solar and wind power. But the share of renewables in the heat and transportation end-use sectors, which accounted for 80 per cent of final energy use, lagged far behind its potential. An acceleration of modern renewables in all sectors will be needed to achieve the target of substantially increasing the share of renewable energy.

Sub-Saharan Africa had the highest share of renewable energy in total energy consumption in 2017, although 85 per cent of it was due to traditional uses of biomass. Latin America and the Caribbean had the largest share of modern renewables among all regions owing to heavy reliance on hydropower and the extensive use of modern bioenergy across all sectors.

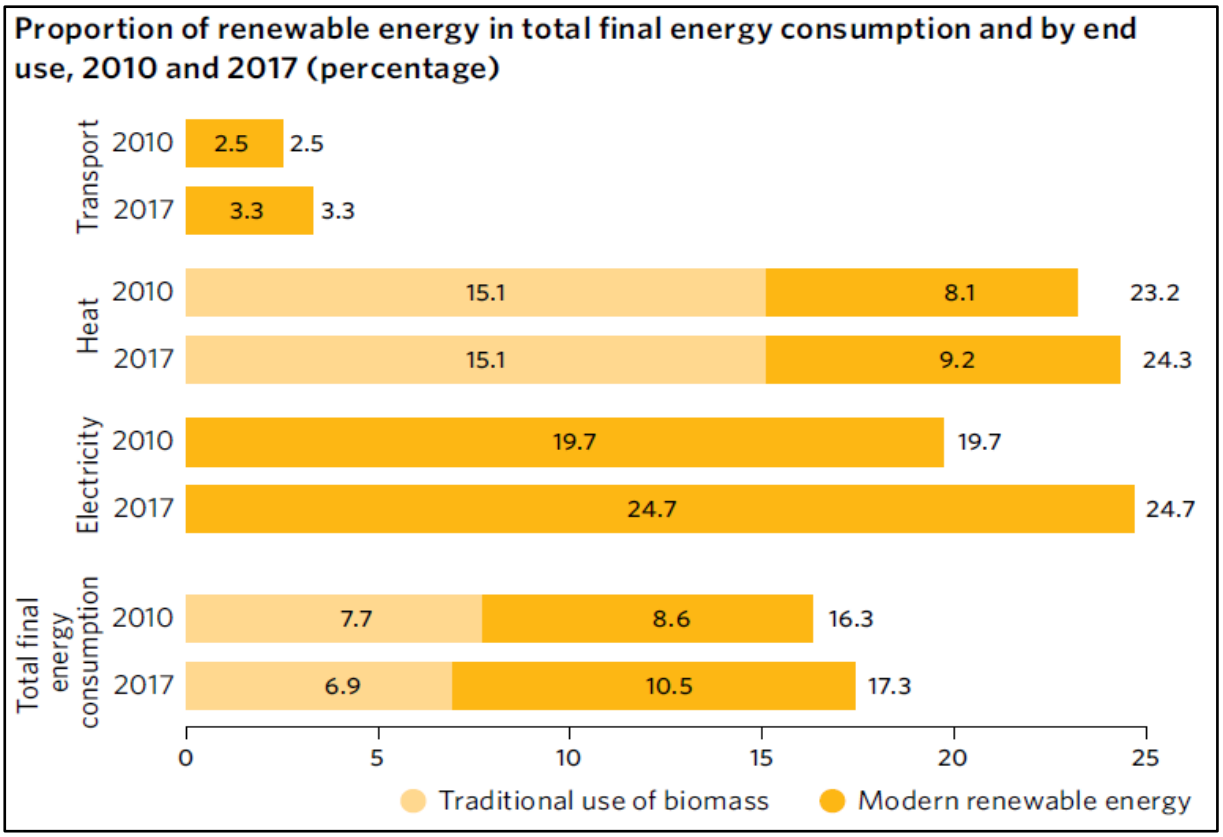

Figure 5-17: Renewable energy

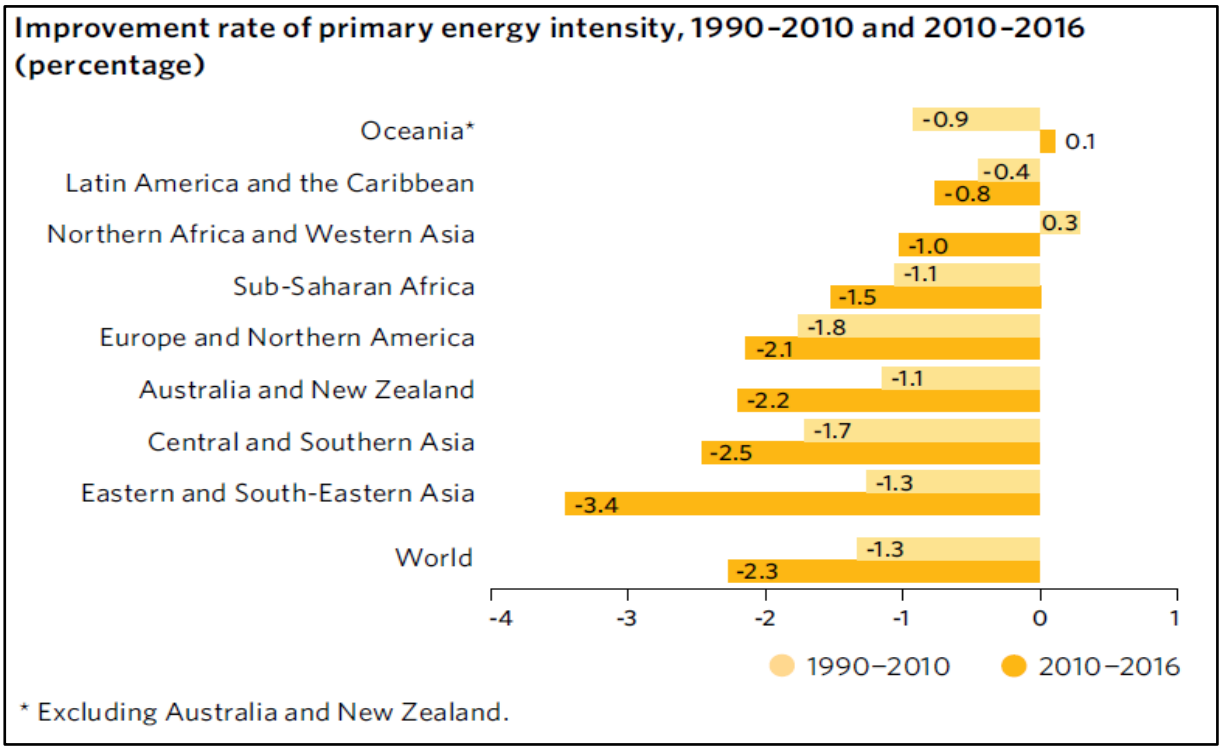

Figure 5-18: Primary energy intensity

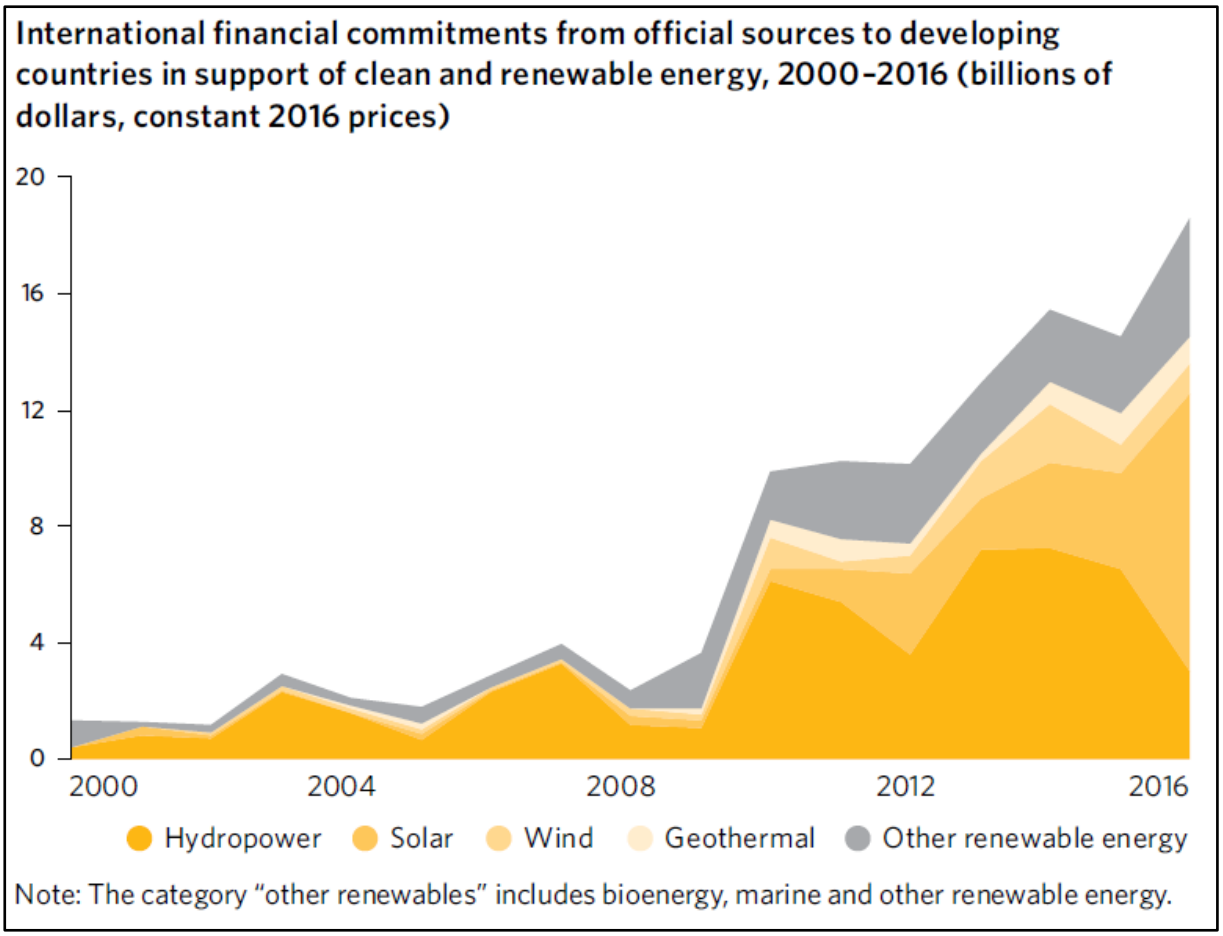

Figure 5-19: Aid to developing countries for renewable energy

5.8 SDG 9: BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

The growth of manufacturing in both developing and developed regions slowed in 2018, attributed largely to emerging trade and tariff barriers that constrain investment and future expansion. Despite the slowdown, the global share of manufacturing value added (MVA) in GDP increased marginally—from 15.9 per cent in 2008 to 16.5 per cent in 2018, when it began to plateau. In LDCs, the share of manufacturing in total GDP increased 2.5 per cent annually between 2015 and 2018. However, that still falls short of the pace needed to achieve a doubling of the MVA share in GDP by 2030, and calls for accelerated action. The disparities in industrial productivity between rich and poor nations remain stark. For instance, MVA per capita was only $114 in LDCs compared to $4,938 in Europe and Northern America, in 2018.

Figure 5-20: Manufacture value added

5.9 SDG 11: MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

Reliable, accessible and affordable public transportation reduces pollution and traffic and promotes productivity and inclusion. Only half the world's urban population has convenient access to public transportation, according to 2019 data from 610 cities in 95 countries. Access is measured as the share of the population within 500 metres walking distance of low-capacity transport systems (buses and trams) and 1,000 metres distance to high-capacity systems (trains, subways and ferries). In addition, many cities have a high prevalence of informal transport systems, which are often deficient in terms of regularity and safety. A focus on short-term investments in road-based public transport infrastructure can translate into higher access to low-capacity public transport systems.

While the pandemic is ongoing, cities may need to introduce additional safety measures to mitigate the elevated risk of coronavirus transmission in crowded public transport. Global data illustrate the need to enhance access to public transport systems that are well integrated with walking and cycling paths through long-term mobility plans and targeted investments.

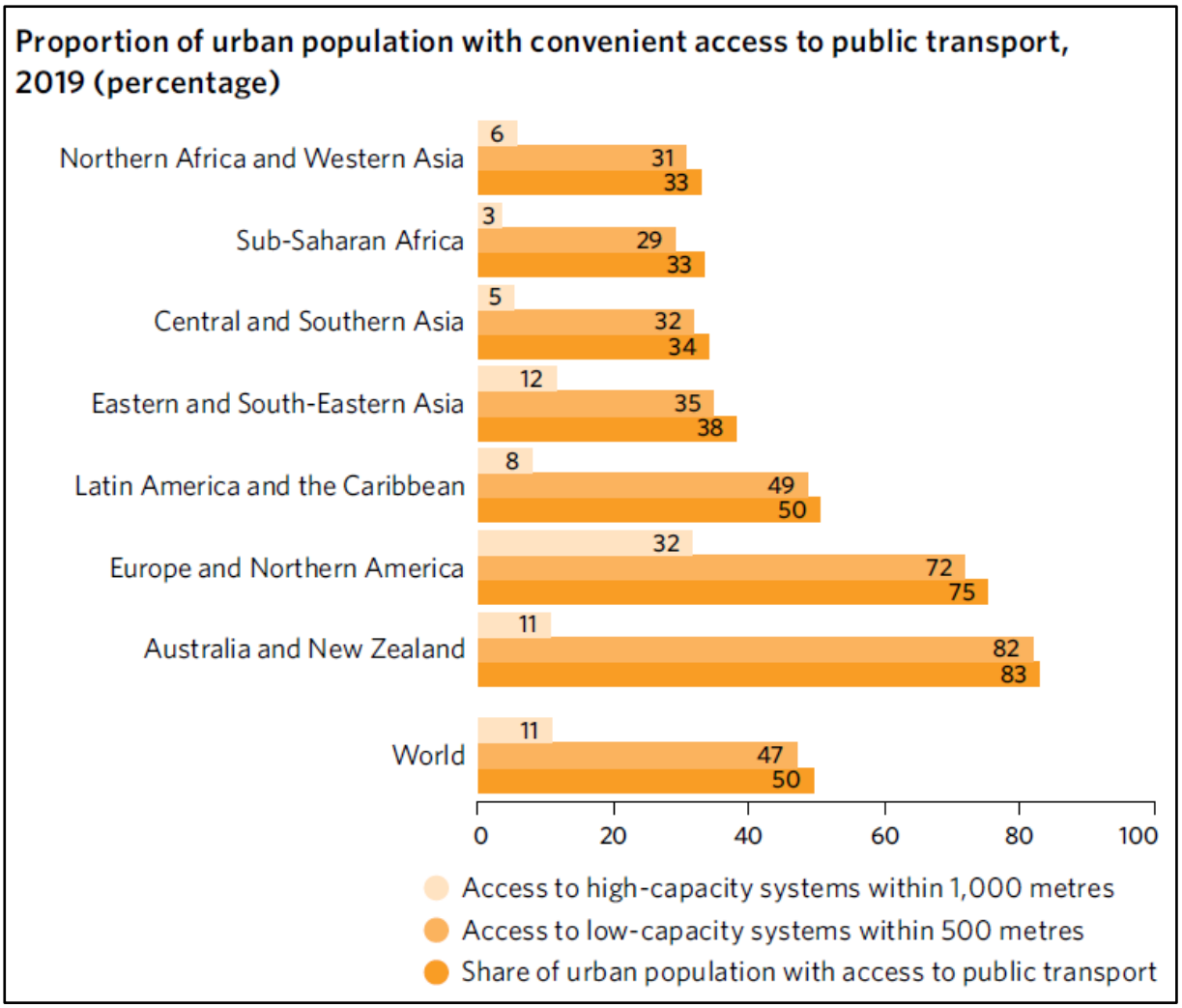

Figure 5-21: Public Transport

How we plan and develop our urban areas, infuse infrastructure and services, mitigate risks and respond to the needs of growing populations determines the long-term prosperity of cities and their people. Over the period 1990 to 2015, most urban areas recorded a general increase in the amount of built-up area per person – that is, the physical expansion of cities was faster than their rates of population growth – according to 2019 data from a representative global sample of 755 cities from 95 countries. In some cities, this rapid expansion reflects unplanned urban sprawl, making the delivery of services more costly and inefficient. On average, all regions except for sub-Saharan Africa and Eastern and South-Eastern Asia recorded a consistent increase in the built-up area per capita.

The pandemic has made it clear that urban planning is crucial for better public health and for mitigating people's vulnerabilities to other hazards, such as natural disasters. As of May 2020, 154 countries have some form of national urban plan. Many national and city governments are now revisiting those plans to help prevent the next pandemic.

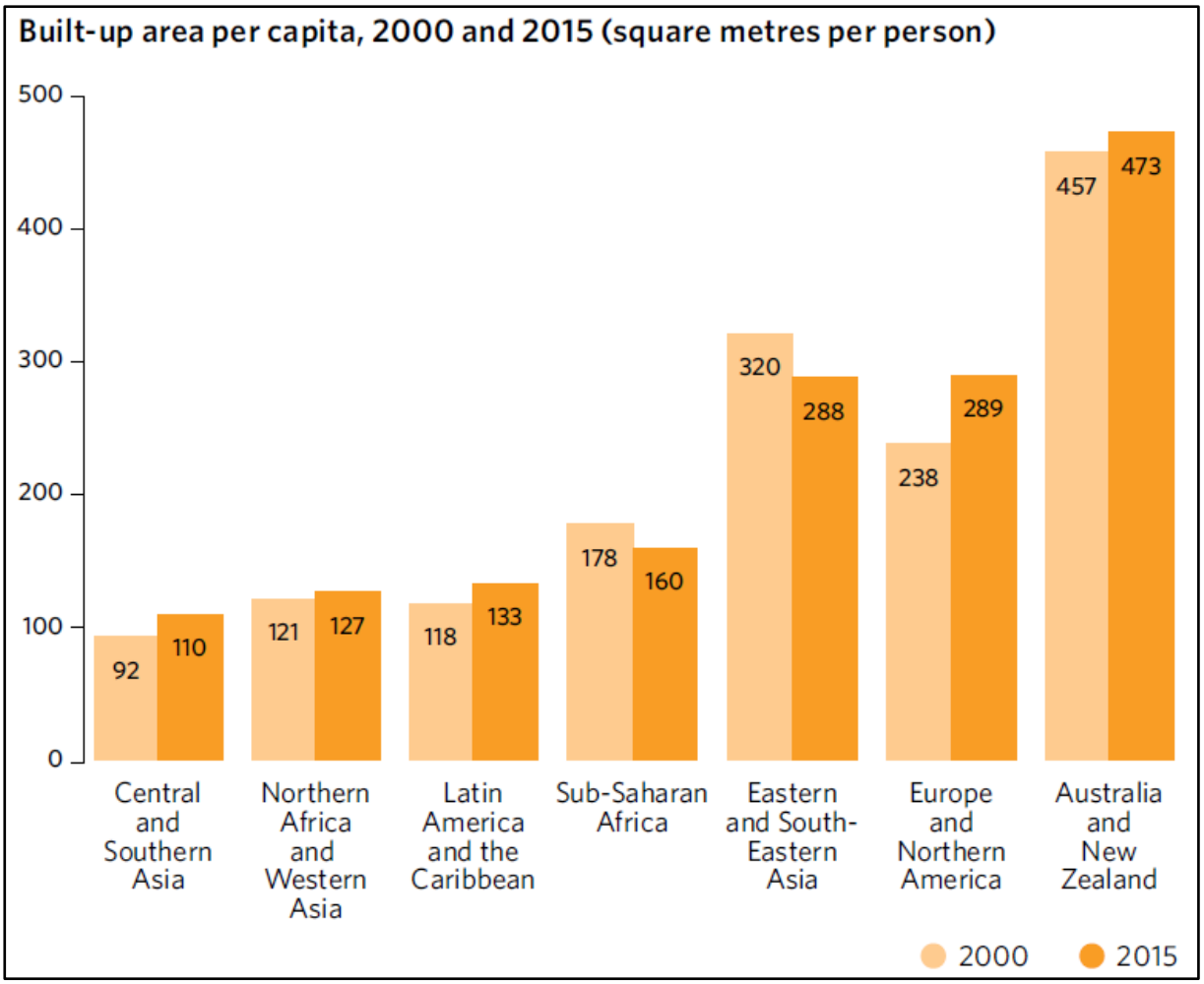

Figure 5-22: Built-up Area

The impacts of COVID-19 are exacerbating the vulnerability of slum dwellers and those living in informal settlements. Many of these urban residents already suffer from inadequate housing with limited or no access to basic infrastructure and services, including water, sanitation and waste management. Overcrowding of public transportation and limited health-care facilities have had a catastrophic effect on these communities, turning them into epicentres within epicentres. Many urban dwellers in the developing world work in the informal sector and are at high risk of losing their livelihoods as cities lock down.

Concerted efforts by national governments, city authorities and other stakeholders led to a significant decline in the proportion of the urban population living in slums – from 28 per cent in 2000 to 23 per cent in 2014. Alarmingly, that trend has reversed as rapid urbanization outpaces the development of housing, infrastructure and services. The proportion of the urban population living in slums rose to 24 per cent in 2018, or over 1 billion people, due to increases in Northern Africa and Western Asia and sub-Saharan Africa.

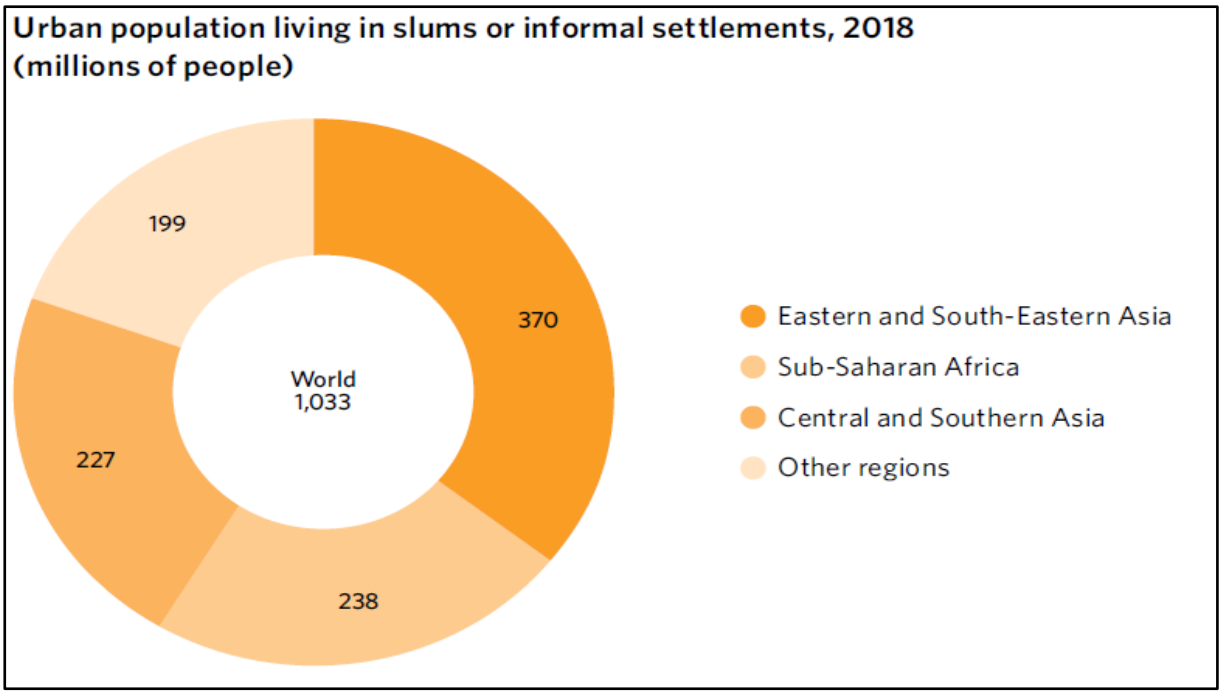

Figure 5-23: Slums and informal settlements

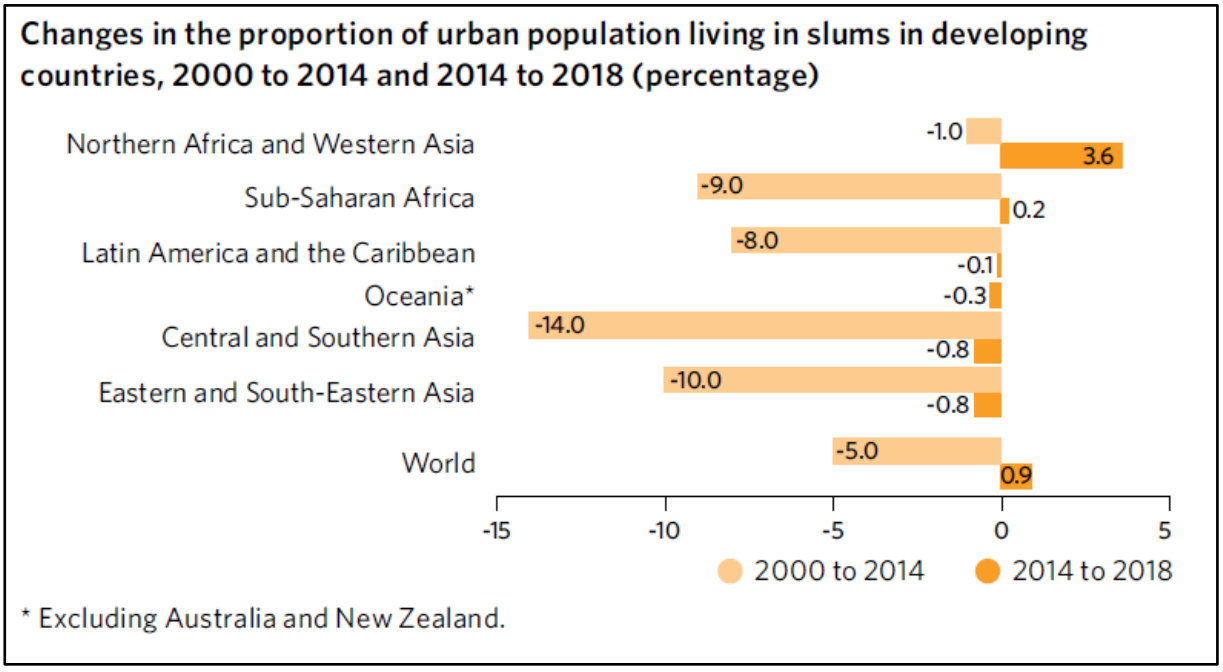

Figure 5-24: Proportion of population living in slums or informal settlements

Reliable, accessible and affordable public transportation reduces pollution and traffic and promotes productivity and inclusion. Only half the world's urban population has convenient access to public transportation, according to 2019 data from 610 cities in 95 countries. Access is measured as the share of the population within 500 metres walking distance of low-capacity transport systems (buses and trams) and 1,000 metres distance to high-capacity systems (trains, subways and ferries). In addition, many cities have a high prevalence of informal transport systems, which are often deficient in terms of regularity and safety. A focus on short-

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While the pandemic is ongoing, cities may need to introduce additional safety measures to mitigate the elevated risk of coronavirus transmission in crowded public transport. Global data illustrate the need to enhance access to public transport systems that are well integrated with walking and cycling paths through long-term mobility plans and targeted investments.

Globally, 2 billion people were without waste collection services, and 3 billion people lacked access to controlled waste disposal facilities, according to data collected between 2010 and 2018. The problem will only worsen as urbanization increases, income levels rise and economies become more consumer-oriented. The total amount of waste generated globally is expected to double from nearly 2 billion metric tons in 2016 to about 4 billion metric tons by 2050.

The proportion of municipal solid waste collected regularly increased from 76 per cent between 2001 and 2010 to 81 per cent between 2010 and 2018. But that does not mean that it was disposed of properly. Many municipal solid waste disposal facilities in low- and middle-income countries are open dumpsites, which contribute to air, water and soil pollution, including by plastic waste, as well as emissions of greenhouse gases such as methane. Investment in waste management infrastructure is urgently needed to improve the handling of solid waste across much of the world.

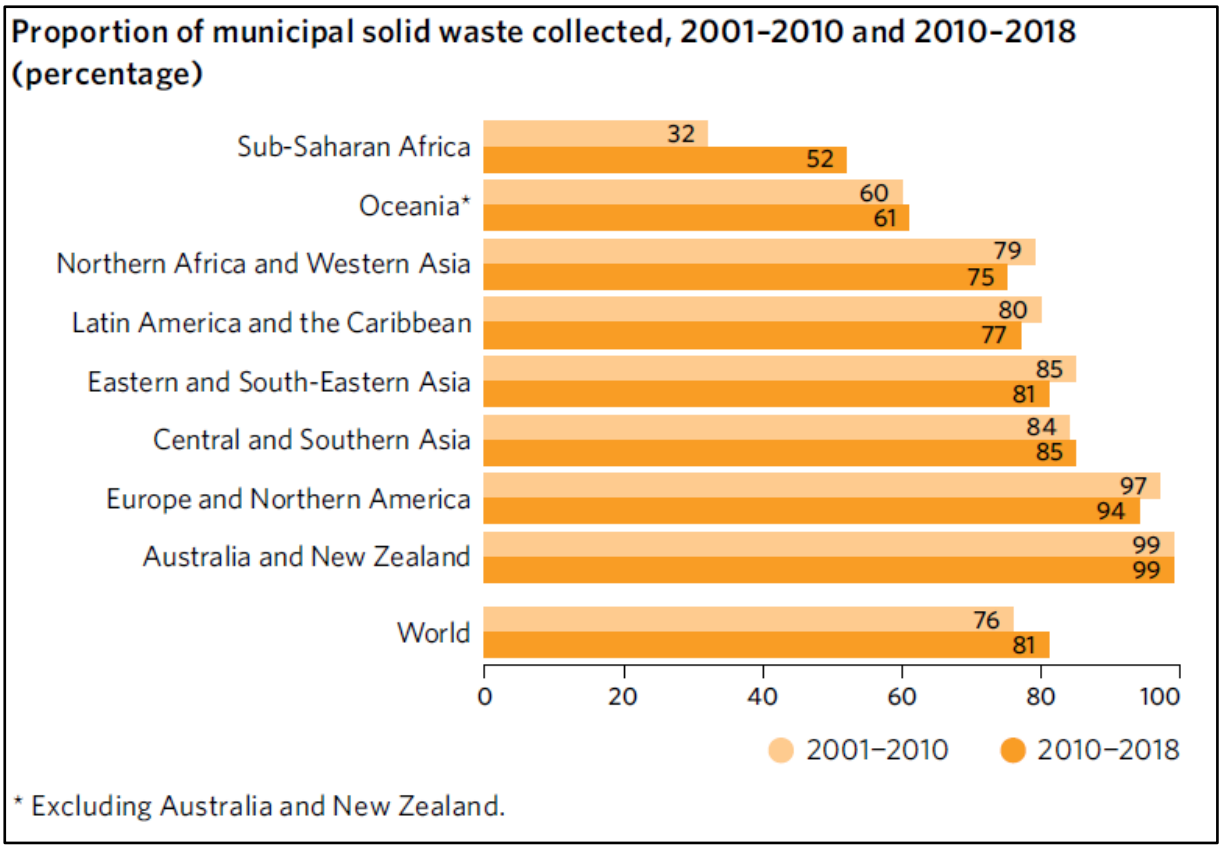


Figure 5-25: Municipal solid waste collection

Nine out of ten urban residents in 2016 were breathing polluted air— that is, air that did not meet the WHO air quality guidelines for annual mean levels of fine particulate matter (PM2.5) of 10 micrograms or less per cubic metre. More than half of those people were exposed to air pollution levels at least 2.5 times above the guideline value. Air quality worsened between 2010 and 2016 for more than 50 per cent of the world's population. Central and Southern Asia and sub-Saharan Africa are the two regions that saw the largest increases in particulate matter concentrations.

In low- and middle-income countries, the air quality of 97 per cent of cities with more than 100,000 inhabitants did not meet air quality guidelines in 2016, compared to 49 per cent in high-income countries. Ambient air pollution from traffic, industry, power generation, waste burning and residential fuel combustion, combined with household air pollution, poses a major threat to both human health and efforts to curb climate change. More than 90 per cent of air-pollution-related deaths occur in low- and middle-income countries, mainly in Asia and Africa.

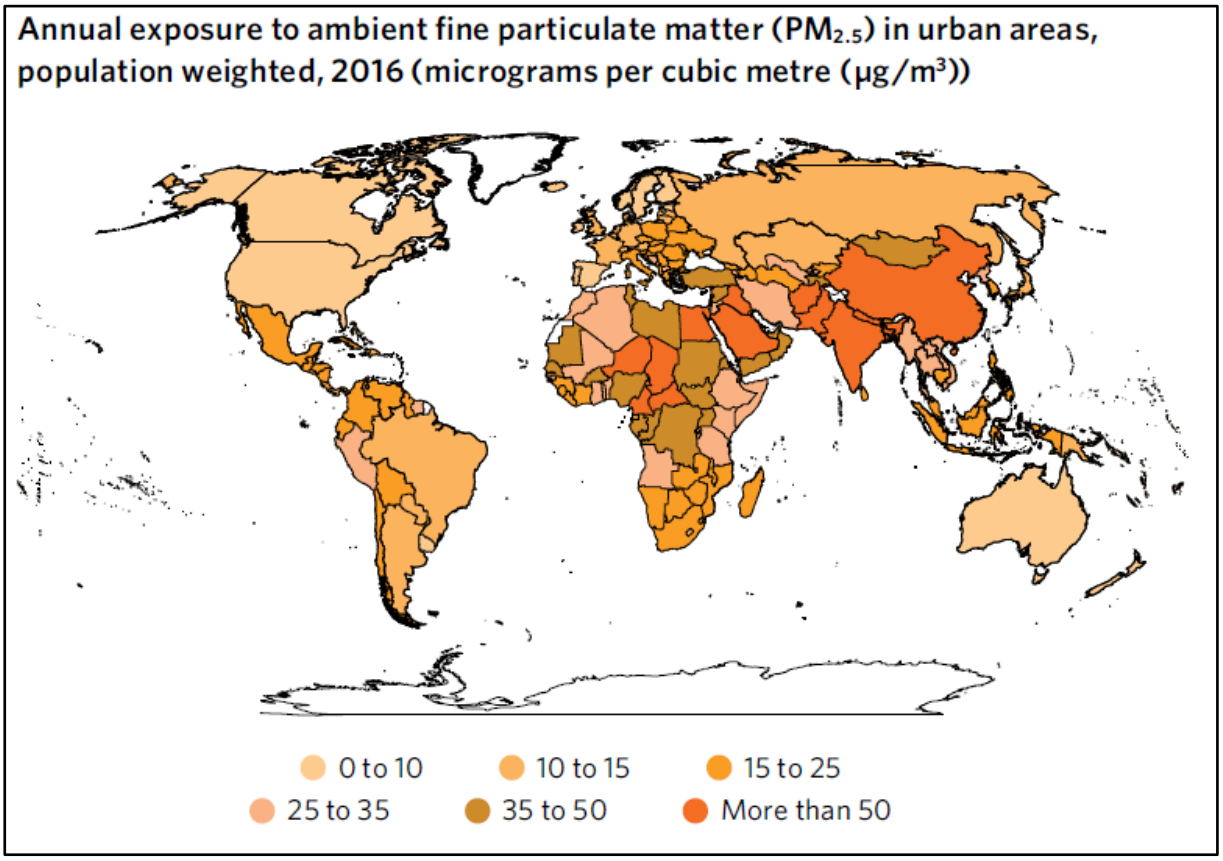


Figure 5-26: Air pollution

5.10 SDG 12: ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

Domestic material consumption (DMC) measures the total amount of materials directly used by an economy to meet the demands for goods and services from within and outside a country. At the global level, DMC is equivalent to the material footprint, and reached 92 billion metric

tons in 2017. DMC increased from 2010 to 2017 in all regions of the world. Particularly striking is the increase in Eastern and South-Eastern Asia, where about 10 billion more metric tons were used in 2017 than in 2010. That increase accounts for about two thirds of the increase at the global level.

The rising share of Eastern and South-Eastern Asia and other emerging economies in global DMC is due to two dynamics. The first is the construction of new infrastructure in emerging and transitioning economies, a pattern that many developing countries are likely to follow in the future. The second is the outsourcing of the material- and energy-intensive stages of production from high-income nations to less resource-efficient countries. The shift in production from the former to the latter means that more natural resources are needed to produce the same output.

Because that shift in economic activity happened faster than improvements in resource efficiency in individual countries, material intensity—defined as domestic material consumption per GDP—stagnated at an average of 1.16 kilograms per dollar from 2010 to 2017. In 2017, developed countries used about one fifth as many natural resources as developing countries to produce the same amount of economic output. Between 2010 and 2017, material intensity decreased in many regions, showing some progress towards the relative decoupling of economic output and DMC. But material intensity increased in other regions, resulting in no change at the global level. Good progress has been made in sub-Saharan Africa, Central and Southern Asia and Oceania (excluding Australia and New Zealand), mostly as a result of increases in GDP.

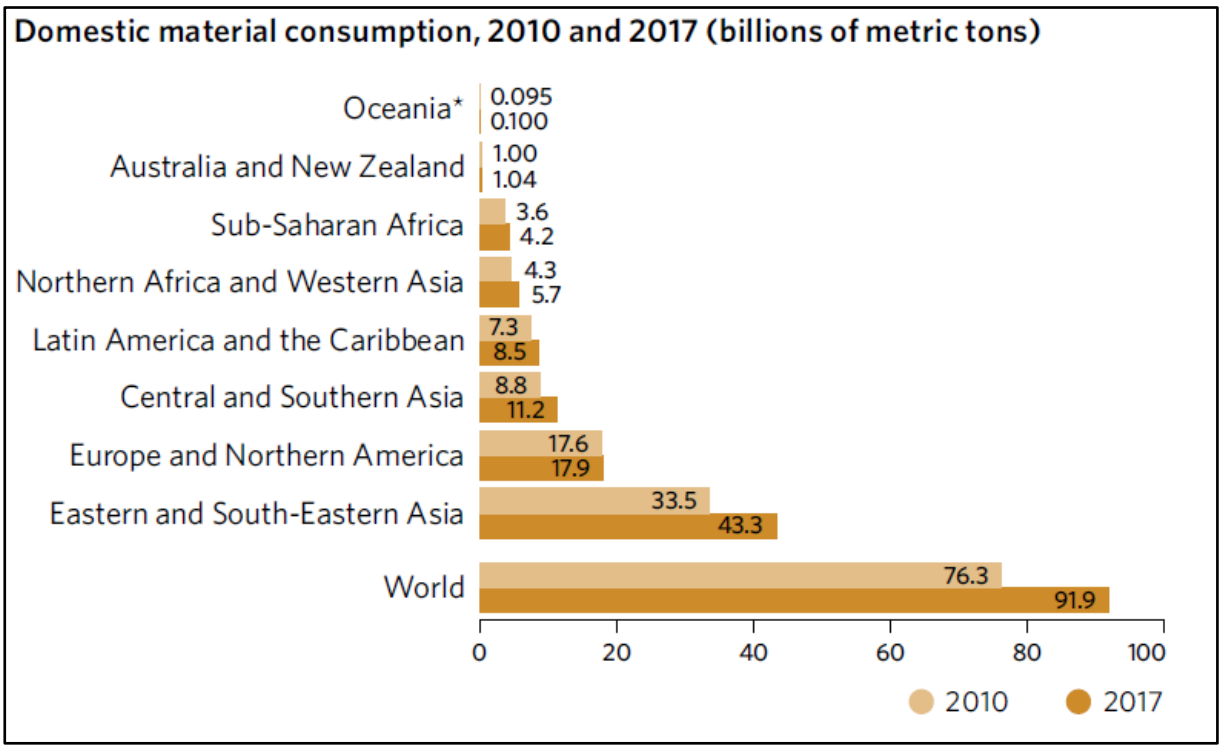


Figure 5-27: Domestic material consumption

5.11 SDG 16: PROMOTE PEACEFUL AND INCLUSIVE SOCIETIES FOR SUSTAINABLE DEVELOPMENT, PROVIDE ACCESS TO JUSTICE FOR ALL AND BUILD EFFECTIVE, ACCOUNTABLE AND INCLUSIVE INSTITUTIONS AT ALL LEVELS

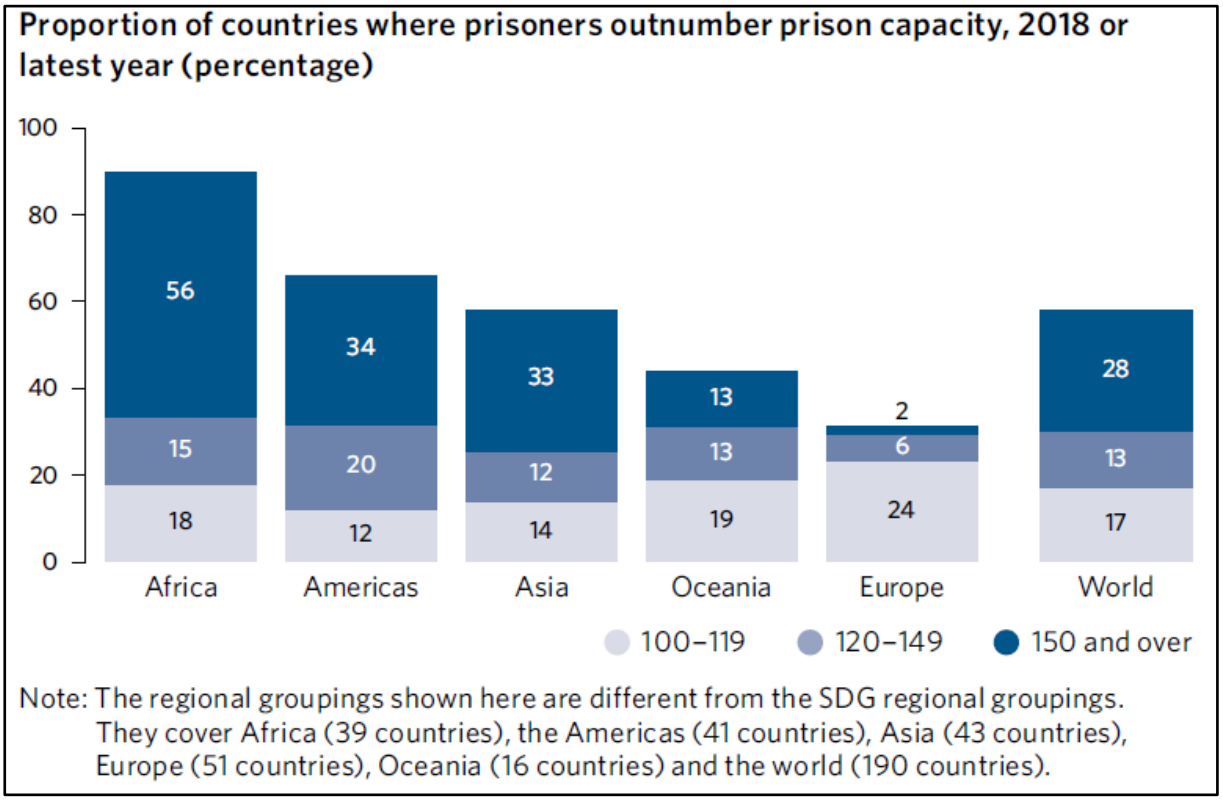


Figure 5-28: Prison overcrowding

Access to justice for all should ensure a fair trial within a reasonably short period of time. However, 31 per cent of prisoners worldwide are being held in detention having been being sentenced for a crime – a level that has not declined since 2005. Significant increases over the past three years were recorded in all regions of Asia and in Oceania.

Prison overcrowding remains a serious problem in many countries, often leading to inhumane conditions, violation of human rights, violence among prisoners and reduced prospects for rehabilitation. Overcrowding is accelerating the spread of COVID-19 across jails and prisons worldwide due to cramped quarters, and the frequent lack of protective gear and access to adequate health care. Of 190 countries worldwide with available data, almost 60 per cent had prison populations exceeding prison capacity; 13 per cent of countries had between 120 per cent and 149 per cent of capacity, and 28 per cent had 150 per cent of capacity or more.

SECTION 3: INDIVIDUAL COUNTRY REPORTS

6 DEMOCRATIC REPUBLIC OF THE CONGO

6.1 THE DRC'S ENERGY POTENTIAL

As stated above, the DRC's large-tiered terrain makes it conducive to waterfalls and dam construction so that the country's hydroelectric potential is one of the largest in the world with 890 sites identified and located in the 145 municipalities of the DRC. The location illustration of these sites is shown in **Figure 6-1** below.

Figure 6-1: DRC's hydropower and hydropower generation. Source: DRC Renewable Energy Atlas, MRHE, August 2014

The DRC is rich in abundant energy resources identified, some of which have not yet been fully inventoried. Such energy resources include waterfalls and rapids for hydropower potential, hydrocarbons, natural gas (methane gas), coal, wood, oil shale, thermal waters, radioactive minerals, solar energy, wind energy, biomass, energy plants, etc.

Table 6-1: DRC Energy Potential (National Energy Commission). Source: 2008 Annual Report, Copirep, Kinshasa 2008

The DRC's energy potential can be summarized as represented in Table 6-1 below.

	Resources	Potential
1	water	774 000 GWh equivalent to 100 000 MW of electricity
2	Forest	122 million ha (equivalent to 8.3 billion TEPI)
3	Hydrocarbons/ oils	230 million barrels raw petroleum
4	Coal	720 million tons including 50 recoverable millions
5	Methane gas	50 billion m^3
6	Uranium	undetermined
7	Agricultural Remaining residue	undetermined

6.1.1 HYDROELECTRIC POTENTIAL

The estimated overall hydroelectric potential across the country is 100,000 MW, 44,000 MW of which are concentrated at the Inga site alone. This potential is distributed by province (former administrative division) as provided in Table 6-2 below.

Table 6-2: Energy Potential by DRC Province. Source: DRC Renewable Energy Atlas, MRHE, August 2014

	Province	Number of sites	Potential in MW
1	Bandundu	114	172
2	Bas-Congo	24	64 000
3	Equateur	58	122
4	Kasaï Occidental	64	433
5	Kasaï Oriental	65	252
6	Katanga	70	2 231
7	Kinshasa	8	
8	Maniema	140	458
9	Nord-Kivu	130	332
10	Province Orientale	52	2 684
11	Sud-Kivu	41	1 197
	Total	**766**	**71 881**

6.1.2 POWER PRODUCTION

Electrical power in the DRC is produced by the National Power Utility (SNEL) and by self-producers mainly made up of private companies (mining sector), religious groups and NGOs. According to the statistics of the Ministry of Water Resources and Electricity, national production is as shown in Table 6-3 below.

Table 6-3: Electricity production in the DRC. Source: DRC Renewable Energy Atlas, MRHE, August 2014

	Producers	Number hydro stations	Number of thermal stations	hydro stations installed capacity (MW)		Thermal stations installed capacity		Total installed capacity			Total capacity available (MW)	
						MW		MW		%		
				2010	2011	2010	2011	2010	2011	2011	2010	2011
1	SNEL &	14,00	36,00	2 414,43	2 415,65	29,46	26,35	2 443,89	2 442,00	93,13%	1 328,52	1 114,00
	SINELAC	1,00		13,30	13,30			13,30	13,30	0,51%		
2	Self-producers	43,00	10,00		116,15		19,50	0,00	135,65	5,17%		5
3	Independent producers	4,00			31,28			0,00	31,28	1,19%		7,42
	Total	**62,00**	**46,00**		**2 576,38**	**29,46**	**45,85**		**2 622,23**	100,00%		**1 126,42**

The distribution by province (formerly administrative division) of installed and available capacity in 2012 is as shown in the next Table 6-4.

Table 6-4: Installed and available powers by province. Source: DRC Renewable Energy Atlas, MRHE, August 2014

	Province	Installed Capacity	Available Capacity	Ratio between available capacity /installed capacity
		MW	MW	%
1	Bandundu	3,57	1,00	28,01%
2	Bas-Congo	1 867,61	891,00	47,71%
3	Equateur	19,38	1,90	9,80%
4	Kasaï Occider	9,15	4,00	43,72%
5	Kasaï Orienta	16,50	11,00	66,67%
6	Katanga	583,60	350,16	60,00%
7	Kinshasa			
8	Maniema	18,45	1,00	5,42%
9	Nord-Kivu	8,84	8,84	100,00%
10	Province Orie	71,37	23,00	32,23%
11	Sud-Kivu	79,54	8,50	10,69%
	Total	**2 678,01**	**1 300,40**	**48,56%**

As a result, the country's electricity generation facilities are only at half their nominal capacity.

It should be noted that SNEL alone produces 95% of the country's electricity. Table 6-5 below, from SNEL's 2019 Annual Report, shows energy production for the period 2015 to 2019.

Table 6-5: Installed and available electricity power in DRC

Item	Year					Ratio (W/Inhabitant)
	2015	2016	2017	2018	2019	Power/Inhabitant
1. Installed capacity (MW)	2 455,42	2 455,42	2 456,43	2 608,50	2 608,80	27,23152401
Hydro	2 426,94	2 426,94	2 426,94	2 576,90	2 576,90	26,89916493
Thermal	28,48	28,48	29,49	31,52	31,84	0,332359081
2. Available capacity in (MW)	1 152,93	1 337,07	1 508,54	1 525,50	1 563,70	16,32212505
Hydraulic	1 140,50	1 324,94	1 324,94	1 512,00	1 549,80	16,17745303
Thermic	12,43	12,13	11,84	13,40	13,85	0,144572025
3. Average capacity used (MW)	1 021,51	1 014,41	1 081,36	1 207,30	1 313,90	13,71482255
Hydro	1 018,00	1 010,87	1 078,07	1 204,90	1 310,80	13,68267223
Thermal	3,51	3,54	2,29	2,40	3,08	0,032150313
4. Raw energy (GWh)	8 919,21	8 889,09	9 450,20	10 561,00	11 494,00	119,9488518
Hydro	8 908,62	8 879,45	9 443,88	10 555,00	11 483,00	119,860023
Thermal	10,59	9,64	6,32	6,63	8,49	0,088622129

From the previous table, it was possible to draw the following table 6-6 on the indicators.

Table 6-6: Hydro power availability and use rate

	Year				
	2015	2016	2017	2018	2019
Power availability rate in hydro	46,99%	54,59%	61,67%	58,68%	60,14%
Capacity utilisation rate in hydro	89,26%	76,30%	72,03%	79,69%	84,58%

According to the 2013 SIE report, SNEL has 50 power plants across the country, including 14 hydroelectric and 36 thermal plants. Its installed capacity of around 2429 MW represents 94.7% of the country's total installed capacity of approximately 2,565 MW, including the 135.5 MW produced by self-producers, independent producers.

For the period 2018 to 2019, SNEL's production fleet was as follows in terms of groups and power.

Table 6-7: Production park and installed generators. Source: SNEL 2019 Annual Report

NETWORKS	Stations	Number of installed machines	Installed machines in MW (2018)	Installed machines in MW (2019)
WESTERN	INGA 1 (Kongo-Central)	6	351,00	351,00
	INGA 2 (Kongo-Central)	8	1 424,00	1 424,00
	ZONGO 1 (Kongo-Central)	5	75,00	75,00
	ZONGO 2 (Kongo-Central)	3	150,00	150,00
	SENGA (Kongo-Central)	6	12,00	12,00
SOUTHERN	NSEKE (Lualaba)	4	260,00	260,00
	NZILO (Lualaba)	4	108,00	108,00
	M'SHA (Haut-Katanga)	6	67,80	67,80
	KONI (Haut-Katanga)	3	42,12	42,12
EASTERN	RUZIZI 1 (Sud-Kivu)	4	29,80	29,80
ISOLATED HYDRO STATIONS	TSHOPO (Tshopo)	3	19,65	19,65
	MOBAYI MBONGO (Nord-Ubangi)	3	11,37	11,37
	BENDERA (Tanganyika)	2	17,20	17,20
	KILUBI (Haut-Lomami)	3	9,00	9,00
TOTAL HYDRO		60	2 576,94	2 576,94
TOTAL THERMAL		75	31,52	31,84
GRAND TOTAL		135	2 608,46	2 608,78

Table 6-8: Energy received and delivered by SNEL. Source: SNEL 2019 Annual Report

Item	*Year*		Increase
	2018	2019	
Energy recived	11 109	12 260	10,35%
Production	10 310	11 278	9,38%
Importation	799	982	22,88%
Energy delivered	10 421	11 252	7,97%
Auxiliaries	31	48	54,14%
HV Customers	4 755	5 380	13,14%
Distribution	5 560	5 755	3,50%
Exportation	75	69	-8,09%

6.1.3 POWER REQUIRED AND POWER SUPPLIED

Table 6-9 below shows the need for electrical energy and the power supplied in MW in 2012.

Table 6-9: Electrical energy needs by province. Source: DRC Renewable Energy Atlas, MRHE, August 2014

	Province	Population in 2012		Electric power required in (MW)			Power supplied	Power shortfall
		Inhabitants	Nomber of households	Households	Other	Total	MW	MW
1	Bandundu	8 373 684	1 395 614	356		356	13,00	343,00
2	Bas-Congo	4 563 439	760 573	194		194	86,00	108,00
3	Equateur	8 177 934	1 362 989	347		347	1,90	345,10
4	Kasaï Occidental	5 480 150	913 358	233		233	4,00	229,00
5	Kasaï Oriental	7 383 932	1 230 655	314		314	11,00	303,00
6	Katanga	11 473 944	1 912 324	487	402	889	550,16	338,84
7	Kinshasa	10 245 494	1 707 582	435	417	852	410,00	442,00
8	Maniema	2 449 926	408 321	104		104	1,00	103,00
9	Nord-Kivu	3 603 322	600 554	153		153	13,84	139,16
10	Province Orientale	9 871 657	1 645 276	421		421	23,00	398,00
11	Sud-Kivu	4 438 667	739 778	188		188	8,50	179,50
	Total DRC	**76 062 149**	**12 677 024**	**3 232**	**819**	**4 051**	**1 122,40**	**2 928,60**

In 2012, the DRC's power requirements were estimated at 4,051 MW, whilst the supplied capacity was about 1,122.40 MW, representing an electricity shortfall of 2,928.60 MW, or 72.3% of the needs.

In 2016, according to the DRC 2017 statistical directory produced by the National Statistics Institute:

The proportion of the population with electricity is estimated at 18.90%;

The proportion of households connected to a public electricity distribution network is estimated at 20.70%;

The proportion of the population satisfied with the quality of public service providing electricity is estimated at 8.80%

This assessment provides an insight into not only the extent of the use of generators in the country to fill this energy gap, but also of the degree of deforestation caused by the use of firewood and charcoal for households, with all the ensuing consequences on the climate by the production of carbon dioxide, gases mainly causing the greenhouse effect.

6.1.4 THE EVOLUTION OF ELECTRICITY SERVICES IN THE DRC

Based on the elements contained in the summary of the action programme to achieve the Government's objectives over the period 2013-2016, it was possible to establish the evolution of the electricity service rate in the country from 2011 to 2016. These elements are contained in Table 6-10 below and represented in the graphs (Figures 6-11 and 6-12) below.

Table 6-10: Electric power service in DRC. Source "Electricity and Drinking Water Sector," MRHE, March 2013

	2011	2012	2013	2014	2015	2016
Total population (in millions)	75,3	77,8	80,4	83,2	86,0	89,0
Population supplied (in millions)	6,8	7,7	8,7	9,5	9,9	10,4
Non supplied Population (in millions)	68,5	70,1	71,8	73,7	76,1	78,6
Supply rate (in percentage)	9,03%	9,90%	10,76%	11,38%	11,51%	11,69%

Table 6-11: Evolution of electricity service in DRC

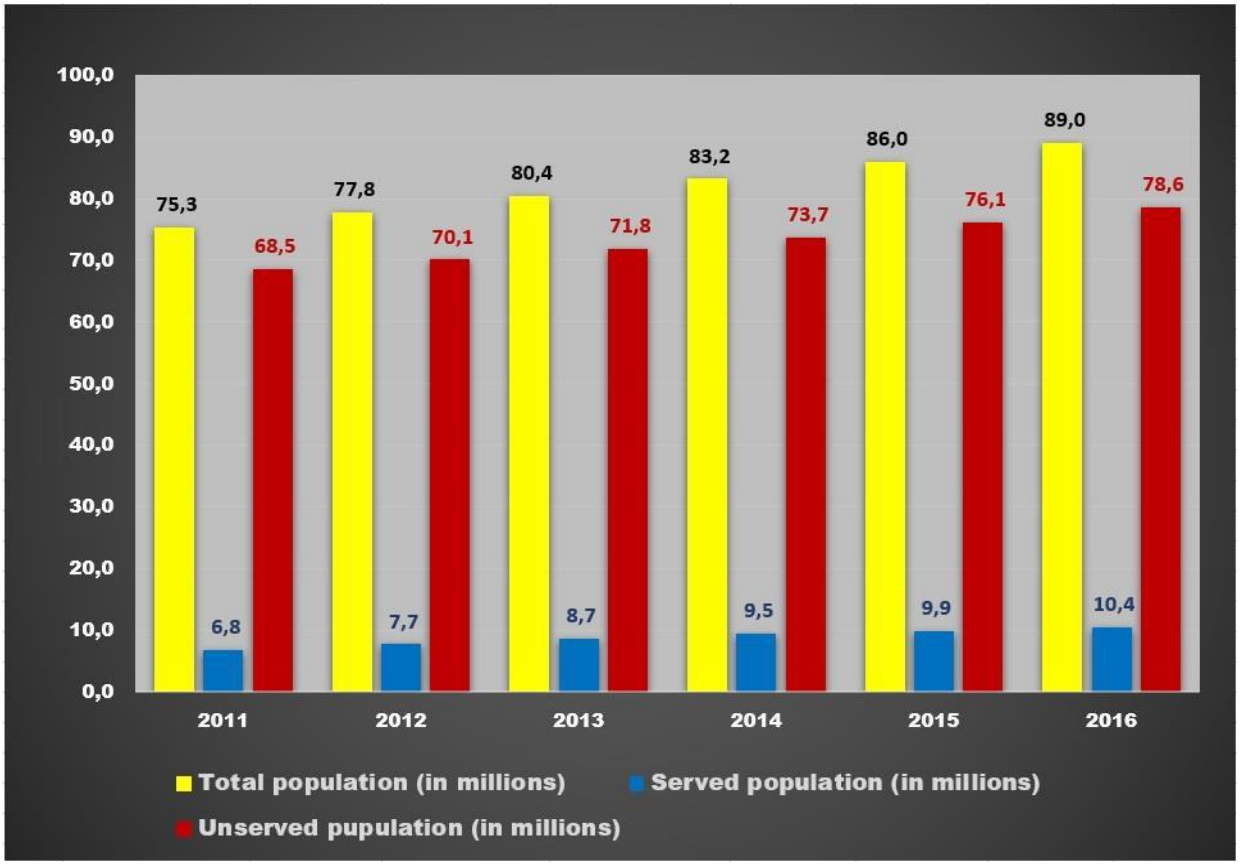
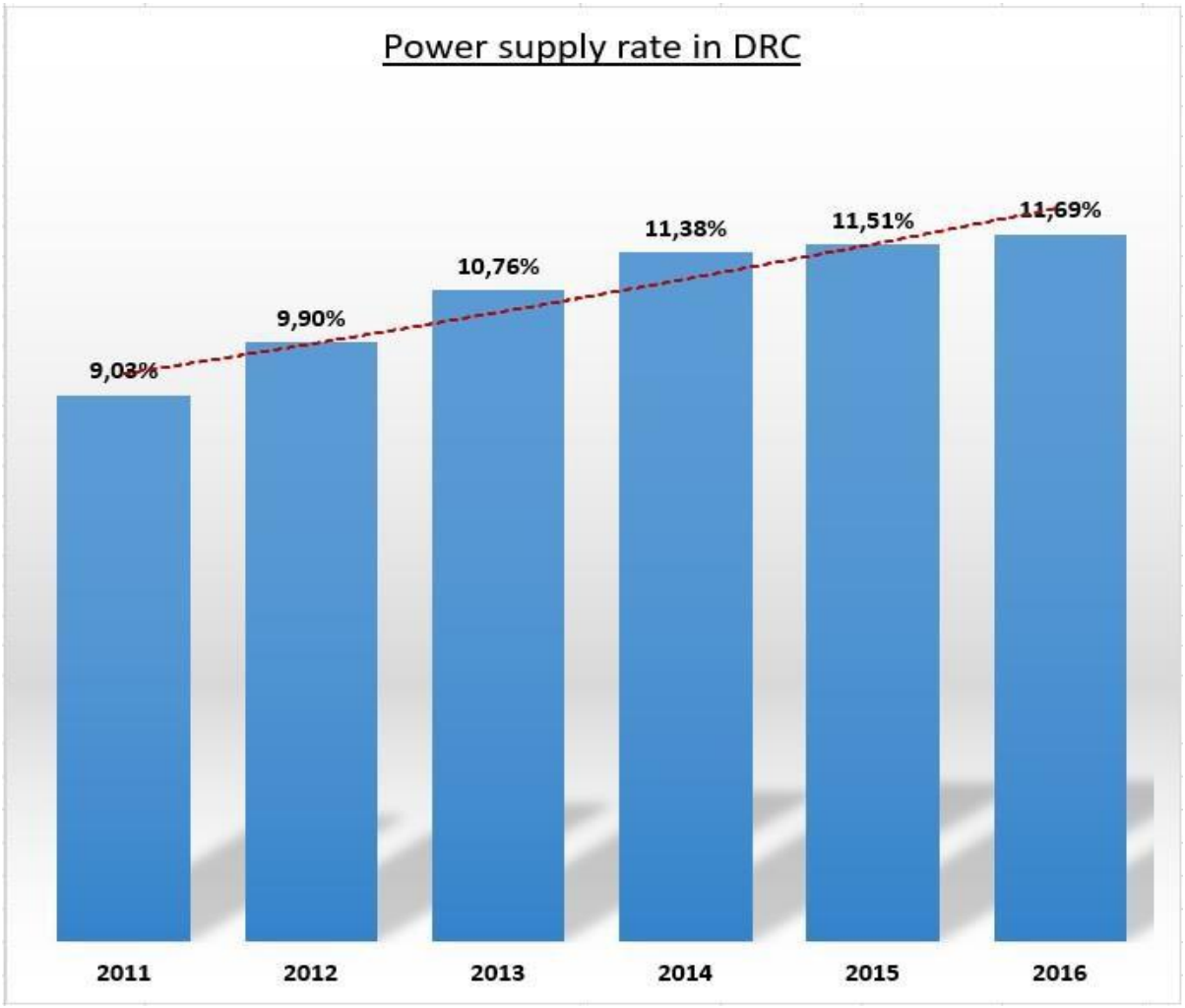


Table 6-12: Changes in electricity service rates in DRC

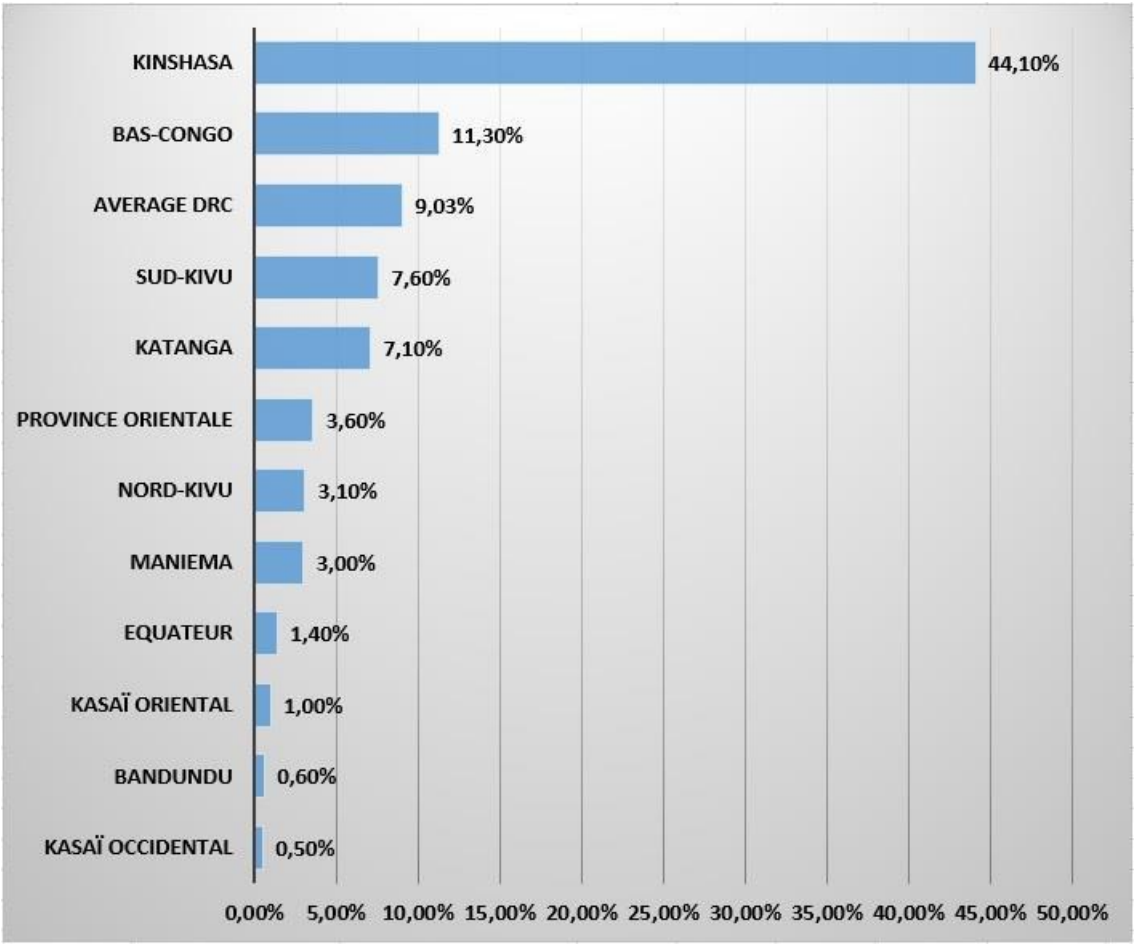


The electricity service rate has a gradual upward curve, but this growth is very slow. This rate rose from 9.03% in 2011 to 11.69% in 2016, an increase of 2.66% over a five-year period. Moreover, this is one of the causes of the country's economic blockade. Indeed, it has been demonstrated that energy consumption is linked to the economic development of acountry. Economic growth in countries is generally accompanied by an increase in the consumption of electricity in the same proportion. There is, however, a large disparity between the provinces, with the electricity service rate ranging from 0.5% in Western Kasaito 44.1% in Kinshasa as shown in Table 6-13 for 2011.

Table 6-13: Access to electricity by province. Source "Electricity and Drinking Water Sector," MRHE, March 2013

		Electricity supply rate in 2011
1	Kasaï Occidental	0,50%
2	Bandundu	0,60%
3	Kasaï Oriental	1,00%
4	Equateur	1,40%
5	Maniema	3,00%
6	Nord-Kivu	3,10%
7	Province Orientale	3,60%
8	Katanga	7,10%
9	Sud-Kivu	7,60%
10	Average DRC	9,03%
11	Bas-Congo	11,30%
12	Kinshasa	44,10%

Table 6-14: Access to electricity by province

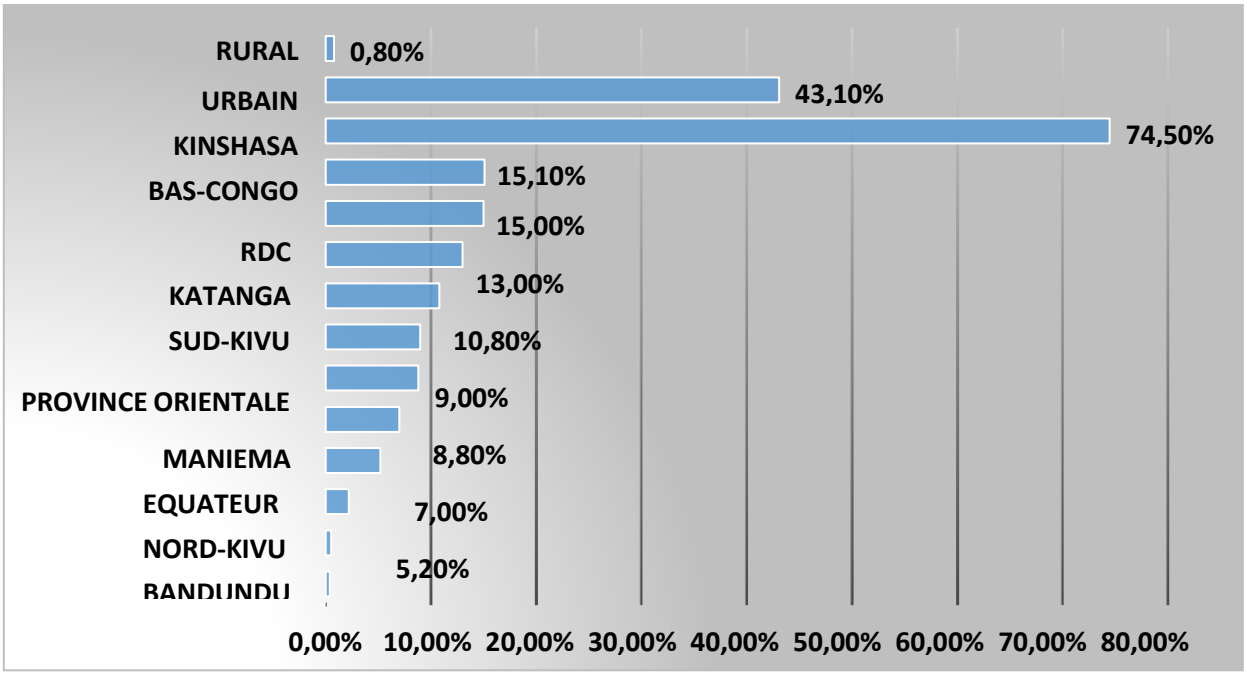


Another indicator of access to electricity in the DRC is the proportion of households with access to electricity by province and in residential area. According to the MDG National Report on the DRC's progress in achieving the MDGs in 2012, this access is presented as follows in Table 6-15 below.

Table 6-15: Household with access to electricity by province in 2012

		Households with access to water in 2012
1	Kasaï Oriental	0,40%
2	Kasaï Occidental	0,50%
3	Bandundu	2,20%
4	Nord-Kivu	5,20%
5	Equateur	7,00%
6	Maniema	8,80%
7	Province Orientale	9,00%
8	Sud-Kivu	10,80%
9	Katanga	13,00%
10	RDC	15,00%
11	Bas-Congo	15,10%
12	Kinshasa	74,50%
13	Urbain	43,10%
14	Rural	0,80%

Table 6-16: Household access to electricity by province

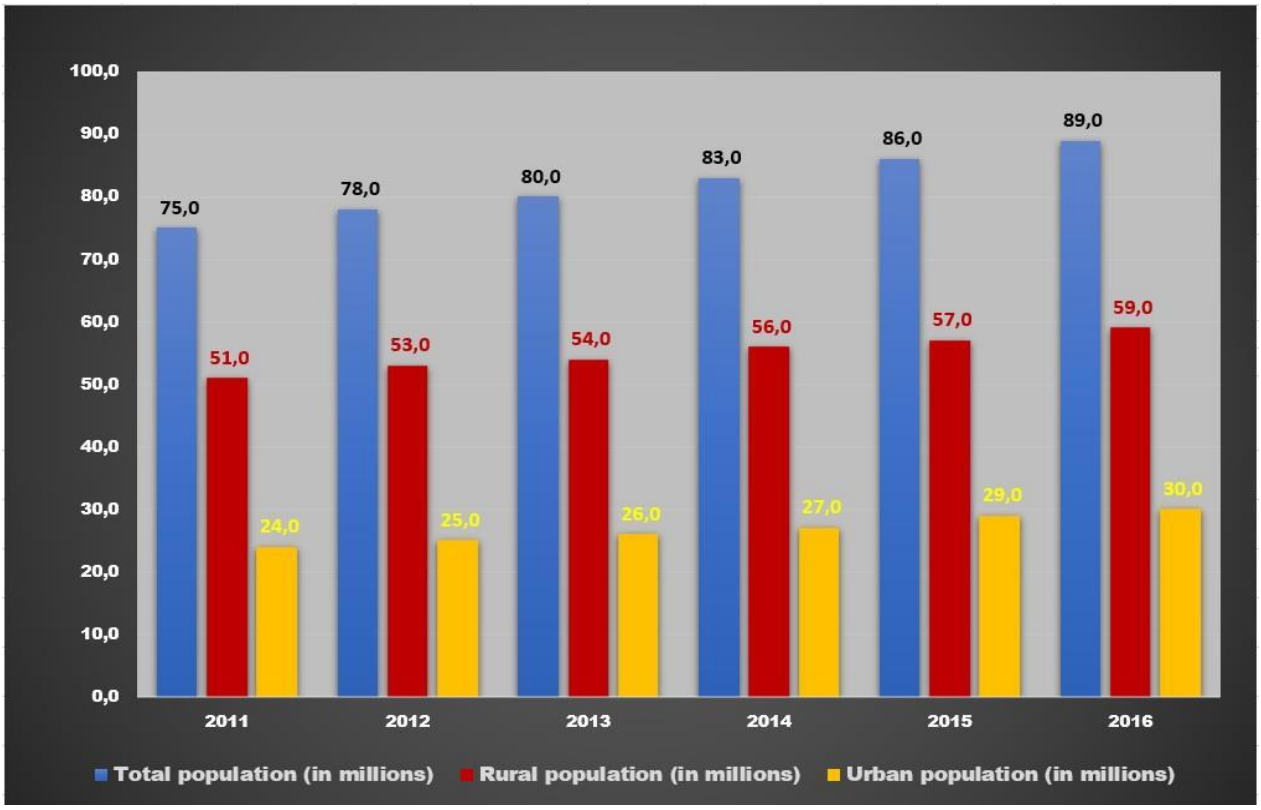


We failed to obtain the share of this electricity service between the urban population and the rural population by province. However, over the same period, the number of urban andrural population has changed as shown in Table 6-17.

Table 6-17: Evolution of the DRC's urban and rural population. Source: "Electricity and Drinking Water Sector," MRHE, March 2013

	2011	2012	2013	2014	2015	2016
Total population (in millions)	75,0	78,0	80,0	83,0	86,0	89,0
Population rurale (en millions)	51,0	53,0	54,0	56,0	57,0	59,0
Urban population (in millions)	24,0	25,0	26,0	27,0	29,0	30,0
Urban population (in percentage)	32,00%	32,05%	32,50%	32,53%	33,72%	33,71%

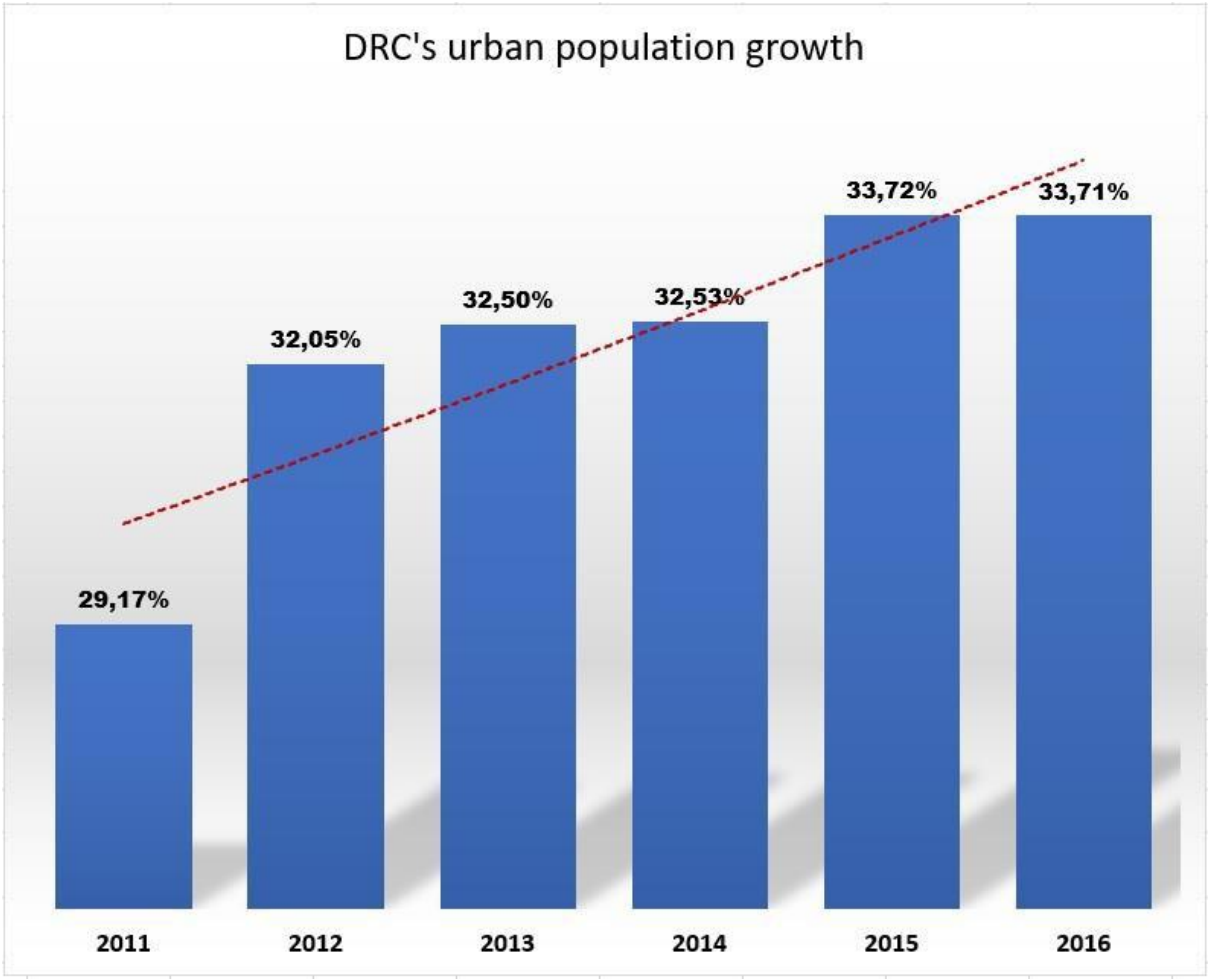
Table 6-18: Changes in the DRC's urban and rural population



The urban population is growing gradually and the trend curve is upward. From 2011 to 2016, it increased by 4.54%.

This gradual rise in the urban population shows that the DRC is certainly heading for a population explosion in the country's urban centres, where in a few years, more than half of the country's population is likely to live. This could certainly lead to more instability in households already living in excessive poverty in urban and peri-urban settings.

Table 6-19: DRC's urban population growth



6.1.5 ENERGY TRANSMISSION

SNEL's transport network consists of high-voltage lines totalling 6,975.36 km, 1,774.00 kmof which at very high direct current voltage (THTCC) connecting Inga (West) to Kolwezi inthe south of the country.

Table 6-20: Electric power transmission lines in DRC. Source: SNEL 2019 Annual Report

Designation	Year	
	2018	2019
Line length (Km)	6 936,86	6 975,36
500 kv (THTCC)	1 774,00	1 774,00
400 kv (THTCA)	253,00	253,00
220 kv (HTCA)	2 417,76	2 418,76
220 kv (HTCA)	328,50	366,00
110-120 kv (HTCA)	1 287,40	1 287,40
66-70 kv (HTCA)	649,20	649,20
50-55 kv (HTCA)	173,30	173,30
41 kv (HTCA) Electrode lines	53,70	53,70

6.1.6 ENERGY DISTRIBUTION

Electrical distribution facilities in the DRC are shown in the following two tables:

Table 6-21: Number of stations. Source: SNEL 2019 Annual Report

Item	Year	
	2018	2019
Number of installed substations	79	81
Number of available stations	78	81
Number of HV/MV TFOs	113	115
Number of HV/MV TFOs available	103	115

Table 6-22: Electricity distribution lines in the DRC. Source: SNEL 2019 Annual

Item	Year	
	2018	2019
1. Network length (Km)	21 158,63	21 356,61
MV network	5 525,92	5 605,36
LV Network	15 632,71	15 751,25
2. MV/LV substations	4 474,00	4 593,00
SNEL	2 499,00	2 548,00
Mixed	66,00	65,00
Private	1 626,00	1 695,00
State	283,00	285,00

6.1.7 INDIRECT AND VOLUNTARY INTERRUPTIONS

Voluntary interruption

Due to the permanent lack of available power in relation to the need of electricity users, the electricity utility operator often resorts to the voluntary interruption known as offloading. For example, in 2012 the deficit in the energy supplied was 2,928.60 MW or 72.3%of the needs.

Indirect Interruption

Table 6-23 below illustrates the indirect interruptions.

Table 6-23: Indirect interruptions. Source: SNEL 2019 Annual Report

Item	Designation	Year	
		2018	2019
1.	Total number of incidents	1 263	1 223
2.	Transmission related incidents	748	791
2.1	Total line faults	655	759
	Bushfire related faults	64	89
	Vegetation related faults	3	11
	Pollution related faults (thunder lightening…)	321	494
	Collapsed pylones, acts of vandalism, material defaults…	267	165
	100 km defaults	10	12
2.2	HV and EHV substation faults	93	32
3.	Other network interference faults	515	432

Figure 6-2: Indirect outages Source: SNEL SA

6.1.8 DRC OTHER ENERGY POTENTIALS

The DRC's energy potential is mainly composed of renewable energies such as water and biomass, as well as fossil fuels including crude oil, natural gas, energy plants, etc.

The data provided by the 2013 SIE-RDC Annual Report show the country's energy balance as follows:

- In 2011, supply was in the order of 23,629 kTEP (TEP: Tonnes Equivalent Oil), compared to 24,116 kTEP in 2010, a decrease of 2%; Total final consumption was 22,047 kTEP compared to 22,611 kTEP in 2010, a decrease of 2.5%;
- Total final consumption is 0.29 TEP per capita. It is lower than the African average of 0.48 TEP per capita and global by 1.25 TEP per capita; Just over 93.3% of total final consumption comes from biomass, while other forms of energy contribute 4.1% for petroleum products and 2.6% for electricity.

UNDP's national report on human development 2016 indicates that most households in DRC use firewood (65.6%) and charcoal (26.8%) for cooking, a total of 92.4% of cooking energy from the forest.

In urban areas, charcoal is the most used (54.0%) Kinshasa (51.6%). In rural areas, on the other hand, firewood is the most used, at about 86.7%.

The distribution of the type of cooking energy is shown in **Table 6-24** below and in the graph (**Figure 6-3**) below.

Table 6-24: Breakdown of the type of cooking energy in the DRC. National Human Development Report 2016, UNDP, August 2017

	Electricity	Gas	Oil	Charcoal	Firewood	Wood dust	Other	Total
Urban	15,5%	0,3%	1,4%	54,0%	28,0%	0,2%	0,6%	100,00%
Rural	0,1%	0,1%	0,7%	11,5%	86,7%	0,5%	0,4%	100,00%

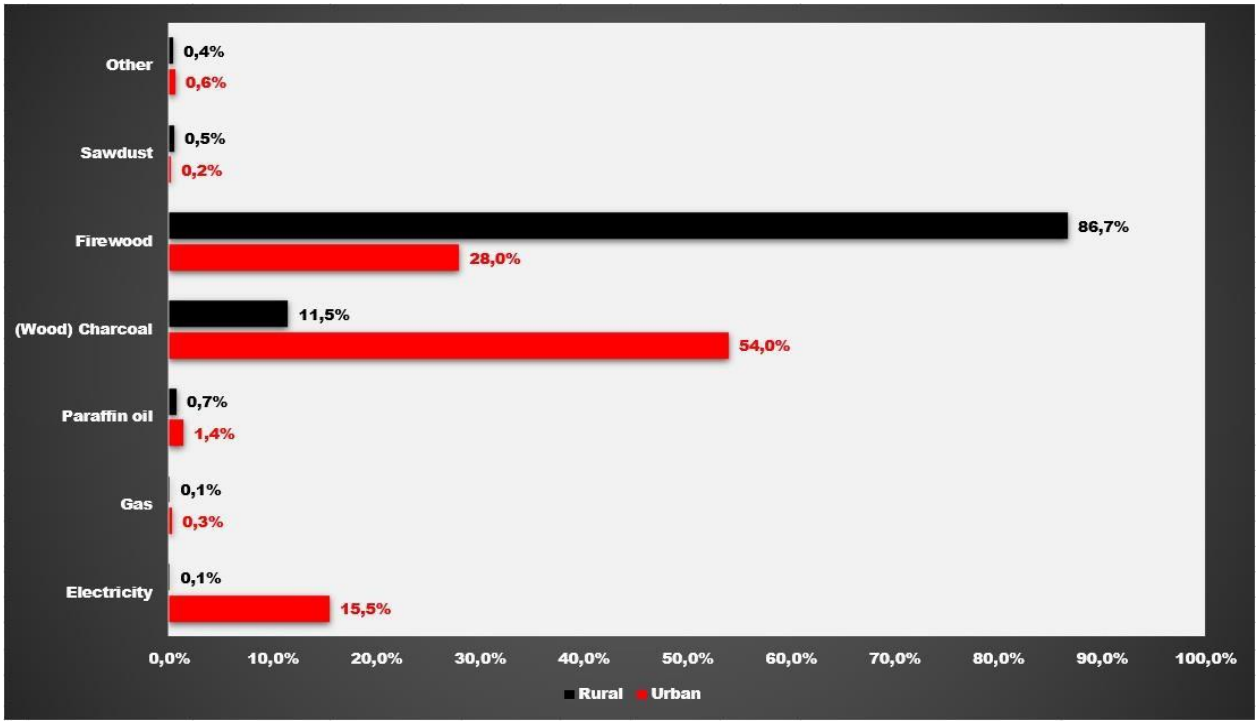


Figure 6-3: Breakdown of the type of cooking energy in the DRC

Fossil fuels

These are crude oil, natural gas and ground coal.

Crude oil

The D RC's crude oil potential is not yet fully assessed, but available data indicate reserves of around 230 million barrels of crude oil in three sedimentary basins:

- The Atlantic Coast Basin;
- The central basin;
- The western basin of the East African Rift.

The only reserves exploited to date are those in the Atlantic Coast Basin.

Other fossil fuels

Other fossil fuels include untapped coal and methane gas. However, two mining companies, respectively Gécamines and Géomine, had industrially operated the Luena coalmines in Haut-Lomami and the Lukuga coalmine in Tanganyika, which have since then been shut down. These two coal deposit reserves are estimated at 720 million tonnes, 50 million of which are mineable. As for methane gas, reserves are estimated at 50 billion m^3 of dissolved methane gas under the waters of Lake Kivu.

Renewable energy

Renewable energy is essentially biomass, hydropower just talked about, geothermal, solar, wind and tidal energy. They are inexhaustible and non-polluting with the exception of biomass.

Biomass

Biomass comes from organic matter such as firewood, charcoal, straw, plant waste and animal world residues, which can be burned and provide energy.

Biomass can generate biogas and biofuels.

In particular, as regards wood, the Congo Basin forest is the second largest tropical forestafter the Amazon rainforest. It extends across Cameroon, Gabon, Congo-Brazzaville and the DRC, covering an area of more than 2 million km^2.

In the DRC alone, the potential of wood energy is estimated at 122 million hectaresequivalent to 8.2 billion TEP.

In the form of firewood and charcoal, biomass ensures the daily survival of millions of Congolese. It accounts for almost 90% of the total energy consumed by the population.

Other renewable energy

As for other renewable energies such as solar energy, it is neither valued nor exploited, despite favourable conditions. Indeed, the available data indicate that the DRC is in a very high band of sunshine with values between 3,250 and 6,000 peak/m^2/day watts, or 3.25 to6 kWh/m^2, compared to 3 kWh/m^2 in European countries where solar energy exploitation is still increasing.

However, the use of solar energy is severely limited to the domestic needs of certain associations in the rural world, and in very small numbers, for example for medical care, livestock, lighting, etc.

As for wind energy, its use is not known in the DRC. In fact, most parts of the country are below the start-up speed of fast wind turbines, which is 5 m per second.

The geothermal potential, consisting of geothermal sites and active volcanoes in the east of the country, is also not exploited.

6.2 WATER SUPPLY

Water is a major part of the human body. It accounts for 60% of the human body. A man cannot live more than four days without drinking. To be healthy, a man needs a minimum of one and a half litres of water per day. In addition, to live properly, i.e. drink, cook, wash,clean the house and clothing, an individual needs about 50 litres of water per day.

In this way, access to water is a prerequisite for survival, hence the importance given to this resource by the United Nations, by international organizations and governments of allcountries of the world.

6.2.1 DRC'S FRESH WATER RESOURCES

The DRC has one of the largest freshwater reserves on the planet. Indeed, the Congo River and Amazon watersheds are the largest in the world. The Congo River with an average flowof 41,000 m^3 per second is the second in the world after the Amazon with an average flowrate of 209,000 m^3 per second.

6.2.2 DRC WATERSHEDS

The freshwaters of the DRC are contained in two watersheds, the Congo River and the Nile River. The Congo River watershed is the largest, extending over 3,730,500 km2 and covering 10 countries.

As represented in **Figure 6-4** below, this Congo River watershed includes the Congo River itself, fed by several tributaries and a lake system made up of ten lakes, which can be grouped by regions as follows:

- The basin lakes including Lake Mai-Ndombe and Lake Tumba;
- The plateau lakes comprising Lakes Moero, Bangwelo and Upemba;
- Mountain lakes with Lakes Kivu, Tanganyika, Albert and Edouard. Lakes Albert and Edouard, however, are located on the Nile side.

Also included in this lake system are the three depression lakes: Kamalondo, Tshangalele and N'Zilo.

The large outlying lakes of the east cover an area of about 48,000 km^2, 47% of which are under Congolese jurisdiction. The DRC part areas are respectively:

- Lake Kivu: 1,700 km^2;
- Lake Tanganyika: 14,800 km^2;
- Lake Albert: 2,420 km^2;
- Lake Edward: 1,630 km^2;
- Lake Moero: 1,950 km^2.

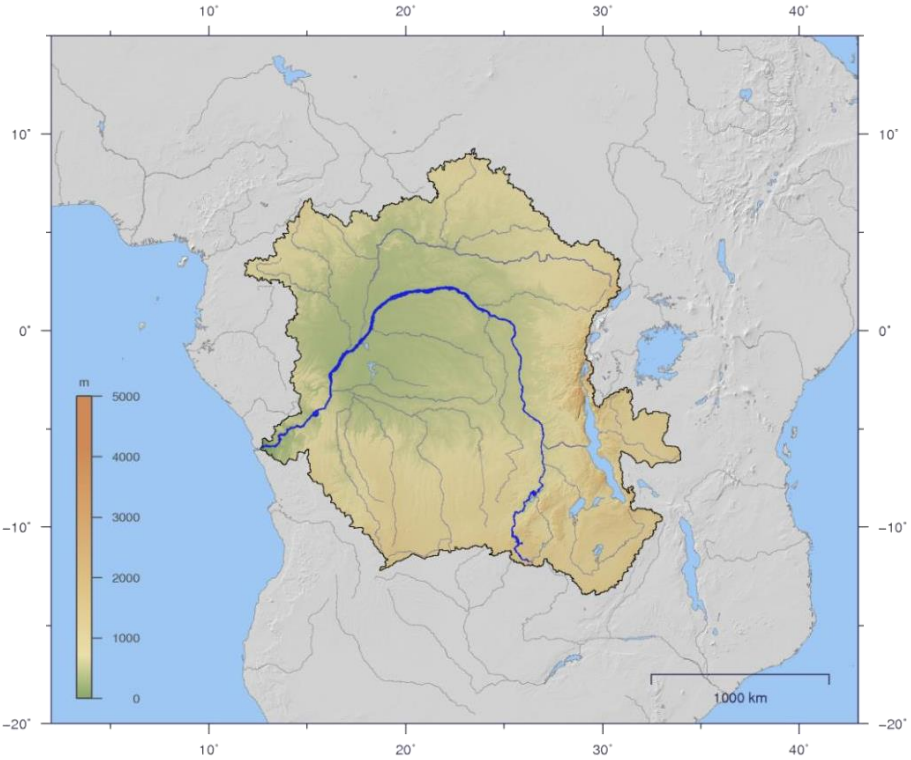


Figure 6-4: Congo River watershed. Source: Google www.google.com

Lakes Mai-Ndombe and Tumba together cover an area of between 2,300 and 7,000 km^2, depending on the dry and rainy seasons.

The depression lakes cover the following areas respectively:

- Lake Kamalondo: 6,256 km^2;
- Lake Tshangalele: 446 km^2; and
- Lake N'Zilo: 280 km^2.

6.2.3 WATER TOWERS

The three large water towers identified and located in the east and in its southern part feed the fresh waters of the DRC. These are the towers of the Albertine Rift, the Lufirian Arc and the Angolan Plateau, respectively.

The DRC cannot run out of fresh water, which it has in abundance in terms of resources. In principle, access to safe drinking water in this country should not be a problem.

6.2.4 THE SITUATION OF DRINKING WATER SERVICES

The period before 1990 until the 1991-2000 decade

Drinking water service was 27% in 1970, 43% in 1980 and 49% in 1990, respectively. At the end of the 1991-2000 decade, the DRC's water service rate fell to 40% of the urban population because of the ongoing conflicts in the country at the end of the decade. Out of a total of 94 operating centres of the state-run company in charge of the public drinking water service, REGIDESO, shown in figure 6-4 below, only 19 centres were still operational in 2000, the rest being either completely destroyed or partially operational.

The period after the 2001-2010 decade

In 2011, the rate of access to safe drinking water in the DRC fell to only 25.3%, or 19.1 million of those served out of a total population estimated at 75.3 million. In the same year, there was a significant imbalance in drinking water service between the provinces (former administrative division), as shown in Table 6-25 and Figure 6-6 below. The recorded rates ranged from 5% in Equateur and Kasai Occidental to 65% in Kinshasa and Bas Congo.

The information available in the Summary of the Action Programme to achieve the Government's objectives for the period 2013-2016 indicates the evolution of the drinking water service as shown in Table 6-25 below and in Figures 6-6 and 6-7 below.

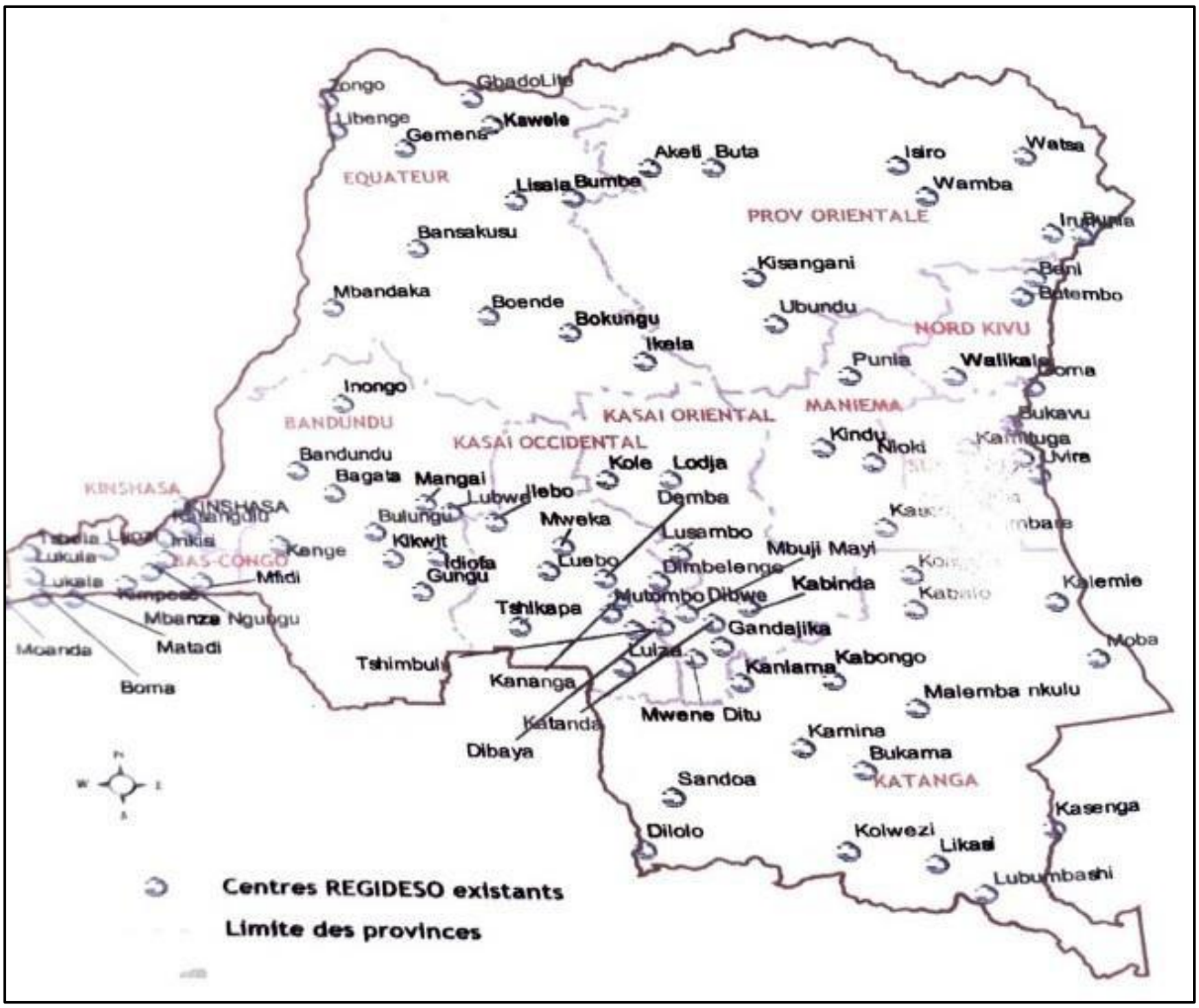


Figure 6-5: REGIDESO operation centres (2 above)

Table 6-25: Access to drinking water by province. Source: "Electricity and Drinking Water Sector," MRHE, March 2013

		Potable/drinking water supply rate in 2011
	Rural areas	1,00%
	Kasaï Occidental	5,00%
	Equateur	5,00%
	Maniema	7,00%
	Bandundu	13,00%
	Kasaï Oriental	18,00%
	Province Orientale	25,00%
	Katanga	25,00%
	Nord-Kivu	30,00%
	Sud-Kivu	37,00%
	Moyenne RDC	43,00%
	Bas-Congo	65,00%
	Kinshasa	65,00%

	2011	2012	2013	2014	2015	2016
Total population (in millions)	75,3	77,8	80,4	83,2	86,0	89,0
Population supplied (in millions)	19,1	21,7	25,3	32,8	31,6	33,7
Non supplied Population (in millions)	56,2	56,1	55,2	50,4	54,5,36,74	55,3
Supply rate (in percentage)	25,37%	27,89%	31,47%	39,42%	36,74%	37,87%

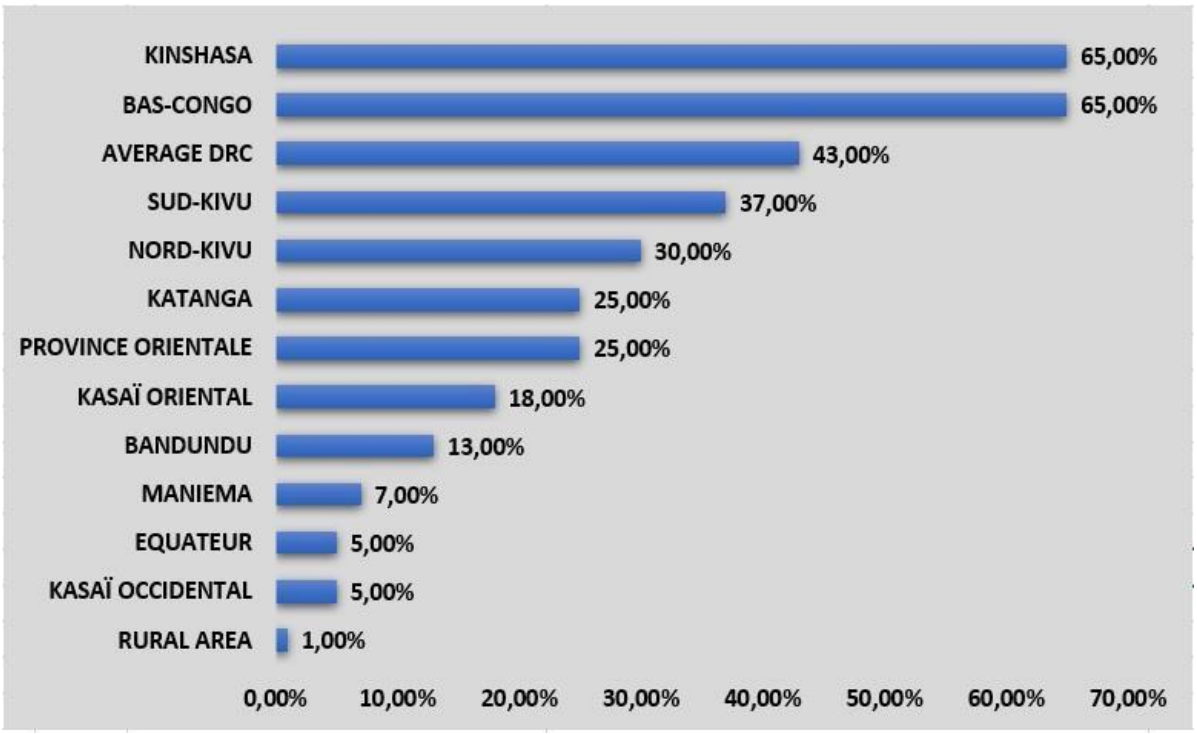


Figure 6-6: Access to drinking water by province 2011

From 2011 to 2016, the evolution in the rate of drinking water service, as reflected in Figure 6-8 below, increased from 25.37% to 37.87%, an increase over five years of only 12.5%. With such a rate, the DRC has not met the MDGs in terms of access to safe drinking water for its population.

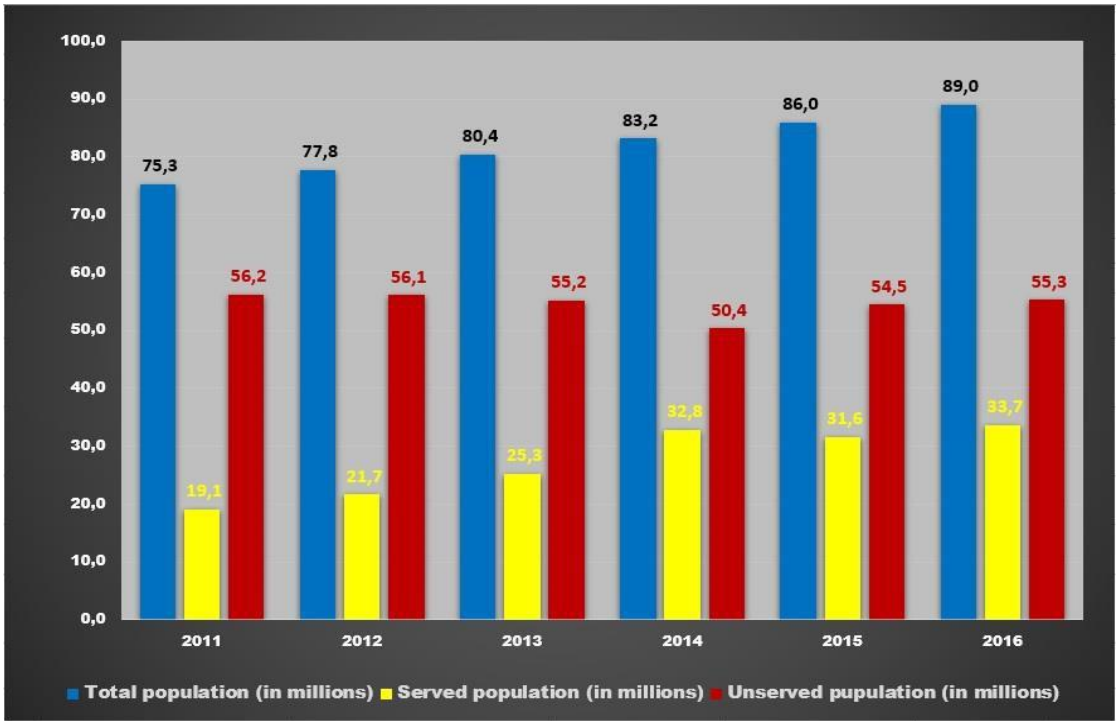


Figure 6-7: Evolution of the DRC's drinking water service

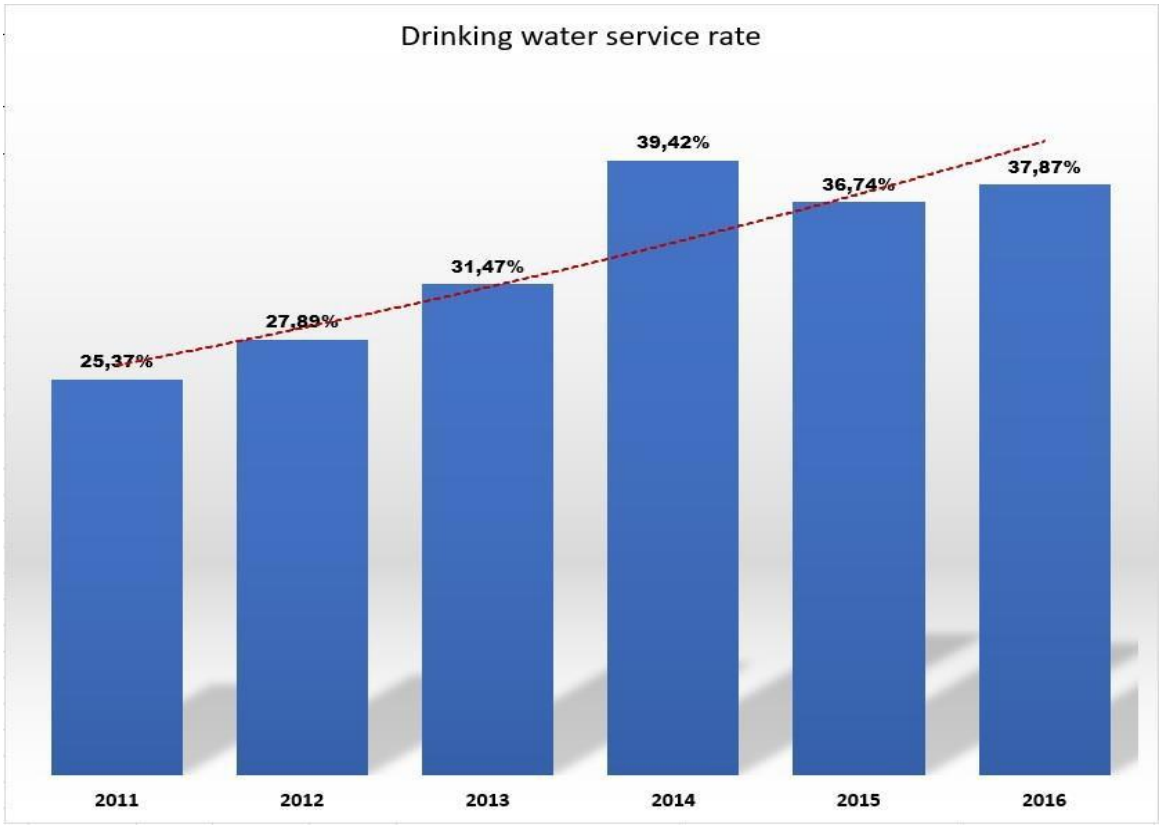


Figure 6-8: Evolution in DRC's drinking water service rate

The price of this service is currently about 0.0125 U.S. dollars, or 500 Congolese francs, per 20-litre water container. This price also includes the maintenance of mini-networks at the expense of the inhabitants organized into user associations. The population itself managesthis provision autonomously and communally.

Network-connected households

Table 6-26: Households connected to the public network in 2017. Source REGIDESO

Province	Number of householdsconnected to the public distribution network
Kinshasa	306 885
Bas-Congo	52 710
Bandundu	17 126
Equateur	15 838
Province Orientale	28 737
Nord-Kivu	25 062
Sud-Kivu	33 538
Maniema	2 873
Katanga	77 098
Kasaï-Oriental	25 483
Kasaï-Occidental	23 665
Total	**611 015**

Community water sources (alternatives to the water utility)

To obtain drinking water in the DRC, many households use other sources, outside of the public water service. According to the 2015 MDG report, 50.4% of the population in DRC have access to safe drinking water, including 32.6% of the population in rural areas and nearly 85% of the urban population, while the rate of drinking water service by the public water operator is less than 40%. For example, about 10.4% of the population has drinking water from alternative sources, including boreholes, wells, etc.

This high access to drinking water of 50.4%, as shown above, can be explained by the provision of water through alternative solutions. Indeed, the services by the Rural Hydraulics, NGOs, religious denominations and private operators have found the alternative to the deficient supply of water by the public operator service. These organizations have indeed set up mini supply networks providing water in the form of fountains to the population living in outlying districts in the large urban cities. The population itself manages this provision autonomously and communally.

A mini-grid usually consists of a borehole equipped with a submersible, manual or electric pump, water pipes, reservoirs (tanks) for water storage and fountains where people draw water.

These mini-networks, located in the outlying neighbourhoods of some urban centres, enable the population to have access to water within 250 meters of their homes.

Table 6-27: Number of drillings installed by the National Rural Hydraulic Service (SNHR). Source: Ministry of Rural Development

Province	2011-2012 Campaign		2012-2013 Campaign		2013-2014 Campaign		Total 2011-2014 campaigns	
	Pumps	**Population served**	**Pumps**	**Population served**	**Pumps**	**Population served**	**Pumps**	**Population served**
Kinshasa	37	493 000	11	87 000	40	534 000	88	1 027 000
Bas-Congo	21	116 000	13	51 000	30	277 000	64	444 000
Bandundu	5	62 000	6	82 000	6	14 000	17	158 000
Equateur	17	17 000	19	38 000	3	3 000	39	58 000
Province orientale	27	65 000	14	33 000	27	65 000	68	163 000
Nord-Kivu	33	33 000	18	56 000	33	33 000	84	122 000
Sud-Kivu	27	141 000	10	29 000	32	108 000	69	278 000
Maniema	5	5 000	6	25 000	5	5 000	16	35 000
Katanga	87	296 000	10	67 000	93	302 000	190	665 000
Kasaï-Oriental	6	120 000	10	10 000	6	120 000	22	250 000
Kasaï-Occidental	13	137 000	7	64 000	23	137 000	43	338 000
Total	**288**	**1 485 000**	**124**	**542 000**	**298**	**1 628 000**	**700**	**3 538 000**

According to a UNICEF study conducted in Kinshasa, Kongo-Central and Equateur, as part of the maintenance of water points in sanitized villages (May 2019), the access to water insome neighbourhoods, particularly Kinshasa, is generally quite degraded, and is more akinto the situation of rural households than that of the country's urban population. Table 6-28, below, includes the drinking water sources of these three provinces.

Table 6-28: Households' main source of drinking water

	Kinshasa		Kongo Central		Equateur		Total	
	Number	%	Number	%	Number	%	Number	%
Manual pump on drilling	608	68,2%	324	64,4%	131	32,3%	1063	60,6%
Manual pump on improved drill	2	0,2%	6	1,2%	28	6,9%	36	1,7%
Regideso	59	6,6%	0	0,0%	0	0,0%	59	3,7%
Equipped source	39	4,4%	106	21,1%	75	18,5%	220	11,4%
Indepedent network	37	4,1%	11	2,2%	57	14,0%	105	5,4%
Other	147	16,5%	56	11,1%	115	28,3%	318	17,2%
Total	**892**	**100,0%**	**503**	**100,0%**	**406**	**100,0%**	**1 801**	**100,0%**

In the three provinces under consideration, the percentage of households that obtain water from a pump is 62.3%, distributed as follows, manual pump mounted on drilling (60.6) and pump on improved wells (1.7%). The main source of household drinking water in these provinces is by manual drilling pump and manual pump on improved wells. These two sources of supply constitute 68.4% for Kinshasa, 65.6% for Central Congo and 39.2% for Equateur, respectively, representing an average of 62.3% for all these provinces. From these figures, it can be established that only 37.7% of households living in villages equipped with hand pumps draw their drinking water from other sources of supply.

Distance to be travelled to obtain water supplies

According to the analysis report on the survey entitled "Water Sanitation and Life Conditions 1 2018" (EACV1), the average distances between households and various sources of supply in Kinshasa are presented in the manner shown in Table 6-29 below:

Table 6-29: Average distance travelled from households to obtain water from water sources

	Average Distance	Average distance during the dry season
In minutes on foot	9,2	12
In metres	448,5	577

In the rainy season, it takes little time due to abundance of water sources, while during thedry season the springs dry up and people have to go farther and farther afield to find water.

The proportion of households with a drinking water source of more than 1 km is 22%.

Availability of water at the tap

Another important aspect of drinking water worth raising is the availability of tap water. In principle, having a faucet/tap does not automatically mean having drinking water available,but it would have to run on the tap.

Given the water source multiplicity, it has been noted that data on water availability from public and private service systems are difficult to quantify. Based on the availability of tap water in some neighbourhoods, where some members of this drafting team live, such accessibility is very low and can be as low as a few hours per month.

Nevertheless, some urban dwellers have increased the availability of tap water by acquiringone or more reservoirs (tanks) of suitable capacity in order for them to significantly increase the availability of tap water. In this way, they even manage to have up to 300 daysof water running available from the tap of their homes.

However, the required equipment for this solution is excessively expensive. These are usually high-capacity tanks, hydraulic pumps and system installation piping. To have sufficient capacity, this installation cost can reach more than US$3,000 to US$5,000 at theexpense of the recipient of this equipment, maintenance costs not included.

Water quality

The analysis report of the EACV1 investigation conducted in May 2018 shows that nearly 23% of the households surveyed collect and drink water from sources that they themselvesconsider non-potable, or whose quality they do not know. This is also true in the rainy season when more sources are available. A majority of households, 56%, collect their drinking water from different locations, and combine drinking and non-drinking water. It should be noted that 9% of households in the neighbourhoods surveyed consume only water deemed non-potable.

Table 6-30: Quality of water source drinking water as estimated by households

	Percentage of households assessing the quality of water	Percentage of households assessing the quality in the dry season
Deemed potable source of water	90.9	85.2
Non potable deemed source of water	19.9	17.3
Unknown quality water source	2.8	1.9

6.3 SANITATION

6.3.1 WASTEWATER MANAGEMENT

The criteria determining a good sanitation system include:

- Increased access to quality water that can supply individual sanitation facilities;
- Good waste management;
- Efficient sewage and storm water disposal.

For example, sanitation, as discussed in this report, consists in assessing individual and collective sanitation facilities to ensure that the population lives in a viable and healthy environment, not conducive to the spread of endemic diseases such as typhoid fever and malaria.

This improvement in the above facilities must go hand in hand with reducing pollution from wastewater treatment and rainwater disposal.

Access to water is essential to ensure a better environment for the population. Although the DRC has an enormous potential in fresh water, as shown above, the population, paradoxically, has very little access to this commodity.

Indeed, a few inhabitants of some upscale neighbourhoods in some urban centres of the country can have permanent access to water and ensure the provision of sufficient water to individual and collective sanitation facilities. The vast majority of urban dwellers, due to lack of water availability, as well as almost the entire rural population, continue to use poor quality water, and sometimes-even sewage.

Often for want of anything a better, these populations are content with river water, unsanitary open wells, ponds, rains and temporary pools. Overall, these water resources are not often of good quality and generally insufficient to drink and cover the various needs that require water. In summary, adequate quality water is needed to ensure permanent access to basic sanitation systems.

In many neighbourhoods in many Congolese cities, the rainwater drainage system is often blocked by sand and solid debris, especially in Kinshasa. The situation is still of concern where the sanitation system is inadequate or non-existent.

Non-channelled rainwater turns into torrents of water and causes recurrent flooding and erosion of soils and hillsides. In addition to the risk of landslides, traffic congestion, many public and private infrastructures are often flooded.

To counteract this deterioration of drains and land, the DRC has proceeded, albeit timidly, with the development of roads, the treatment of gutters as well as the fight against erosion and, at least slightly, with the collection of waste regularly blocking the gutters. Since then, it has been found that where the gutters have been cured or built, the floods cause much less damage. A few initiatives have been undertaken in this regard. Kinshasa, for example, has developed a "Roads and Sanitation of Kinshasa" project, which aims to improve the living conditions of poor people by creating jobs, sanitation, improving the accessibility of neighbourhoods and

opening up some of the city's municipalities. This project has prioritized the municipalities of Kimbanseke, Kisenso, Masina, Barumbu, Kinshasa, Gombe,Lingwala and Ngaliema.

Access to basic sanitation systems has not been as widespread in all cities in the country, but Kinshasa and Lubumbashi are relatively more successful in sanitation than other cities.

Regarding the city of Kinshasa, for instance, the strength in this area rests particularly on:

- The existence of technical services such as the OVD, the RATPK (the Sanitation and Public Works Authority of the city of Kinshasa), etc.;
- The existence of a sanitation policy;
- The construction of sanitation works through the Government's programme (channels, sewers, etc.);
- The acquisition of sanitation and laboratory analysis equipment by, in particular, the OVD;
- The creation of the RATPK;
- The provision of tillers per municipality to enable the collection of household waste;
- The creation of a technical landfill in Kinshasa in Mpasa;
- The creation of transit dumps in nine municipalities in the city (Barumbu, Kinshasa, Gombe, Lingwala, Kintambo, Bandalungwa, Ngiri-Ngiri, Kalamu and Kasavubu).

Similar structures do not yet exist in other urban centres in the country.

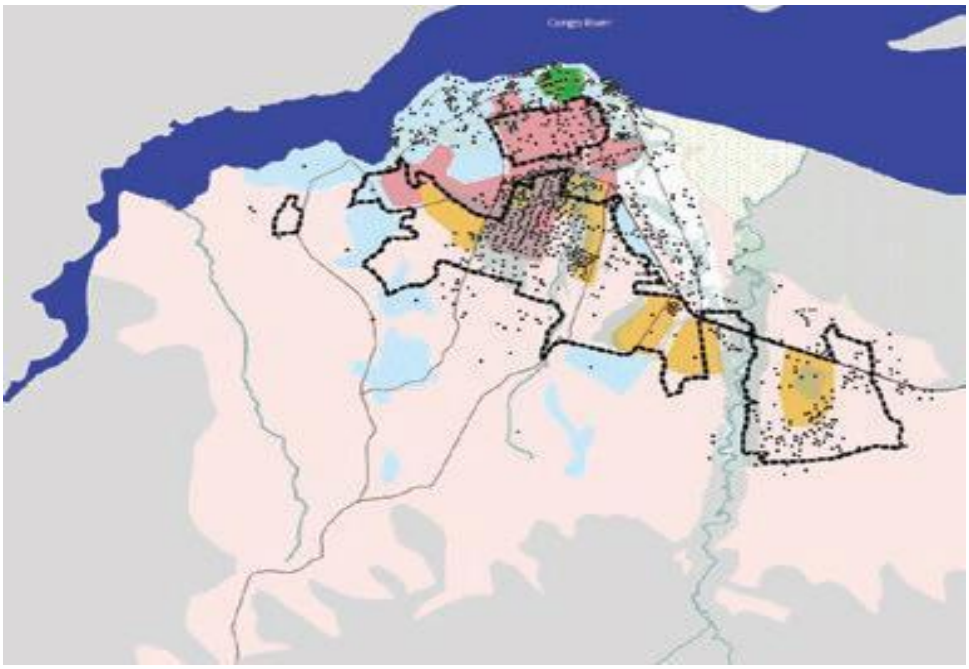


Figure 6-9: Sanitation plan for the city of Kinshasa. Source: WASH Poor in a Water-Rich Country

High-density areas

Individual drilling at high risk of contamination Water table less than 2 metres below the surface

Storm water drainage used as a combined sewer

Sanitation mainly on site. Mainly functional Storm water drainage

Sanitation mainly on site. Poor drainage Repair status

6.3.2 FAECAL MANAGEMENT

The state of toilets in urban areas remains a major concern in the DRC, as very few people have access to an improved toilet. The statistics in the Habitat III Final Report as shown in Table 6-31 below clearly show this.

Table 6-31: Evolution of urban toilet condition in %

	2007	2008
Improved	21,2%	18,7%
Rudimentary	74,5%	74,5%
Nature	4,3%	7,8%

Over the course of 7 years, the proportion of the urban population with improved toilets has decreased by 2.5%, that of rudimentary toilets has remained at the same level while thatof those who go out into the wild increased by 3.5%. This is a deplorable regression in the context of improving the sanitation system.

The colonial sewer system in central Kinshasa has been dysfunctional for decades. Today, the majority of the capital's population depends on latrines. While open defecation is low (2%), only 21% of Kinshasa inhabitants have access to improved unshared toilets. Of these, less than 7% also have hand-washing facilities. Worryingly, even faecal matter from improved facilities is generally not disposed of safely due to weak service chain sanitation.

Even improved latrines are generally of poor quality with faeces seeping into soil or water bodies (CNAEA et al.2015). More than 37% of households had never emptied their pits, leaving them overflowing or moving when they were full.

The dangers of hazardous containment are increased by the limited availability of professional draining services. There are no public service trucks. Private mechanical emptying services are small-scale and expensive (about 10 companies with 2 to 5 trucks each). Drain costs are relatively high with even individual manual drains charging between $50 and $200.

Kinshasa does not have safe disposal or treatment sites. Trucks unload sludge at the confluence of the YOLO and KALAMU rivers, or use a site near NDOLO Airport (Limete municipality). The volume of sludge reaching streams has been estimated at 400 cubic metres per day (IGIP 2006; OPM 2016).

6.4 ELIMINATION OF SOLID WASTE

One of the major environmental ills of urban centres in the DRC is that of waste. Poorly managed, household waste pollutes both water and atmosphere and thus affects the health of urban populations.

According to UNDP's National Human Development Report 2016, from 2000 to 2010, the amount of waste generated by the DRC's urban population is as shown in Table 6-32 below.

Table 6-32: Quantities of waste (in %) generated by the urban population from 2000 to 2010

Kind of waste	Residential areas	Planned townships	Old townships	New townships	Extensions	Grand market	General average
Waste	55,30%	39,10%	44,20%	28,20%	33,70%	28,00%	38,10%
Kitchen midden	13,00%	12,40%	8,50%	1,60%	3,00%	0,00%	6,40%
Papers and cartons	4,10%	8,30%	4,20%	3,00%	2,30%	9,00%	5,20%
Rags	3,70%	1,30%	2,30%	9,70%	0,60%	0,50%	3,00%
Metals	7,90%	1,80%	3,70%	3,00%	1,60%	0,70%	3,10%
Plastics	2,40%	3,30%	2,80%	2,30%	2,30%	1,90%	2,50%
Glass, bones and miscelleanous waste	2,30%	3,00%	2,80%	2,30%	0,10%	1,60%	2,00%
Sand, gravel	10,80%	30,80%	31,20%	51,20%	55,10%	58,20%	39,60%
Fermented materials	**76,10%**	**61,10%**	**59,30%**	**42,50%**	**39,60%**	**37,00%**	**52,20%**
Inert materials	**23,90%**	**38,90%**	**40,70%**	**57,50%**	**60,40%**	**60,00%**	**47,70%**

0,00% 5,00% 10,00% 15,00% 20,00% 25,00% 30,00% 35,00% 40,00% 45,00%

78% of urban waste in the DRC consists of sand, gravel, and debris.

In Kinshasa, for instance, apart from the nine transit dumps identified above, there are noother controlled landfills. However, some municipalities have undeveloped but authorized public landfills. Some of these existing in residential neighbourhoods are anarchic and thusconstitute uncontrolled public dumps. There are numerous such landfills in Kinshasa called"Fulu".

However, it must be noted is that Congolese households dispose of their household wastein a variety of ways: public or private organized service, incineration or burial, discharge onpublic roads, either in a stream or in a nearby dump, compost or manure.

The same report mentions the following proportions for waste disposal as shown in Table6-33 and Figure 6-10 below.

Table 6-33: How waste disposal is removed by Congolese households (in %)

Waste evacuation mode	Proportion
Evacuation into the rivers and springs	2,40%
Evacuation through other means	4,40%
Incineration	8,60%
Evacuation on public streets	8,70%
Waste evacuation services	10,90%
Transformation into compost	12,20%
Hiding in the ground	21,90%
Throwing away in wild disposal sites	30,80%

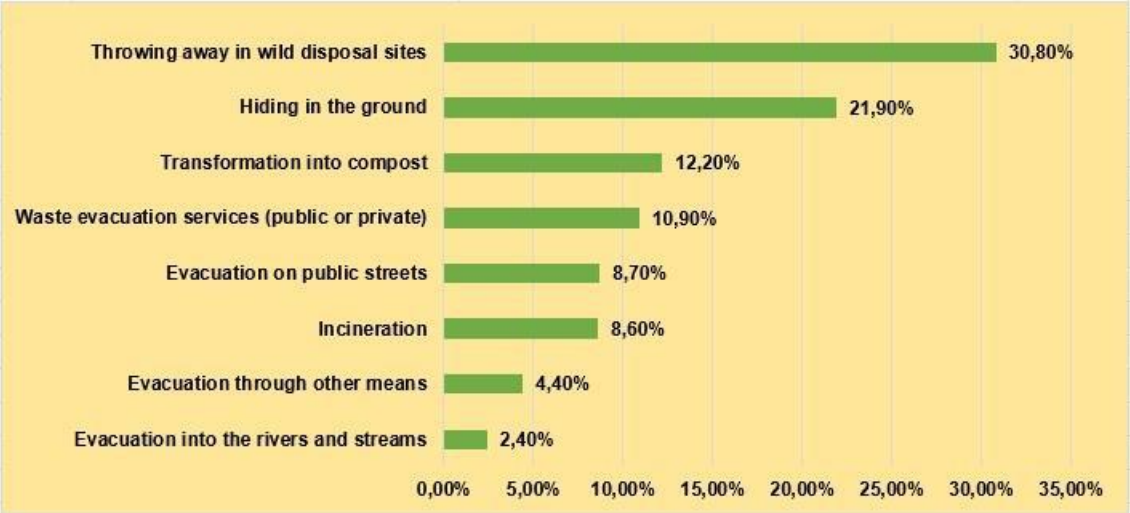


Figure 6-10: % distribution of waste by method of disposal

It is difficult for the DRC to estimate the production of solid waste by industrial plants due to a lack of control and information on the production and quantity of solid waste produced. However, for the city of Kinshasa, industrial waste production is estimated to be 20% of the total volume of waste produced in the city.

In Kinshasa, for example, small-scale studies show that the rate of plastic in landfills has increased sharply and currently ranges between 13.2% and 22.2%.

In the DRC, the use of individual facilities is more widespread for the discharge of domestic waste and the commercial sector.

It should be noted, however, that the high population growth in the urban environment as experienced by the country's major cities, led by Kinshasa and Lubumbashi, will greatly amplify the discharge of household waste, which, if not well managed now, will further increase the spread of diseases such as typhoid and malaria.

In short, what is needed for the DRC is better sanitation of public environments (hospitals, industries, public places, etc.), a good environment for urban households in the collection of household waste and control of anarchic dumps. This will help eradicate tropical and dirty-hands diseases. In addition, more than anything, we need to finance the construction of waste treatment and waste recycling plants.

Table 6-34: Volume of waste evacuated in Kinshasa and Lubumbashi in cubic metres

	2012	2013	2014
PARAU	149 970	258 180	257 700
PARAU's Partners	130 617	215 655	256 865
Private Individuals	33 682	5 804	74 603
TOTAL	314 269	477 159	588 801

Table 6-35: Waste composition and locations of waste disposal structures in Kinshasa

Waste	Percentage	Location of structures	Numbers
Organic Materials	65	Boulevard Lumumba	12
Plastic	15	Gombe	15
Metals	7	Lingwala	4
Textiles	6	Kintambo	5
Inert Materials	4	Kinshasa	6
Glass	2	Barumbu	7
Other	1	Ngaliema	4

6.5 ROADS

With its huge area of 2,345,409 km^2, the Democratic Republic of Congo (DRC), needs a large network of communication routes to include:

- Making it easier to transport people and goods thereby facilitating the circulation of people and;
- Ensuring the security of the national territory;
- Ensuring connectivity between provincial main towns;
- Unlocking isolated areas, mainly those with high population density and agri-industrial production;
- Ensuring connectivity with border countries through the construction of internal and external corridors;

Facilitating the evacuation of basic necessity products to consumption centres; Open up outward roads:

- Transportation in the DRC has always been a challenge due to the morphology of the terrain and the difficult climatic conditions. To solve this problem, the country has:
- A road network of nearly 153,209 km including national, provincial, urban roads and agricultural service roads that the country needs to maintain and develop infrastructure;
- A 5,035 km railway network ;
- A network of waterways with a length of 16,238 km; and
- 270 airports and airfields, 101 of which are open to public traffic, 164 are private and 5 are military.

The following photos (Figures 6-11 and 6-12), on the DRC's road infrastructure, were presented in Kinshasa by ONICIV Engineers at the training seminar on the development of the "Infrastructure Report Card project" in March 2020.

Figure 6-11: National dirt road (ONICIV March 2020)

Figure 6-12: Lumumba Boulevard - Kinshasa Limete (ONICIV March 2020)

The DRC's road infrastructure covers a large network of nearly 153,209 km consisting of national, provincial, urban roads and agricultural and local roads.

6.5.1 ROADS UNDER THE MANAGEMENT OF THE RAOD AUTHORITY (OR).

Roads under the management of the RAOD AUTHORITY include national roads, and provincial priority and secondary roads distributed as shown in Table 6-36 below.

Table 6-36: Roads under the responsibility of the RAOD AUTHORITY. Source: "RAOD AUTHORITY in a Nutshell" Leaflet, March 2014

Designation		National roads	Provincial roads	Provincial roads	Length
Sand roads	Length	17 501	20 201	17 245	54 947
	(Proportion)	84,62%	100,00%	100,00%	94,53%
Paved roads	Length	3 182	0	0	3 182
	(Proportion)	15,38%	0,00%	0,00%	5,47%
Total	Length	20 683	20 201	17 245	58 129
	(Proportion)	35,58%	34,75%	29,67%	100,00%

The interpretations of this table are included in Figures 6-15 and 6-16 below.

National and provincial roads account for approximately 35% of all roads under the management of the RAOD AUTHORITY, respectively. Provincial secondary roads account for 30% of the roads managed by this Office.

Only 15% of the national roads under the control of the OR are paved, all other roads beingin dirt, including national ones at a rate of 85%. No provincial roads are paved.

These roads are spread over the national territory as shown in Figure 6-17 below.

The distribution by province and in increasing order of the 58,129 km of roads under the Office's management is presented as shown in Table 6-37 below.

Based on the total length of these roads by province, we have established in % theproportions of km of all these roads contained in each of the provinces.

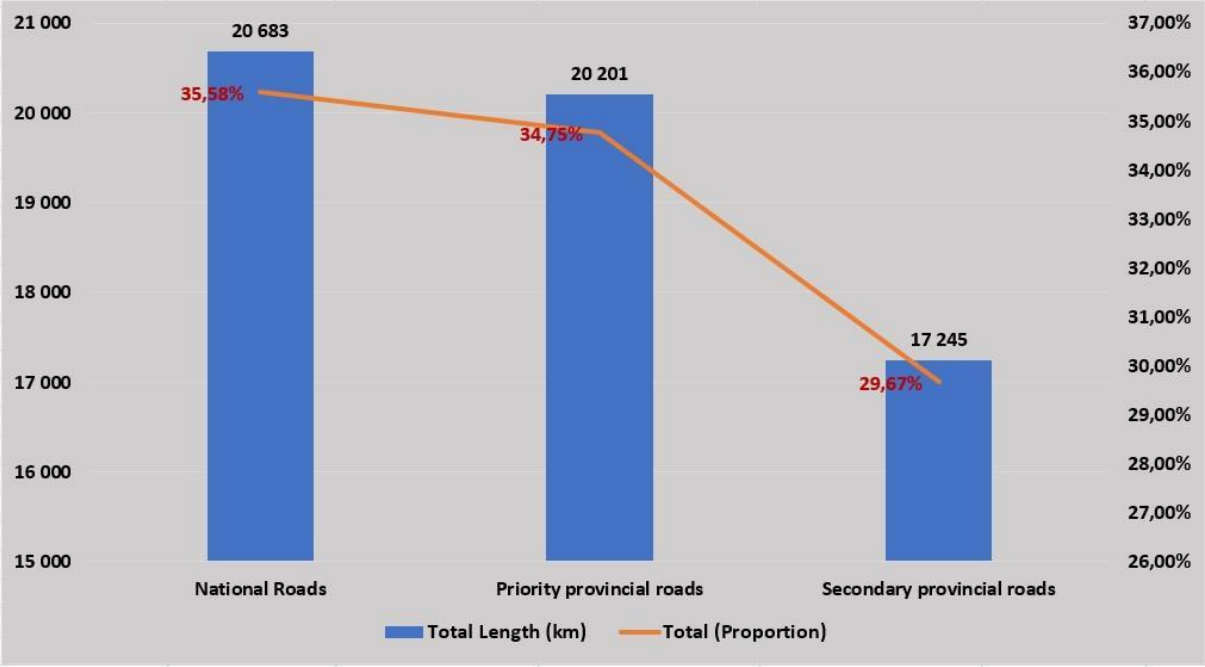


Figure 6-13: Distribution in km and % in proportion to the total mileage of roads managed by the RAOD AUTHORITY

The province with the least mileage of roads under the responsibility of the RAOD AUTHORITY is Kinshasa with 0.43 per cent (252 km) of these kilometres, while Maniema has the highest number of these kilometres at 6.56% (3,812 km).

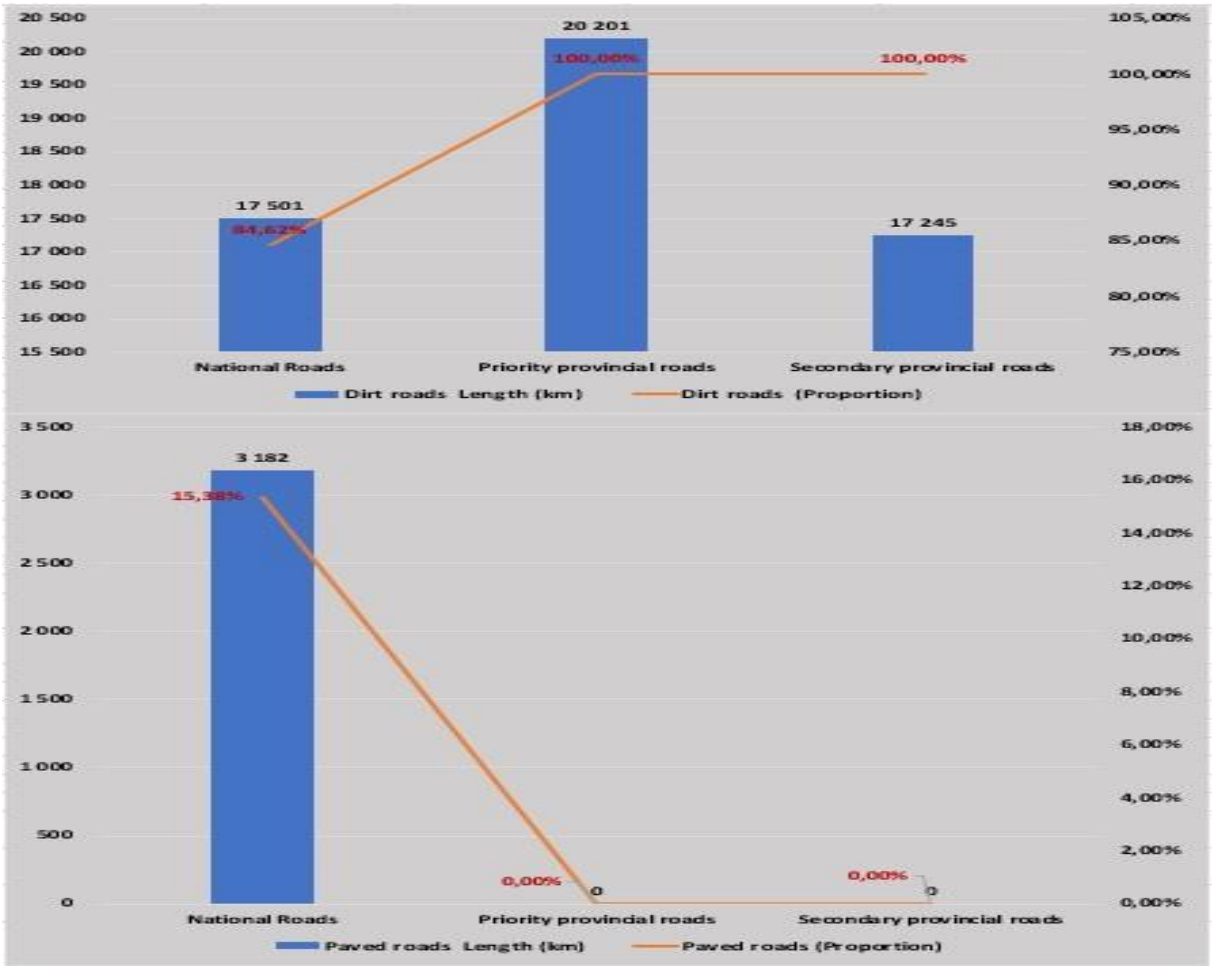


Figure 6-14: Distribution in km and % of paved and dirt roads

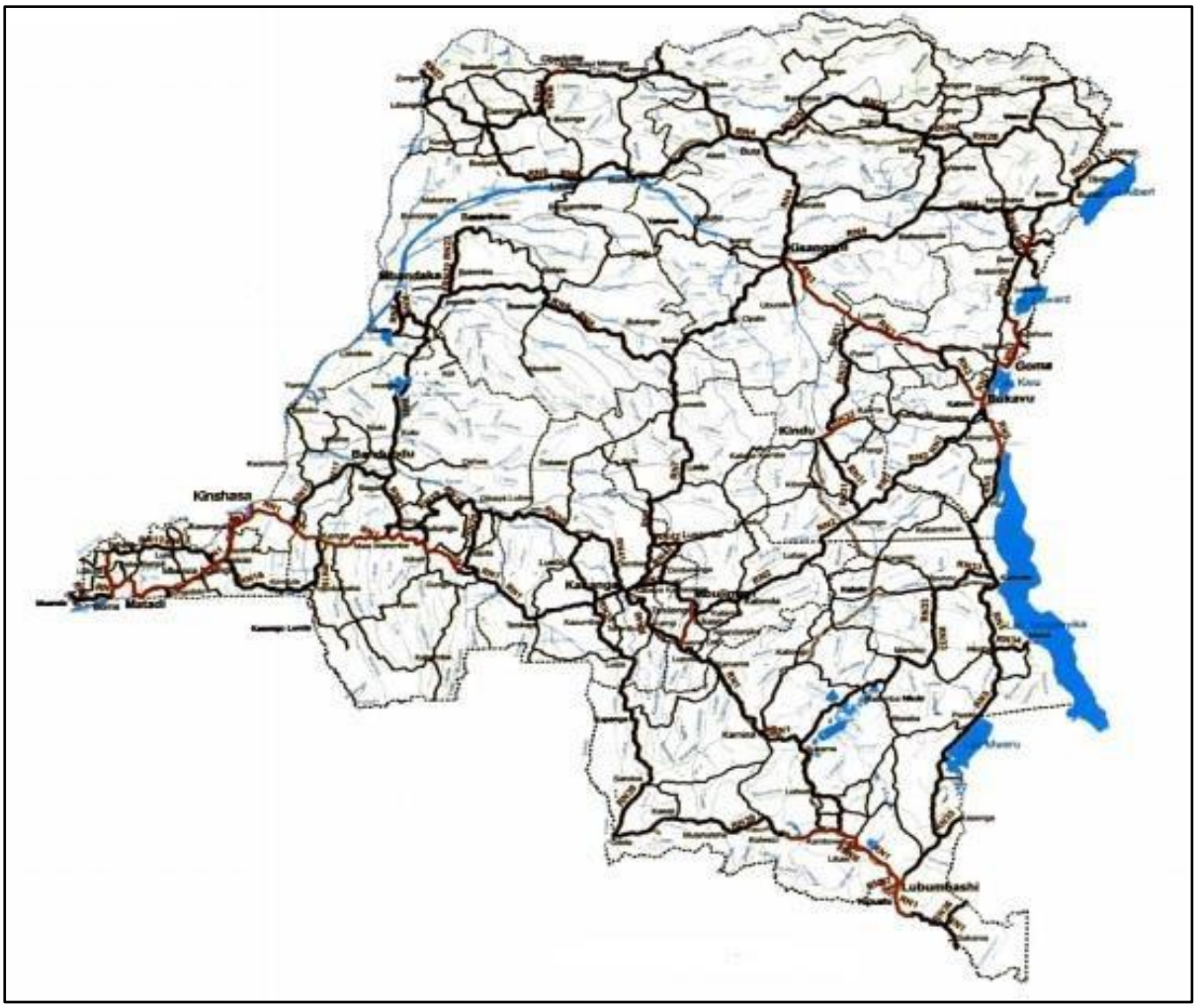


Figure 6-15: Road classification card (OR). Source: Annual Activity Report, Fiscal Year 2013, RAOD AUTHORITY

Table 6-37: Distribution by province of roads under the responsibility of the RAOD AUTHORITY. Source: Annual Activity Report, Fiscal Year 2017

No	Province	National roads	Priority provincial roads	Secondary provincial roads	Total length
1	KINSHASA	252	0		252
2	KASAI ORIENTAL	278	15	32	325
3	KWANGO	356	1 243	1 266	2 865
4	NORD-UBANGI	433	576	372	1 381
5	SUD-UBANGI	457	684	965	2 106
6	MONGALA	484	483	880	1 847
7	SANKURU	553	1 127	477	2 157
8	LOMAMI	626	485	725	1 836
9	HAUT-UELE	684	1 270	473	2 427
10	HAUT-LOMAMI	691	895	639	2 225
11	TSHUAPA	699	702	525	1 926
12	KASAI	702	867	389	1 958
13	ITURI	723	691	554	1 968
14	MAI-NDOMBE	729	1 151	1 118	2 998
15	NORD-KIVU	823	511	412	1 746
16	EQUATEUR	866	373	305	1 544
17	SUD-KIVU	1 023	643	250	1 916
18	MANIEMA	1 057	1 485	1 270	3 812
19	HAUT-KATANGA	1 081	921	829	2 831
20	BAS-UELE	1 083	404	830	2 317
21	KWILU	1 092	779	1 108	2 979
22	TANGANYIKA	1 118	1 456	203	2 777
23	TSHOPO	1 122	1 213	1 218	3 553
24	LUALABA	1 174	973	1 066	3 213
25	KASAI CENTRAL	1 207	363	470	2 040
26	KONGO CENTRAL	1 370	891	869	3 130
	TOTAL	**20 683**	**20 201**	**17 245**	**58 129**

Table 6-38: The total length by province of all roads under the responsibility of the RAOD AUTHORITY

Province	Total length (km)	Proportion(%)
KINSHASA	252	0,43%
KASAI ORIENTAL	325	0,56%
NORD-UBANGI	1 381	2,38%
EQUATEUR	1 544	2,66%
NORD-KIVU	1 746	3,00%
LOMAMI	1 836	3,16%
MONGALA	1 847	3,18%
SUD-KIVU	1 916	3,30%
TSHUAPA	1 926	3,31%
KASAI	1 958	3,37%
ITURI	1 968	3,39%
KASAI CENTRAL	2 040	3,51%
SUD-UBANGI	2 106	3,62%
SANKURU	2 157	3,71%
HAUT-LOMAMI	2 225	3,83%
BAS-UELE	2 317	3,99%
HAUT-UELE	2 427	4,18%
TANGANYIKA	2 777	4,78%
HAUT-KATANGA	2 831	4,87%
KWANGO	2 865	4,93%
KWILU	2 979	5,12%
MAI-NDOMBE	2 998	5,16%
KONGO CENTRAL	3 130	5,38%
LUALABA	3 213	5,53%
TSHOPO	3 553	6,11%
MANIEMA	3 812	6,56%
TOTAL	**58 129**	**100,00%**

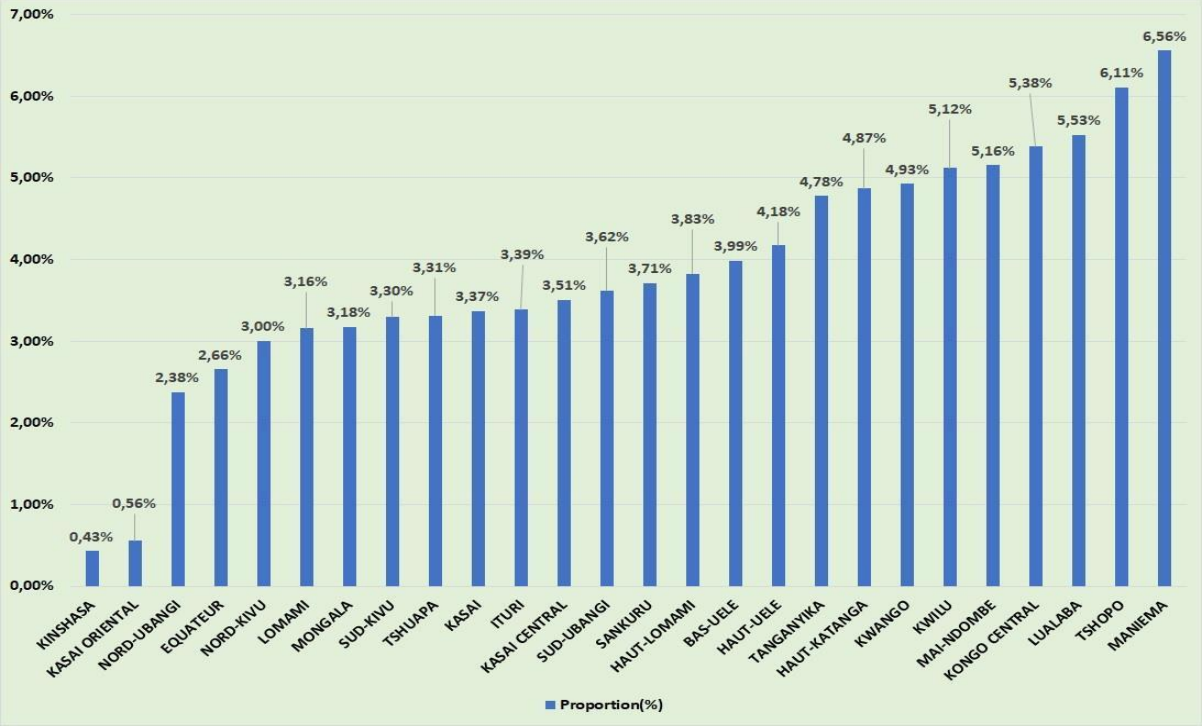


Figure 6-16: Distribution in % of the total length of roads under the responsibility of the RAOD AUTHORITY

Table 6-39: The total length by province of national roads under the responsibility of the RAOD AUTHORITY

Province	National roads (km)	Proportion (%)
KINSHASA	252	1,22%
KASAI ORIENTAL	278	1,34%
KWANGO	356	1,72%
NORD-UBANGI	433	2,09%
SUD-UBANGI	457	2,21%
MONGALA	484	2,34%
SANKURU	553	2,67%
LOMAMI	626	3,03%
HAUT-UELE	684	3,31%
HAUT-LOMAMI	691	3,34%
TSHUAPA	699	3,38%
KASAI	702	3,39%
ITURI	723	3,50%
MAI-NDOMBE	729	3,52%
NORD-KIVU	823	3,98%
EQUATEUR	866	4,19%
SUD-KIVU	1 023	4,95%
MANIEMA	1 057	5,11%
HAUT-KATANGA	1 081	5,23%
BAS-UELE	1 083	5,24%
KWILU	1 092	5,28%
TANGANYIKA	1 118	5,41%
TSHOPO	1 122	5,42%
LUALABA	1 174	5,68%
KASAI CENTRAL	1 207	5,84%
KONGO CENTRAL	1 370	6,62%
TOTAL	**20 683**	**100,00%**

Kinshasa has the lowest mileage, 1.22% (252 km on 20,683km) of national roads and Kongo-Central has the highest mileage of national roads with 6.62% (1,370 km) of national roads located in this province.

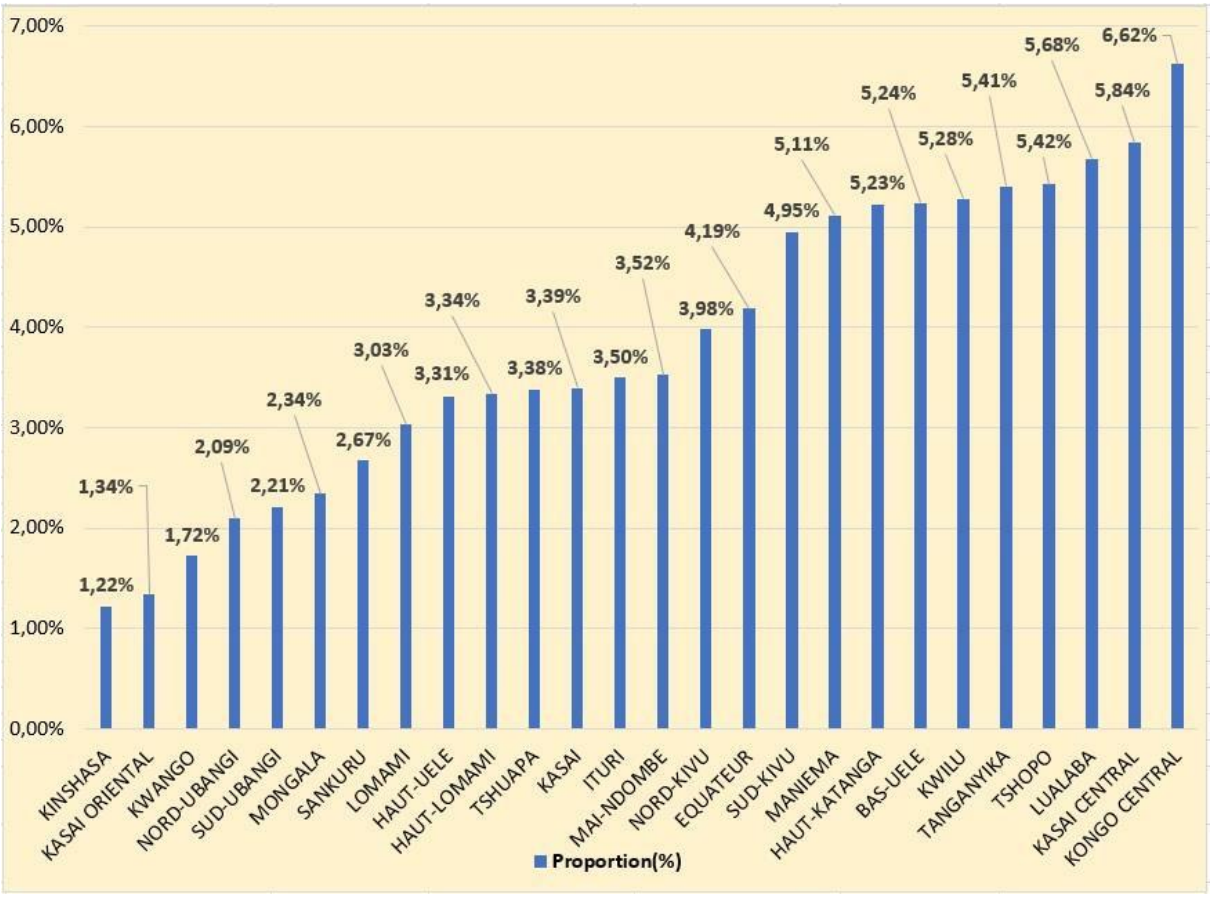


Figure 6-17: Distribution in percentage of the total length of national roads under the responsibility of the RAOD AUTHORITY

Under the same conditions, we also examined the portions of priority provincial and secondary provincial roads, respectively, to identify their distribution across the 26 provinces of the country.

Table 6-40: The total length by province of priority roads under the responsibility of the RAOD AUTHORITY

Province	Priority provincial roads	Proportion (%)
KINSHASA	0	0,00%
KASAI ORIENTAL	15	0,07%
KASAI CENTRAL	363	1,80%
EQUATEUR	373	1,85%
BAS-UELE	404	2,00%
MONGALA	483	2,39%
LOMAMI	485	2,40%
NORD-KIVU	511	2,53%
NORD-UBANGI	576	2,85%
SUD-KIVU	643	3,18%
SUD-UBANGI	684	3,39%
ITURI	691	3,42%
TSHUAPA	702	3,48%
KWILU	779	3,86%
KASAI	867	4,29%
KONGO CENTRAL	891	4,41%
HAUT-LOMAMI	895	4,43%
HAUT-KATANGA	921	4,56%
LUALABA	973	4,82%
SANKURU	1 127	5,58%
MAI-NDOMBE	1 151	5,70%
TSHOPO	1 213	6,00%
KWANGO	1 243	6,15%
HAUT-UELE	1 270	6,29%
TANGANYIKA	1 456	7,21%
MANIEMA	1 485	7,35%
TOTAL	**20 201**	**100,00%**

Figure 6-18: Percentage breakdown of total length of priority roads under the responsibility of the Roads Office

Kinshasa does not have that kind of roads. The highest rate in terms of priority roads is Maniema with 7.35% (1,485 km) of these roads, while Kasai Oriental covers only 0.07% (15 km).

Table 6-41: The total length by province of secondary roads under the responsibility of the RAOD AUTHORITY

Province	Secondary provincial roads	Proportion (%)
KINSHASA	0	0,00%
KASAI ORIENTAL	32	0,19%
TANGANYIKA	203	1,18%
SUD-KIVU	250	1,45%
EQUATEUR	305	1,77%
NORD-UBANGI	372	2,16%
KASAI	389	2,26%
NORD-KIVU	412	2,39%
KASAI CENTRAL	470	2,73%
HAUT-UELE	473	2,74%
SANKURU	477	2,77%
TSHUAPA	525	3,04%
ITURI	554	3,21%
HAUT-LOMAMI	639	3,71%
LOMAMI	725	4,20%
HAUT-KATANGA	829	4,81%
BAS-UELE	830	4,81%
KONGO CENTRAL	869	5,04%
MONGALA	880	5,10%
SUD-UBANGI	965	5,60%
LUALABA	1 066	6,18%
KWILU	1 108	6,43%
MAI-NDOMBE	1 118	6,48%
TSHOPO	1 218	7,06%
KWANGO	1 266	7,34%
MANIEMA	1 270	7,36%
TOTAL	**17 245**	**100,00%**

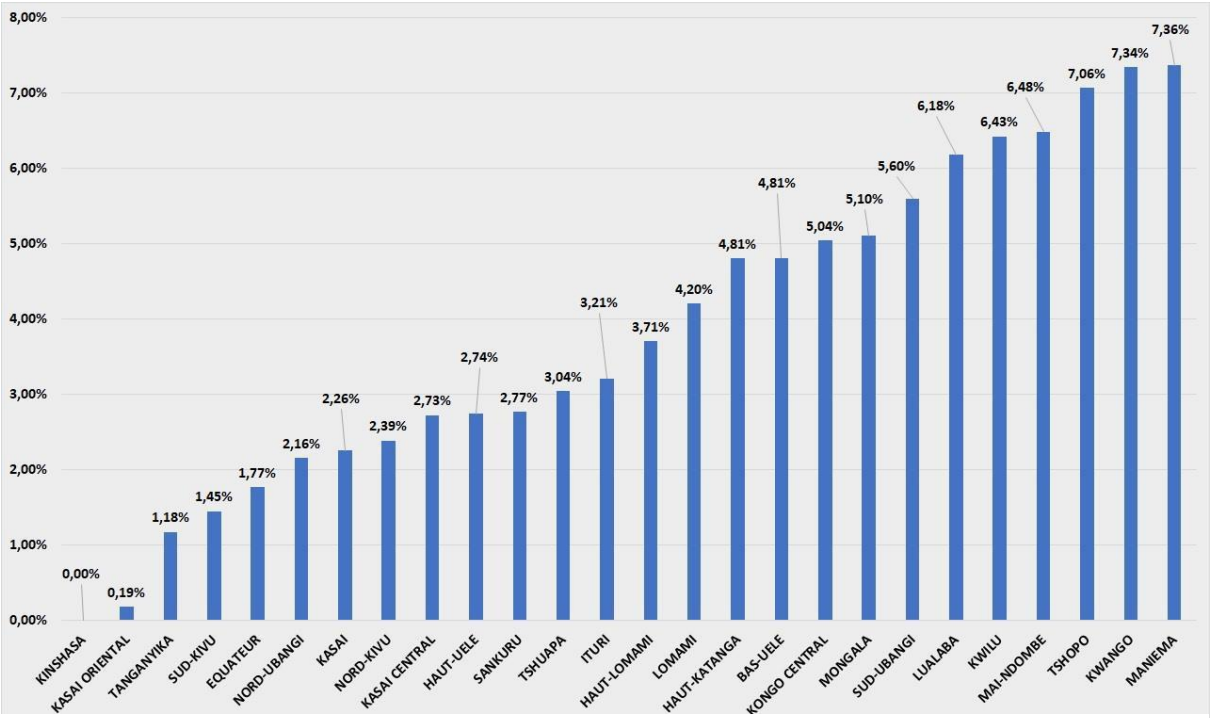


Figure 6-19: Percentage breakdown of the total length of secondary roads under the responsibility of the RAOD AUTHORITY

As with priority roads, Maniema holds 7.36% (1,270 km) of these roads and Kasai Oriental contains 0.19% (32 km).

Studies carried out in 1990 on the feasibility of the DRC's road network showed that on this network, about 90% of the country's road traffic was concentrated on 30,788 km, which connect provincial capitals and major production centres and areas of high population concentration. This network was called the National Ring.

This network is divided into two distinct parts:

- Roads connecting provincial chief tows with 11,584 km; and
- The roads connecting the main socio-economic pools of the country with 19,204 km.

The main axes of this national ring, including the roads of national and regional integration,are in red in Figure 6-21 below:

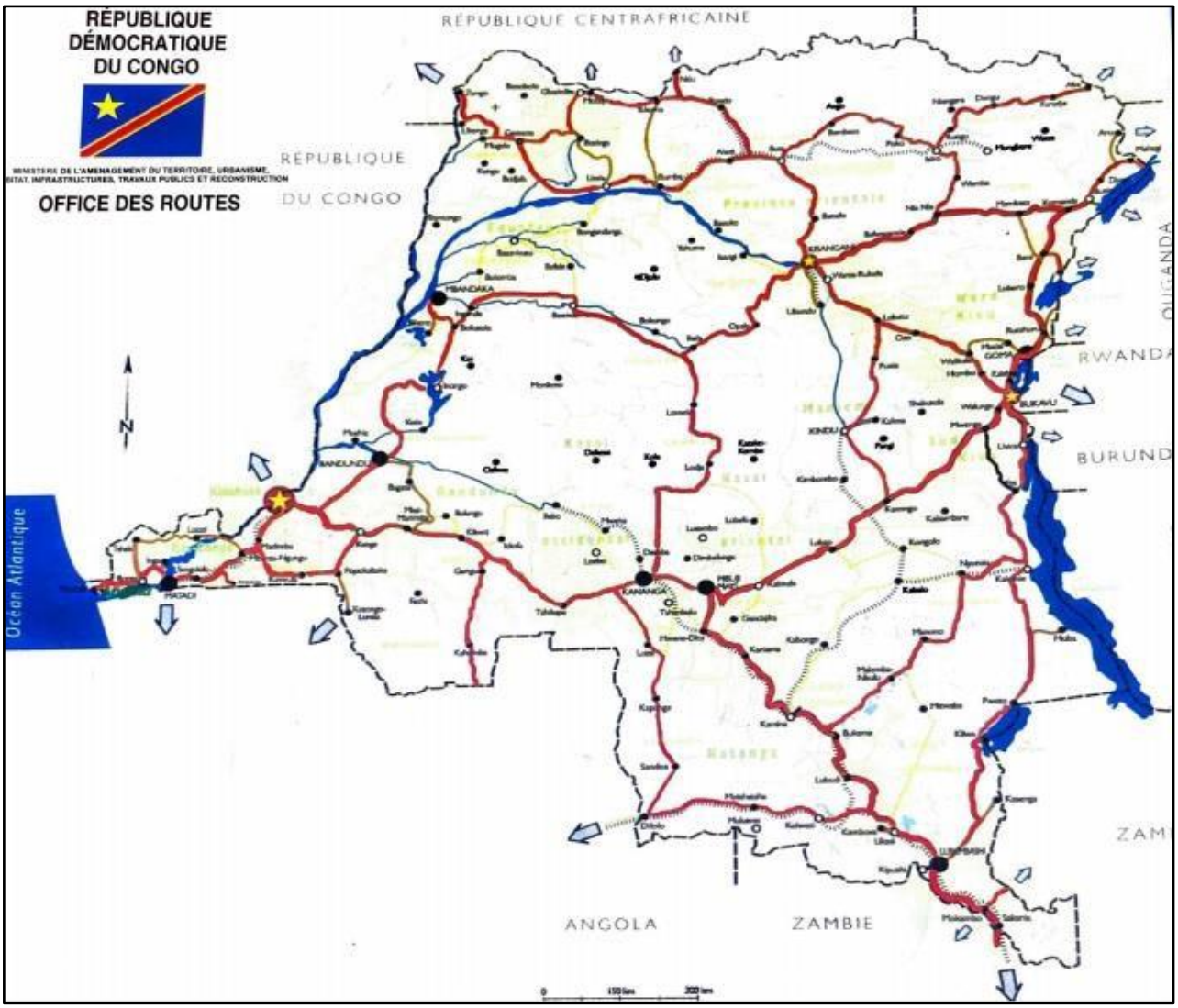


Figure 6-20: Major roads of national and regional integration. Source; "RAOD AUTHORITY in a Nutshell" Leaflet, March 2014

Table 6-42: The total length by province of the National Ring

Province	National Ring Network (km)	Proportion (%)
KINSHASA	251	0,82%
KASAI ORIENTAL	299	0,97%
NORD-UBANGI	517	1,68%
SUD-UBANGI	527	1,71%
MONGALA	866	2,81%
KWANGO	892	2,90%
EQUATEUR	991	3,22%
HAUT-LOMAMI	998	3,24%
ITURI	1 030	3,35%
HAUT-UELE	1 034	3,36%
SANKURU	1 053	3,42%
KASAI CENTRAL	1 056	3,43%
TSHUAPA	1 118	3,63%
MAI-NDOMBE	1 172	3,81%
NORD-KIVU	1 218	3,96%
TSHOPO	1 313	4,26%
LOMAMI	1 368	4,44%
BAS-UELE	1 413	4,59%
HAUT-KATANGA	1 477	4,80%
KASAI	1 516	4,92%
LUALABA	1 516	4,92%
SUD-KIVU	1 653	5,37%
KWILU	1 713	5,56%
KONGO CENTRAL	1 744	5,66%
MANIEMA	1 974	6,41%
TANGANYIKA	2 079	6,75%
TOTAL	**30 788**	**100,00%**

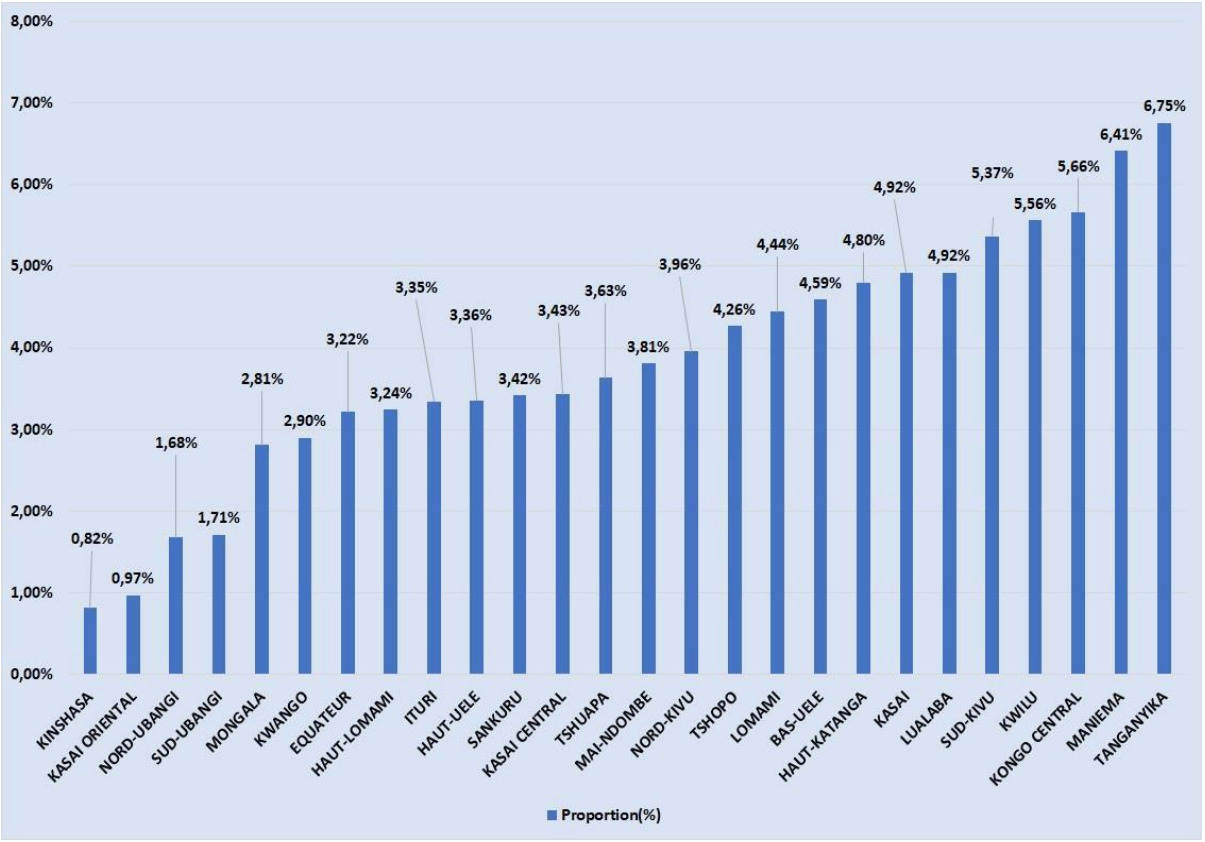


Figure 6-21: Percentage breakdown of the national Ring portion by province

The Tanganyika has the longest stretch of the National Ring with 6.75% of it representing 2,079 km. Kinshasa has the shortest network of the National Ring with 0.82% of the National Ring for 251 km.

The road network managed by the RAOD AUTHORITY also includes 3,500 bridges with spans of 4 to 750 m for a total length of 68,000 m and 175 ferries/ferryboats (motor and winch). Of these BRIDGES, 1,886 are located on the national Ring's priority network.

6.5.2 ROADS UNDER THE MANAGEMENT OF THE CITY ROADS AND DRAINAGE AUTHORITY(OVD).

The Roads and Drainage Authority managed in 2010 a network of 7,400 km and in 2019, the network increased to 9,639.72 km of urban roads distributed as shown in Table 6-43 and Figure 6-22 below.

Table 6-43: The length of road and drainage infrastructure. Source: Livre d'Or, 50 ans de République (Golden Book, 50 Years of Republic), Gescom, OVD presentation for 7400 km

	Paved roads	Paved roads	Total roads
2010 (km)	793,00	6 607,00	7 400,00
Proportion %	10,78%	89,28%	100,00%
Drainage collectors	300		
2019 (km)	1 964,68	7 675,04	9 639,72
Proportion %	20,38%	79,62%	100,00%
Drainage collectors (km)	616,34		

In 2010, the DRC's paved urban roads accounted for a portion equivalent to 11% (793 km) of all urban roads in the country. This portion has increased to 20.38% in 2019.

The total length (9,639.72 km) of the urban road indicated for 2019 is distributed by province in the manner shown in Table 6-44 below and its percentage breakdown in increasing order is shown in the graph below. This length is divided between the paved part (1964.68 km) and the unpaved part (7,675.04 km).

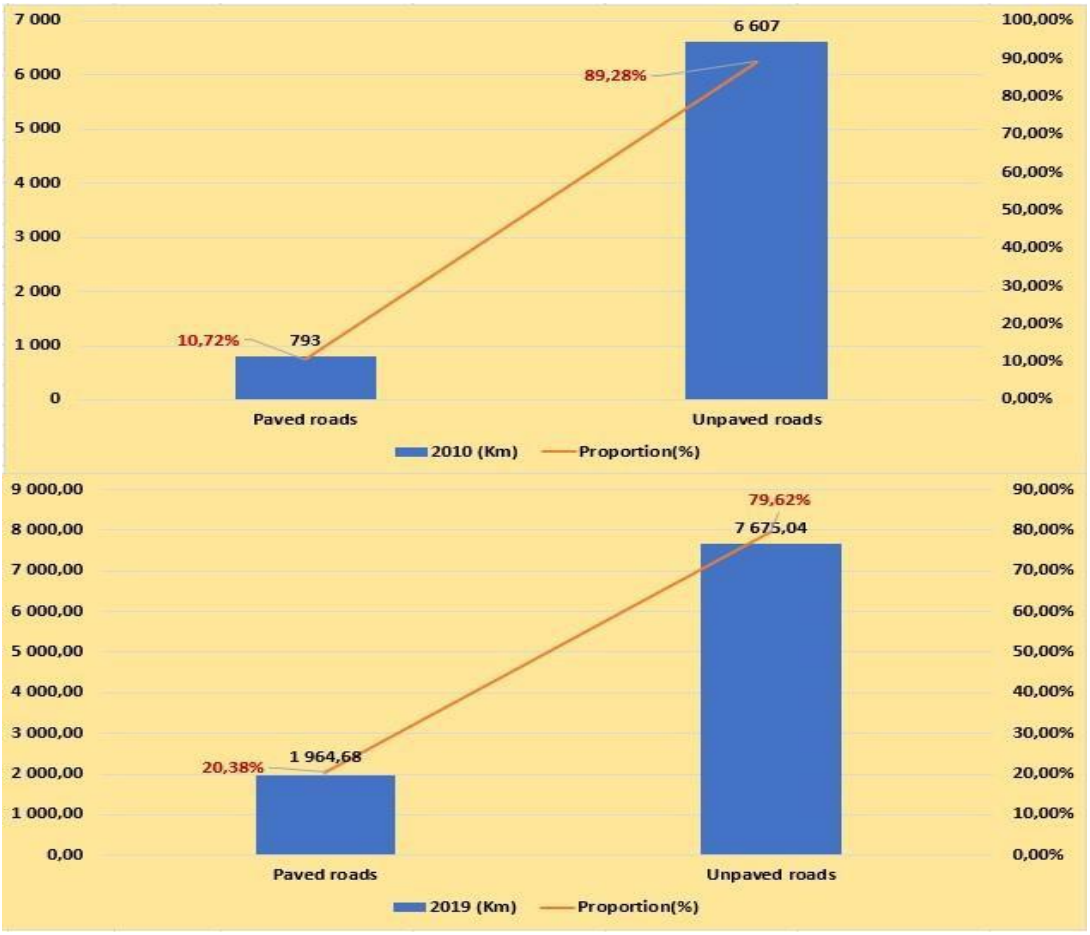


Figure 6-22: Percentage breakdown of DRC's urban road length in 2010 and 2019

Table 6-44: Breakdown of road system by province

No	Province	Paved roads	Unpaved roads (km)	Total length (km)
1	KINSHASA	679,00	2 685,00	3 364,00
2	KASAI ORIENTAL	35,50	348,00	383,50
3	NORD-UBANGI	40,29	78,14	118,43
4	EQUATEUR	72,95	176,19	249,14
5	NORD-KIVU	66,62	403,88	470,50
6	LOMAMI	8,00	97,20	105,20
7	MONGALA	3,60	84,00	87,60
8	SUD-KIVU	76,00	176,00	252,00
9	TSHUAPA	0,00	52,04	52,04
10	KASAI	5,40	100,00	105,40
11	ITURI	1,50	250,00	251,50
12	KASAI CENTRAL	74,24	615,00	689,24
13	SUD-UBANGI	0,00	132,09	132,09
14	SANKURU	0,00	42,63	42,63
15	HAUT-LOMAMI	8,61	9,63	18,24
16	BAS-UELE	0,00	71,89	71,89
17	HAUT-UELE	2,20	35,93	38,13
18	TANGANYIKA	4,00	39,09	43,09
19	HAUT-KATANGA	552,13	853,77	1 405,90
20	KWANGO	5,00	15,33	20,33
21	KWILU	25,51	136,20	161,71
22	MAI-NDOMBE	0,00	107,11	107,11
23	KONGO CENTRAL	82,16	215,17	297,33
24	LUALABA	124,00	600,00	724,00
25	TSHOPO	70,00	151,00	221,00
26	MANIEMA	28,26	199,76	228,02
	TOTAL	**1 964,97**	**7 675,05**	**9 640,02**

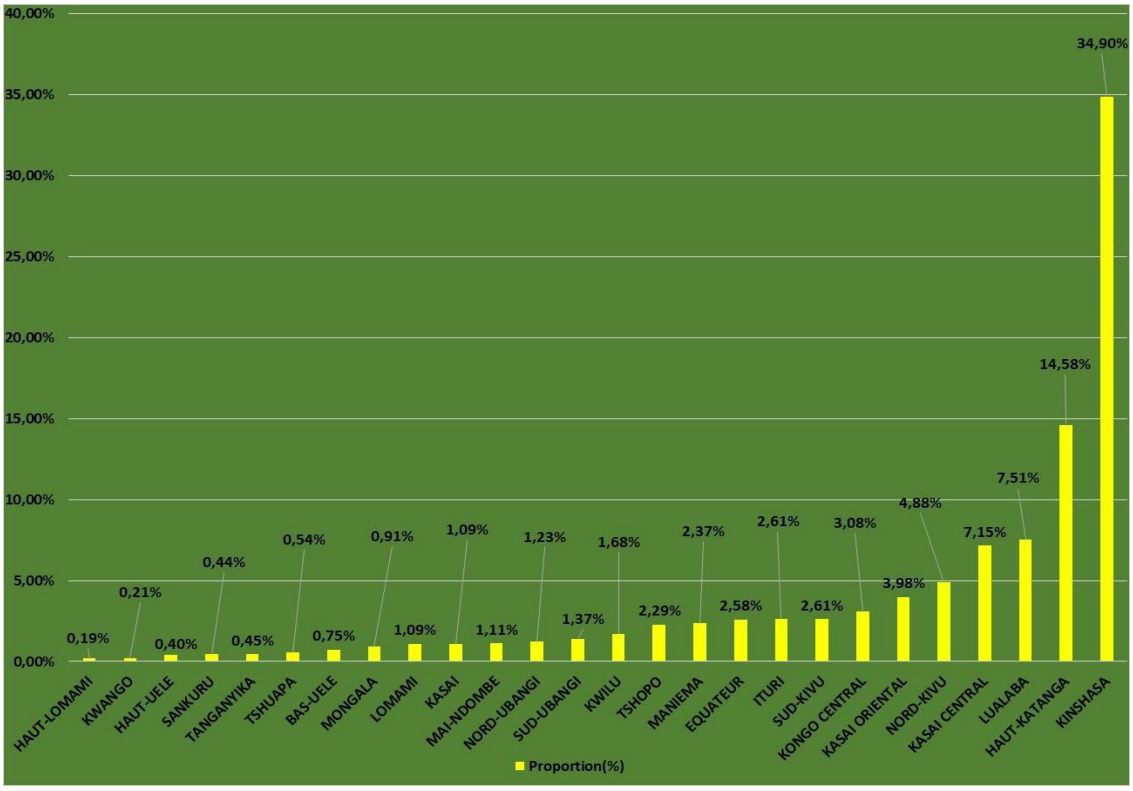


Figure 6-23: The province-by-province percentage breakdown of the paved portion of urban roads

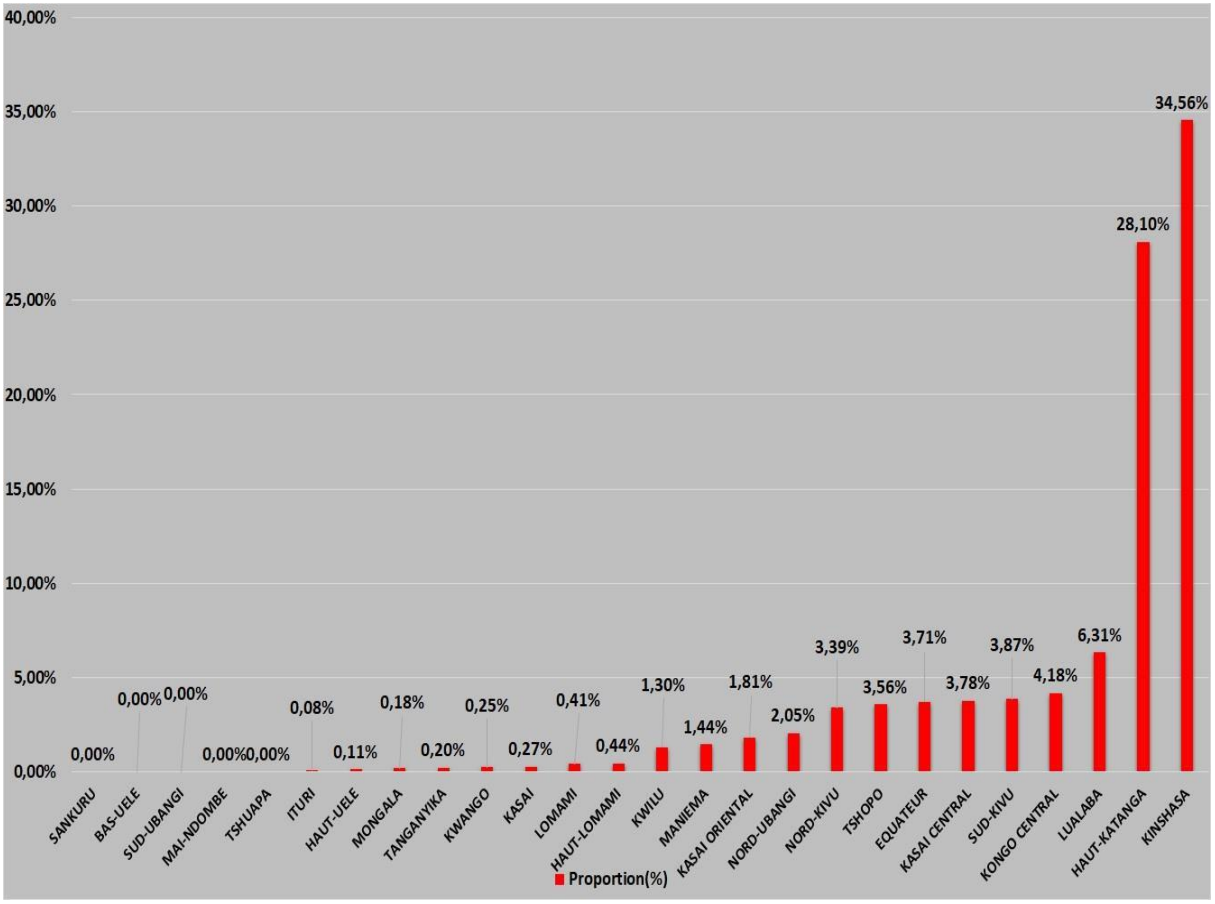


Figure 6-24: Percentage breakdown of asphalt road length by province in 2019

As for the percentage breakdown by province of the unpaved part of the urban roads, it isshown by increasing order in Figure 6-25 below.

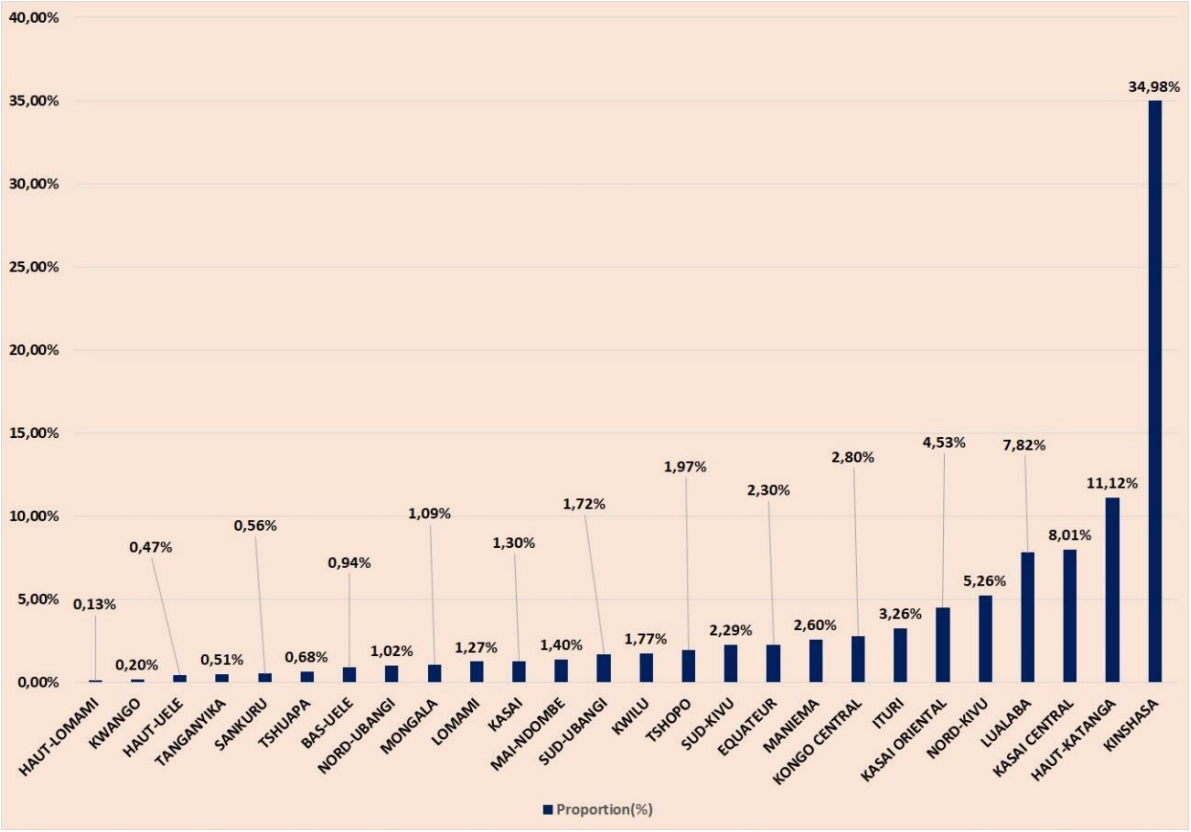


Figure 6-25: Percentage breakdown of unpaved road length by province in 2019

The province of Kinshasa and Haut-Katanga are equipped with 34.90% (3364 km) and 14.58%(1405.9 km) of the country's urban roads respectively, occupying almost 50% of the country's urban road infrastructure.

The least endowed provinces are Haut-Lomami and Kwango with 0.19% (18.24 km) and 0.21% (20.33 km) respectively.

As regards paved roads, the province of Kinshasa and Haut-Katanga are equipped with 34.56% (697 km) and 28.10% (552.13 km) of the country's coated urban roads, respectively. Therefore, they both occupy 62.66% the country's urban road infrastructure. The provincesof Tshuapa, South Ubangi, Sankuru, Bas-Uele and Mai-Ndombe have no paved urban roads. Ituri and Haut-Uele's paved urban roads represent 0.08% (1.5 km) and 0.11% (2.2 km) of nationally coated urban roads respectively.

6.5.3 ROADS UNDER THE MANAGEMENT OF THE AGRICULTURAL SERVICE ROADS DIRECTORATE (DVDA)

87,680 km of roads of local interest or agricultural service are under the management of the Agricultural Service Roads Directorate.

Due to the lack of regular maintenance and vehicle traffic, the layout of some sections of these roads has tuned into a trail. Therefore, out of the total of 87,860 km of roads, only 59,175 km are clearly identifiable and maintained. The chart below shows the breakdown of these roads by province.

Table 6-45: Breakdown of agricultural service roads

No	PROVINCES	QTY(km)
1	BAS-UELE	2 482
2	EQUATEUR	1 125
3	HIGH-KATANGA	2 070
4	HIGH-LOMAMI	2 103
5	HIGH-UELE	2 611
6	ITURI	2 088
7	KASAÏ	2 356
8	CENTRAL KASAÏ	2 570
9	CENTRAL KASAÏ	824
10	KONGO CENTRAL	3 429
11	KWANGO	2 048
12	KWILU	4 954
13	KINSHASA	1 805
14	LOMAMI	1 722
15	LUALABA	2 560
16	MAÏ-NDOMBE	1 449
17	MANIEMA	2 763
18	MONGALA	1 213
19	NORTH-KIVU	2 306
20	NORTH-UBANGI	904
21	SANKURU	3 948
22	SOUTH-KIVU	2 008
23	SOUTH-UBANGI	1 688
24	TANGANYIKA	2 980
25	TSHOPO	3 187
26	TSHUAPA	1 982
	GRAND TOTAL	**59 175**

6.5.4 STATE OF ROAD INFRASTRUCTURE UNDER THE MANAGEMENT OF THE RAOD AUTHORITY

In our quest to objectively build up the state of the DRC's road infrastructure, we have currently obtained only information relating to the 2012 and 2013 National Ring. We are still up to now looking for up-to-date information. We have also obtained information on the state of the roads dating back to 2010.

The State of the National Ring as at 31 December 2012 and 31 December 2013, from the RAOD AUTHORITY's Annual Report of Activities, Fiscal Year 2012, is presented as shown inTables 6-46 and 6-47 below.

Table 6-46: State of the National Ring in 2012.Source: Annual Activity Report, Fiscal Year 2012, Office of

	Province Situation 2012	Total length (km)	Good shape (km)	Good shape (en %)	Average shape (km)	Average Shape (%)	Poor shape (km)	Poor state (in %)
1	Bandundu	3 777	1 331	35,24%	725	19,20%	1 722	45,59%
2	Bas-Congo	1 744	1 060	60,78%	412	23,62%	272	15,60%
3	Equateur	4 019	711	17,69%	657	16,35%	2 651	65,96%
4	Kasaï Occidental	2 572	230	8,94%	230	8,94%	2 112	82,12%
5	Kasaï Oriental	2 720	378	13,90%	620	22,79%	1 722	63,31%
6	Katanga	6 070	2 400	39,54%	1 324	21,81%	2 346	38,65%
7	Kinshasa	251	223	88,84%	19	7,57%	10	3,98%
8	Maniema	1 218	527	43,27%	478	39,24%	213	17,49%
9	Nord-Kivu	1 974	688	34,85%	562	20,06%	724	36,68%
10	Province Orientale	4 790	1 434	29,94%	1 047	21,86%	2 309	48,20%
11	Sud-Kivu	1 653	680	41,14%	396	23,96%	578	34,97%
	TOTAL	**30 788**	**9 662**	**31,38%**	**6 470**	**21,01%**	**14 659**	**47,61%**

Table 6-47: State of the National Ring in 2013

	Province Situation 2013	Total length (km)	Good shape (km)	Good shape (in %)	Average shape (km)	Average shape (in %)	Poor shape (km)	Poor shape (in %)
1	Bandundu	3 777	1 436	38,02%	754	19,96%	1 587	42,02%
2	Bas-Congo	1 744	1 083	62,10%	284	16,28%	377	21,62%
3	Equateur	4 019	791	19,68%	689	17,14%	2 539	63,17%
4	Kasaï Occidental	2 572	267	10,38%	452	17,57%	1 853	72,05%
5	Kasaï Oriental	2 720	454	16,69%	557	20,48%	1 709	62,83%
6	Katanga	6 070	2 824	46,52%	1 366	22,50%	1 880	30,97%
7	Kinshasa	251	220	87,65%	18	7,17%	13	5,18%
8	Maniema	1 218	741	60,84%	483	39,66%	750	61,58%
9	Nord-Kivu	1 974	772	39,11%	281	23,96%	165	8,36%
10	Province Orientale	4 790	1 641	34,26%	806	16,83%	2 343	48,91%
11	Sud-Kivu	1 653	555	33,58%	473	28,61%	625	37,81%
	TOTAL	**30 788**	**10 784**	**35,03%**	**6 163**	**20,02%**	**13 841**	**44,96%**

The interpretation of these tables enabled us to produce graphs reflecting the states of the National Ring, comparing over the two years respectively the evolution of good roads, roads in average condition and roads in poor condition by province. Although limited to two years, this interpretation provides an idea of the condition of these roads based on the provincial averages over these two years as shown in these graphs.

35% of the National Ring roads are in good condition, 20% are in average condition and 45% are in poor condition throughout the country.

As the weather conditions remain the same in the country, and given the significant increase in vehicles transporting people and goods, it can be considered that in 2021 the deterioration of the country's roads should increase significantly.

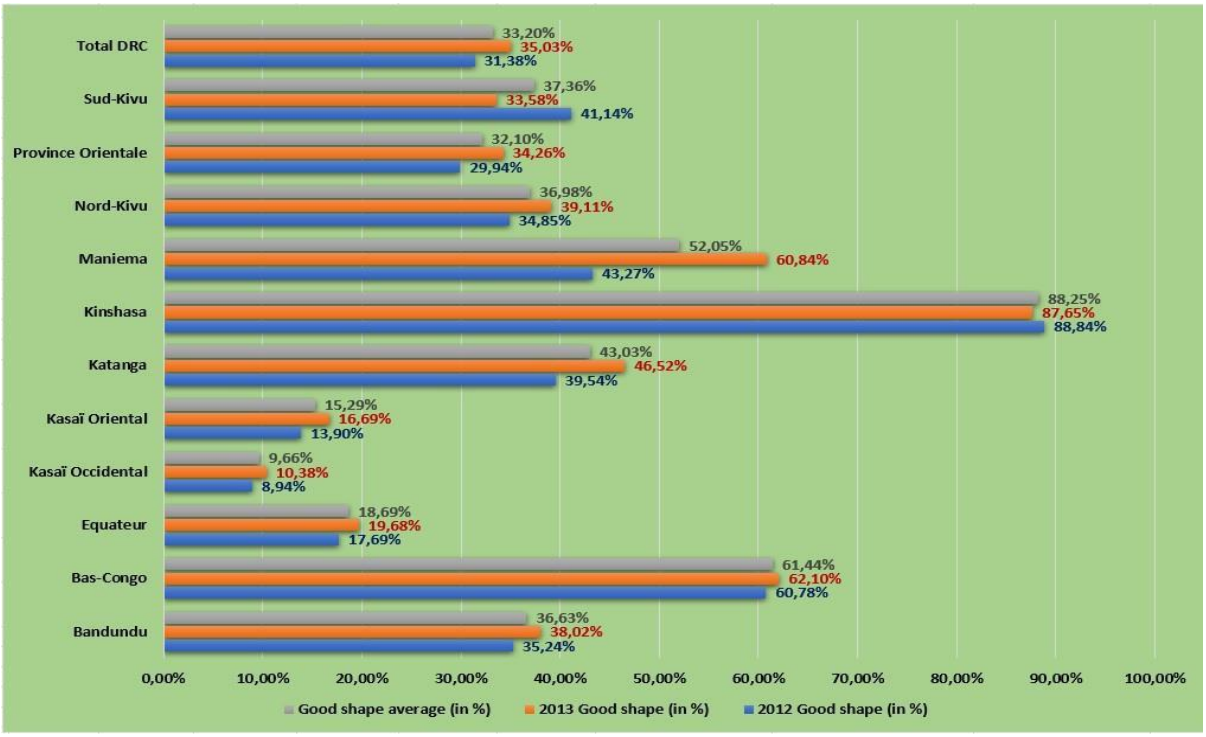


Figure 6-26: Province breakdown of National Ring roads in good condition (%)

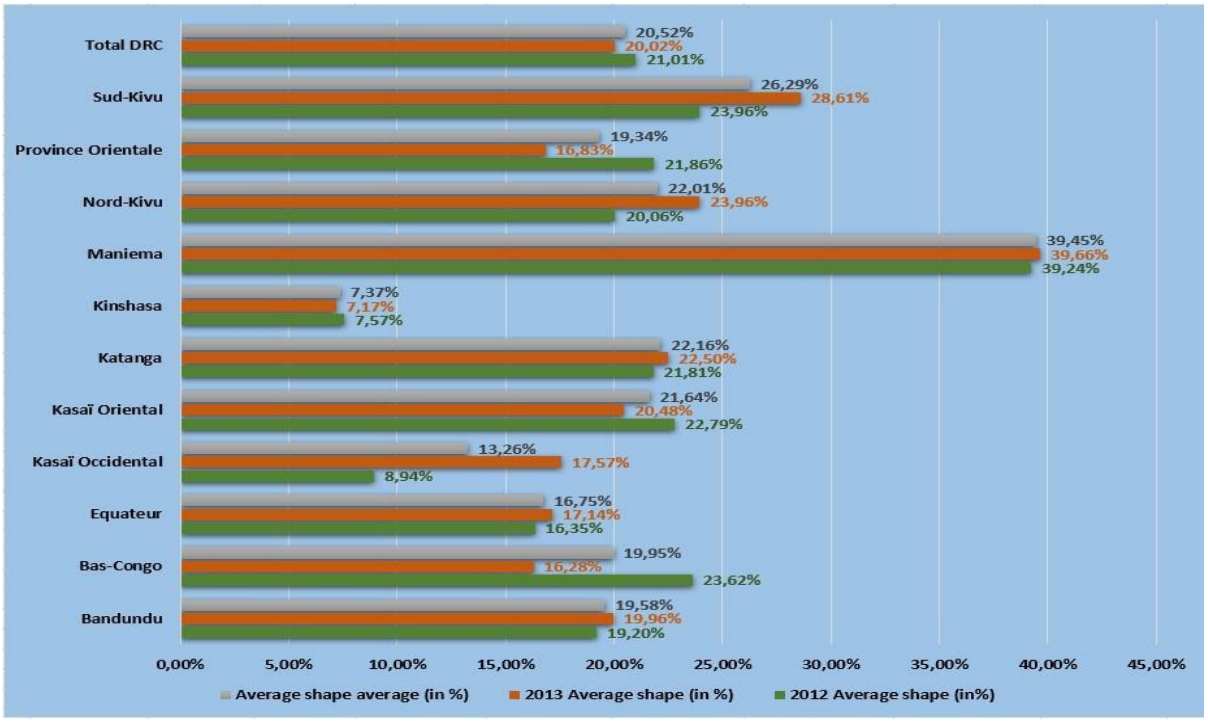


Figure 6-27: Province breakdown of National Ring roads in good condition (%)

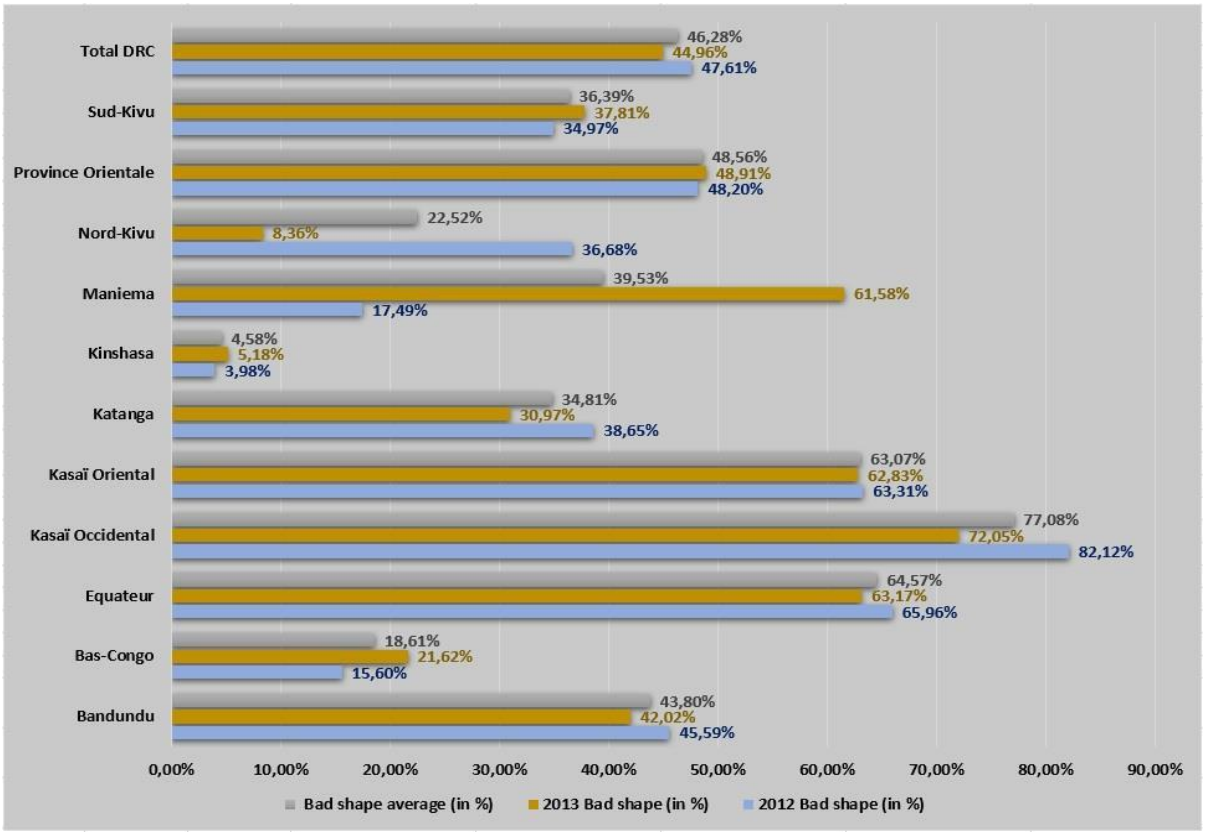


Figure 6-28: Province breakdown of National Ring roads in poor condition of the (%)

6.5.5 STATE OF ROAD INFRASTRUCTURE UNDER THE MANAGEMENT OF THE ROADS AND DRAINAGE AUTHORITY

Worn out and dilapidated, the urban road network is, it had respectively in 2010 and 2019, the state as shown in Table 6-48 and interpreted in Figure 6-29 below. Currently, this system is no longer able to fight erosion and flooding because watersheds and drainage works have not been properly cured for a long time.

Table 6-48: State of Urban Roads in 2010 and 2019

	Total length (km)	Good shape (km)	Good shape (in %)	Average acceptable shape (km)	Average shape (in %)	Poor shape (km)	Poor shape (in %)
Overall road network in 2010	7 400,00	740,00	10,00%	1 110,00	15,00%	5 550,00	75,00%
Overall road network in 2019	9 640,01	2 072,00	21,49%	2 593,50	26,90%	4 976,42	51,62%
Paved roads in 2010	1 964,68	1 064,20	54,17%	379,68	19,33%	520,40	26,49%
Unpaved roads in 2019	7 675,04	1 007,80	13,13%	2 213,82	28,84%	4 453,03	58,02%

We have not obtained the current status of this network. Nevertheless, the state seems very outdated and is at the origin of much of the repetitive flood damage and innumerableerosions experienced by most cities in the country. The main and secondary roads of almost all cities are in an advanced state of disrepair.

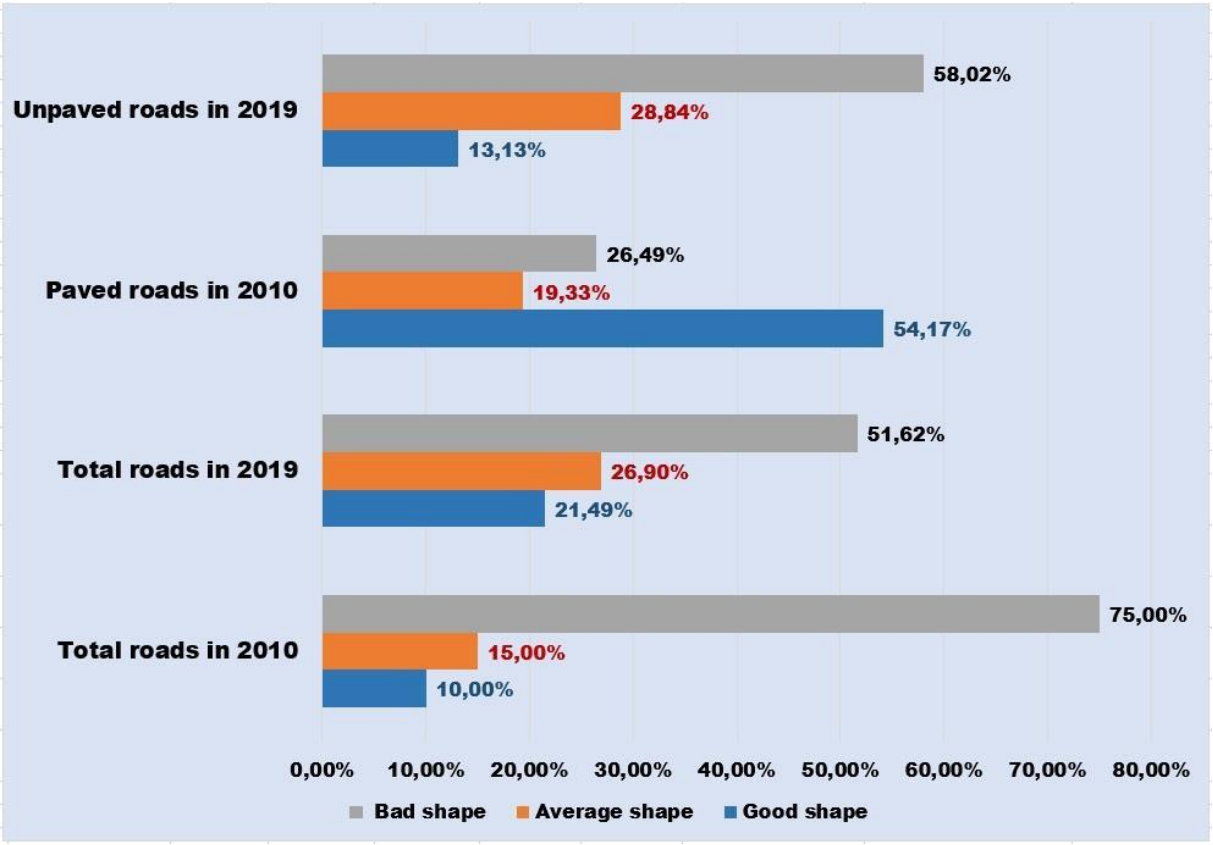


Figure 6-29: Assessment of the state of DRC's urban roads (%)

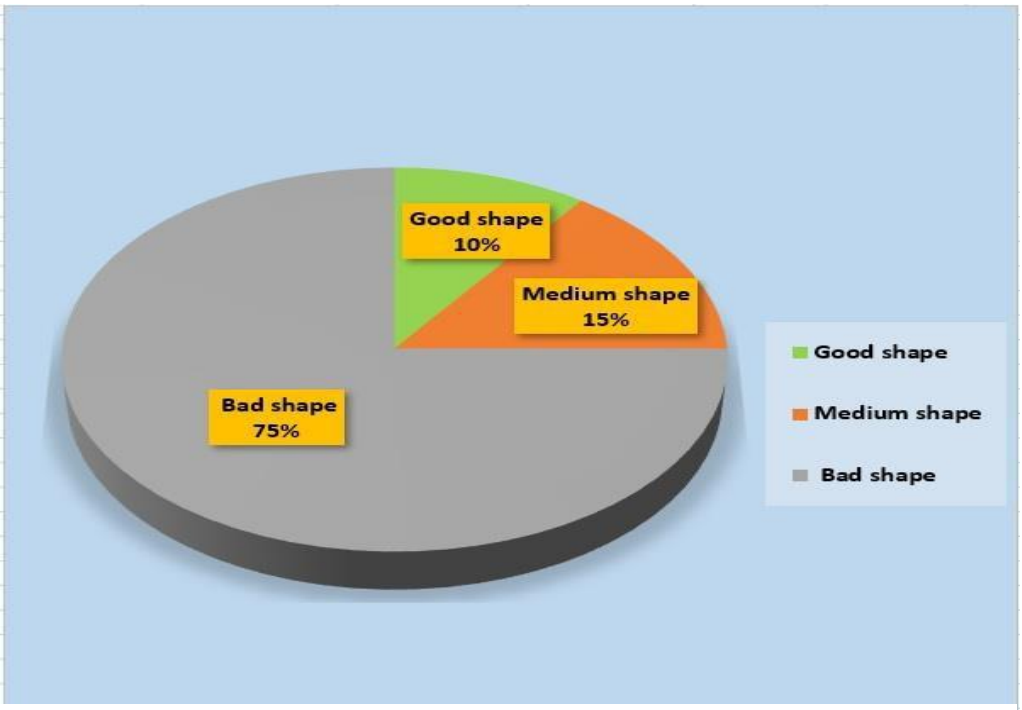


Figure 6-30: Assessment of the state of total urban roads in 2010 (in %)

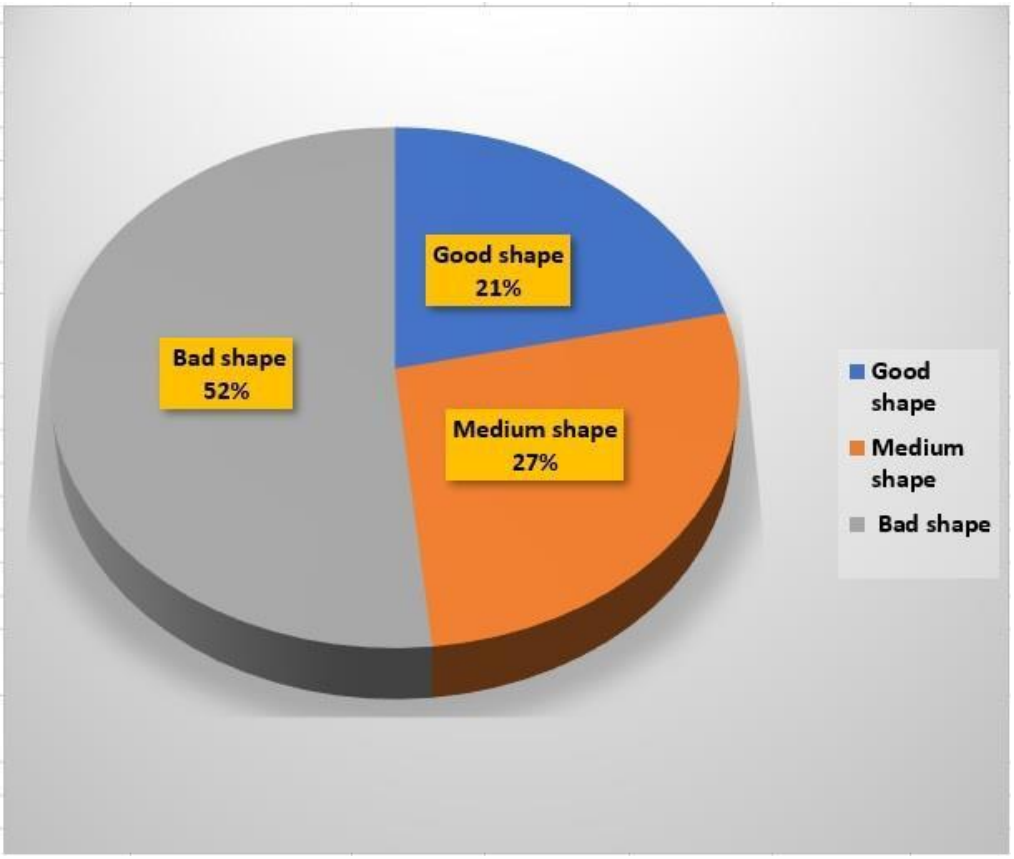


Figure 6-31: Assessment of the state of total urban roads in 2019 (%)

The figures above provide a general assessment of the overall condition of total urban roads in 2010 and 2019, respectively. There was a marked improvement in the condition of urban roads between these two years. Urban roadinfrastructure in good condition increased from 10% in 2010 to 24% in 2019, an increase of 14% in nine years.

Similarly, urban road infrastructure in average condition increased from 15% in 2010 to 61% in 2019, an increase of 46% in nine years, which is very appreciable. As for urban road infrastructure in poor condition, there has been a remarkable leap, its proportion has increased from 75% in 2010 to 15% in 2019, an improvement of 60%.

6.5.6 ROAD DENSITY

Table 6-49: Road Density by province

No	Province	Length of Roads (km)	Area (km²)	Roads Density (km/100 km²)
1	Bas Uele	4 870,9	148 370	3,3
2	Equateur	2 918,1	103 929	2,8
3	Haut-Katanga	6 306,9	132 460	4,8
4	Haut-Lomami	4 346,2	108 232	4,0
5	Haut Uélé	5 076,1	89 706	5,7
6	Ituri	4 307,5	65 675	6,6
7	Kasaï	4 419,4	95 656	4,6
8	Kasaï Central	5 299,2	59 126	9,0
9	Kasaï Oriental	1 532,5	9 547	16,1
10	Kinshasa	5 421,0	9 968	54,4
11	Kongo Central	6 856,3	53 934	12,7
12	Kwango	4 933,3	89 997	5,5
13	Kwilu	8 094,7	78 461	10,3
14	Lomami	3 663,2	56 441	6,5
15	Lualaba	6 497,0	121 340	5,4
16	Mai-Ndombe	4 554,1	127 276	3,6
17	Maniema	6 803,0	132 285	5,1
18	Mongala	3 147,6	58 156	5,4
19	Nord-Kivu	4 522,5	59 499	7,6
20	Nord-Ubangi	2 403,4	56 659	4,2
21	Sankuru	6 147,6	104 358	5,9
22	Sud-Kivu	4 176,0	65 087	6,4
23	Sud-Ubangi	3 926,1	51 661	7,6
24	Tanganyika	5 800,1	134 975	4,3
25	Tshopo	6 961,0	199 619	3,5
26	Tshuapa	3 960,0	132 992	3,0
	TOTAL	**126 944,0**	**2 345 410,0**	5,4

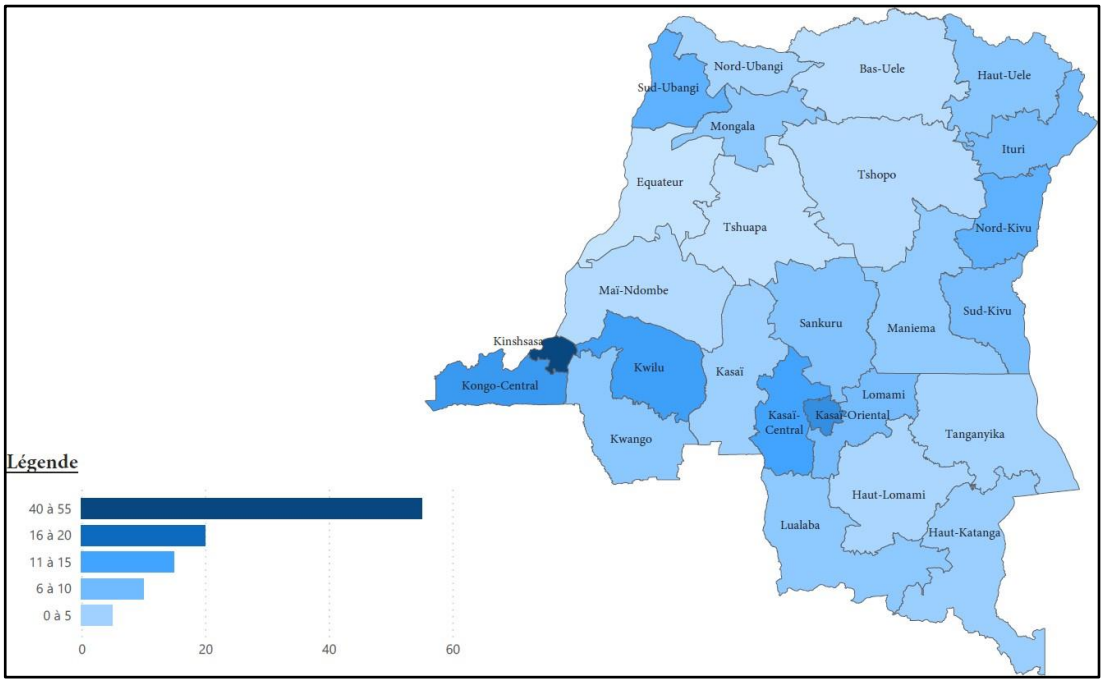


Figure 6-32: Road density by province. Source: ONICIV

6.6 AIRPORTS

6.6.1 THE IMPORTANCE OF THE AIR NETWORK

The DRC has 504 airstrips scattered throughout the country. The national runways are under the responsibility of the Air Routes Authority (RVA) and, to a certain extent, by the Decentralized Territorial Entities (ETD). Other airstrips are under the responsibility of their private sector owners or by churches.

Of the 504 runways available to the DRC, 270 have the rank of airfields, including 101 , which are open to public traffic, 164 are operated by private individuals and 5 are located in military bases.

Of the 101 airfields open to public air traffic, RVA manages 54, including 4 international airfields (Kinshasa-N'Djili, Lubumbashi-Luano, Goma and Kisangani-Bangboka).

6.6.2 DRC AIRFIELD AND HELI STATION CLASSIFICATIONS

As part of the development of this report, we classified the DRC's airfields and helistations based on the following four elements:

1. State:
   - OPS : Operational;
   - INOP: not operational.
2. Type:
   - APT: airport; [2]
   - RWY: track;

- HLS: Helistation.

3. Runway length:
   - More than 3,047 - sub-category 1 ;
   - Between 2,438 and 3,047 - sub-category 2;
   - Between 1,524 and 2,438 - subcategory 3;
   - Between 914 and 1,524 - sub-category 4;
   - Less than 914 - sub-category 5.
4. Rolling layer:
   - Paved: Concrete, bitumen
   - Unpaved: Battered Earth, Earth

Subsequently, we established the criteria for their classification as shown below.

1. Class A : Operational and coated airport, length (A1, A2, A3, A4);
2. Class B : Operational and unpaved airport, length (B1, B2);
3. Class C : Operational and coated track, length (C3, C4, C5);
4. Class D : Unpaved operational track, length (D3, D4, D5);
5. Class E : Non-operational;
6. Class ANC : Unclassified Airport ;'
7. Class F : Operational and unpaved helistation;
8. Class H : Non-operational helipad ;'
9. Class HNC : Unclassified Helistation.

Based on these criteria, the Commission was able to consolidate the DRC's airstrips in the manner included in Table 6-50 below.

Table 6-50: DRC Airport and Helistation Classification

Type of airstrip	A1	A2	A3	A4	B3	B4	C3	C4	C5	D3	D4	D5	E	ANC	Total
Identified number	4	2	6	1	3	1	5	4	1	11	38	28	49	187	340
Type of helistations	H	G	HNC												
Identified number	8	8	148												164
Total															504

Other classifications were made, including the nature of the surface layer, the ownership of the runway and the use as shown in Tables 6-51 to 6-52 below, respectively.

Table 6-51: Classification of airports and helistations by use of the runway

Classification per type of utilization					
Usage	Civil	Privé	Public	Non classé	Total
Identified number	154	160	6	184	504

Table 6-52: Classification of airports and helistations by nature of the runway surface layer

Classification per type covering layers	
Paved with concrete	27
Unpaved: strengthened soil	477
Total	**504**

Table 6-53: Classification of airports and helistations by runway

Classification per group									
Owner	State	RVA	Private	Religious	Enterprises	State-owned entities	Monusco	Unclassified	**Total**
Number counted	67	48	80	44	43	8	1	213	**504**

6.6.3 STATE OF AIRPORT INFRASTRUCTURE

We have not been able to obtain information on the state of airport infrastructure.

6.7 PORTS

The hydrological regime of rivers in the DRC's geographical area is such that the river system remains navigable all year round, even during low water levels, despite some restrictions. These rivers are natural routes and represent a major potential in facilitating domestic trade.

The map in Figure 6-33 below gives a general picture of the situation of these waterways, lake and river routes in the DRC.

The DRC's waterway system is about 16,238 km long, divided into three fore bays:

- The 150 km maritime bay from Matadi to Banana, which is managed by the Congolese Seaway Company (CVM) (formerly RVM);
- The middle bay including the Congo River (Kinshasa-Kisangani), the Kasai River and their tributaries. This bay totals 13,458 km of waterways under the management ofthe Waterways Authority (RVF);

- The upper bay includes the Lualaba and the lakes and totals 2,630 km of waterways.

6.7.1 GENERAL STATE OF PORTS IN DRC

The majority of the ports of the Democratic Republic of Congo were built in the first half ofthe 20th century during the colonial era. These infrastructures were perfectly functional atthe time for their bulk cargo-handling mission. Today, however, some are no longer suitable for traffic with the introduction of containers, which cannot be handled due to lackof equipment.

At present, the situation of these ports is worrying due to the dilapidated infrastructure and equipment. While some ports have had one-off maintenance work, most have not profited from adequate maintenance or re-equipment. Hence, the docks have deteriorated, sanded or made inaccessible by wrecks of sunken boats and barges. In general, cranes are old and have low lifting capacity.

In addition, international port security requirements are struggling to be implemented at seaports. However, no major incidents have occurred since the introduction of these guidelines contained in the ISPS Code.

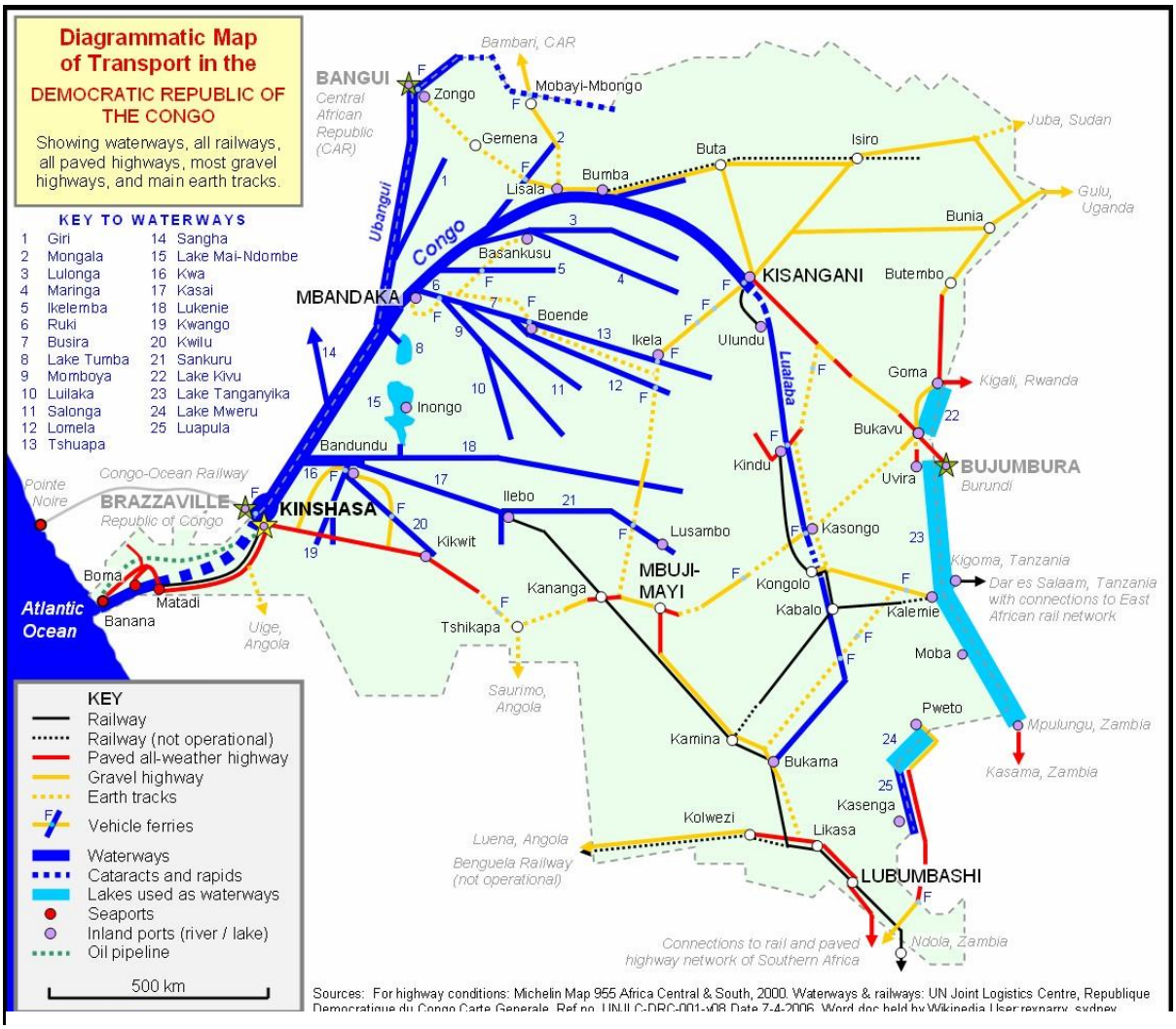


Figure 6-33: Geographic location of DRC's waterways, lakes and rivers

6.7.2 SEAPORTS

The DRC has three seaports, the largest of which, Boma and Matadi (SCPT and MGT), are located on the sea bay and the third, Banana (with a 100 m wharf) is located on the edge of the Atlantic Ocean. The Matadi port accounted for 95% of the country's total port trafficin 2011, with nearly 2.4 million tonnes of traffic.

6.7.3 MAJOR RIVER PORTS

The main river and lake ports, as can be seen in Figure 10 above, are located, among others in:

- Kinshasa, Mbandaka, Lisala and Bumba, Kisangani (Congo River) ;
- Kinshasa, Mubenzele, Zongo (Congo River -Ubangi);
- Kinshasa, Bandundu, Ilebo (Congo River -Kasaï)
- Kinshasa, Bandundu, Bulungu, Kikwit (Congo River -Kwilu);
- Kinshasa, Kwamouth, Nioki, Kutu, Inongo (Congo River – Lake Mai-Ndombe) ;
- Ubundu, Kindu (Congo River) ;
- Kongolo, Malemba-Nkulu, Bukama (Congo River -Lualaba) ;
- Kalundu, Kalemie, Muliro (near Mpulungu in Zambia) (Lake Tanganyika) ; and
- Goma, Bukavu (Lake Kivu).

To provide a quick overview of some important ports, we ranked them according to a few criteria defined below:

- Partially converted wharf, non-concreted courtyard with self-propelled crane or crane
- Wharf, courtyards with self-propelled crane
- Partially equipped wharf and courtyard, crane and self-propelled crane
- Wharf, converted and to be rehabilitated courtyards, crane, self-propelled or gantry crane
- A converted wharf with a modern crane.

Table 50 below gives ONICIV's assessment of these ports in accordance with the criteria developed by the Drafting Commission for this purpose. This assessment applies respectively to the main river and sea ports.

Table 6-54: DRC Port Classification

		Port	***Category***
River Ports	River Axis	Public SCTP	4
		Mbandaka	2
		Lisala	1
		Bumba	1
		Kisangani right bank	4
		Kisangani left bank	3

	Kasaï Axis	Bandundu	1
		Ilebo	4
Lake Ports		Kalemie	3
		Kalundu	3
Maritime Ports		Matadi SCTP	4
		Matadi MGT	5
		Boma	4
		Banana	3

6.7.4 THE STATUS OF PORT INFRASTRUCTURE AND WATERWAYS

We did not obtain an inventory of the state of all that infrastructure. However, in general,it can be said that domestic water transport is currently characterized by the lack of maintenance of equipment, wharves and tracks, as well as the lack of markings of these tracks. All this results in a significant deterioration of the navigation conditions, by transport and port infrastructure and equipment in poor condition and in insufficient quantities.

6.8 RAILWAY

6.8.1 THE STATUS OF RAILWAY INFRASTRUCTURE

The DRC has three non-interconnected railway networks totalling 5,035 kilometres. Three public companies, namely the Commercial Transport and Ports Corporation (SCPT) (formerly ONATRA), the Uélé-Fleuve Railway Company (CFUF) (formerly CFU) and the National Railway Company of Congo (SNCC), are responsible for these networks. They manage their infrastructure (tracks, rolling stock and maintenance equipment, installations, buildings, etc.) as well as the operation of rail transport. Figure 6-34 below shows the setting up of these three networks across the country.

Figure 6-34: Implementation of the DRC's three rail networks (Google: www.google.com)

6.8.2 THE SCPT NETWORK

The SCPT railway track network has a length of 366 km between Kinshasa and the port of Matadi. In the past, this railway played an important role in the transfer of import and export goods between Kinshasa and Matadi. To date, with less than 10% of the traffic on this axis, railway activities are insignificant and practically abandoned.

The gauge of this network is 1,067 m, or 42 inches.

6.8.3 THE CFUF NETWORK

Currently out of operation, the CFUF network is 1,028 km long and connects Bumba to Mungbere, with the Dulia-Bondo and Andoma-Titule branches. The last stretch that was still in service connected Aketi to Isiro for a distance of 842 km with a frequency of one train every two to three months.

The gauge of this network is 0.6 m.

6.8.4 THE SNCC NETWORK

SNCC operates a 3,641 km rail network, 858 km of which are electrified. This electrified lineis located in the Lubumbanshi-Tenke, Tenke-Kamina and Tenke-Mutshatsha sections.

It should be noted, however, that this network is based on several sections, ranging from Lubumbashi to Sakania (on the Zambian border), to Ilebo (on the Kasai River), from Tenketo Dilolo (on the Angolan border), from Kamina to Kalemie (on the Tanzanian border), fromKabalo to Kindu and from Ubundu to Kisangani.

The gauge of this network is 1,067 m.

6.8.5 STATE OF THESE NETWORKS

We have not been able to obtain detailed information on the state of the railway infrastructure, but it is obvious that it is generally in poor condition, given the increase in accidents in different operational areas of these networks. These are indeed lacking in infrastructure quality and have resulted in increased delays and costs in transporting products from production or supply centres to consumption ones.

6.9 CARE AND HEALTH

6.9.1 HEALTHPOLICYOBJECTIVE

Based on the Millennium Development Goals (SDGs), the DRC's health policy aims to contribute to improving the health condition to enable all to live healthy lives and promotethe well-being of all, at all ages, as part of the universal health coverage.

This objective is in line with Article 47 of the DRC Constitution, which enshrines health as one of the fundamental rights of the Congolese people. The National Health Policy, adopted in 2001, focuses on primary health care (PHS).

6.9.2 THE CENTRAL LEVEL

In the organization of the DRC health system, the central level consists of the Minister's Office, the General Secretariat with the Central Directorates, Specialized Programmes, theGeneral Inspectorate of Health, hospitals and other national structures.

These structures include:

- The Human Resources Directorate (HR);
- The Directorate of Studies and Planning (DEP);
- The Directorate of Organization and Management of Health Care Services (DOGS);
- The Directorate of Pharmacy and Medicines (DPM);
- The Directorate of Disease Control (DLM);
- The Directorate of Health Sciences Education (DESS);
- The Directorate of Family Health and Special Groups (DSFG);
- The Directorate of Financial Affairs (DAF);

- The Archives and New Information and Communication Technologies (DANTIC) Directorate.

6.9.3 THE INTERMEDIATE LEVEL

The intermediate level refers to the provincial level, which is composed as follows:

- Provincial Ministry of Health;
- Provincial Division of Health;
- Provincial Health Inspectorate; Provincial Hospital;
- Other Provincial Health Facilities.

This level plays the role of technical supervision, monitoring and translation of guidelines, strategies, policies into instructions and technical sheets to facilitate the implementation of actions at the level of Health Zones.

6.9.4 OPERATIONAL LEVEL: HEALTHZONE

For health management purposes, the national territory is divided into 516 health zones (ZS) with 434 General Referral Hospitals (HGR) and 8,504 planned health areas (AS), 8,266 of which have a Health Centre (CS). This level is tasked with implementing the primary health care strategy.

As such, the SZ is defined as a distinct geographical area within the boundaries of a territory or administrative municipality comprising a population of about 50,000 to 100,000 people in rural areas and 100,000 to 250,000 people in urban areas.

The operational implementation unit is the Health Zone, which organizes the structures responsible for managing comprehensive, ongoing and integrated health care.

The health zone is subdivided into health areas, which, through a health centre, covers about 5,000 to 10,000 inhabitants, for the offer of the minimum package of activities, abbreviated PMA.

6.9.5 STATE OF INFRASTRUCTURE

What are the different problems faced by the hospital system? The central problem facing the DRC's entire hospital system is the population's poor access to quality health care. This problem is the result of four direct major causes:

1. Governance in health facilities is very unsatisfactory:
   - Widespread passive corruption in health facilities;
   - Inefficacies and inefficiencies in health facilities;
2. People's access to health care is inequitable;
   - Physical accessibility of care and services is inequitable;
   - The affordability of health care and services is unfair;
   - The socio-cultural accessibility of populations to health care and services is inequitable
3. Training for health workers and health research are inadequate to the needs of the sector in relation to resource availability;
4. The mismatch between financial resources and the missions of institutions

5. The quality of services and care provided to populations remains inadequate and veryunsatisfactory.

6.9.6 HEALTH INDICATORS

We present some health-related SDG indicators taking into account provinces in their old configurations.

Table 6-55: Number of health structures for 100 000 inhabitants

Number of health structures for 100 000 habitants	*DRC*	*KINSASHASA*	*BAS CONGO*	*BANDUNDU*	*EQUATEUR*	*PROVINCE ORIENTALE*	*NORTH - KIVU*	*SOUTH - KIVU*	*MANIEMA*	*KATANGA*	*KASAI ORIENTAL*	*KASAI OCCIDENTAL*
Number of inhabitants	*95 784 841*	*14 004 250*	*6 176 002*	*8 197 036*	*943 676*	*10 934 656*	*9 954 397*	*6 394 239*	*2 5840 504*	*11 809 588*	*10 934 656*	*6 842 653*
Health centres for 100 000 inhabitants	*8,73*	*2,41*	*6,22*	*13,25*	*125,68*	*11,64*	*4,95*	*9,49*	*10,72*	*9,19*	*7,85*	*11,36*
Health Zones for 100 000 inhabitants	*5,39*	*2,50*	*5,02*	*6,34*	*73,12*	*7,59*	*3,42*	*5,32*	*6,96*	*5,76*	*4,48*	*6,28*
Planned Health Areas : ZS	*9,10*	*2,74*	*6,22*	*13,41*	*125,89*	*11,87*	*5,86*	*10,45*	*11,18*	*9,75*	*7,94*	*11,75*
Referral General Hospitals for 100 000 inhabitants	*0,44*	*0,20*	*0,45*	*0,60*	*5,51*	*0,49*	*0,28*	*0,47*	*0,35*	*0,50*	*0,36*	*0,60*
Provincial/National Hospitals for 100 000 inhabitants	*0,01*	*0,03*	*-*	*-*	*0,11*	*0,02*	*-*	*0,02*	*-*	*0,01*	*-*	*0,01*

Table 6-56: Number of health staff per category for 100 000 inhabitants

Number of health staff bycategory for 100 000 inhabitants	*DRC*	*KINSA HASA*	*BAS CONGO*	*BAND UNDU*	*EQUA TEUR*	*PROVINCE ORIEN TALE*	*NORTH-KIVU*	*SOUTH-KIVU*	*MANI EMA*	*KATANGA*	*KASAI ORIEN TAL*	*KASAI OCCIDENTAL*
Number of inhabitants	*95 784 841*	*14 004 250*	*6 176 002*	*8 197 036*	*943 676*	*10 934 656*	*9 954 397*	*6 394 239*	*2 584 504*	*11 809 588*	*10 934 656*	*6 842 653*
Doctors/Physicians	*6,09*	*12,99*	*6,77*	*6,51*	*15,47*	*4,48*	*4,27*	*9,07*	*7,12*	*5,60*	*3,17*	*3,33*
Dentist Surgeons	*0,05*	*0,16*	*0,16*	*0,05*	*0,11*	*0,01*	*0,02*	*0,00*	*0,04*	*0,00*	*0,02*	*0,01*
Nurses	*62,45*	*30,53*	*88,68*	*146,99*	*380,32*	*57,45*	*44,93*	*50,76*	*82,88*	*52,03*	*62,27*	*77,82*
Midwife	*1,62*	*0,00*	*0,37*	*12,76*	*0,00*	*0,30*	*0,36*	*0,39*	*0,00*	*0,00*	*3,58*	*0,00*
Other health staff	*5,41*	*7,84*	*0,05*	*0,45*	*0,00*	*35,83*	*0,32*	*0,00*	*0,00*	*0,14*	*0,11*	*0,92*

Table 6-57: Number of medical training institutions

Number of medical training institutions	*RDC*	*KINSA HASA*	*BAS CONGO*	*BAND UNDU*	*EQUA TEUR*	*PROVINCE ORIEN TALE*	*NORTH-KIVU*	*SOUTH-KIVU*	*MANIEMA*	*KATANGA*	*KASAI ORIEN TAL*	*KASAI OCCIDENTAL*
Number of medical education institutions in 2015												

Number of inhabitants	*95 784 841*	*14 004 250*	*6 176 002*	*8 197 036*	*943 676*	*10 934 656*	*9 954 397*	*6 394 239*	*2 5840 504*	*11 809 588*	*10 934 656*	*6 842 653*
ITM	*406*	*33*	*48*	*53*	*3*	*51*	*27*	*44*	*6*	*34*	*35*	*36*
ISTM	*110*	*7*	*6*	*23*	*12*	*9*	*22*	*5*	*5*	*9*	*6*	*8*
Faculty of Medicine	*57*	*8*	*4*	*5*	*4*	*3*	*12*	*5*	*2*	*3*	*5*	*1*
ITM % /100 000 inhabitants	*0,42*	*0,24*	*0,78*	*0,65*	*0,32*	*0,47*	*0,27*	*0,69*	*0,23*	*0,29*	*0,32*	*0,53*
ITM % ISTM/100 000 inhabitants	*0,11*	*0,05*	*0,10*	*0,28*	*1,27*	*0,08*	*0,22*	*0,08*	*0,19*	*0,08*	*0,05*	*0,12*
Faculty of Medecine % /100 000 inhabitants	*0,06*	*0,06*	*0,06*	*0,06*	*0,42*	*0,03*	*0,12*	*0,08*	*0,08*	*0,03*	*0,05*	*0,01*
Institution of Medical Techniques : ITM					***Higher Institute of Medical Technique : ISTM***							

Table 6-58: Health indicator in relation to ODD

Province	Health areas per province	Population per province	Status: Heath centres built with durable materials	Reference General hospitals equipped with 100 beds/ province
Bandundu	52	8 197 036	124	22,00%
Bas-Congo	31	6 176 002	53	12,00%
Equateur	69	9 436 676	134	21,00%
Kasaï Occidental	49	6 842 563	128	12,00%
Kasaï Oriental	43	9 450 930	96	6,00%
Katanga	67	11 809 588	117	17,00%
Kinshasa	35	14 004 250	20	7,00%
Maniema	18	2 584 504	31	16,00%
Nord-Kivu	34	9 954 397	83	7,00%
Province Orientale	83	10 934 656	144	
Sud-Kivu	34	6 394 239	77	16,00%
Total	**515**	**95 784 841**	**1 007**	

6.9.7 NATIONAL LIFE EXPECTANCY

According to the Human Development Report (UNDP, 2015), life expectancy in the DRC is 51 years for men and 54 years for women. Indeed, the increase observed since 2011 showsthat the Democratic Republic of Congo gains on average 4 months in life expectancy eachyear, or one year every three years.

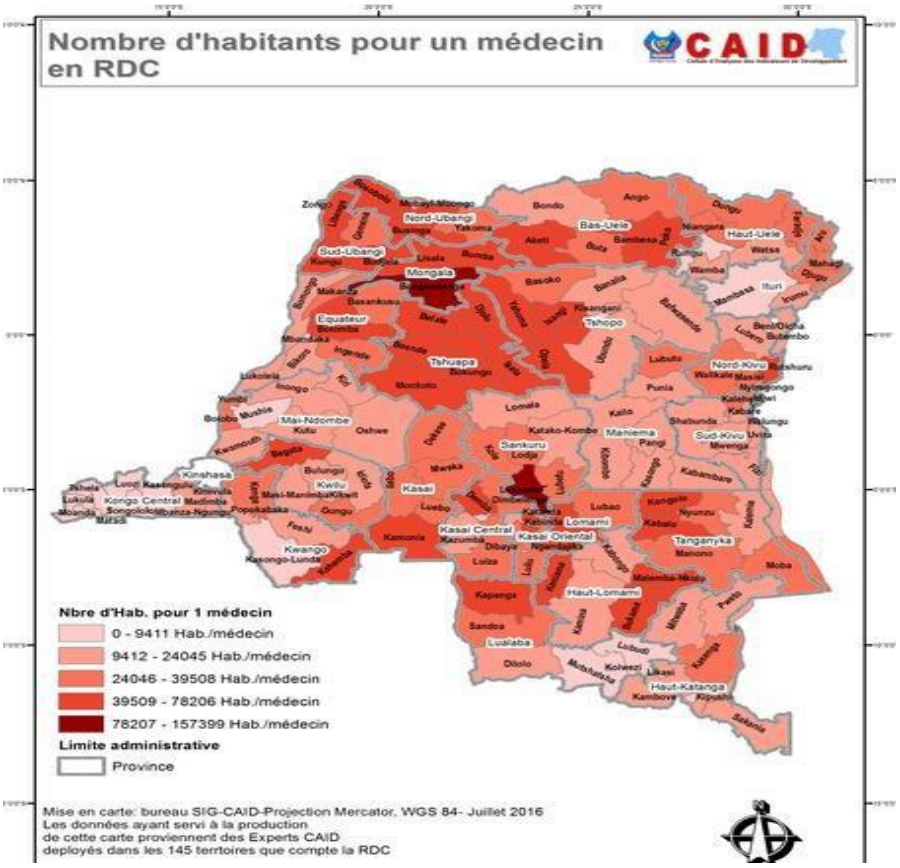


Figure 6-35: Number of inhabitants per doctors/physicians

6.9.8 SOME HEALTH STATISTICS

Table 6-59: Health statistics

	National (DRC)	Urban	Rural	Male	Female	Poorer	Richer	Expected target
Access to health care	68,60%	58,40%	74,90%			33,40%	14,60%	<70%
Chronical malnutrition	42,70%	32,50%	47,10%	45,20%	40,20%	49,70%	22,90%	<20%
Very severe Malnutrition	2,60%	1,40%	3,20%	3,20%	2,10%	3,00%	1,20%	<15%
Child underweight/low weight (Emaciation or body thinness)	7,90%	5,00%	9,10%	9,10%	6,60%	8,40%	4,10%	<5%
Child mortality for children of less than 5 years (number of deaths per 1 000)	104	96	108	115	108	117	76	
Infant mortality 'number of deaths per 1 000)	58	59	68	67	63	65	50	
Neonatal motrality (number of deaths per 1 000)	28	28	31	32	28	27	22	
Mother mortality per 100 000 deliveries	846							
Chronical malnutrition (less than 5 years)	42,70%	32,50%	47,10%	45,20%	40,20%	49,70%	22,90%	<20%
Child underweight/low weight	22,60%	14,30%	26,10%	24,70%	20,40%	28,10%	8,10%	<10%
Children with poor weight (born with < 2 500 g)	7,10%	7,10%	7,10%			6,30%	6,05%	<5%
Children vaccination : BCG	83,40%	92,10%	79,341,6%	83,50%	83,30%	74,10%	96,00%	80,00%
Full coverage vaccination: PEV (Extended Vaccination Programme)	45,30%	53,00%	41,60%	45,10%	45,50%	36,10%	65,00%	70,00%
Modern contraception: A	27,20%	20,20%	32,40%			42,20%	15,10%	<20%
Modern Contraception : women between 15 to 49 years	7,80%	14,60%	4,60%			3,30%	17,20%	<15%
Prenatal Consultation (CPN)	88,00%	94,00%	86,00%			79,00%	96,00%	90,00%
HIV status per province (men and women)	1,20%	1,60%	0,90%	0,60%	1,60%	0,60%	1,80%	
HIV status per province (women)	1,20%	2,30%	1,20%	0,60%		1,20%	0,60%	
Malaria presence	22,60%	19,60%	23,90%	23,20%	22,00%	23,10%	12,40%	<20%
Severe breathing infections	6,70%	6,00%	6,90%	6,95%	6,50%	7,10%	5,00%	<5%

6.9.9 CONCLUSION

The national health system in the DRC is very well organized. Indeed, the entire national territory has been divided into Health Zones (ZS). Although well organized, the health sector is not sustainable and access to care is only 68.6% nationally. We must also add the dilapidated health infrastructure and the weakening of the level of equipment.

The issue of access to health care is further aggravated by the people's income, which translates into health coverage of 34.4% for the poor and 14.4% for the rich.

6.10 SCHOOLS AND UNIVERSITIES

The DRC's population growth is exponential as indicated above. With this high population growth, the school-age population also increases proportionally.

To respond to this situation, it is imperative to increase the public provision of education interms of infrastructure (schools, classrooms, sanitation facilities, etc.) and teachers. In addition to the public offer of education, a private supply of education has developed in the DRC, which has grown rapidly to fill the gaps in the public supply.

As a result, the education sector has become an important sector for private investment inthis country, and therefore an area for business as profitable as others. However, the commodification of education has had a beneficial effect on the country, which has made making a significant

contribution to the substantial increase in the supply of education in the DRC, at all levels, whether in the provision of primary and secondary education or university.

6.10.1 PRIMARY AND SECONDARY EDUCATION INFRASTRUCTURE.

Statistics from UNDP's 2016 National Human Development Report show in Table 6-60 belowthe primary education situation for the public and private sectors.

Table 6-60: Primary education statistics

School Year	Schools	Class-rooms	Number of Pupils	Number of Teachers
2006/2007	29 420	232 686	8 839 888	171 457
2007/2008	31 923	251 366	9 973 365	187 837
2008/2009	34 512	266 855	10 244 086	202 153
2009/2010	35 890	276 983	10 572 412	208 138
2010/2011	37 749	286 908	11 082 501	216 578
2011/2012	40 484	306 967	11 926 835	233 680
2012/2013	43 218	326 533	12 600 876	339 951
2013/2014	48 147	363 249	13 534 625	383 207
2014/2015	51 977	391 390	14 338 520	457 970

From these statistics, we can draw first-rate information to assess this primary education, through interpreting the recorded figures.

The number of schools increased from 29,420 schools in the 2006/2007 school year to 51,977 schools and the number of classes from 232,686 to 391,390 in the 2014/2015 school year. The evolution is experiencing exponential growth in the pace of the trend curve.

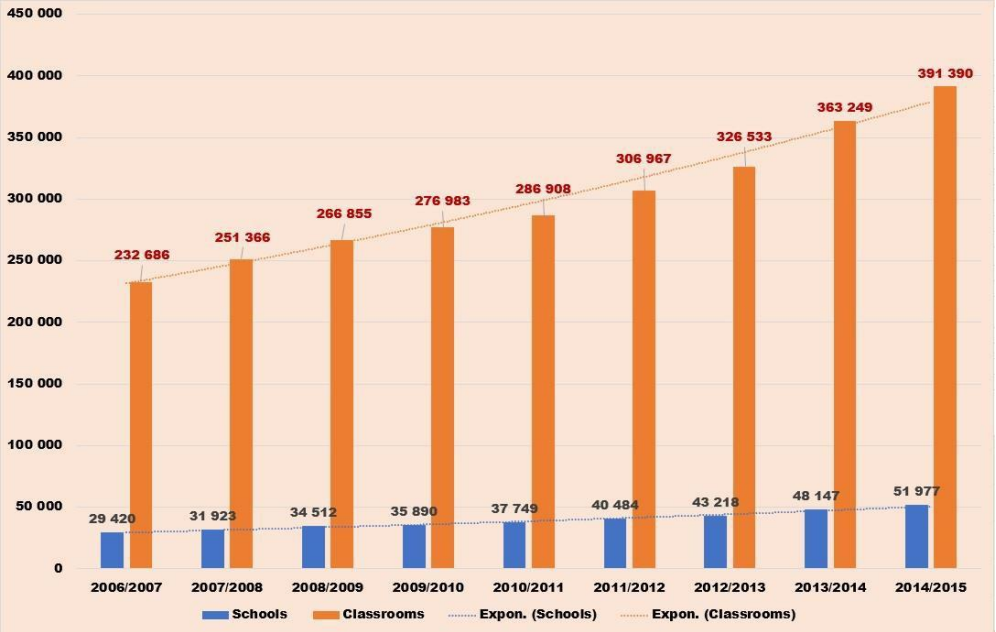


Figure 6-36: Assessment of the number of primary education schools and classes

The average frequency is 2,820 schools and 19,838 classes created per year. The pace is good, but these schools and classes would have to meet the required standards. This is notoften the case, as many schools are simply housed in old dwelling houses. Regarding builtschools; these do not usually comply with any standards and often present the risk of wallcollapse or roof removal during bad weather. This remark is also true for secondary and even university education.

This evolution of the creation of schools and classes per year in primary schools is also exponential.

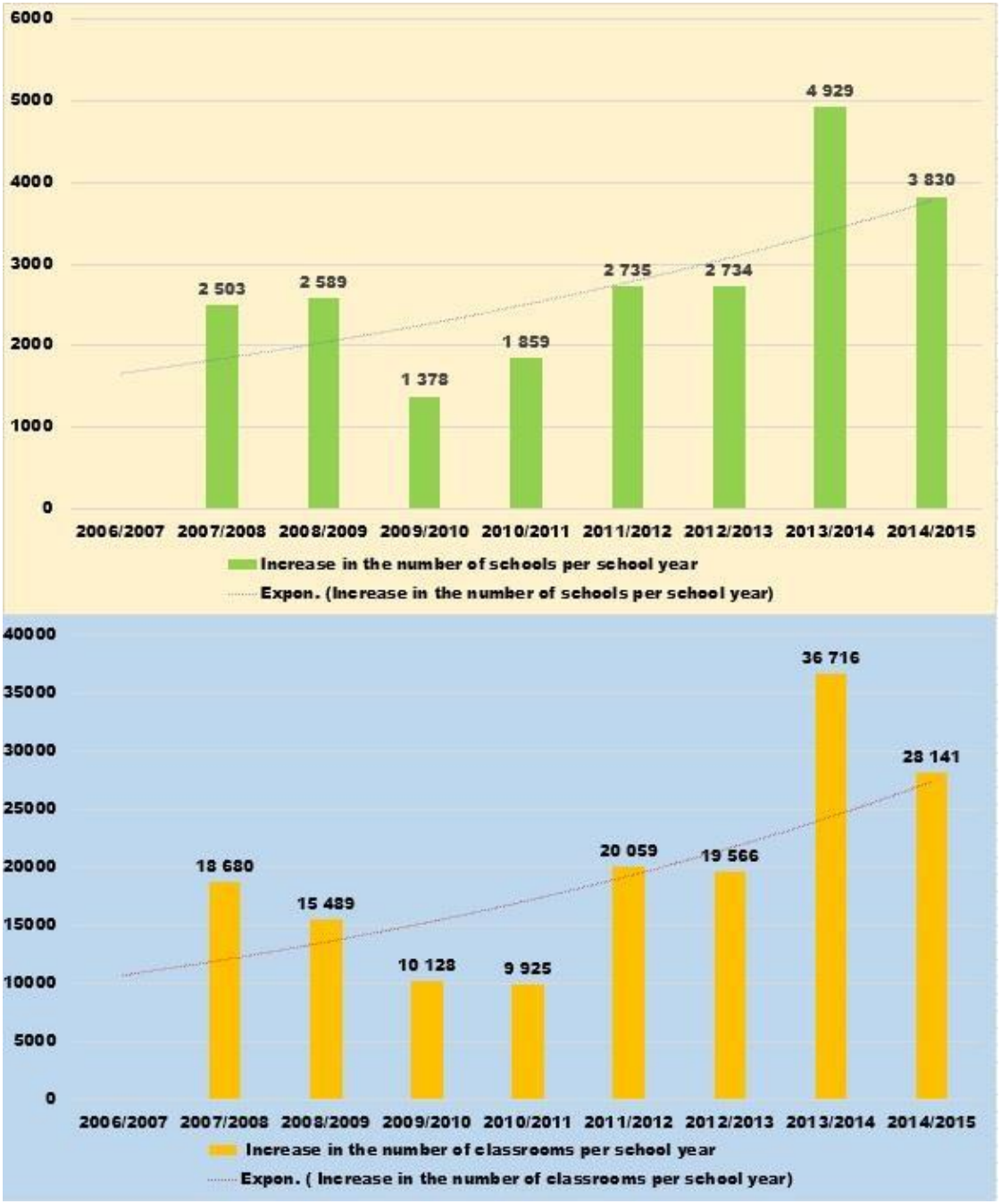


Figure 6-37: Assessment of the number of primary education schools and classes built per year

6.10.2 EVOLUTION OF THE NUMBER OF PUPILS AND TEACHERS AT THE PRIMARY LEVEL

For information, the number of students and teachers also increased during the reporting period.

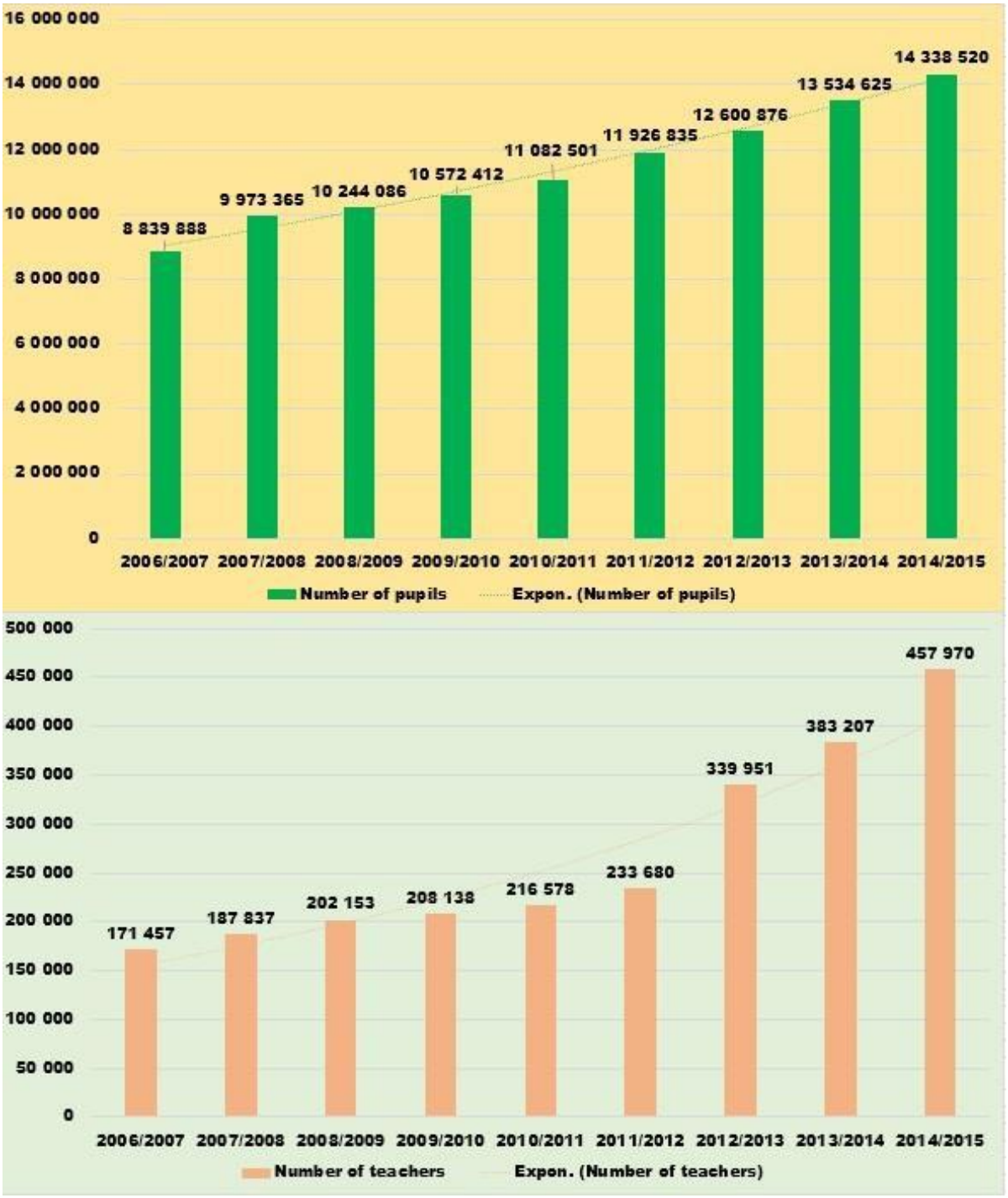


Figure 6-38: Assessment of the number of primary education pupils and teachers

The average number of annual student growth per year is 687,329 new students entering primary school. The average number of new teachers per year is 35,814. Figure 6-39 below provides the growth trend in the number of new students and teachers per year.

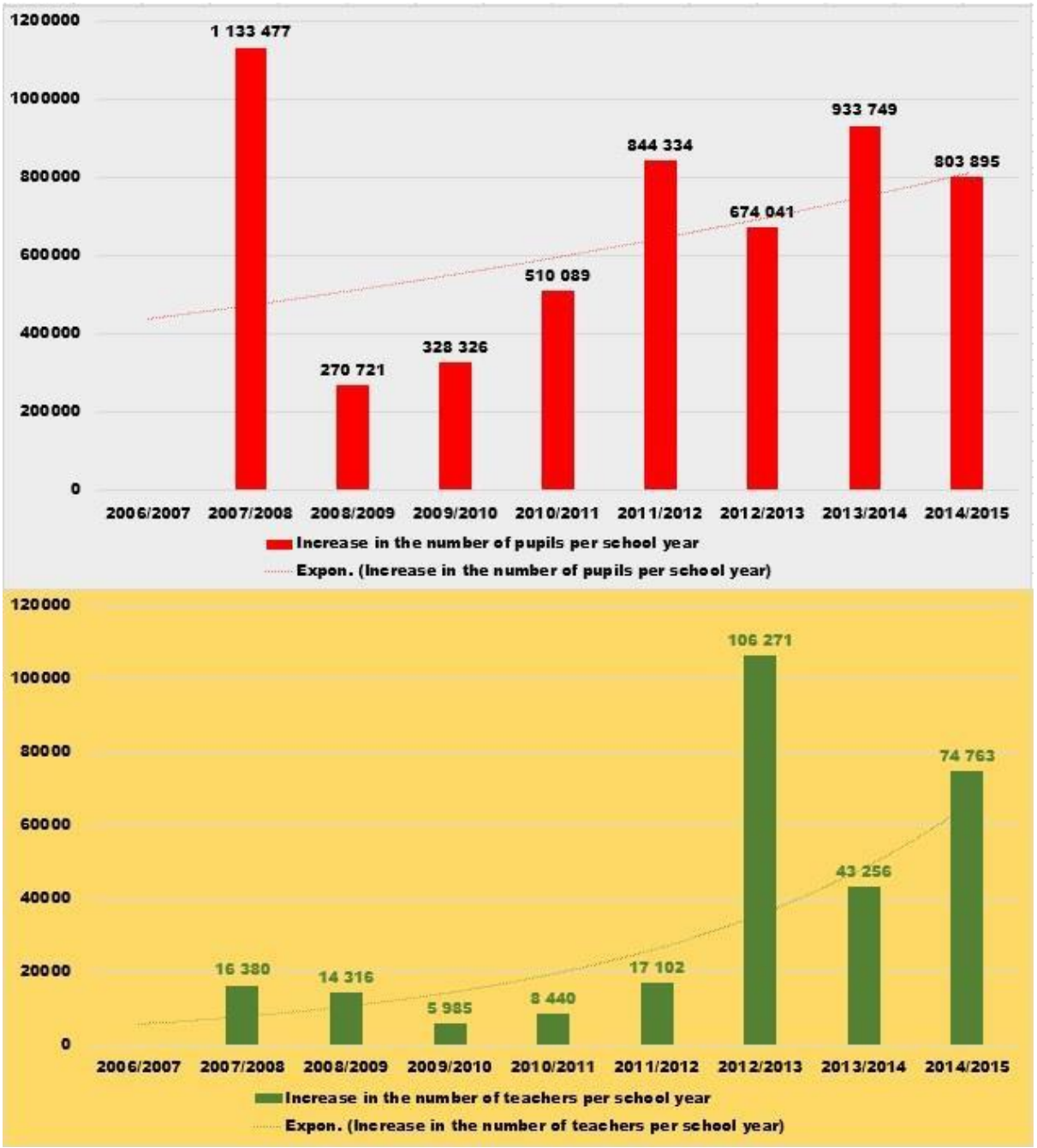


Figure 6-39: Assessment of the number of primary education pupils and teachers per year

6.10.3 STATISTICS ON THE NUMBER OF SCHOOLS AND CLASSES AT SECONDARY SCHOOL

Statistics from the same Report show the situation in Table 6-61 below for secondaryeducation in the DRC in the private and public sectors.

Table 6-61: Secondary education statistics

School Year	Schools	Class-rooms	Number of Pupils	Number of Teachers
2006/2007	14 163	98 866	2 815 234	179 635
2007/2008	15 231	131 269	3 113 803	188 808
2008/2009	16 927	143 613	3 398 550	212 273
2009/2010	17 381	151 853	3 484 466	218 320
2010/2011	19 708	170 315	3 782 945	248 591
2011/2012	20 372	174 190	3 893 647	253 929
2012/2013	22 698	191 613	3 995 631	281 996
2013/2014	23 759	208 950	4 388 425	300 719
2014/2015	25 453	226 330	4 635 814	324 114

We can draw substantial information from these statistics to assess this secondary education.

6.10.4 EVOLUTION OF THE NUMBER OF SCHOOLS AND CLASSES IN SECONDARY SCHOOLS

The number of schools increased from 14,163 schools in the 2006/2007 school year to 25,453 schools and the number of classrooms from 98,866 to 226,330 in the 2014/2015 school year. This evolution, which is included in chart (Figure 6-40) below, is also experiencing, like that of the primary, an exponential growth as regards the pace of the trend curve.

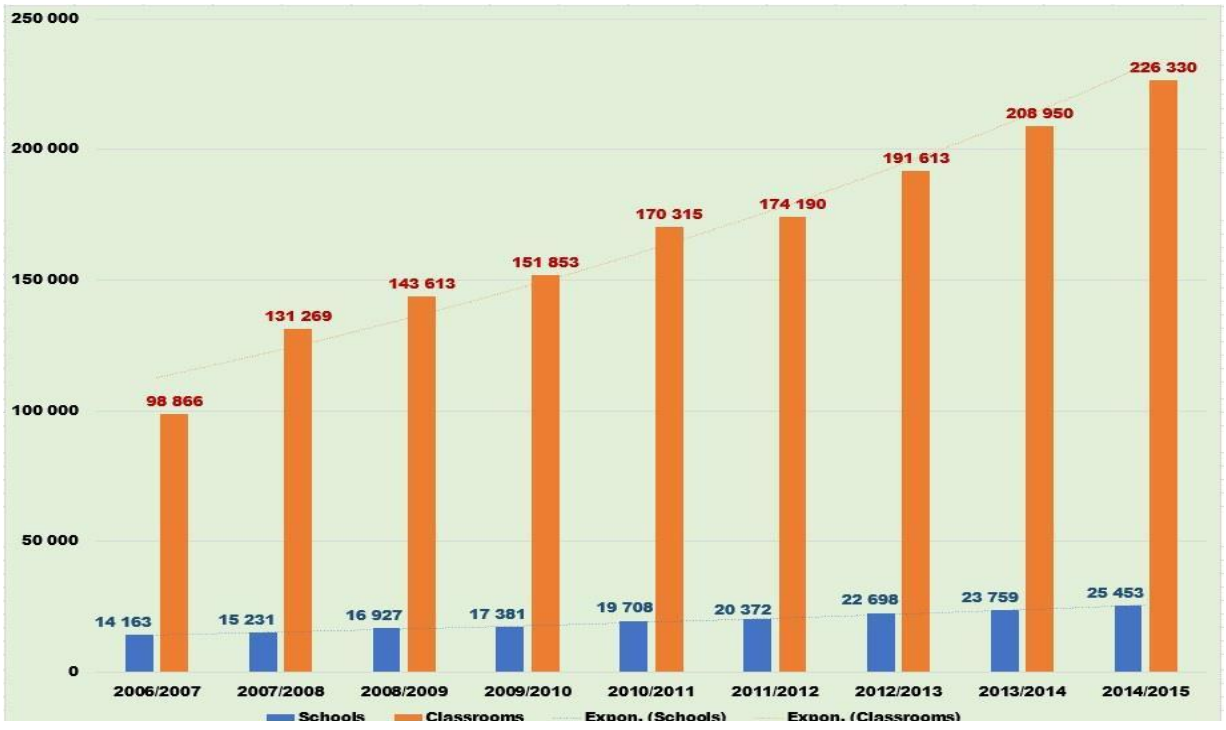


Figure 6-40: Assessment of the number of secondary education schools and classes

With regard to the number of schools and courses that increases per year, Figure 6-41 below gives the evolution of the schools and classes built per year 2006/2007 to 2014/2015.

As for the number of schools and classes increasing per year, Figure 6-42 below shows the evolution of the number of secondary education pupils and teachers from 2006/2007 to 2014/2015.

The average frequency of creation in secondary education is 1,411 schools and 15,933 classes per year. While the pace of high school creation is increasing, the pace of class numbers is downward. During the reporting period, on average, the number of classes erected per year decreased from 2006 to 2015 as shown by the trend curve.

For the creation of secondary schools, the trend curve is increasing and exponential.

6.10.5 EVOLUTION OF THE NUMBER OF STUDENTS AND TEACHERS AT THE SECONDARY LEVEL

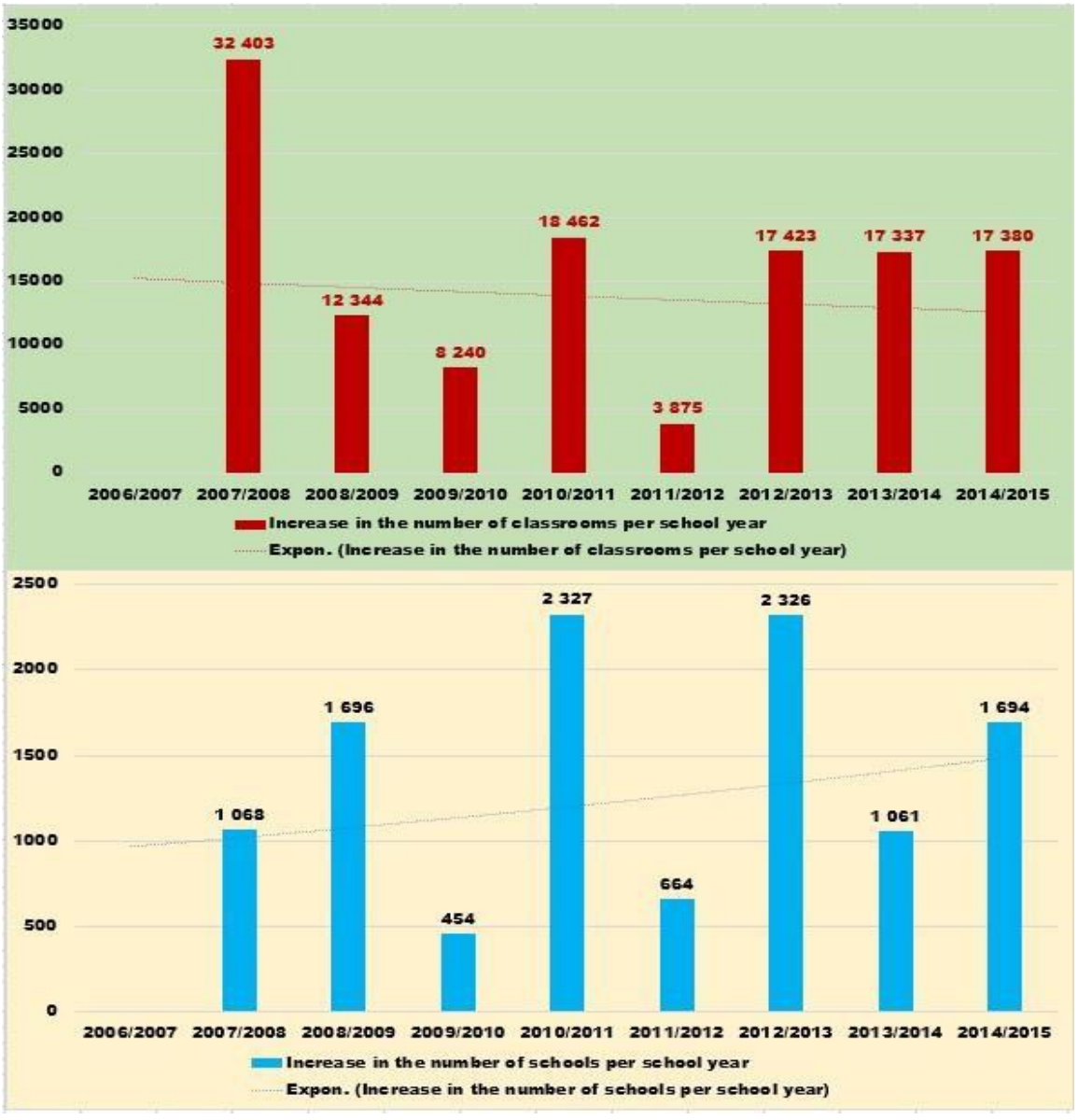


Figure 6-41: Assessment of the secondary education schools and classes built per year

The number of students and teachers in secondary education increased during the periodunder review.

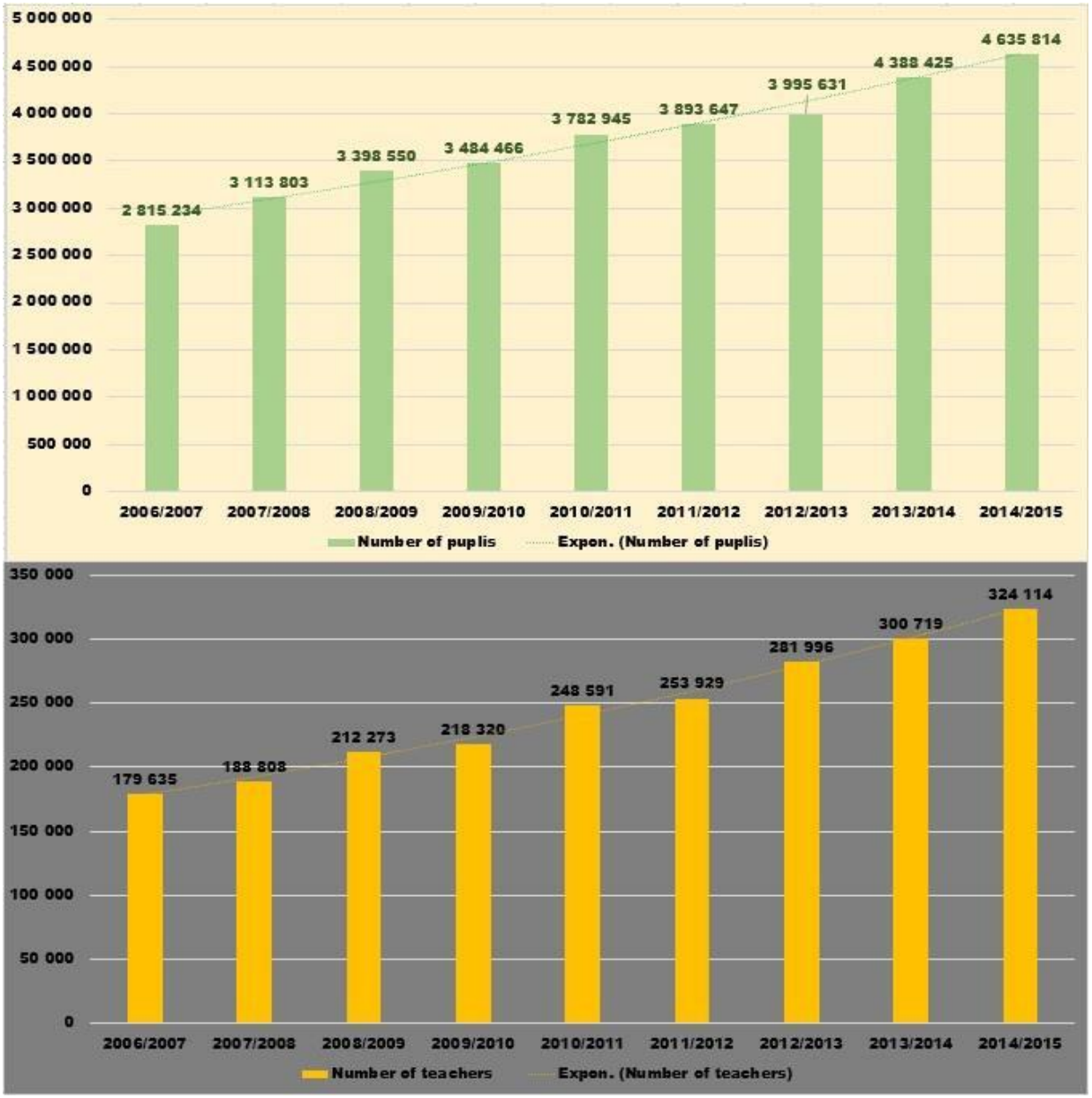


Figure 6-42: Assessment of the number of secondary education pupils and teachers

The average annual growth of high school students per year is 227,573 new studentsentering secondary education. The average number of new teachers per year is 35,814.

Figure 6-43: Assessment of gthe number of secondary education puplis and teachers per year

6.10.6 EVOLUTION OF THE NUMBER OF STUDENTS AND TEACHERS AT THE PRIMARY LEVEL

The processing of data from UNDP's 2016 National Human Development Report provides a % ratio of the number of secondary schools created to the number of schools created annually in primary school.

Table 6-62: School and classroom creation ratio between primary and secondary education

	2006/2007 to 2007/2008	2007/2008 to 2008/2209	2008/2009 to 2009/2010	2009/2010 to 2010/2011	2010/2011 to 2011/2012	2011/2012 to 2012/2013	2012/2013 to 2013/2014	2013/2014 to 2014/2015	Total	Average per year
Annual increase in the number of schools per school year in primary	2 503	2 589	1 378	1 859	2 735	2 734	4 929	3 830	22 557	2 820
Annual increase in the number of schools per school year in secondary	1 068	1 696	454	2 327	664	2 326	1 061	1 694	11 290	1 411
Coefficient of primary school increase as compared to the increase in secondary schools	2,34	1,53	3,04	0,80	4,12	1,18	4,65	2,26	2,00	2,00
Yearly increase in the number of classrooms per school year in primary	18 680	15 489	10 128	9 925	20 059	19 566	36 716	28 141	158 704	19 838
Yearly increase in the number of classrooms per school year in secondary	32 403	12 344	8 240	18 462	3 875	17 423	17 337	17 380	127 464	15 933
Coefficient of increase in primary classrooms as compared to the increase in secondary classrooms	0,58	1,25	1,23	0,54	5,18	1,12	2,12	1,62	1,25	1,25

The result drawn from this table shows that in the DRC, for two primary schools created, there is a secondary school erected. As for classes, the creation of a primary class corresponds to about more or less of a secondary class (1.25 class) created, or about 80% of the classes created in secondary school compared to the classes created in primary school.

6.10.7 STATE OF THE PROVISION OF PRIMARY AND SECONDARY EDUCATION AT THE PROVINCIAL LEVEL

It is clear that the supply of education is making significant progress at the national level, as noted above. Based on the information contained in the same UNDP Report, as shown in Table 6-63 below, it is possible to draw up a great deal of substantial information about the situation of these schools in the DRC.

Statistics by provinces in 2014 show that 87% of primary schools in the country are public compared to 13% of privately owned primary schools. As for secondary schools, 81% of secondary schools are public and 19% privately owned.

Comparing the percentage of schools in each province (relating to the total number of schools in the country), the demographic weight expressed as a % of these provinces, we arrive at the situation noted in the graph.

Regarding primary education, some provinces have more schools in terms of their demographic weight:

- Bandundu: the province has 17.23% of the country's primary schools with a population weight of 10.93%;
- Equator: the province has 10.97% of the country's primary schools with a population weight of 9.89%;
- Kasai Oriental: the province has 9.26% of the country's primary schools with a population weight of 8.80%;
- Kasai Occidental: the province has 9.34% of the country's primary schools with a population weight of 8.09%;

- The other provinces have either a lower percentage or at least equal to their demographic weight.

Table 6-63: Breakdown of primary and secondary education by province

Primary Schools						
Province	Number of public schools	Number of private schools	Total	%	Population	%
Kinshasa	1 369	2 703	4 072	8,46%	8 168 580	11,78%
Bas-Congo	1 881	244	2 125	4,41%	4 370 716	6,30%
Bandundu	8 235	61	8 296	17,23%	7 582 459	10,93%
Equateur	5 118	163	5 281	10,97%	6 861 423	9,89%
Province Orientale	4 891	289	5 180	10,76%	7 370 523	10,63%
Nord-Kivu	2 746	364	3 110	6,46%	5 247 529	7,56%
Sud-Kivu	2 947	397	3 344	6,95%	6 026 096	8,69%
Maniema	1 563	39	1 602	3,33%	1 881 820	2,71%
Kasaï Oriental	3 839	620	4 459	9,26%	6 104 826	8,80%
Kasaï Occidental	4 104	392	4 496	9,34%	5 614 900	8,09%
Katanga	4 959	1 224	6 183	12,84%	10 137 644	14,61%
DRC	41 652	6 496	48 148	100,00%	69 366 516	100,00%
%	86,51%	13,49%				
Secondary Schools						
Province	Number of public schools	Number of private schools	Total	%	Population	%
Kinshasa	10 775	17 711	28 486	13,63%	8 168 580	11,78%
Bas-Congo	11 370	1 893	13 263	6,35%	4 370 716	6,30%
Bandundu	46 814	445	47 259	22,62%	7 582 459	10,93%
Equateur	18 244	1 483	19 727	9,44%	6 861 423	9,89%
Province Orientale	12 243	1 895	14 138	6,77%	7 370 523	10,63%
Nord-Kivu	10 908	2 256	13 164	6,30%	5 247 529	7,56%
Sud-Kivu	9 728	2 081	11 809	5,65%	6 026 096	8,69%
Maniema	6 431	342	6 773	3,24%	1 881 820	2,71%
Kasaï Oriental	10 796	3 102	13 898	6,65%	6 104 826	8,80%
Kasaï Occidental	15 294	1 339	16 633	7,96%	5 614 900	8,09%
Katanga	15 868	7 932	23 800	11,39%	10 137 644	14,61%
RDC	168 471	40 479	208 950	100,00%	69 366 516	100,00%
%	80,63%	19,37%				

Concerning secondary education, some provinces, as for primary school, have moreschools in terms of their demographic weight:

- Bandundu: the province has 22.62% of the country's primary schools with a population weight of 10.93%;
- Kinshasa: the province has 13.63% of the country's primary schools with a population weight of 11.78%;
- The other provinces have either a lower percentage or at least equal to their demographic weight.

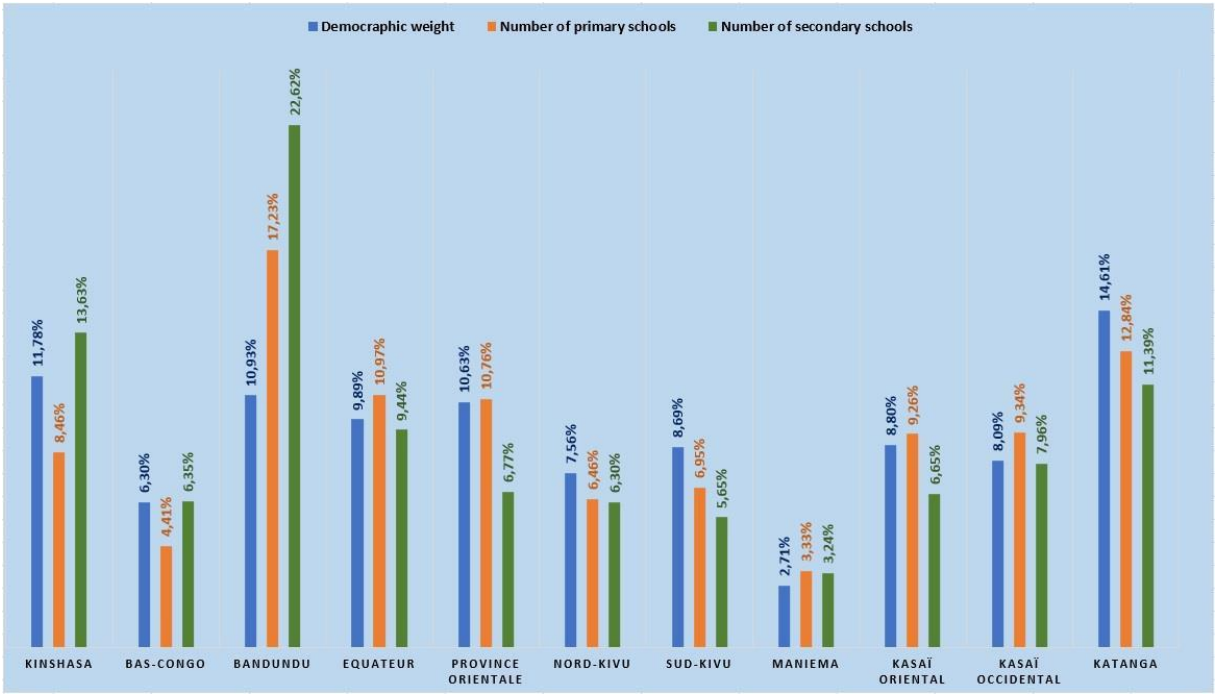


Figure 6-44: Number of primary and secondary education schools carried forward to the provincial demographic weight

6.10.8 NUMBER OF STUDENTS PER CLASS AND PER TEACHER IN PRIMARY AND SECONDARY SCHOOLS

Table 60 below shows the number of students per class and per teacher in primary and secondary schools. This table shows that in the DRC, the primary school has a ratio of 38 pupils per class and 46 pupils per teacher respectively. As for secondary school, this ratio is 23 students per class and 15 students per teacher, respectively.

Table 6-64: Number of primary education pupils enrolled by sex by province 2012-2014

Province	2012		2013		2014	
	Boy	Girl	Boy	Girl	Boy	Girl
Kinshasa	448 187	454 870	475 614	484 267	518 564	526 346
Bas-congo	349 064	315 869	351 769	323 307	356 176	331 343
Bandundu	873 755	785 401	879 565	814 981	938 692	869 008
Equateur	732 640	586 346	743 871	624 452	801 398	676 399
Province orientale	724 806	651 209	744 767	682 037	790 485	726 168
North-Kivu	515 188	458 078	539 647	484 597	595 544	539 524

South-Kivu	484 096	408 115	463 881	436 135	514 068	484 369
Maniema	180 312	115 874	205 362	190 135	212 694	192 440
Katanga	899 561	544 827	1 017 216	846 544	1 046 633	877 018
Kasaï-Oriental	626 686	546 504	645 352	577 334	720 220	637 271
Kasaï-Occidental	560 102	455 345	583 153	486 890	640 593	539 672

Table 6-65: Ratios of pupils per class and per teacher of primary and secondary schools of the DRC

Primary Schools										
	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	Average
Classrooms	232 686	251 366	266 855	276 983	286 908	306 967	326 533	363 249	391 390	
Number of pupils	8 839 888	9 973 365	10 244 086	10 572 412	11 082 501	11 926 835	12 600 876	13 534 625	14 338 520	
Number of teachers	171 457	187 837	202 153	208 138	216 578	233 680	339 951	383 207	457 970	
Pupils per classroom	38	40	38	38	39	39	39	37	37	38
Pupils per teacher	52	53	51	51	51	51	37	35	31	46
Secondary Schools										
Classrooms	98 866	131 269	143 613	151 853	170 315	174 190	191 613	208 950	226 330	
Number of pupils	2 815 234	3 113 803	3 398 550	3 484 466	3 782 945	3 893 647	3 995 631	4 388 425	4 635 814	
Number of teachers	179 635	188 808	212 273	218 320	248 591	253 929	281 996	300 719	324 114	
Pupils per classroom	28	24	24	23	22	22	21	21	20	23
Pupils per teacher	16	16	16	16	15	15	14	15	14	15

6.10.9 INFRASTRUCTURE FOR HIGHER AND UNIVERSITY EDUCATION.

The number of higher and university education institutions in the DRC has evolved as shown in Table 6-66 below.

Table 6-66: Number of higher and university education institutions from 2010 to 2014

	Public Institutions	Private Institutions	Total
2010	400	423	823
2011	381	371	752
2012	379	385	764
2013	399	428	827
2014	408	494	902

The graph drawn up below, shows the evolution of the number of these establishments from 2010 to 2014.

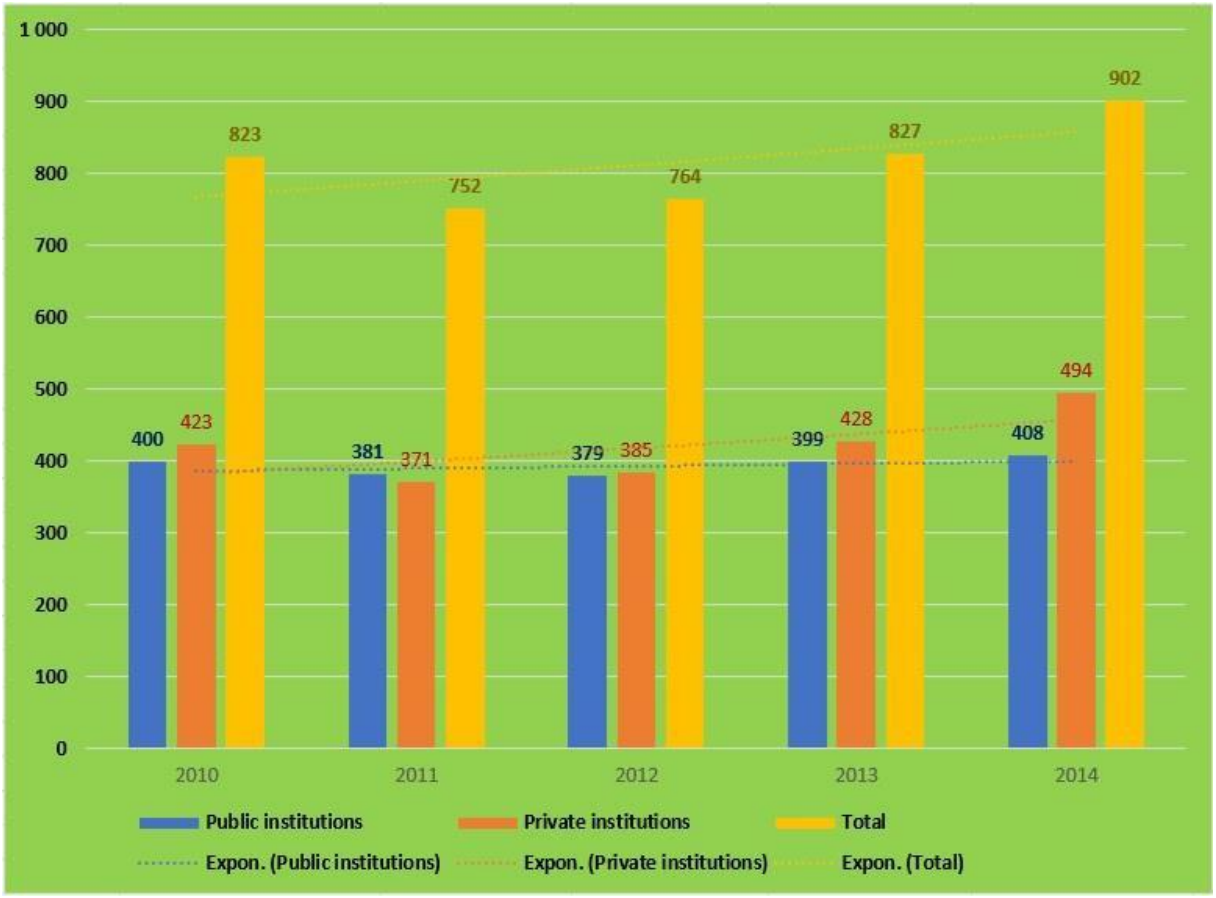


Figure 6-45: Evolution of the higher and university institutions from 2010 to 2014

The number of public institutions remained virtually constant throughout the period underreview, while the number of those held by private institutions grew gradually, albeit slowlyalong the trend curve.

In total, with the contribution of the private sector, the total number of institutions of higher and university education increased over the period under review.

Table 6-67, below shows the distribution of these establishments by province between 2010and 2014. and Figure 6-46 shows this percentage breakdown by province.

Table 6-67: Breakdown of the number of higher and university education by province

Province	2010	Breakdown	2011	Breakdown	2012	Breakdown	2013	Breakdown	2014	Breakdown
Kinshasa	64	7,78%	61	8,43%	73	9,55%	75	9,07%	76	8,43%
Bas-Congo	51	6,20%	44	6,08%	53	6,94%	56	6,77%	57	6,32%
Bandundu	88	10,69%	71	9,81%	81	10,60%	86	10,40%	96	10,64%
Equateur	60	7,29%	54	7,46%	48	6,28%	58	7,01%	62	6,87%
Province Orientale	55	6,68%	59	8,15%	62	8,12%	68	8,22%	73	8,09%
Nord-Kivu	190	23,09%	153	21,13%	130	17,02%	145	17,53%	47	5,21%
Sud-Kivu	25	3,04%	30	4,14%	68	8,90%	67	8,10%	166	18,40%
Maniema	71	8,63%	33	4,56%	35	4,58%	42	5,08%	74	8,20%
Katanga	102	12,39%	109	15,06%	93	12,17%	94	11,37%	98	10,86%
Kasaï Oriental	47	5,71%	49	6,77%	57	7,46%	57	6,89%	63	6,98%
Kasaï Occidental	70	8,51%	61	8,43%	64	8,38%	79	9,55%	90	9,98%
DRC	823	100,00%	724	100,00%	764	100,00%	827	100,00%	902	100,00%

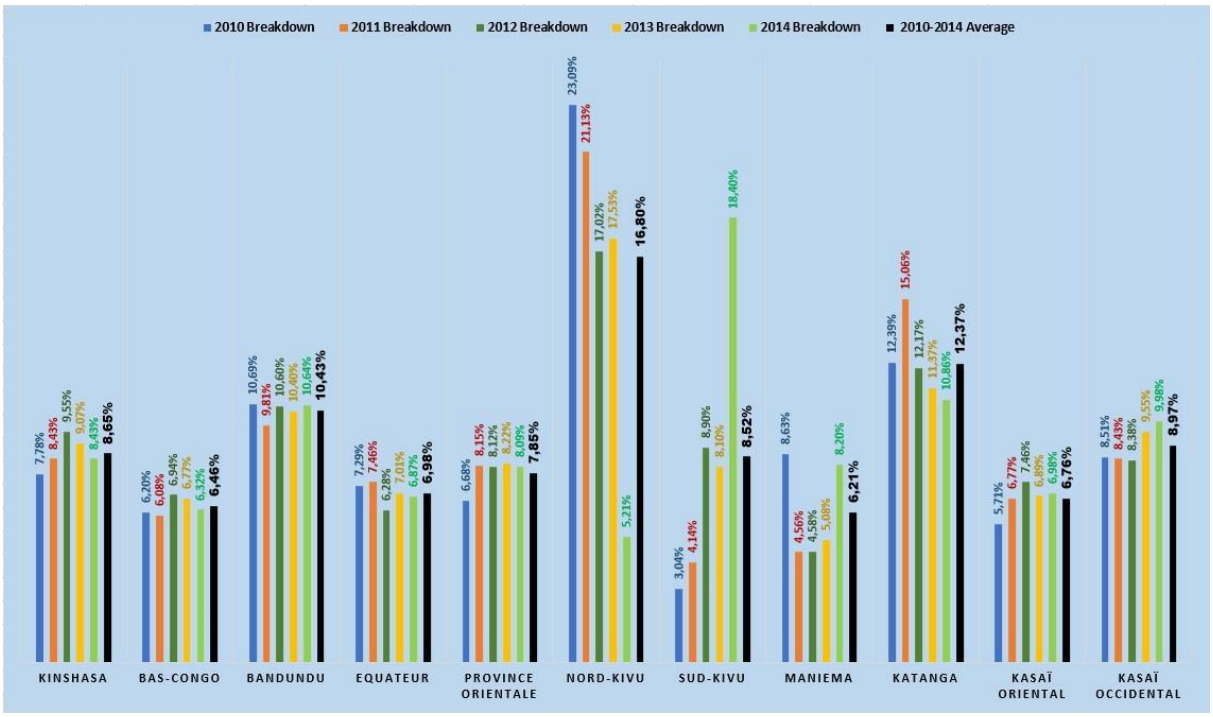


Figure 6-46: % Breakdown of the number of higher and university institutions by province

Comparing the percentage of higher and university education institutions in each province (compared to the total number of higher and university education institutions in the country), the demographic weight expressed as a % of these provinces, we arrive at the situation noted in Figure 6-47 below.

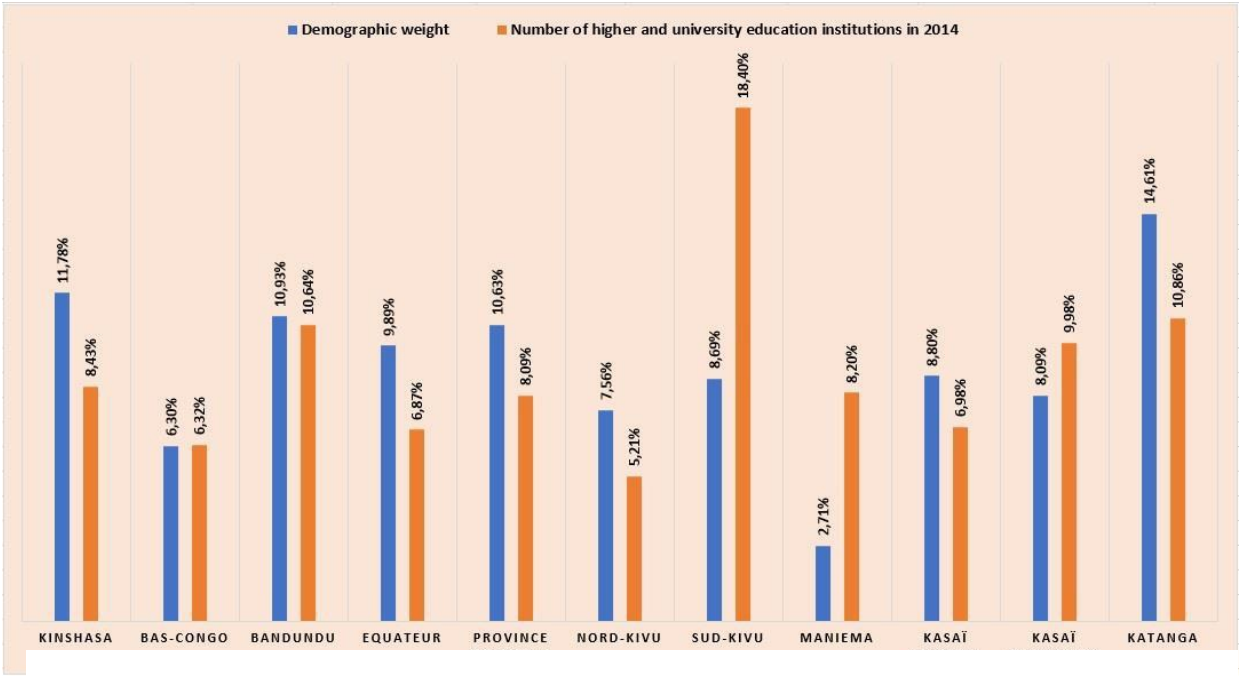


Figure 6-47: % Breakdown of the number of public institutions by provinces and of demographic weights by provinces

For higher and university education institutions, some provinces, as for primary and secondary schools, have more institutions relating to their demographic weight in 2014:

- South Kivu: the province has 18.40% of the country's higher education and university institutions with a population weight of 8.69%;
- South Kivu: the province has 8.20% of the country's higher education and university institutions with a population weight of 2.71%;
- Kasai Occidental: the province has 9.98% of the country's higher education and university institutions with a population weight of 8.09%;
- The other provinces have either a lower percentage or at least equal to their demographic weight.

6.10.10 STATE OF THE PRIMARY AND SECONDARY EDUCATION INFRASTRUCTURE

The infrastructure of the former official schools and those managed by the religious denominations on behalf of the State are in generally good condition and maintenance and renovation work is regularly undertaken there, although some of these schools have not been renovated for a long time. As for other schools, the private ones in particular, some are in immaculate condition while others have an advanced level of decay.

6.10.11 STATE OF HIGHER EDUCATION AND UNIVERSITY INFRASTRUCTURE

Traditional universities and colleges are largely in good condition and well equipped. However, the infrastructure of some higher university education institutions does not seem to meet the requirements for such education, as many are in a state of remarkable inadequacy and the necessary basic infrastructure is lacking. This is the case for this auditorium, taken from the photos in Figure 6-47 below, of a university visited by ONICIV officials in February 2021.

Figure 6-48: University auditorium (ONICIV February 2021)

6.11 PRISONS

6.11.1 CONGOLESE PRISON LEGISLATION

Under Congolese law, DRC prisons are classified into two categories, military prisons and civilian prisons.

Civilian courts are divided into three classes:

- Prison and rehabilitation centres, in short CPR, at each seat of a Court of Appeal, orin each provincial capital;
- Prison and correctional houses, abbreviated MAC, at each seat of a high court, inthe chief-town of the former districts, except where there is a central prison;
- Detention centres at each headquarters of a peace court, in each either territory or municipality, except where there is a central or district prison.

Military jurisdictions are subdivided into three classes as follows:

- Prison and military rehabilitation centres, abbreviated CPRM;
- Military prisons and correctional facilities;
- Military detention centres.

6.11.2 PLACES OF DETENTION, THEIR CAPACITY AND THE PRISON POPULATION

The Democratic Republic of Congo has 208 prisons, including 205 civilians and 3 military personnel, 132 of these prisons are operational, with 130 civilians and 2 military personnel.

The dilapidation and lack of maintenance of such buildings has led to the closure of some places of detention and the transfer of military detainees to civilian prisons. This contributes a lot to their overcrowding. Almost all prisons were built before the DRC gainedindependence in 1960.

Reports on the number of prisoners periodically reported to the ministerial authority showthat prison and rehabilitation centres alone have the largest number of staff, about 70% of the prison population.

As part of the report, 11 prison and rehabilitation centres were examined, with a prison anda correctional Centre as well as a prison and military rehabilitation Centre on which information is available. These are the centres listed below in Table 6-68.

Table 6-68: Prison population and occupancy rate of some DRC detention centres

#	Province	City	Category	Prison Population	Statistics Date	Accommodation capacity	Centre construction date	Occupancy Rate (%)
1	Bandundu	Bandundu	CPR	379	Mai-17	300	Avant 1960	126,33
2	Equateur	Mbandaka	CPR	276	Mai-17	500	1929	55,2
3	Haut Katanga	Lubumbashi	CPR	2399	Juin-20	600	Avant 1960	399,83
4	Kasaï Central	Kananga	CPR	613	Mai-17	150	1953	408,67
5	Kinshasa	Kinshasa	CPR	7889	Févr-19	1500	Avant 1960	525,93

6	Kongo Central	Matadi	CPR	610	Mai-17	150	1934	406,67
7	Maniema	Kindu	CPR	414	Mai-17	200	1938	207
8	Tshopo	Kisangani	CPR	1046	Mars-16	500	Avant 1960	209,2
9	South Kivu	Bukavu	CPR	1850	Oct-19	350	1924	528,57
10	Kasaï	Mbuji Mayi	CPR	915	Mai-17	200	1953	457,5
11	North Kivu	Goma	CPR	1500	Mai-17	250	Avant 1960	600
12	Ituri	Bunia	MAC	1202	Juil-15	500	Avant 1960	240,4
13	Kinshasa	Ndolo	CPRM	1160	Juil-15	520	Avant 1960	223,08

6.11.3 COMMENTS

Overcrowding is affecting many prisons in the DRC. The overall occupancy rate based on available data is 338%, representing an over-occupation of 238%.

The review of the table above shows, for example, with regard to occupancy, that the Goma RPC comes first with a 600% occupancy rate, i.e. a 500% over occupation. This is followed by the Bukavu CPR with an occupancy of 528%, meaning 428% over occupation, then the CPR of Kinshasa with an occupancy of 525% or an over occupation of 425% and the CPR of Mbuji-Mayi with an occupation at 457% or an over occupation of 357%.

6.11.4 STATE OF THE PLACES OF DETENTION FACILITIES - CONDITION OF DETENTION

The dilapidation of the majority of prisons is of great concern. In fact, almost all places of detention built before 1960 have not undergone any rehabilitation or increased their capacity. On rare times, however, there has been rehabilitation, which consisted in carrying out only a few minor works.

Based on the United Nations minimum set of rules for the treatment of detainees (Mandela Rules), Table 66 was drawn up to assess the state of infrastructure and conditions of detention in the 13 prisons considered above. However, information about Kinshasa's establishments is not yet available.

The rules for assessing prisons are those contained in the International Rules known as "Mandela". These rules include category separation, detention facilities, personal hygiene, clothing and bedding, food, physical and sports activity, health services and the library.

Table 6-69: Assessment of some detention centres infrastructure in DRC

#	Province	City	Prison	Categoty Separation				Detention Rooms								Personal sanitation		Clothing and beddings	Food		Physical and Sports Activities		Health Services							Libraries	Commets
				RM 11				RM 12		RM 13	RM 14		RM 15	RM 16	RM 17	RM 18		RM 21	RM 22		RM 23		RM 25		RM 27		RM 28	RM 29		RM 64	
				11.a	11.b	11.c	11.d	12.1	12.2	13	14.1	14.2	15	16	17	18.1	18.2	21	22.1	22.2	23.1	23.2	25.1	25.2	27.1	27.2	28	29.1	29.2	64	
1	Bandundu	Bandundu	CPR	OK	X	X	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1
2	Equateur	Mbandaka	CPR	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	OK	X	X	X	X	X	X	X	2
3	Haut Katanga	Lubumbashi	CPR	OK	X	X		X	X	X			OK	OK	OK	OK	OK	X	OK	OK	X	X	OK	OK	X	X		X	X	X	3
4	Kasaï Central	Kananga	CPR	OK	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4
5	Kinshasa	Kinshasa	CPR	OK																											5
6	Kongo Central	Matadi	CPR	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	OK	X	X	X	X	X	X	X	6
7	Maniema	Kindu	CPR	OK	X	X	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	OK	X	X	X	X	X	X	X	7
8	Tshopo	Kisangani	CPR	OK	X	X	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8
9	South Kivu	Bukavu	CPR	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	OK	X	X	X	X	X	X	X	9
10	Kasaï	Mbuji	CPR	OK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10

		Mayi																													
11	North Kivu	Goma	CPR	OK	X		X		X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	11
12	Ituri	Bunia	MAC		X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	12
13	Kinshasa	Ndolo	CPRM																												13

Comments :

X : rule not met OK : rule met

RM x : Mandela Rule

6.11.5 COMMENTS ON CONDITIONS OF DETENTION IN THE 13 PRISONS UNDER CONSIDERATION

1. The Bandundu CPR has 3 men's pavilions, a women's pavilion and a children's pavilion. It is very dilapidated. Its sanitary facilities are inadequate; there is no kitchen; the dormitories are unsanitary. Inmates sleep on the floor, at best on a mat. Each pavilion has an outdoor shower and toilet; but these are very dilapidated. The prison has no fence. It has a shop, a dispensary, a mill and a small vegetable garden.
2. The Mbandaka CPR is in ruins, dilapidated and unsanitary. Prisoners sleep on the floor with a mat. No beds, mattresses, sheets, blankets. There is a toilet in the prison in a state of great unsanitary conditions. Men and women will relieve themselves in the prisonyard. When it rains the water enters the dormitories.
3. The Kasapa CPR Buildings are even more or less solid. Women are kept separate from men, as are adults from minors. Kasapa prison has become a nursery for qualified officers for other prisons in the DRC.
4. In Central Kasai, the Kananga CPR is in a state of very advanced disrepair. Only one dormitory remains in good condition to house the inmates out of the five built since colonial times. The others only have walls because the roof and other equipment disappeared after a fire. There is a dispensary but no medicine, and inmates do not receive enough food.
5. The Matadi CPR, which occupies a former ONATRA DEPOT, has nine pavilions including one for women. Minors are mixed with adults in a pavilion called VIP. A pavilion is now under rehabilitation to house sick inmates. There is a need to rehabilitate sanitary facilities that are in short supply and very dilapidated. Detainees are not well fed and there is a clinic without staff or medicine.
6. The Kindu CPR has seven dormitories (six in the men's quarter, but only three of which are operational and 1 in the women's area), 2 toilets and 2 showers built by the ICRC (International Committee of the Red Cross), but in insufficient numbers. Inmates sleep either on pavement or on mats, toilets are dirty due to lack of water availability. Food is assured but its quality and quantity are poor, cells are not lit due to lack of electricity, drinking water is served to all male inmates from a single tap, no recreation area.
7. The Kisangani CPR is in a state of great disrepair despite some work undertaken by partners such as the ICRC. Of the 27 dormitories and quarters for single men, three are operational. Of the four dormitories and wards for women, none is operational, so all women and minors are housed at the Guard and Education Establishment. There is no lighting, no ventilation. There are unhygienic sanitary facilities in the prison yard and holes in each cell for nighttime needs. Some inmates sleep on mats and others on pavement or blankets. There is an existing dispensary but it lacks medical Equipment and products.
8. The Bukavu CPR has 12 cells but only five are operational. The dormitories are overcrowded because of the number of cells available. Health infrastructure is dilapidated and often broken. There is no shortage of water, but the toilets are often clogged. No mattresses. Inmates sleep on the floor. The prison still has a large courtyard where inmates spend the day.

9. The MBuji-Mayi CPR buildings in Eastern Kasai are very dilapidated and there is even a risk of collapse. The dormitories are overcrowded and there is no light or ventilation. There are 7 showers and 5 toilets but no doors. There is no running water and detainees do not have the opportunity to wash regularly. There are no beds or mattresses, prisoners sleeping on the floor. To improve the fate of the prisoners somewhat, MONUC donated mattresses and other equipment to the prison.
10. The Goma CPR (Munzenze) is also very dilapidated. The dormitories are poorly equipped. No sleeping and cell cleaning equipment. The prison is not electrified. At nightfall, the inmates are in total darkness. The cells are not ventilated. Most toilets are clogged. The 3 toilets out of the 11 functional have no door. With the intervention of the local Red Cross, hygienic conditions have improved relatively. It is important, however, to point out that the showers are in a state of disrepair. No beds or mattresses. Inmates sleep on the pavement. There is a lack of blankets because two or three inmates use the same blanket. This increases the risk of disease contamination.
11. The Bunia MAC, also located in a warehouse not intended to be used as a prison, has a space for about 100 people, but in which up to 150 or even 190 prisoners are piled up. It is also in very poor condition.

6.11.6 OPINIONS AND CONSIDERATIONS

Based on data collected on the infrastructure of detention facilities, the following considerations can be formulated:

- Infrastructure dilapidation

The dilapidation of the majority of establishments is very pronounced. Almost all places of detention were built during the colonial era (before 1960), and have not undergone any rehabilitation or increase in occupancy capacity. On rare times, these institutions have undergone a rehabilitation consisting of minor work.

- Overcrowding

The first major problem of DRC's places of detention is overcrowding. This prison overcrowding is the result of a multitude of factors, including the lengthening of the preventive detention duration (there are more prisoners awaiting trial in DRC prisons than those convicted), the lack of places of detention and the increase in the number of detainees, especially the military.

- Food

In terms of food, the situation is deplorable in most prisons in the DRC. The amount of meals given to each inmate is insufficient. Inmates have only one meal a day consisting of bean corn and the meal is not regular at all. Usually the detainees' families, religious denominations and national and international NGOs bring food to detainees.

- Health care

Health care in prisons is also lacking or non-existent. Health care workers are content to provide first aid and inmates are only transferredto the hospital when cases become serious.

These conditions of detention (suffocation, lack of access to care, malnutrition) have repeatedly led to cases of death. It should also be noted that Congolese prisons do not have reintegration activities.

However, there is no separation between categories of civilian and military detainees in these civilian prisons, which exposes the former tomilitary pressure.

6.12 CONCLUSION AND SUMMARY

The Report's Editorial Board has worked hard to achieve the results presented above.

Data collection has been hampered, largely, by the fact that such data were unavailable with a sufficient degree of updating. Nevertheless, every step has been made to obtain the information required to meet the spirit and letter of the terms of reference submitted to ONICIV in the development of this Report.

The deficiencies that would be identified will certainly be corrected and improved, when the next Report is ready. The "SDG Commission" of the National Order of Civil Engineers, ONICIV, recommends to note the following:

- Table 1 gives the administrative subdivision of the Democratic Republic of Congo with the 11 former provinces subdivided into 26 newprovinces and indicates the difficult task of gathering the data needed to meet the TDRs against a very difficult political backgroundcharacterized by a radical change in institutions and health conditions hit by COVID-19. With some provinces having the size of somestates south of the Sahara, ONICIV hopes that in the development of the next report the African Federations of EngineersOrganizations, FAEO, will take into account this reality in the Budget and in timing allocated.
- We are endeavouring to meet the two requirements of the ToRs in the table below:

Table 6-70: Conclusion by sector

Sector	How much infrastructure does a country have and is that enough?	What is the status of the infrastructure is it properly utilized and maintained?
Roads	The DRC comprises 153,209 km of national, provincial and agricultural service roads. It is sufficient and requires a significant rehabilitation, especially for agricultural service roads to enable the rural population to evacuate their agricultural products.	These infrastructures are not properly operated and maintained.
Water Supply	The DRC has many rivers. Unfortunately, there are few infrastructures, and this leads to the development of several other types of alternative water supply, including manual pump or pump drilling, depending on the location.	Public infrastructure in major cities is generally properly operated and maintained. Efforts must be made to bridge the gap in rural and peri-urban areas in order to reduce the distances travelled by the population. Infrastructure must be provided to reduce the incidental or voluntary interruptions of the public service in charge of this sector.
Sanitation	The DRC has only a few regulatory sanitation infrastructures. The population as a dump of solid waste uses sanitation works.	The state of these infrastructures is deplorable, misused by the population and poorly maintained.

Sector	How much infrastructure does a country have and is that enough?	What is the status of the infrastructure is it properly utilized and maintained?
Elimination of solid waste	The DRC does not have the proper infrastructure to dispose of solid waste. The solid waste produced by industries and companies is not well managed by public utility services. The few infrastructures left before the country's independence are usually blocked. Instead, the population uses rivers as a dump of solid waste. The associated infrastructure is not sufficient.	The state of these infrastructures is deplorable, untapped properly and poorly maintained.
Airports	Airport infrastructure is in sufficient quantities across the country.	The condition of such infrastructures requires good maintenance and rehabilitation made possible for proper operation.
Ports	There are port infrastructures on every major port Centre. There are plenty of them.	The condition of these infrastructures requires good maintenance and rehabilitation for a rational operation.

Railway	The railway infrastructure is in a dilapidated state, although it is sufficient. Because of this obsolescence, virtually all roads are overloaded and deteriorate rapidly because the tonnage flowing through them is beyond the capacity provided for in their design. This is particularly the case for the roads from Tshopo province to Ituri to the Republic of Uganda.	These infrastructures are not operated at their maximum capacity and are poorly maintained.
Sector	How much infrastructure does a country have and is that enough?	What is the status of the infrastructure is it properly utilized and maintained?
Energy	The DRC has a hydro potential of 100,000 MW disseminated at 890 sites across the 145 municipalities of the country. It is insufficient and the importation on the electric current is greater than the exportation.	The infrastructure relating to the production of electrical energy is in full rehabilitation to cover the demand of the population. They are properly operated and regularly maintained, through agreements with bilateral and multilateral partners.
Healthcare	The DRC has a large health infrastructure system. It is sufficient throughout the Republic. An effort is to be made by the public authorities to reduce distances in order to enable the rural population to have access to health care.	Many health infrastructures are properly operated and well maintained.

Schools and Universities	Infrastructure for primary and secondary education and for higher and university education has increased considerably since the sector was liberalised. They are sufficient.	These infrastructures are generally well operated and maintained, with a few exceptions.
Sector	How much infrastructure does a country have and is that enough?	What is the status of the infrastructure is it properly utilized and maintained?
Prisons	The DRC does not have a sufficient number of penitentiary institutions. There is a prison population beyond the prison capacity design. This leads to the deficiency in food that relevant services are unable to fill. Thus, prisoners not having families in the places of their incarceration happen to die due to insufficient food and access to health care. Mandela standards are not met in almost all penitentiary institutions, with the exception of Kasapa prison.	These infrastructures are not well maintained and too properly used to meet the required standards.

7 KENYA

7.1 WATER, SANITATION AND IRRIGATION INFRASTRUCTURE REPORT CARD

The Ministry of Water, Sanitation and Irrigation is mandated with supply of water for domestic and industrial use as well as for Irrigation. As such, the Ministry has been tracking the level of service given to the citizens on an annual basis.

The target under SDG 6.1a is 'By 2030 achieve universal and equitable access to safe and affordable drinking water for all' with the indicator being the proportion of population using safely managed drinking water services.

The most frequently used definition of access to safe water is that of the United Nations Development Programme (UNDP), which states that those with access comprise: "The proportion of the population using any piped water, public tap, borehole with a pump, protected well, and springs or rainwater".

Currently, the proportion of population with access to water is estimated to be 64%. This includes 76% of population in urban areas and 60% of population in rural areas. This is projected to grow to 80% nationally by the end of 2022 with 100% of population in urban areas and 69% of population in rural areas having access to water.

The water services providers are mandated with supplying water to the consumers. Currently there are 89 registered WSPs consisting of 14 very large WSPs serving over 35,000 consumers, 32 large WSPs serving over 10,000 consumers, 16 medium-sized WSPs serving over 5,000 consumers and 25 small WSPs serving less than 5,000 consumers.

The WSPs however do not cover the entire population. Areas not covered have Community water schemes that supply water to a significant population.

Access to sanitation is measured by the percentage of the population with access and using improved sanitation facilities. Improved sanitation facilities usually ensure separation of human excreta from human contact, and include: Flush or pour-flush toilet/latrine (to Piped sewer system, Septic tank or Pit latrine); Ventilated improved pit (VIP) latrine; Pit latrine with slab or Composting toilet.

Currently, the proportion of population with access to sanitation is estimated to be 32%. This is projected to grow to 40% nationally by the end of 2022.

Sewered sanitation coverage refers to the number of people served with flush or pour- flush to piped sewer systems, as a percentage of the total population within the service area of the utility. Currently, the proportion of population with access to sewerage in urban areas is estimated to be 28% and is expected to grow to 37% by end of 2022. According to impact report, there are 32 sewerage systems in Kenya in 21 counties.

The following is the summary of the water and sanitation report card.

Table 7-1: Water access and sanitation in Kenya

S/N	INDICATOR	SUB-INDICATOR	CURRENT STATUS	PROJECTED STATUS BY 2022
1	Access to water	Proportion of Population with Access to Water Nationally	64%	80%
		Proportion of Population with Access to Water in Urban Areas	76%	100%
		Proportion of Population with Access to Water in Rural Areas	60%	69%
2	Access to sanitation	Proportion of Population with Access to Sanitation Nationally	32%	40%
		Proportion of Urban Population with Access to Sewerage Services	27.9%	37%

The following is the graphical representation of the projected proportion of population with access to safe water.

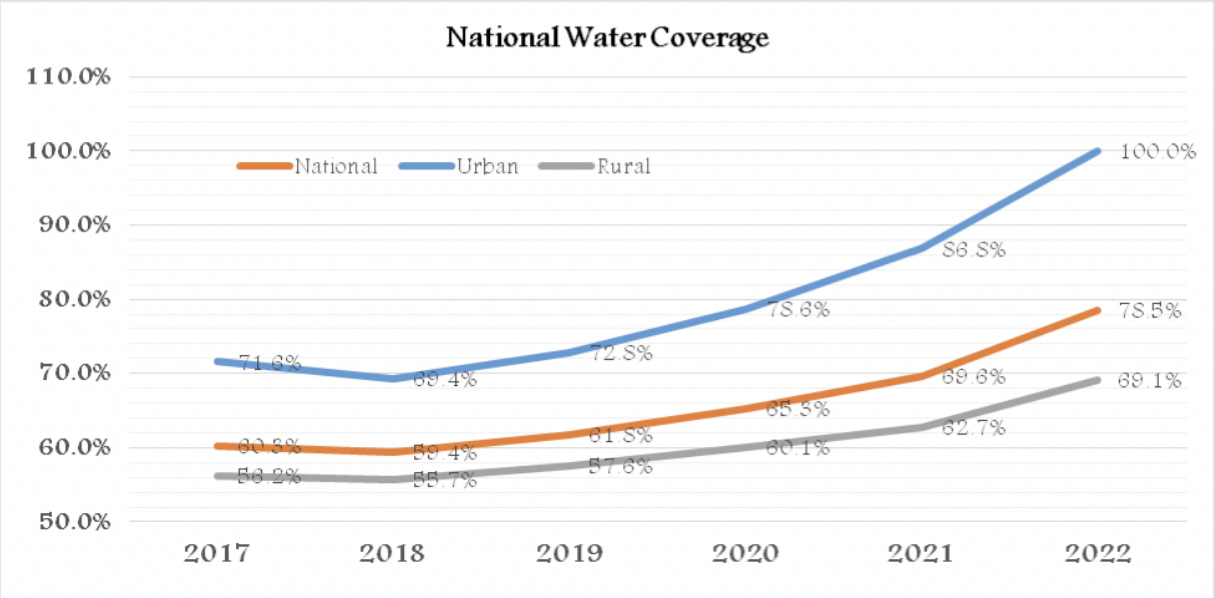


Figure 7-1: Projected Water coverage to be achieved by year 2022

The following is the graphical representation of the projected proportion of urban population with access to sewerage

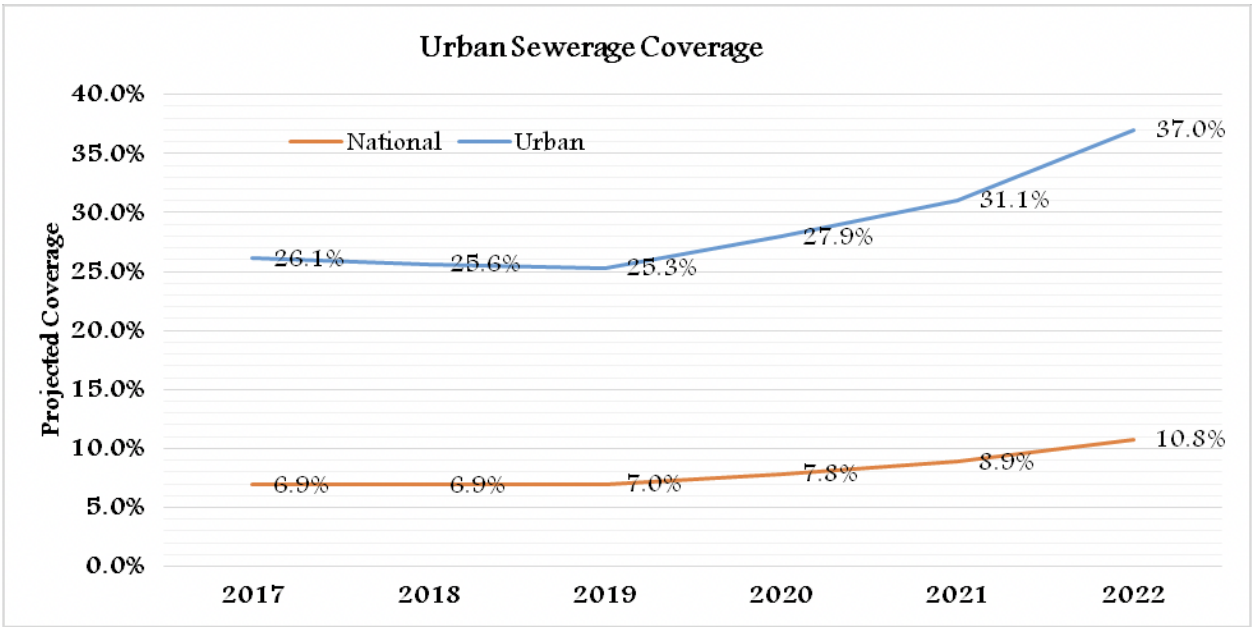


Figure 7-2: Projected Sewerage coverage to be achieved by year 2022

List of dams in Kenya

- Gitaru Dam
- Kamburu Dam
- Kiambere Reservoir
- Kindaruma Reservoir
- Masinga Reservoir
- Koromojo Dam
- Masinga Dam
- Mukurumudzi Dam
- Nairobi Dam
- Ruiru Dam
- Rukenya Dam
- Sasamua Dam
- Thika Dam

7.1.1 CURRENT STATUS AND RATING

Kenyans have significantly more access to safe drinking water (59%) than to basic sanitation (29 per cent). Access to safe drinking water has increased by 12% since 2000, while access to basic sanitation has decreased by 5%. In Kenya, 9.9 million people drink directly from contaminated surface water sources, and an estimated five million people practice open defecation. Only 25% of people have soap and water hand-washing facilities at home.

According to the sanitation cluster group committee members, the sanitation scoring rating has been categorized as D- based on the desk top study and background of the country's current sanitation status. This grade is considered poor and at risk. The grading matrix is shown in the table below.

According to the sanitation cluster group committee members, the scoring rating for solid waste has been categorized as E based on a desk top study and background of the country's current solid waste status. This grade is deemed insufficient. The grading matrix is shown in the table below.

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below

Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition, committed investment, regulatory regime and planning processes.	Minor rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Major rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Critical rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Infrastructure is totally inadequate for present and future use

7.2 TRANSPORTATION INFRASTRUCTURE REPORT CARD 2021

7.2.1 ROAD SECTOR

Kenya is ranked 60th in terms of road quality according to the Global Enabling Trade Report 2016[i] The quality (extensiveness and condition) of road infrastructure is qualitatively rated [1 = extremely poor—among the worst in the world; 7 = extremely good—among the best in the world][1] The report further indicates that the road quality has improved slightly.

It is not economically sustainable to maintain a large unpaved road network. The total length of paved roads per 1,000 inhabitants in Kenya is 21.9km which is less than the EAC member countries' average of 25.3km. (African Development Bank, 2014).

It is recommended that roads be upgraded to paved standards to create a reliable and resilient road network and to minimize maintenance costs in the long term for sustainability. In this analysis, it is noted that KRB undertook a Road Inventory and Condition Survey in 2009 and 2018.

From the 2018 RICS, road network conditions for both county roads and national trunk roads have improved over the last 10 years. In summary, 46.17% of all the classified paved road network are in good condition, 40.22% are in fair conditions, 10.62% are in poor condition while 2.99% are under construction.

14.54% of the classified unpaved network is in good condition, 46.91% are in fair condition, 36.71% are in poor condition while 1.83% are under construction.

Thus, 73.92% of all the classified roads are in maintainable state whereas 26.08% are either dilapidated and require reconstruction or are under construction.

Table 7-2: ROAD NETWORK BY SURFACE TYPE

Road Class	**Surface Type 2018**		
	Paved	**Unpaved**	**Total km 2018**
S & A	4,874.313	3,111.949	7,986.262
B	4,366.281	8,160.937	12,527.218
C	3,499.592	15,986.908	19,846.500
Road Class	**Surface Type 2018**		
	Paved	**Unpaved**	**Total km 2018**
S & A	4,874.313	3,111.949	7,986.262
B	4,366.281	8,160.937	12,527.218
C	3,499.592	15,986.908	19,846.500
Sub-Total	**12,740.186**	**27,259.794**	**39,999.980**
D	1,224.741	11,689.590	12,914.331
E	716.937	11,522.380	12,239.317
F	464.944	9,091.470	9,556.414
G	1,837.996	85,272.824	87,110.820
Sub-total	**4,244.618**	**117,576.264**	**121,820.882**
Total Classified	**16,984.804**	**144,836.058**	**161,820.862**
New	468.529	34,184.977	34,653.506
Narrow	198.977	50,083.516	50,282.493
Sub-total	**667.506**	**84,268.493**	**84,935.999**
Grand Total	**17,652.310**	**229,104.551**	**246,756.861**

Table 7-3: ROAD NETWORK CONDITIONS-2018 ROAD INVENTORY AND CONDITION SURVEY

Road Class	Paved					Unpaved					Grand Total
	Good	Fair	Poor	U/C	Paved Total	Good	Fair	Poor	U/C	Unpaved Total	
CLASSIFIED NETWORK											

S	145.97	10.22	0.49		156.68						**156.68**
A	2,779.97	1,545.56	140.02	78.30	4,543.84	87.49	1,307.15	1,655.57	59.40	3,109.60	**7,653.45**
Au	133.45	7.36	2.11	29.97	172.89	0.59	0.39	0.11	1.25	2.34	**175.23**
B	2,053.20	1,254.25	239.97	91.24	3,638.66	819.40	2,842.38	3,122.28	84.45	6,868.52	**10,507.18**
Bu	255.28	363.42	82.26	29.90	730.86	229.88	729.56	288.87	44.12	1,292.43	**2,023.29**
C	1,695.53	1,458.35	210.92	80.91	3,445.70	2,398.19	7,764.56	5,500.25	235.53	15,898.53	**19,344.23**
Cu	19.82	24.91	5.00	3.84	53.58	28.51	32.71	17.77	7.13	86.12	**139.69**
D	289.46	344.50	147.48	7.90	789.35	1,799.73	4,914.64	3,535.37	93.96	10,343.70	**11,133.05**
Du	127.74	211.84	91.02	4.62	435.22	321.80	626.17	370.46	27.34	1,345.78	**1,781.00**
E	242.18	221.63	76.72	10.03	550.55	2,204.48	5,743.56	3,497.17	50.58	11,495.80	**12,046.34**
Eu	41.43	94.79	29.72	0.25	166.19	0.26	9.40	17.11	0.51	27.28	**193.47**
F	110.74	46.44	19.00	1.22	177.40	1,548.56	4,314.61	2,874.35	54.99	8,792.51	**8,969.91**
Fu	83.96	136.99	66.16	0.34	287.45	52.57	122.64	120.49	2.60	298.30	**585.75**
G	344.77	250.73	174.41	0.06	769.97	10,138.21	33,875.01	34,521.50	239.05	78,773.78	**79,543.74**
Gu	262.33	467.10	330.74	7.12	1,067.29	1,192.14	2,361.66	2,904.83	41.44	6,500.08	**7,567.36**

Total Classified											**161,820.37**
UNCLASSIFIED NETWORK											
NEW	282.09	124.54	57.80	3.04	467.47	4,229.40	14,728.48	14,876.85	352.65	34,187.38	**34,654.85**
NR	80.92	77.23	38.41	2.42	198.98	4,959.70	18,020.77	27,007.21	95.37	50,083.05	**50,282.03**
Total Unclassified											**84,936.88**
Grand Total	**8,948.84**	**6,639.84**	**1,712.22**	**351.16**	**17,652.07**	**30,010.93**	**97,393.71**	**100,310.20**	**1,390.35**	**229,105.19**	**246,757.26**

7.2.2 ROAD DENSITY

Kenya has a total classified road network length of 161,820.36km. From the CIA website, Kenya is ranked 32nd in the world in terms of road network length. The country is the 3rd highest in Africa after South Africa (ranked 10th with 747,014km) and Nigeria (ranked 29th with 193,200km). This is comparatively higher than similar sized neighbouring countries such as Ethiopia (110,414km) Tanzania (86,482km).

Table 7-4: Comparison of Road Densities for sample Countries

Country	Road network (km)	Population	Country Size (Km^2)	Road Density ($Km/100Km^2$)
Kenya	161,820.36	48,460,000	580,367.00	**27.88**
Malaysia	82,144.00	28,310,000	329,758.00	**24.91**
South Africa	754,600.00	56,000,000	1,220,000.00	**61.85**
Tanzania	87,581.00	55,570,000	945,087.00	**9.27**

India	5,603,293.00	1,324,000,000	3,287,000.00	**170.47**
Ethiopia	113,066.00	102,000,000	1,104,000.00	**10.24**

Source: World Atlas (2019), www.roadtraffic-technology.com

Road density is the ratio of the length of the country's total road network to the country's land area. This indicator is part of the FAO Suite of Food Security Indicators. It measures the Km of road per 100 square km of land area, where road network total includes motorways, highways, and main or national roads, secondary or regional roads, and all other roads in a country. This indicator provides information on the possibility of physical access to markets. As shown in Table 3 above, Kenya has a road density of 27.88km/100km^2. Ethiopia and Tanzania have road densities of 10.24km/100km^2 and 9.27km/100km^2 respectively.

From the above, it is seen that Kenya's road network is extensive and ranks high globally. However, only 15% of the roads are paved and 35% of the network is all weather with the bulk (105,351.05km) of earth surface.

7.2.3 RURAL ACCESSIBILITY INDEX

Rural Access Index (RAI) is an important global indicator for measuring people's transport accessibility in rural areas. The index was endorsed by the World Bank's Transport Sector Board in 2003 as a sustainable, consistent and simple method compared to its predecessor. RAI uses spatial data of road network and population distribution to define the proportion of the rural population who live within 2 km (equivalent to a walk of 20-25 minutes) of paved and gravel roads in good and fair condition (all weather roads). Figure 9 presents the findings of the RAI analysis by county. Data reveals low level RAI in Northern, Eastern and parts of the coastal region. Indicatively the Northern corridor (Mombasa-Uganda border) records fair RAI.

The RAI estimates vary significantly across the counties (11-100%). RAI is dependent on population distribution patterns and tends to be higher where the population density along the road network is high. A lower RAI has been observed in Lamu County. This is due to factors that correlate with the index which are, the reduction in the length of all-weather roads and the reduction of rural population caused by rural population migration to urban areas. Insecurity has also affected the RAI in Lamu due to the recent and frequent terrorism attacks experienced. Another contributing factor is accessibility. Development and maintenance of roads is paramount to an improved RAI

Kenya has recorded improved performance in the RAI. A report by World Bank Group in 2014 using government data for 2009 estimated the rural access index of 56%. Comparatively the 2017 values stood at 62.49 percent. This shows improved accessibility for all, and especially rural dwellers. Comparatively, out of 45 countries in Sub-Sahara Africa region, Kenya was ranked 23.

In conclusion, the resultant RAI estimates vary significantly across the counties and across constituencies trickling down to sub locations in Kenya. These estimates are useful for road planning and prioritization purposes. Road network expansion and improvement are both

important to raise the RAI and thus the Kenyan government should prioritize this in order to achieve vision 2030.

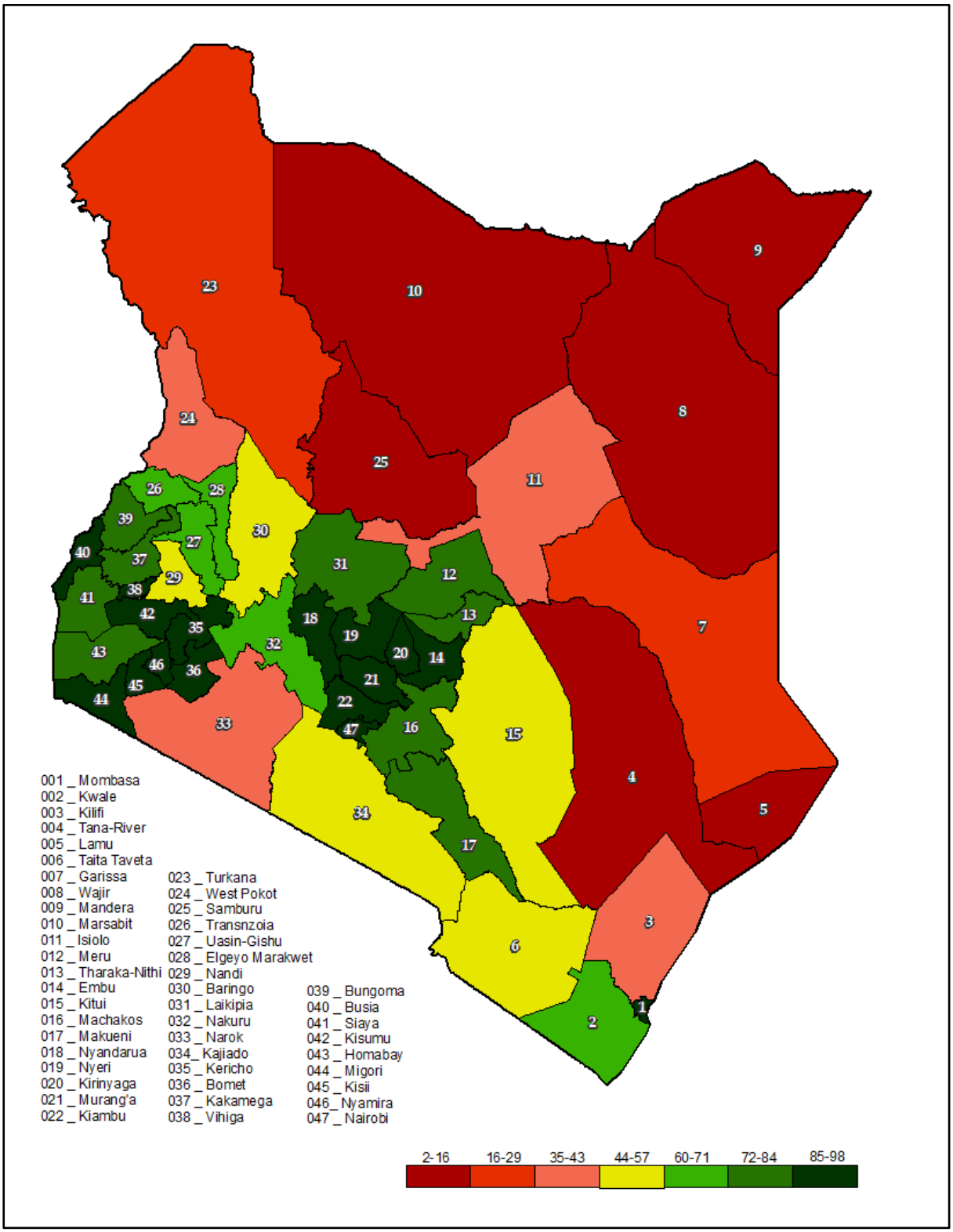


Figure 7-3: Rural accessibility

Overall Assessment

There has been an overall improvement in the quality of the infrastructure over the last 10 years evidenced by better road conditions, higher rural accessibility index and increased contribution to the GDP by the road sector. This is attributed to the increased investment which has grown from Kshs. 66 billion in 2009 to over Kshs. 200Billion in 2019.

In spite of the improvement, there still exist gaps mainly in financing. The 2nd RSIP estimated a gap of Kshs. 227 billion to have a nominal improvement in the road network condition based on the projected budgets. This is against the backdrop of rising costs of construction with components such as land acquisition, relocation of services, delays due to financing challenges, requiring urgent attention.

7.3 RAILWAY SECTOR

The Government of Kenya has since the year 2014 implemented railway projects within the Republic of Kenya. The developments are aimed at expanding the railway network, as well as ensuring there is interconnectivity of available railway systems.

To date, the Government through the Ministry, has implemented the following:

7.3.1 HEAVY HAUL AND FREIGHT LINES

~ Construction of the 472km Standard Gauge Railway (SGR) line connecting Mombasa to Nairobi (2014 – 2017),

~ Construction of the 120km SGR line connecting Nairobi to Naivasha (2017 – 2019),

~ Revitalization of the 177km Meter Gauge Railway (MGR) line connecting Thika and Nanyuki (2019 – 2020),

~ Construction of a new 250m MGR extension line connecting Nanyuki station line with Vivo Energy Depot in Nanyuki (2020),

~ ^Rehabilitation of the 5.5km MGR line connecting Kisumu port and the National Cereals and Produce Board (NCPB) facility in Kisumu (2019), Construction of new 1.8km MGR extension line connecting NCPB and Kenya Pipeline Company (KPC) Depot (oil terminal/fueling point, in Kisumu). The Government has also re-fitted the Wagon-Ferry, Marine Vessel (MV) Uhuru and her tug-boat MV Peeda (2019), and MV Uhuru is currently providing cargo transport services to Port Bell in Uganda. This has provided a road and rail connection with water transport.

In addition Revitalization/Rehabilitation works are ongoing on;

~ The 465km MGR section connecting Longonot and Malaba, the 217km MGR branch line connecting Nakuru and Kisumu,

~ The 78km MGR branch line connecting Gilgil and Nyahururu, the 456km MGR section connecting Mombasa and Konza,

~ The 165km Commuter Rail network within Nairobi Metropolitan Area, and

~ Construction of the 23.5km new MGR link connecting Naivasha ICD and Longonot MGR station. This later link is providing interconnectivity between the SGR line and the MGR line.

There is also operational interconnectivity between the MGR and the SGR at the Nairobi Inland Container Depot (ICD), where the two lines exist side by side.

7.3.2 PASSENGER LINES

Passenger services are being offered on a medium and long distance basis, on the Mombasa - Nairobi - Naivasha SGR lines (Phase 1 SGR and Phase 2A SGR), as well as on the Thika - Nanyuki MGR Branch Line.

Commuter services (short distance) is being offered on:

~ The 165km Commuter Rail MGR Network, which covers; Nairobi - Kikuyu, Nairobi - Ruiru, Nairobi - Syokimau - Athi River - Lukenya, Nairobi - Makadara - Embakasi Village, and

~ The 34km SGR section covering Nairobi - Ongata Rongai - Ngong.

The Government has also planned to Revitalize; the 69km MGR section connecting Kisumu and Butere, the 65km MGR branch line connecting Leseru and Kitale, and a new 4.7Km MGR line connecting Mai Mahiu SGR station with the Naivasha ICD – Longonot station new MGR link. This link is to be used for connection of passenger services.

Further, the Government has plans for development of SGR line extension along the Northern Corridor Route to connect Naivasha and Kisumu (262km), and Kisumu to Malaba (107km). There are also plans for development of SGR lines along the Lamu Port, South Sudan, Ethiopia Transport (LAPSSET) corridor to connect Lamu and Isiolo, Isiolo and Moyale, Isiolo and Nairobi, and Isiolo, Lodwa.

7.4 AVIATION SECTOR

Kenya Airports Authority (KAA) was established under an Act of Parliament in 1991 with the responsibility of providing and managing all airports in Kenya. Under Cap 395, KAA is mandated to provide efficient and effective airport facilities and services in a sustainable environment.

It is also mandated to provide facilitative infrastructure for aviation services between Kenya and the outside world. Its main functions being to:

- Administer;
- Control; and
- Manage aerodromes.

7.4.1 LEGAL, INSTITUTIONAL AND REGULATORY FRAMEWORK

The civil aviation sector operates under the general guidelines of the International Civil Aviation Organization (ICAO) stipulated in various annexes in force and domesticated by the Kenya Civil Aviation Authority.

The Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works, State Department of Transport, created by the Constitution of Kenya, is responsible for policy direction of the Sector.

Kenya Civil Aviation Authority (KCAA) established under the Civil Aviation Act1 (No. 21 of 2013) is responsible for safety and security oversight as well as air traffic management.

The Kenya Airports Authority (I<AA) established under Cap 3952 of 2020 of the Laws of Kenya provides aviation facilities, infrastructure and services including developing public airstrips on an agency basis.

The airlines, national and foreign, provide passenger and cargo transport services locally and internationally.

1 Kenya Civil Aviation Authority Act (No. 21 of 20 13) is an Act of Parliament to make Provision for the control, regulation and orderly development of civil aviation in Kenya and for matters incidental thereto or connected therewith.

2 Kenya Airports Authority (Cap 395) is an Act of Parliament to establish the Kenya Airports Authority (KAA), to provide for the powers and functions of the Authority and for connected purposes.

7.4.2 ROLE OF AVIATION IN THE NATIONAL ECONOMY

Kenya Vision 2030 is the economic blueprint overarching the pursuit of a globally competitive and prosperous Country enjoying high quality of life enabled by sustained annual GDP growth of 10%, a just and cohesive society and clean and secure environn1ent under the stewardship of issue based, people centered, result oriented and accountable political democracy.

The aviation sector generally stimulates the Kenya Vision 2030 through facilitation of business and tourism travel, global supply chain, socio-cultural, educational and humanitarian activities. Specifically, the sector supports job creation estimated at 410,000 jobs. Airlines, Kenya Airports Authority, Kenya Civil Aviation Authority, Concessionaires, Aircraft Maintenance, Repairs and Overhaul companies account for direct jobs of 15,000. Buying of goods and services from local suppliers support 96,000 jobs. Expenditure by employees on consun1er goods and services as well as by foreign tourists supports 43,000 and 257,000 jobs respectively. The attendant gross value-added contribution to the GDP is estimated at US$ 3.2 billion, equivalent to 4.6% of GDP.

Finally, the sector also facilitates express connections locally and internationally thereby supporting flow of goods, foreign exchange earnings, investments in productive assets, movement of people and ideas, sports, cultural exchange and emergency and humanitarian interventions for sustainable economic growth.

7.4.3 OWNERSHIP AND MANAGEMENT OF AERODROMES

Kenya has approximately 584 airfields distributed nationally as per the Aerodrome Information Publication (AIP) of 20 20 [unpublished]. 18 of these airfields are managed by Kenya Airports Authority (KAA), 8 by the Military for surveillance; 50 airfields are operated by the Kenya Wildlife Services (KWS) for the management of the National Parks and Game Reserves; 196 overseen by the respective County Commissioners; and 312 private ones used for emergency, security, picnic, agriculture and general socio-economic activities.

The above 584 aerodromes have the following types of pavement surfaces:

- Paved runways: Bitumen 58, Concrete 2; and
- Unpaved runways: Earth/Murram/Sand 345 and Grass 179.

The following are aerodromes owned and managed by KAA: -

- Jomo Kenyatta International Airport (JKIA) at Nairobi
- Moi International Airport (MIA) at Mombasa
- Kisumu Airport
- Eldoret International Airport
- Wajir International Airport
- Wilson Airport
- Manda (Lan1u) Airport
- Lodwar Airport
- Lokichoggio Airport
- Malindi Airport
- Nanyuki Civil Airstrip
- Ukunda Airport
- Eldoret Bon1a Airstrip
- Garissa Airstrip
- Isiolo Airport
- Kakamega Airstrip
- Kitale Airstrip
- Kabunde (Homabay) Airstrip

Table 7-5: Ownership of aerodromes

Agency Managing the Aerodromes	Total Number	Runway Surface Type			
		Bitumen/ Asphalt	Grave1/ Murram/ Sand	Concrete	Grass
KAA	18	18	0	0	0
Military	8	4	2	1	1
KWS	50	6	32	0	12
Government (MOTIH&UD, OP)	196	24	150	0	22
Private Airstrips	312	6	161	1	144
Sub - Total	**584**	**58**	**345**	**2**	**179**
Helipads	20				

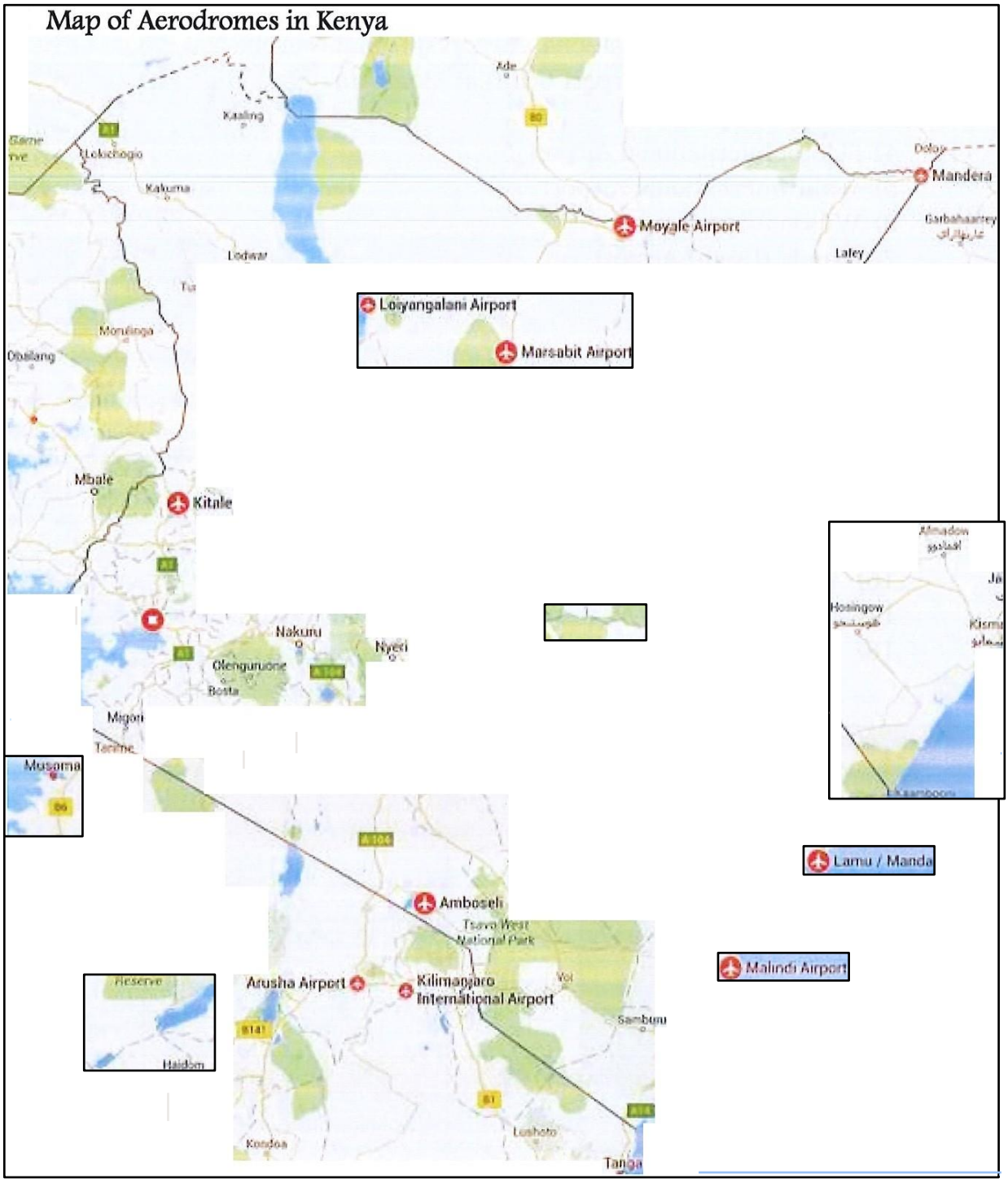


Figure 7-4: Aerodromes in Kenya

7.4.4 KEY STAKEHOLDERS AND THEIR ROLES

The Key stakeholders and their respective roles in the airfield development are as shown in the Table below:

Ministry/Department/Agency	Policy and Re Responsibility and Reguulatory Responsibilities
Department of Transport Interior &mCo-ordination of National Government	Policy Direction and Economic Oversight Security
National Treasury and Planning	Resource Allocation
National Audit Office	Expenditure Audit
Kenya Civil Aviation Authority Kenya Airports Authority Kenya Defense Forces Kenya Meteorological Agency Kenya Wildlife Services Council of Governors	Aviation Safety and Security Development Agent Airspace Surveillance Weather Safety (Aviation Meteorology) Development Ag en t Intergovernmental Relation s

7.4.5 CURRENT RATING

According to the transportation cluster group committee members, the transportation scoring rating has been categorized as C based on the desk top study and background of the country's current sanitation status. This grade is considered adequate. The grading matrix is shown in the table below:

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition, committed investment, regulatory regime and planning processes.	Minor rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable	Major rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable	Critical rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable	Infrastructure is totally inadequate for present and future use

	infrastructure to be fit for its present and future use	infrastructure to be fit for its present and future use	infrastructure to be fit for its present and future use

7.5 ENERGY INFRASTRUCTURE REPORT CARD 2021

7.5.1 INSTITUTIONAL STRUCTURE

The energy sector in Kenya is governed by the Constitution of Kenya,2010 (CoK), the Energy Act ,2019 and other regulatory instruments that may be in place from time to time. The sector has advanced in electricity generation ,transmission ,distribution and retailing .This arises from implementation of various reforms ,notably the Electric Power Act ,1997 ,Sessional paper no.4 of 2004 ,the Energy Policy ,2018 and the Energy Act ,2019.The Energy Act,2019 repealed the Energy Act ,2006 ,the Kenya Nuclear Electricity Board Order No.131 of 2012 and the Geothermal Resources Act ,1982.The reforms in the energy sector have seen a complete re-organization of functions ,driven by the need to place responsibilities to specific institutions that would specialize in the mandate vested on them to enhance efficiency .The institutional structure in the electricity sub-sector in Kenya comprises the following:

a) The Ministry of Energy (MoE)

MoE is responsible for the formulation and monitoring of the implementation of policies to enable an environment for efficient operation and growth of the sector. It sets the strategic direction for the sector, and provides a long-term vision for all sector players. It is also responsible for the national energy planning, mobilization of financial resources for the sector and licensing of coal and geothermal resources as related to downstream activities.

b) Energy and Petroleum Tribunal (EPT)

EPT is a quasi-judicial body whose mandate is to hear and determine disputes on all matters referred to it in relation to the energy and petroleum sectors. It also has original appellate jurisdiction to hear and determine decisions of EPRA.

c) The Energy and Petroleum Regulatory Authority (EPRA)

EPRA is responsible for economic and technical regulation of the energy and petroleum sectors. Its functions include licensing, energy audit, tariff review and setting, oversight, enforcement of regulations, dispute resolutions, and approval of power purchase agreements and network service contracts.

d) Rural Electrification and Renewable Energy Corporation (REREC)

REREC is mandated to develop renewable energy resources other than geothermal and large hydro power, in addition to extending electricity supplies to the rural areas, managing the rural electrification fund and mobilizing resources for rural electrification.

e) The Kenya Electricity Generating Company PLC (KenGen)

KenGen is mandated to generate electric power from various sources including hydro, geothermal, thermal, solar and wind.

f) Kenya Electricity Transmission Company (KETRACO)

KETRACO is mandated to develop, own, maintain, and operate the transmission grid network and regional power interconnections. It is also responsible for facilitating regional power trade through its transmission network.

f) Nuclear Power and Energy Agency (NuPEA)

NuPEA is responsible for promoting the development of nuclear energy and awareness creation of the nuclear programme. It is also responsible for the co-ordination of research and development as well as capacity building in the energy sector.

g) Kenya Power and Lighting Company PLC (KPLC)

KPLC is the main off-taker in the power market, buying bulk power from power generators for on-ward supply to consumers. It also undertakes transmission of electricidal energy, electricity distribution as well as supply and retail of electric power. It is also currently the power system operator.

h) Geothermal Development Company (GDC)

GDC is a fully owned Government Special Purpose Vehicle (SPV) to undertake surface exploration of geothermal fields; exploratory, appraisal and production drilling; managing proven steam fields, early generation and sell steam to investors.

i) Independent Power Producers (IPPs)

IPPs are private investors involved in power generation.

From the institutional structure provided, it is clear the sub-sector is properly resourced to fulfill its current mandate and also respond to any changes and challenges in the operating environment.

7.5.2 OPERATIONAL STATUS

The Sub-sector is led, managed, operated and maintained by local professionals, engineers and technicians who are highly trained and skilled. Supportive legislation and policies have enabled competition in the generation segment of the electricity supply market to improve efficiency and expand scope of resource mobilization by encouraging private sector participation.

The legislative and policy standing has been reinforced through the National Energy Policy ,2018 and the Energy Act ,2019.The Act provides many features of relevance to the development of a whole sale market ;the creation of the Energy & Petroleum Regulatory Authority (EPRA) ,a new Energy and Petroleum Tribunal ;the creation of the Rural Electrification and Renewable Energy Corporation (REREC) combining mandates with rural electrification and renewable energy ,and provisions for net metering and feed-in-tariffs. It has a regulating regime with EPRA and its predecessor bodies providing independent economic regulation for more than 20 years.

Regional interconnections are being developed to maximize trade opportunities under the East Africa Power Pool (EAPP) with a 500KV line between Kenya and Ethiopia due for

completion during 2021, a 400kv double circuit line with Uganda under construction and a 400kv double circuit line with Tanzania under implementation

The off-taker is carrying out network re-enforcement projects which entail reconductoring sections of the power lines, building new sub-stations to enhance capacity, provide flexibility of network and address overloads. Innovative approaches to maintenance such as thermal vision cameras to identify loose joints detected by variation in temperature to initiate timely repairs and avoid breakdowns as well as live line maintenance program to carry out maintenance without switching off supply.

There is reduced dependance on high-cost fuel based IPPs to meet local demand due to renewable IPPs coming on-line in the last 3 years. There is diversification of energy resource base with hydro accounting for less than a third of effective capacity.

The total Installed capacity is about 3030MW and against a population of about 50 million. About 800mw of the installed capacity is hydro and dependent on hydrology;750mw is thermal power mainly used in peaking due to high cost;330MW is wind; 50mw is solar which is intermittent. Wind and Solar are intermittent, hence the energy mix is fragile

On a positive note, access rate to electricity doubled between 2014 and 2018 to 75% and the country is on an ambitious plan to achieve 100% access by 2022.

System losses stand at about 23.4% due to technical and commercial factors arising from the expanded transmission and distribution network as well as increased electricity pilferage. However, various measures have been put in place to reverse the trend. Various strategies have been adopted to curb losses such as metering of transformers to zero-in on areas around transformers where losses occur.

Peak demand is currently at 1930mw ,while electricity demand has increased at 3.9% against a projected growth of 6% of the last few years .The pricing model is take-or-pay pricing model for Power Purchase Agreements (PPA) that factors in the fixed capacity charges or deemed energy generation ,which is currently unfavorable to the off-taker in the absence of the anticipated demand growth .The un-realized sales have consistently resulted into lower-than expected revenues ,leading to eroded financial performance for the off-taker . Due to lower - than expected demand growth, the off-taker is pursuing rescheduling of planned generation capacity projects to obtain an optimal power demand- supply balance

7.5.3 CHALLENGES

a) The extent of the apparent surplus capacity in the market, which may affect the incentives facing potential new entrants in the generation sector and creates risks that the off-taker may be exposed to the costs of spare capacity, especially where there are take-or-pay provisions in the PPAs.

b) The financial performance of key sector participants, particularly the off-taker in the context of spare capacity, demand not growing as fast as anticipated, PPA obligations, increasing fixed costs arising from electrification, and relatively high technical and commercial losses.

c) The extent to which the regulatory and legislative arrangements promote the development of new capacity by IPPs under merchant arrangements to customers and not just for sale to the single off-taker under sovereign guarantees as under the current arrangement.

d) The need for ancillary services to be provided and how best to price these.

e) Large companies are already installing solar PV systems; allowing them to reduce reliance on, or fully disconnecting from the off-taker network. These trends may accelerate under whole sale market competition, creating an important revenue impact for the off-taker, with it losing 'high value' customers at a time when it is absorbing the costs associated with high levels of rural electrification.

7.5.4 CONCLUSION

The sector is well constituted and structured to perform its mandate and respond to emerging changes and challenges in the market. There are already interventions being worked on to address the challenges mentioned to ensure the sector remains vibrant.

Source;

- Consultancy services for the Power Market Study in the Electric Power Sub-sector (Inception report), April ,2021.
- Draft Integrated National Energy Planning Framework ,2020.
- Kenya Power and Lighting PLC Annual report, June 2020.

7.5.5 CURRENT RATING

According to the energy cluster group committee members, the energy scoring rating has been categorized as B based on the desk top study and background of the country's current energy status. This grade is considered good. The grading matrix is shown in the table below.

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition, committed investment, regulatory regime and planning processes.	Minor rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present	Major rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present	Critical rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present	Infrastructure is totally inadequate for present and future use

	and future use	and future use	and future use

7.6 EDUCATION INFRASTRUCTURE SCORECARD 2021

7.6.1 NUMBER OF SCHOOLS

As at 2019, Kenya had approximately 46,530 pre-primary centres, 32,344 primary schools and 10,487 secondary schools. The table below shows the trend in the growth of pre-primary centres, and primary and secondary schools.

Table 7-6: Number of Basic Education Institutions by Level, 2017-2019

	2017	2018	2019
Pre-Primary			
Public	25,381	25,589	28,383
Private	16,398	16,728	18,147
Total	41,779	42,317	46,530
Primary			
Public	23,139	23,336	23,286
Private	8,310	8,447	9,058
Total	31,449	31,783	32,344
Secondary			
	7,543	8,791	8,933
Public	1,415	1,479	1,554
	8,958	10,270	10,487
Private			
Total			

The number of pre-primary centres increased from 41,779 in 2017 to 46,530 in 2019 representing a growth of 11.4 percent. The public sector witnessed a higher increase in the number of centres, by about 11.8 percent (from 25,381 in 2017 to 28,383 in 2019); partly due to accelerated investment in new pre-primary centres by county governments following the devolution of pre-primary education function. Similarly; the private sector witnessed a 10.7

percent increase in the number of pre-primary centres (from 16,398 in 2017 to 18,147 in 2019). Nevertheless, the share of private pre-primary centres remained at about 40 percent.

Primary schools increased from 31,449 in 2017 to 32,344 in 2019, representing an increase of 2.8 percent. Public primary schools increased by 0.6 percent, from 23,139 schools in 2017 to 23,286 schools in 2019 while private primary schools increased by 9 percent, from 8,310 schools in 2017 to 9,058 schools in 2019. Unlike the case in the pre-primary sub-sector, there was a higher rate of increase in the number of private primary schools relative to public schools. Nevertheless, public primary schools still account for the largest share of primary schools, at 72 percent.

At secondary school level, the number of schools increased by 16.8 percent, from 8,958 in 2017 to 10,487 in 2019. The number of public secondary schools increased by 18.4 percent, from 7,543 schools in 2017 to 8,933 schools in 2019 while private secondary schools increased by 9.7 percent, from 1,415 schools in 2017 to 1,554 schools in 2019. Unlike the case in primary schools, there was a higher percentage increase in public secondary schools relative to private schools. Over the three-year period, public secondary schools have accounted for about 85 percent of all secondary schools in Kenya, partly due to the Free Day Secondary Education and the 100 percent transition policy. The reduction in the average school size is expected to contribute to improved performance, as well as promotion, completion and transition rates.

7.6.2 CLASSROOM AND CLASS SIZE

Table 7-7: Classrooms and Learner to Classroom Ratio in Public Schools

	Classrooms	Learners to classroom ratio
Primary Schools	213,786	40
Secondary Schools	68,541	45

Source: MoE

The total number of classrooms in primary schools recorded in 2019 is 213,786 while the number of classrooms in secondary schools is 68,541. On average, there are 40 and 45 learners per class at primary and secondary school level, respectively. Based on this data, the country seems to have realized the recommended learner to classroom ratio. However, there exist disparities in class sizes across the country.

7.6.3 SCHOOLS ACCESS TO ELECTRICITY

According to the Ministry of Energy, almost all public primary schools, 97 percent, are connected to electricity. The chart below shows the proportion of schools with access to electricity, with 81 percent connected to the national grid and 16 percent connected to solar, representing 19,018 and 3,755 schools respectively.

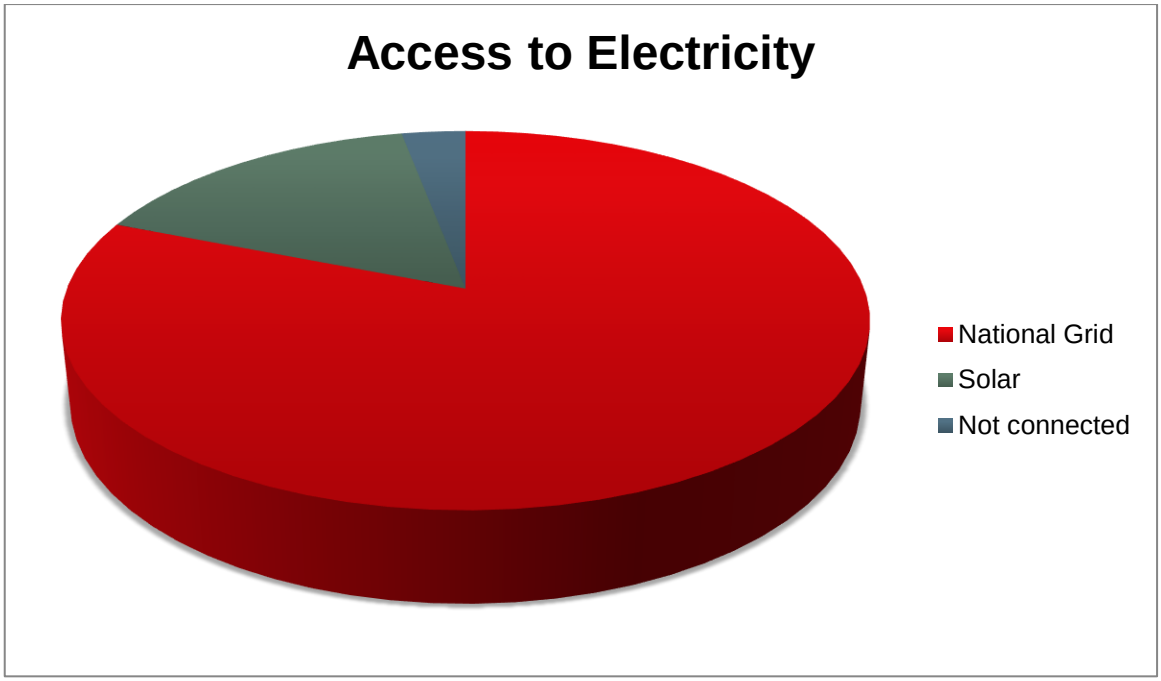


Figure 7-5: Schools Access to electricity *Source:* Ministry of Energy (2019)

7.6.4 INTERNET CONNECTIVITY

Figure shows the number of primary schools installed with a complete set of digital devices as of 2019.

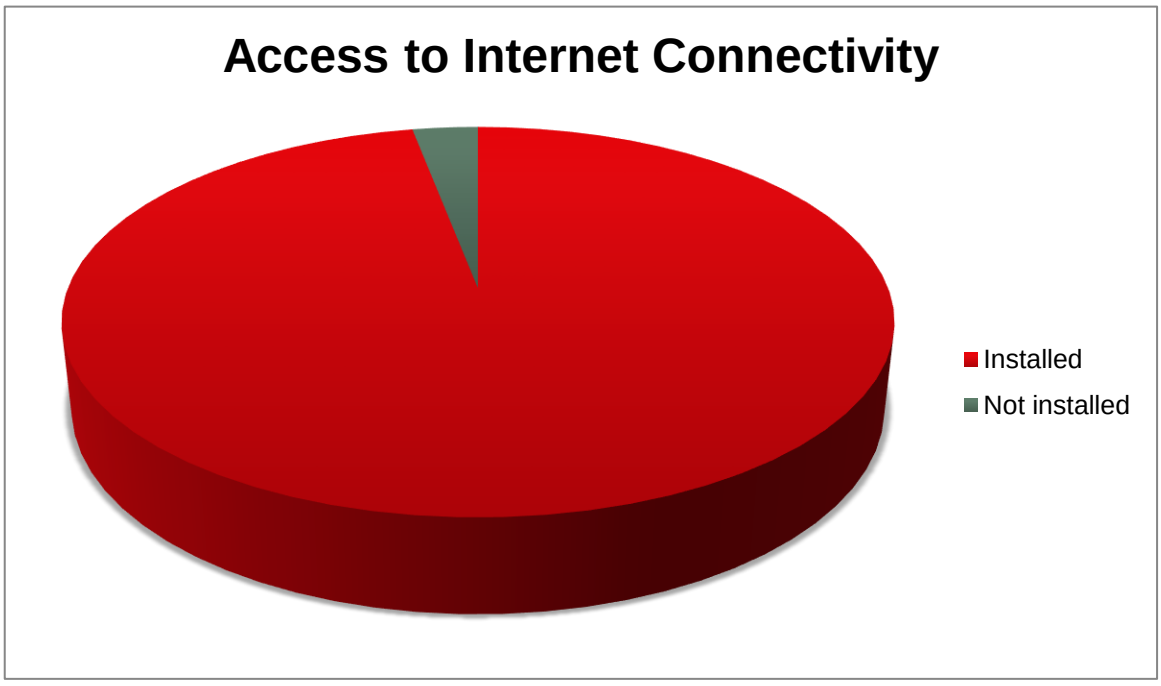


Figure 7-6: Schools access to Internet Source: ICT Authority (2019)

7.6.5 PUPIL TEXTBOOK RATIO

Pupil textbook ratio is one of the indicators of quality education. In 2019, the provision of textbooks was done under two arrangements namely, centralized procurement and

distribution by MoE and at school level through capitation. The data provided in this section, is for the books provided through the centralized procurement and distribution by MoE. In central procurement, the focus has been on numeracy and literacy because they are the foundational skills in education.

Table 7-8: Pupil Textbook Ratio for Public Primary Schools per Subject

Grade	2019 Enrolment	Number of Text Books Distributed	Pupil textbook ratio
Grade 1	1,037,447	988,359	1:0.95
Grade 2	1,043,478	1,004,662	1:0.96
Grade 3	1,019,440	995,380	1:0.98
Total	**3,100,365**	**2,988,401**	**1:0.96**

Source: Kenya Institute of Curriculum Development

The data shows that the 1:1 Pupil Textbook Ratio in Mathematics, English and Kiswahili has almost been achieved in Grade 1, 2 and 3.

Class	2019 Enrolment	Number of Text Books Distributed	Pupil textbook ratio
Class 7	1,132,931	1,213,830	1:1.07
Class 8	942,580	1,213,830	1:1.29
Total	**2,075,511**	**2,427,660**	**1:1.17**

Source: Kenya Institute of Curriculum Development

The table above shows that the 1:1 Pupil Textbook Ratio for primary education, Classes 7 and 8 has been achieved. The beyond 1:1 ratio could have been due to the fact that projections were done using enrolment in the previous classes.

At secondary school level, the core subjects offered are in Languages, Sciences and Mathematics.

The table below shows the number of textbooks distributed in secondary schools, for the core subjects namely English, Kiswahili, Mathematics, Chemistry, Biology and Physics.

Class	2019 Enrolment	Number of Text Books Distributed	Pupil textbook ratio

Form 1	799,673	1,006,166	1:1.26
Form 2	849,289	1,006,166	1:1.18
Form 3	719,807	1,000,205	1:1.39
Form 4	657,005	1,149,922	1:1.75
Total	**3,025,774**	**4,162,459**	**1:1.38**

Source Kenya Institute for Curriculum Development

The data shows that the 1:1 Student Textbook Ratio in English, Kiswahili, Mathematics, Chemistry, Biology and Physics, has been achieved in secondary schools. The beyond 1:1 ratio could have been due to the fact that projections were done using enrolment in the previous classes.

7.6.6 TEACHERS

Teachers are vital in the achievement of quality of education. The availability and quality of the teaching force is therefore important in the achievement of the aforesaid.

Level	**Male**	**Female**	**Total**
Pre-Primary			
Public			52,780
Private			39,579
Primary			
Public	104,684	114,076	218,760
Private			68,772
Secondary			
Public	62,110	43,124	105,234
Private			11,676

Source: MoE, Teachers Service Commission, County Governments.

As at 2019, the data shows that the government is the main employer of the teaching force in the country. At pre-primary school level, the government contributed 57.15 % of the teachers while at primary school level, it contributed 76.17 %. At the secondary school level, the government employed 89.48 % of the teachers. This data also indicates that the investment of the private sector in the employment of teachers progressively declines with the advancement of the level of basic education.

7.6.7 PUPILS TEACHER RATIO

Pupil Teacher Ratio (PTR) is a major indicator of quality education. A lower PTR indicates that there is increased contact between individual learner and the teacher hence improved quality of education.

Table 7-9: ***Pupils Teacher Ratios by Level of Basic Education***

	Public			Private		
	Enrolment	No. Of teachers	PTR	Enrolment	No. Of teachers	PTR
Pre-Primary	1,916,690	52,780	37	821,897	39,579	21
Primary	8,454,606	218,760	39	1,617,434	68,772	24
Secondary	3,045,227	105,234	29	214,780	11,676	19

Source: Ministry of Education

There are 37 learners for every teacher in public pre-primary centres, which shows that they have not met the recommended PTR of 25:1 compared to private centres at 21:1. The Pupil Teacher Ratio (PTR) for public primary schools is 39:1 while it is 24:1 in private primary schools. The national PTR, at primary level, accounting for both PTR in public and private schools seems to be favorable compared to the international standards of 40:1. However, in public primary schools in Kenya, the practice is to have one teacher per class irrespective of the enrolment.

At the secondary level, Student Teacher Ratio is 29:1 and 19:1 for public and private secondary schools, respectively. These ratios are lower than the recommended standard of 35:1. However, the government uses a staffing norm determined by the Curriculum Based Establishment for each school. In this regard, the subjects taught and administrative duties for each school determine the number of teachers.

7.6.8 CURRENT RATING

According to the education cluster group committee members, the education scoring rating has been categorized as B based on the desk top study and background of the country's current education status. This grade is considered good. The grading matrix is shown in the table below

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructur	Minor rehabilitation required in one or more of the infrastructur	Major rehabilitation required in one or more of the infrastructur	Critical rehabilitation required in one or more of the infrastructur	Infrastructure is totally inadequate for present and future use

	e condition, committed investment, regulatory regime and planning processes.	e condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	e condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	e condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use

7.7 HEALTH INFRASTRUCTURE REPORT CARD 2021

7.7.1 BED DENSITY

Bed density remained significantly low 14 beds per 10,000 population while health facility population levels was on average 2.2 health facilities per 10,000 population with great disparities in Counties. National, county and sub-county hospitals have been equipped with specialized equipment and information undergoing automation. Many counties have purchased the state of art ambulances and modernized some of the health facilities to provide comprehensive service delivery and facilitate referral services.

Kenya aimed to increase the health facility density from 1.9 per 10,000 population in 2013 to 2.5 per 10,000 population in 2016. This target was not met. The density during the review period remained stagnant at 2.2-2.3 per 10,000 population but represents an improvement, albeit small, from the baseline value. These was more than the required number of facilities but with clear disparities with some counties having less than 1 health facility while others had 4 health facilities per 10,000 people. However, most of these facilities are not meeting the minimum standard norms and therefore misclassified.

7.7.2 BED POPULATION RATIO

The results suggest that on average bed density in Kenya declined steadily during the review period but remained higher than the average in the African region of 10 beds per 10,000 population. In 2016, Kenya had 14.1 beds per 10,000 population, which represents one bed for every 709 people with only 25% of the counties with densities exceeding 18 per 10,000.

7.7.3 HEALTH FACILITIES

Health Facilities by Level, Type and Ownership, 2015 – 2019

KEPH LEVEL	Type of health facility	Ownership	2015	2016	2017	2018	2019
Level 2	Dispensary	MoH	3,768	4,019	4,350	4,459	4,652

		Private FBO NGO	120 783 20	121 792 20	126 812 21	138 819 23	147 829 27
	Sub Total		**4 ,691**	**4 ,952**	**5 ,309**	**5 ,439**	**5 ,655**
	Medical Clinic	MoH Private FBO NGO	11 3,302 9 201	11 3,570 10 217	11 3,902 11 233	13 4,193 16 238	14 4,427 17 240
	Sub-Total		**3 ,523**	**3 ,808**	**4 ,157**	**4 ,460**	**4 ,698**
	Stand Alone	MoH Private FBO NGO	30 130 21 81	34 137 22 85	34 143 22 86	34 149 22 90	34 169 22 93
	Sub-Total		**262**	**278**	**285**	**295**	**318**
	Total		**8 ,476**	**9 ,038**	**9 ,751**	**1 0,194**	**1 0,671**
Level 3	Medical Centre	MoH Private FBO NGO	0 335 3 20	0 387 3 20	0 469 3 21	0 582 7 23	0 685 8 24
	Sub total		**358**	**410**	**493**	**612**	**717**
	Health Centre	MoH Private FBO NGO	1,000 10 192 26	1,014 10 198 30	1,023 11 201 37	1,028 12 202 37	1,039 13 204 39
	Sub total		**1 ,228**	**1 ,252**	**1 ,272**	**1 ,279**	**1 ,295**
	Nursing Home	MoH Private FBO NGO	0 183 5 8	0 194 5 8	0 214 5 8	0 249 5 9	0 286 5 10
	Sub total		**196**	**207**	**227**	**263**	**301**
	Total		**1 ,782**	**1 ,869**	**1 ,992**	**2 ,154**	**2 ,313**

Level 4	Primary care hospitals	MoH Private FBO NGO	357 181 99 12	358 202 100 12	353 231 101 12	354 269 106 12	356 303 109 14
	Total		**649**	**672**	**697**	**741**	**782**
Level 5	**Secondary Care Hospitals**	MoH Private FBO NGO	9 2 3 0	9 2 3 0	13 2 3 0	13 2 3 0	13 2 3 0
	Total		**14**	**14**	**18**	**18**	**18**
Level 6	Tertiary Referral Hospitals	MoH Private FBO NGO	4 0 0 0	4 0 0 0	6 0 0 0	6 0 0 0	6 0 0 0
	Total		**4**	**4**	**6**	**6**	**6**
	Grand Total		**10,925**	**11,597**	**12,464**	**13,113**	**1 3,790**

Source: Division of Health Informatics, Ministry of Health

The number of health facilities increased by 5.2 per cent to 13,790 in 2019, with Level 2 facilities accounting for 77.4 per cent of the total facilities. Level 2 facilities constituted of dispensaries (53.0%), medical clinics (44.0%) and the stand-alone facilities (3.0%). In 2019, the Government owned 82.3 per cent of the dispensaries while 94.2 per cent of the medical clinics were owned by the private sector.

Level 3 health facilities increased from 2,153 in 2018 to 2,313 in 2019, accounting for 16.8 per cent of the total facilities. Level 3 facilities constituted medical centers (31.0%), health centres (56.0%) and nursing homes (13.0%). The Government owned most of the health centres at 82.2 per cent while private sector owned 95.0 per cent of the nursing homes. The

number of levels 4, 5 and 6 hospitals collectively accounted for 5.8 per cent of the total health facilities in 2019. The government and private sector combined owned 84.3 per cent of the primary health care hospitals.

7.7.4 HEALTH PERSONNEL

Category	2015		2016		2017		2018		2019	
	Number	No. per 100,000 population	Number	No. per 100,000 population	Number	No. per 100,000 population	Number	No. per 100,000 population	Number	No. per 100,000 population
Medical Officers and Dentists Medical Officers Dentists	9,202 1,098	21 2	10,377 1,156	23 3	10,922 1,211	23 3	11,647 1,257	24 3	12,090 1,288	25 3
Pharmacists and Technologists Pharmacists Pharmaceutical Technologists	2,994 7,895	7 18	3,169 8,673	7 19	3,373 9,358	7 20	3,512 10,126	7 21	3,825 10,815	8 23
Clinical Officer	15,397	35	17,093	38	18,776	40	20,392	43	21,801	46
Public Health Officers and Technicians Public Health Officers Public Health Technicians			1,684 348	4 1	3,064 717	7 2	3,506 1,029	7 2	4,390 1,328	9 3

Laboratory Technologists and Technicians Laboratory Technologists Laboratory Technicians	4,230 1,363	10 3	6,651 1,734	15 4	10,603 3,065	23 7	11,688 3,622	24 8	13,144 3,886	28 8
Nurses (BSc)	2,904	7	4,002	9	4,819	10	5,961	12	7,242	15
Nurses Registered Nurses Enrolled Nurses	41,178 22,305	93 51	47,480 22,820	105 50	51,420 23,068	110 50	57,564 23,783	120 50	58,247 28,822	122 61
Nutritionists and Dietician s Nutritionists & Dietician s Nutrition & Dietetic Technologists Nutrition & Dietetic Technicians	1,691 2,066 378	4 5 1	1,853 2,608 500	4 6 1	2,106 3,122 619	5 7 1	3,066 4,430 813	6 9 2	3,573 5,284 927	8 11 2

Source: Health Sector Regulatory Bodies

There is a general increase in the number of registered health personnel in different cadres in 2019. The largest number of registered health personnel was nurses, with registered nurses being 58,247 and enrolled nurses constituting 28,822. In the review period, the number of registered personnel per 100,000 population rose for all the cadres of registered health personnel. Registered nurses had the highest ratio of 122 per 100,000 population while Nutrition and Dietetics Technicians had the lowest ratio at 2 per 100,000 in 2019. The proportion of medical officers and clinical officers stood at 25 and 46 per 100,000 population, respectively during the same period.

7.7.5 MEDICAL TRAINING

The number of middle level medical graduates increased by 16.1 per cent from 10,869 in 2017/18 to 12,620 in 2018/19 academic years. Diploma accounted for 73.3 per cent of the graduates, with majority attaining a diploma in community health nursing at 3,308 in 2018/19. The number of graduates with a diploma increased by 26.2 per cent to 9,251 in the same year. The number of graduates who had attained certificate level decreased by 9.0 per cent from 3,117 in 2017/18 to 2,837 in 2018/19 academic years. The decline may be attributed to the reduction in the number of graduates who attained certificate in health records and information technology. The number of graduates with higher diploma increased from 421 in 2017/8 to 532 in 2018/19 academic years. Nursing and Clinical Medicine and Surgery accounted for 62.4 per cent of graduates who attained higher diploma in 2018/19 academic year.

7.7.6 CURRENT RATING

According to the health cluster group committee members, the health scoring rating has been categorized as D based on the desk top study and background of the country's current health status. This grade is considered poor and at risk. The grading matrix is shown in the table below

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition, committed investment, regulatory regime and planning processes.	Minor rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructur	Major rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructur	Critical rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructur	Infrastructure is totally inadequate for present and future use

	e to be fit for its present and future use	e to be fit for its present and future use	e to be fit for its present and future use

7.8 PRISONS

The British East Africa protectorate established the prison system in Kenya with the passage of the East Africa Prisons Regulations in April 1902. The reforms in the penal system were strengthened after independence with the enactment of Chapters 90 and 92 to establish the Kenya Prisons, and the Act (Cap 90) has since been reviewed, the most recent being in 1977. The Borstal Act (Cap 92) has also been reviewed, with the most recent revision occurring in 1967.

The Kenya Prisons Service is a division of the Ministry of Interior and National Government Coordination. It contributes to public safety and security by ensuring the safe custody of all persons lawfully committed to prison facilities and facilitating the rehabilitation of custodial sentenced offenders for community reintegration. It is a critical component of the Criminal Justice System that has the most impact on people's liberties and freedom, especially those who are in conflict with the law.

The Service gained autonomy in 1911 and has since grown to a Department of 118 institutions, of which 94 (115) are for adult offenders and three (3) (2 Borstal and 1 YCTC) are primarily for juvenile offenders. Chapters 90 and 92 of the Kenyan Laws (Prisons and Borstal Acts) empower the Service to carry out its mandate. The current prison population is 54,000, with 48% being pre-trial detainees and the remainder being sentenced prisoners. The total number of employees, including uniformed officers and auxiliary personnel, is approximately 22,000 people.

The Governance, Justice, Law, and Order Sector (GJLOS) is divided into fourteen (14) sub-sectors: Interior and Coordination of National Government; Office of the Attorney General and Department of Justice; The Judiciary; Ethics and Anti-Corruption Commission (EACC); Office of the Director of Public Prosecutions (ODPP); Commission for the Implementation of the Constitution (CIC); Office of the Registrar of Political Parties (RPP); Witness Protection Agency (WPA); Kenya Electoral Commission (NGEC) and Independent Policing Oversight Authority (IPOA).

7.9 CONCLUSION

Kenya has a large, but uneven, infrastructure that is still superior to that of its neighbors. Nairobi is the Eastern and Central African transportation hub, as well as the largest city between Cairo and Johannesburg. Despite persistent equipment deficiencies, inefficiency, and corruption, the Port of Mombasa is the region's most important deep-water port, serving the shipping needs of more than a dozen countries. As a result of these shortcomings, the Port of Mombasa has undergone extensive expansion and rehabilitation.

The GOK continues to be the largest investor in transportation infrastructure. This is being driven by ongoing expansion projects in rail, port, and road networks, which are part of the government's intent to maintain Kenya's position as a regional commercial, transportation, and economic hub, as well as to increase Kenya's attractiveness as an investment destination.

However, insufficient funding continues to be a barrier to the timely implementation of desired projects.

Kenya will soon reintroduce toll roads with the participation of the private sector. The Nairobi-Nakuru-Mau Summit highway, Thika Road, Nairobi's Southern Bypass, Nairobi expressway, and a second Nyali bridge in Mombasa city are currently earmarked for tolling under a PPP plan. The move is expected to help raise funds for road infrastructure development and maintenance. Another upcoming PPP toll road is the $650 million JKIA to Westland four-lane expressway, which will include a dedicated lane for large-capacity buses as part of the bus rapid transit (BRT) plan to improve public commuter service.

Several Kenyan airports have been designated for expansion. An ongoing modernization program at Jomo Kenyatta International Airport (JKIA) will include the construction of modern terminals, the development of a national airport masterplan, the installation of integrated security systems at all major airports, the installation of communication equipment, and the development of institutional capacity. JKIA is the busiest airport in East and Central Africa, and the continent's seventh busiest. Originally designed to serve 2.5 million passengers per year in the 1970s, the airport's ongoing modernization and expansion program has increased capacity to 7.5 million, with a projected increase to 20 million passengers by 2030.

Nairobi is planning to build a light commuter rail system that will connect Nairobi suburbs to the city's central business district. The project will include the construction of nine railway transport corridors with the goal of decongesting the city. The project will be implemented as a public-private partnership (PPP) and is expected to cost $300 million. It will include the rehabilitation of 60 kilometers of existing rail networks in Nairobi, the construction of 5-7 kilometers of new tracks to JKIA, new signaling systems, and rolling stock. The project's feasibility studies have already been completed.

7.10 RECOMMENDATIONS

Adequate and predictable financial resources are critical to achieving Kenya's long-term waste management goals. Given the magnitude of the waste management challenge, it is critical to mobilize both internal and external sources of funding. As a result, Kenya requires a suitable framework to attract and effectively utilize waste management finance. Sustainable waste management actions will be required to be integrated into budgetary processes at all levels of government. Sufficient budgetary allocation will be prioritized for all institutions performing sustainable waste management functions to ensure that the necessary human, technical, and financial resources are available.

8 NIGERIA

8.1 COUNTRY ECONOMIC & SOCIO-POLITICAL OVERVIEW

Nigeria – regarded worldwide as the largest black nation in the world lies between latitude 40˚ and 140˚north of the equator and longitudes 30˚and 140˚east of the Greenwich Meridian. The country lies entirely within the tropical zone and occupies about 923 773 km2 (about 3% of Africa's landscape). Nigeria is a multi-ethnic and culturally diverse federation of 36 autonomous states and the Federal Capital Territory. The political landscape is partly dominated by the ruling All Progressives Congress party (APC) which holds 217 out of 360 seats at the National Assembly; 64 out of 109 seats in the Senate; and 19 out of 36 State Governors.

Based on elaboration carried out by Worldometer from the latest United Nations data, the current population of Nigeria is 211,688,931 as at August 5, 2021. This is equivalent to 2.64% of the total world population and about 14% of the total African population. Nigeria has 52% of its population in the urban areas with a median age of 18.1years, regarded as one of the countries with the highest youth population. (Worldometer, 2021).

In so many areas, especially economically, Nigeria remains a paradox of some sort with both challenging yet equally promising business outlook. The political economy of the country continues to receive government attention in the bid to make it more investor friendly given most of the work done by its current Vice-President, Prof Yemi Osibanjo, to improve the country's ease of doing business ranking in recent years. However, the state of the country's infrastructure development remains abysmal, although this is far better than most sub-Saharan African countries. (Adewale, 2011)

Nigeria's macroeconomic situation is much more challenging now than when the last Nigerian Infrastructure Report Card was released in 2017. This is complicated by the recent COVID-19 health challenges and declining economic fortunes for the country due to lockdowns and sharp decline in oil prices since 2015 – 2016. The country has also experienced economic recession twice in the past six years resulting in declining GDP growth from 6.3% before 2016 to 2.2%, increased inflation from single digits in 2014 to 17% currently. (The World Bank, 2020)

The biggest economy in Africa faces massive developmental challenges especially the need to reduce dependency on oil which most of the advanced economies are moving away from, diversification of the economy to highlight other foreign income earning potentials, and most significantly, address its insufficient infrastructure as well as build strong and effective institutions. These are existing structural issues that has left the economy fragile and susceptible to external shocks like the COVID-19 pandemic.

Table 8-1: National Economic and Social Indicators

S/N	Indices	Nigeria	Africa Benchmark			Global Benchmark		
			South Africa	Ghana	Kenya	USA	UK	China
1	**POPULATION & DEMOGRAPHY**							
i	Population (million)	206	59	31	53	329	67	1402
ii	Population Growth Rate (%)	2.5	1.3	2.1	2.2	0.4	0.6	0.3
iii	Average Age of Population (yrs)	18.1	27.6	21.5	20.1	38.1	40.5	38.4
2	**POWER INFRASTRUCTURE**							
i	Installed Power Generation Capacity (MW)	12,522	58,095	4,000	1,429	1,117,475	85,000	2,370,000
ii	Installed Power Capacity (KW per 1000 ppl)	61	985	129	27	3,397	1,269	1,690
3	**ECONOMOMIC IMPACT**							
i	GDP (Billion USD) (2019)	448	351	67	96	21,433	2,831	14,280
ii	GDP Growth Rate (%) (2019)	2.2	0.2	6.5	5.4	2.2	1.5	6.1
iii	GDP Per Capita (USD)	2,097	5,090	2,329	1,838	63,543	40,285	10,500
iv	Unemployment Level (%)	33	28.5	4.5	2.65	8.1	4.9	4.2
4	**SOCIAL IMPACT**							
i	Human Development Index (HDI) Ranking	161	114	138	143	17	13	85
i	Murder Rate (per 100,000 ppl)	9.85	33.97	1.68	4.87	5.35	1.2	0.6
ii	Life expectancy (yrs)	54	64	64	66	78	81	76

The table above elaborates some key economic indicators that underpins the importance of infrastructure to sustainable development. As the figures depict and agreed by several developmental analysts, one of the major constraints to sustained economic growth and development in Nigeria seems to be inadequate infrastructure. Consequently, a cursory review of recent development plans from the Federal Government such as the National Vision 20:2020 (NV 20:2020) and the Economic Recovery and Growth Plan (ERGP), 2017-2020, consistently points to weak infrastructure as one of the factors that has seriously undermined the country's economic performance over the years.

According to the African Development Bank, Nigeria ranks 24th in the 2020 Africa Infrastructure Development Index (AIDI) produced by the African Development Bank to monitor and evaluate the status and progress of infrastructure development across the continent, with an index of 23.27 which is below the likes of Seychelles, Egypt, Libya and South Africa who make up the top 4 on that list. (Africa Development Bank, 2020) The figure below shows Nigeria's comparison against other Africa Benchmark countries in the Africa Infrastructure Development Index (AIDI)

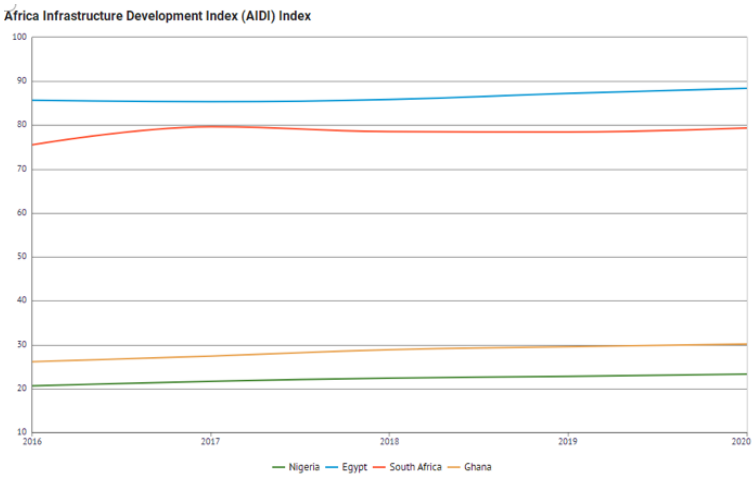


Figure 8-1: Africa Infrastructure Development Index (AIIDI) Index

Country	2016	2017	2018	2019	2020
Nigeria	20.60124477	21.63582537	22.36513551	22.76328586	23.26621872
Egypt	85.6630422	85.35020019	85.84677164	87.23023772	88.38999021
South Africa	75.51516614	79.63473979	78.52736328	78.43007084	79.34416521
Ghana	26.09740459	27.38367427	28.83504093	29.51380286	30.12582358

It is important to note that Nigeria has one of the highest population growth rates in the world with no clear strategy articulated to curb this in a way that matches its development. Experts expect that in the coming years, even more pressure will come on the already insufficient infrastructure provisioning in the country due to this as population is expected to climb up to 264million over the next couple of years. (Federal Ministry of Finance, Budget & Planning, 2020)

In the revised National Integrated Infrastructure Masterplan, 7 priority areas are identified for focused investment due to under-investment in these areas and its inherent ability to kickstart economic development.

Table 8-2: Africa Infrastructure Development Index (AIIDI) Index. (Source: Global Infrastructure Hub, 2020)

S/N	Measures	Unit of Measure	NIGERIA	S/AFRICA	KENYA	GHANA	USA	UK	CHINA
1	GINI COEFFICIENT	0 - 100 worst	43.0	63.0	40.8	43.5	41.5	33.2	38.6
2	GROSS GOVT DEBT	% of GDP	30.0	60.0	62.0	64.0	106.0	86.0	56.0
3	URBANIZATION RATIO	%	50.0	66.0	27.0	56.0	82.0	83.0	59.0
4	ROAD CONNECTIVITY	0 - 100 best	77.5	96.2	72.1	73.4	100.0	91.3	95.7
5	QUALITY OF ROAD INFRASTRUCTURE	1 - 7 best	2.5	4.5	4.1	3.0	5.5	4.9	4.6
6	EFFICIENCY OF TRAIN SERVICES	1 - 7 best	1.8	3.0	4.0	1.9	5.2	4.3	4.5
7	EFFICIENCY OF AIR TRANSPORT SERVICES	1 - 7 best	3.4	5.5	5.0	3.7	5.8	5.3	4.6
8	EFFICIENCY OF SEAPORT SERVICES	1 - 7 best	2.5	4.5	4.2	3.1	5.6	5.2	4.5
9	ELECTRICITY ACCESS	% of Population	59.8	84.2	73.4	84.3	100.0	100.0	100.0
10	ELECTRICITY SUPPLY QUALITY	% of Output Lost	15.0	8.7	19.5	23.9	5.4	7.4	4.9
11	EXPOSURE TO UNSAFE DRINKING WATER	% of Population	75.6	27.8	61.9	75.5	0.3	0.3	16.0
12	RELIABILITY OF WATER SUPPLY	1 - 7 best	2.1	4.4	3.6	4.2	6.2	6.4	4.9
13	DIGITAL ADOPTION INDEX	0 - 1 best	0.4	0.6	0.5	0.5	0.7	0.8	0.6
14	MOBILE BROADBAND SUBSCRIPTION	# per 100 population	30.7	76.0	41.9	91.8	142.5	96.9	95.4
15	FIXED BROADBAND INTERNET SUBSCRIPTION	# per 100 population	0.0	2.4	0.0	0.2	35.6	39.6	28.5

These priority areas include Energy, Transportation, Information and Communications Technology, Water, Agriculture and Mining, Housing, Social Infrastructure, Vital Registration and Security. A look at benchmark data from Global Infrastructure Hub, Nigeria is performing poorly than most African countries selected for the benchmark in these priority areas. Nigeria has the lowest quality of road infrastructure amongst the six benchmark countries. Similarly, it performs lowest in the areas of efficient train services, efficient air transport services, efficient seaport services as well as the lowest figure in terms of access to electricity. The country also performs lowest in terms of reliability of water supply, digital adoption and broadband subscription.

It is with this understanding that The Global Infrastructure Hub has estimated that Nigeria's cumulative infrastructure spending needs to be about US$ 878 billion between 2016 and 2040, translating to about US$35 billion per year. In a recent comment credited to the Governor of the Central Bank of Nigeria, Mr Godwin Emefiele, Nigeria requires investment worth N3.1 trillion in critical infrastructure to be able to attain double digits growth in the economy referencing the National Integrated Infrastructure Masterplan. The revised NIIMP recognizes this as well as the role the private sector needs to play in infrastructure development. The revised plan has realistically narrowed down the total infrastructure investment to USD 2.3 trillion over the next 23 years. The Federal Government of Nigeria has thus approved the establishment of a N1trillion Infrastructure company – Infra-Co and is seeking public-private collaboration in tackling infrastructure deficit.

The strategy of involving private investment is not only necessitated by the need to follow best practice as obtained in other developed climes but due to dwindling funding position of the government. Even though the present government have increasingly committed higher percentages of its annual budget to fund infrastructure, high debt servicing ratio and rising debt profile has realistically cut down on such commitments.

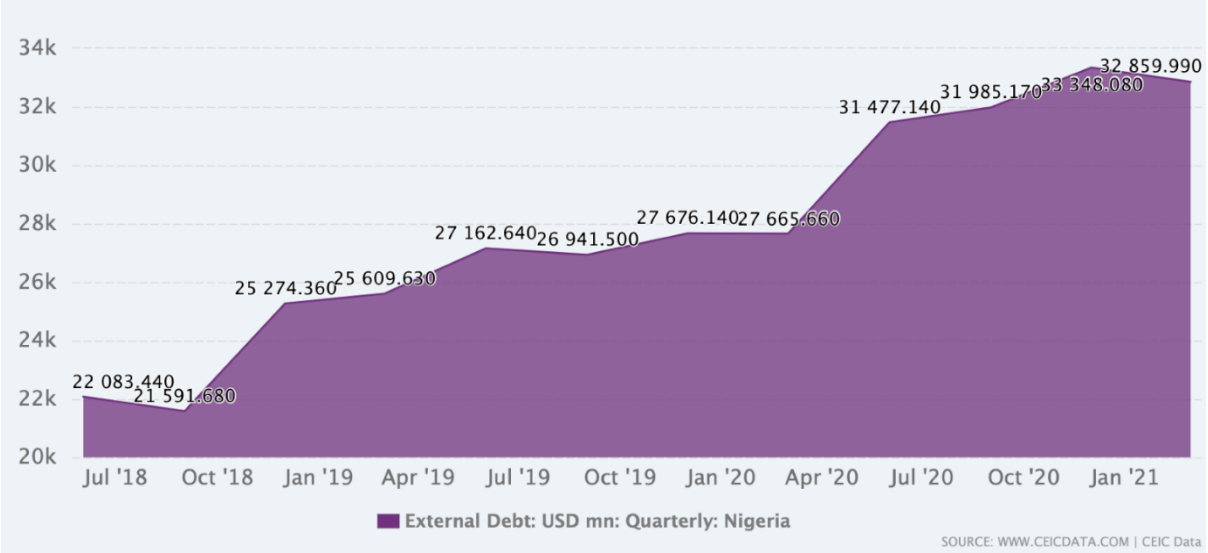


Figure 8-2: Nigeria - External Debt Exposure

8.2 THE NATIONAL INFRASTRUCTURE REPORT CARD

The Global Competitiveness Report for 2019 by the World Economic Forum ranked Nigeria infrastructure 130 out of a total of 141 countries with a score of 39.7 (from a scale of 1 to 100). Inadequate supply of infrastructure was mentioned as the most problematic factor for doing business in Nigeria, followed by corruption, access to financing and policy instability among other factors. As noted in the recently concluded National Engineering Infrastructure Summit for 2021, it is no longer secret that Nigeria has huge problems of provision of sustainable infrastructure which has resulted in negative direct and indirect consequences on human livelihoods and Human Development Index(HDI) of the country.

Nigeria's infrastructure stock as a percent of GDP is 35% as at 2016 well below the likes of Brazil (47%), India (58%), Indonesia (70%), China (76%), Poland (80%), and South Africa (87%). This is also well below internationally accepted benchmark of 70% minimum. This data highlights the huge gap in infrastructure positioning further made complex by the country's financial resources to close or at least minimize this gap. Certainly, authorities and policy makers must therefore prioritize provisioning beyond just political considerations but on areas with the most appreciable impact on the country's ability to accelerate economic development.

It is against this that the Nigerian Society of Engineers (NSE) has taken on the project of tracking improvements in the nation's critical infrastructure while suggesting areas of priority to stakeholders and policy makers in the journey to building a world class infrastructure for Africa's most populous nation and largest economy.

8.2.1 OBJECTIVES

The role of benchmarking and assessing performance of public infrastructure in the improvement of infrastructural development in Africa is seen as a right step towards encouraging more focused infrastructural development.

The Nigerian Infrastructure Report Card was developed by the Nigerian Society of Engineers against this need with the overarching goal towards driving Nigeria's Infrastructure revolution to:

1. Grade the state of built infrastructure in all sectors and states
2. Provide policy makers an empirical guide in making choices and investment decisions with respect to infrastructure development
3. Drive the efficient allocation of resources for the renewal and continued development of the nation's infrastructure stock.
4. Enhance competition among the different levels of governance in the race for economic improvements and also assist them in improving policy, regulation, planning, provision, operation and maintenance of the infrastructure stock.

8.3 INFRASTRUCTURE REPORT CARD RATING METHODOLOGY

The concept of infrastructure grading and benchmarking has been adopted in various developed climes to track and report improvements in their respective national infrastructure stock on a periodic basis. The Nigerian Society of Engineers (NSE) after careful study of the American Society of Engineers (ASCE)'s methodology of grading America's infrastructure as determined by a panel of engineers who are tasked to evaluate each category on the basis of its condition and performance, need versus capacity, and need versus funding have come up with a similar methodology.

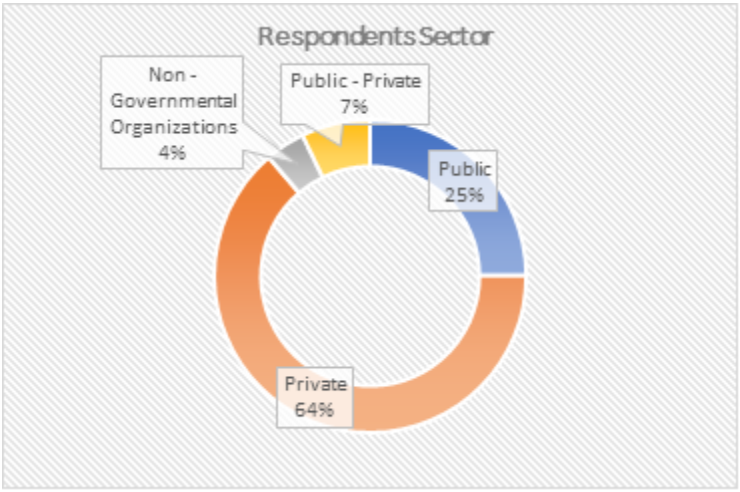


Figure 8-3: Respondents' sector

To further improve the quality of the report in line with its original concept and scope, we have included Executive Insights Section to capture the thoughts of key actors, players and policy makers in each infrastructure category. This will help us examine strategies towards addressing key issues and plans for the short to medium term horizon.

Another section that has been added to the report is the Infrastructure Providers' perspective which include data from the various MDAs and providers of infrastructure. This is expected to provide balance and context to the qualitative rating from end users. The National

Infrastructure Scorecard Report Committee has engaged widely with key Ministries, Department and Agencies (MDAs) most of whom have magnanimously provided focal persons to collaborate and share data on activities towards developing infrastructure within their purview.

The final introduction made in this year's report is the International Benchmark comparison where we have benchmarked key infrastructure indices with counterpart countries to provide context in terms existing gaps and how we can properly frame our aspirations.

According to the pattern in previous years, a qualitative assessment of the state of Nigeria's infrastructure was carried out by Engineers and other top Professionals/Executives in both the private and public sectors of the Nigerian economy. The survey which was administered online to a carefully selected group of top professionals received tremendous responses which surpassed the previous edition. Majority of our respondents were from the private sector (63.79%), public sector (24.92%) and others. As expected, most responses received were from Lagos (42%), Abuja (14%) and Rivers (8%), the major percentage of respondents (49%) was from the Engineering profession and 51% non – Engineering professionals practicing in various segments of the economy such as:

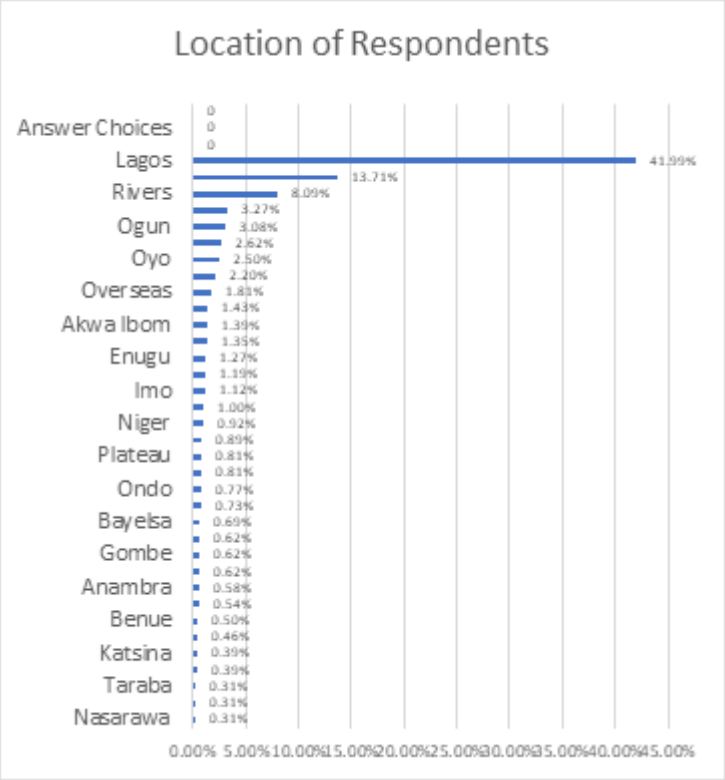
Table 8-3: Participants' Demography

Electrical Power	7.05%
Primary/Secondary/Higher Education, Education Management	11.67%
Oil & Gas	15.49%
Real Estate Construction, Commercial Real Estate, Residential Real Estate	21.26%
Construction, Civil Engineering, Aviation, Railroad, Trucking, Shipping	17.49%
Sports, Leisure, Travel & Tourism	1.62%
Hospital & Healthcare	2.58%
Security, Law Enforcement, Legal Services, Law Practice	4.04%
Food Production, Agiculture	7.05%
Information & Communications Technology	11.75%

The survey highlighted the observations of the professionals and other stakeholders responsible for the planning, construction, operation and maintenance and management of these infrastructure. NSE is uniquely placed to do this because its membership is drawn from all sectors of the engineering community, all tiers of government, the private sector designers and constructors, suppliers of equipment and materials, and even suppliers of finance. Moreover, it is a learned society and operates as a not-for-profit organization and has been able to reach out to other professionals through their various bodies to participate in this exercise.

The survey was administered, collated and analyzed by Analysts from our consultants at Alpha Mead Group who have been part of this project from its maiden edition in 2015 and results reviewed by the National Working Committee of the Engineering Indices & Infrastructure Scorecard Report Committee.

8.4 THE NATIONAL INFRASTRUCTURE SCORECARD SURVEY



The National Infrastructure Scorecard Survey was used to directly measure respondents' assessment of the capacity/adequacy of infrastructure provisioning based on their experience as well as functionality of what has been provided within their locality. It is important to note that the survey is expected to collate infrastructure user's perspective which may not be empirical, or data driven, even though some respondents may draw from known data on mental comparison from a similar experience from other climes.

The survey had a total of 70 questions in 15 infrastructure categories, designed to allow respondents choose infrastructure category that best fits their experience and industry area. This ensured that responses received were objectively and professionally assessed for best result. It was opened for participation from the month of April 2021 to August 9th, 2021 and a total of 2,601 responses was received.

The Infrastructure Scorecard Survey was circulated widely online, specifically targeting professionals at Executive level in their various institutions with at least 10years experience in their respective industries. Following the social class ranking system, we estimated our typical respondents to be in within the mid-30s to 50s age range.

Expectedly, therefore, participants are key stakeholders or opinion leaders whose input and involvement in the sub-sector is significant enough to be able to influence the provision or public perception of the standard of service or performance of the infrastructure.

8.4.1 DATA ANALYSIS

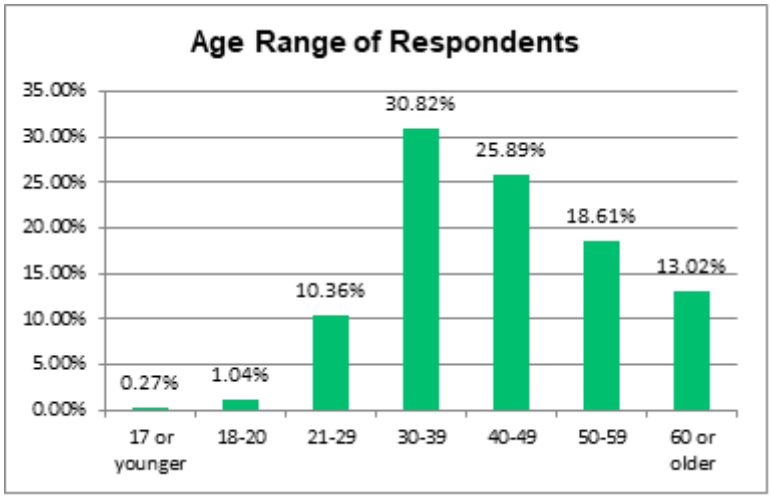


Figure 8-4: Age Range of Respondents

The 15 infrastructure categories were analyzed using carefully selected parameters that will easily facilitate international comparison. Comparison was also made with rating of previous edition to show areas where progress has been made or otherwise show decline. These parameters were slightly modified to add meaning to participants but are fundamentally the same and can be relatable with previous responses.

Each infrastructure listed was rated based on 7 distinct criteria on a 5-point weighted scale as follows:

0 – Non- Existent

1 – Poor

2 – Fair

3 – Satisfactory

4 – Comparable to Africa's best

5 – Comparable to the best (Global)

The 7 distinct criteria for assessment is adapted and modified from the USA Infrastructure Grading Criteria:

1. **Capacity:**

This rate the infrastructure in terms of adequacy and capacity to meet current and future demand. Assessment does not take into account, the quality of infrastructure provided but focusses on capacity to handle current and the near future demand.

2. **Funding**

Current level of funding (from all levels of government) for the infrastructure category compared to the estimated funding need. This rates the current level of funding required for the operations and maintenance of the infrastructure

3. **Future Provision**

Cost to improve the infrastructure and determine if future funding prospects will be able to meet the need. This also assesses future provisioning for growth and expansion as well as infrastructure upgrade.

4. **Operations & Maintenance**

Owners' ability to operate and maintain the infrastructure properly (efficiently and effectively) and in compliance with government regulations.

5. **Public Safety**

This assesses the extent to which the condition and design of the infrastructure allows for safe use and the extent the public's safety is jeopardized by the condition of the infrastructure.

6. **Resilience**

Infrastructure system's capability to prevent or protect against significant threats and incidents and to recover and reconstitute critical services with minimum damage to public safety and health, the economy, and national security.

7. **Innovation**

Implementation and strategic use of innovative techniques and delivery methods.

The Nigerian Infrastructure Scorecard Report uses the Cumulative Grade Point Average (CGPA) to rate infrastructure across the 15 Infrastructure Categories based on public users rating. The rating of each infrastructure is represented alphabetically with A, B, C, D, E and F, details of rating system is shown in table 1

8.4.2 LIMITATION OF ANALYSIS

The Nigerian Infrastructure Scorecard Report may not provide a completely accurate assessment of various infrastructures as assessment is based largely on the perception of respondents and reported on the aggregate. It is important to note that respondents' assessment is dependent on relative knowledge of the infrastructure.

This is however reduced to the barest minimum by ensuring that respondents are carefully selected and are only allowed to assess infrastructure categories around their area of expertise and experience.

Also, the inclusion of Executive Insights and Infrastructure Providers perspective for some infrastructure categories is expected to balance these assessment and give clear insight into improving policy, regulation, planning, provision, operation, maintenance and management of infrastructure stock. This has been included in this third edition to provide additional assurance on the quality of infrastructure assessment contained in this report.

Table 8-4: Cumulative Grading Scale and Interpretation for Infrastructure Rating

F			E			D			C			B			A		
F3	F2	F1	E3	E2	E1	D3	D2	D1	C3	C2	C1	B3	B2	B1	A3	A2	A1
1	1.335	1.67	1.68	2.01	2.34	2.35	2.68	3.00	3.01	3.19	3.36	3.37	3.86	4.34	4.35	4.68	5.00
Unfit for purpose			Poor State			At Risk			Satisfactory for now			Comparable to Africa's Best			Comparable to global best		
Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate attention is required.			Infrastructure is on the verge of failure and urgent rehabilitation is required to prevent complete failure or restore to serviceable state			Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience and even danger without prompt attention			Infrastructure condition is acceptable although stressed at peak periods. It will need investment in the current medium term expenditure framework period to avoid serious deficiencies			Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents			Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure pressure from unusual events		

Table 8-5: List of Rated Infrastructure

	Category	Infrastructure
1	Electric Power	Power Generation Power Transmission Power Distribution
2	Transportation	Roads & Bridges Infrastructure Rail (National & Commutal) Seaports
3	Aviation	Aviation
4	Security & Law	Police Stations Courts of Law Prisons CCTV Infrastructure
5	Healthcare	Primary Healthcare Infrastructure Teaching Hospital General Hospital
6	Education	Primary Education Secondary Education Vocational Institutions Tertiary Institutions (Universities & Polytechnics
7	Oil & Gas	Oil Pipeline Gas Pipeline Exploration and Production Infrastructure Petroleum Refining Infrastructure Refined Petroleum Products Distribution Infrastructure
8	Culture & Tourism	Important Tourism Attractions Public Recreational Parks
9	Sports	Sports Stadia
10	Agriculture	Food Grain Storage Infrastructure Food Processing Infrastructure Irrigation Infrastructure
11	Water Resources	Public Water Supply Dams
12	Waste Management	Refuse, Sewage, Special Waste (Hazardous, Medical, Electronic, etc)
13	Emergency Response	Fire Stations Emergency Response & Operations Centers Accident Centers
14	Information & Communications Technology	Internet Broadband Infrastructure Cloud Computing Infrastructure Telecommunications Infrastructure Radio/TV Infrastructure Artificial Intelligence & Robotics Infrastructure
15	Housing	Social Mass Housing

8.5 THE 2021 NATIONAL INFRASTRUCTURE REPORT CARD RATING & ANALYSIS

In line with the format of the previous editions of the Infrastructure Report Card, the rating of each infrastructure is at national level. As data availability improves, it is our intention to present infrastructure rating at sub-national level especially regionally. Therefore, the results presented provides a national perspective to the state of our Infrastructure.

The overall rating of Nigeria's infrastructure was F1 – Unfit for Purpose. This rating remains unchanged since 2017 after it dropped by 2points from E2 in the 2015 infrastructure rating. Despite increased budgetary allocation by government for infrastructure development in the past six years.

Figure 8-5: National Infrastructure Rating 2021

A comparative analysis of the various infrastructure categories revealed the highest rated category in Nigeria to be Oil & Gas Infrastructure (E1) - 2.06 followed by Aviation (E2) - 2.01 and Information and Communications Technology Infrastructure (E2) - 1.82. These infrastructure categories showed a slight improvement in rating from the previous year 2017 which was ranked respectively E3 (1.98), E3 (1.94) and E3 (1.79). It is worthy to note that these three sectors combined contributed to 18.29% of GDP in Q4 20201.

In total, the two main areas of concerns of Nigerians regarding the state of our national infrastructure remains Operations and Maintenance – F1(1.54) and Funding -F1 (1.56) both

rated Unfit for purpose. Operations & Maintenance was also a major area of worry in the previous editions of the scorecard since inception. Interestingly, infrastructure providers seem to agree with this position as we see many strategies developed to tackle the issue of poor maintenance culture and creating funding strategies

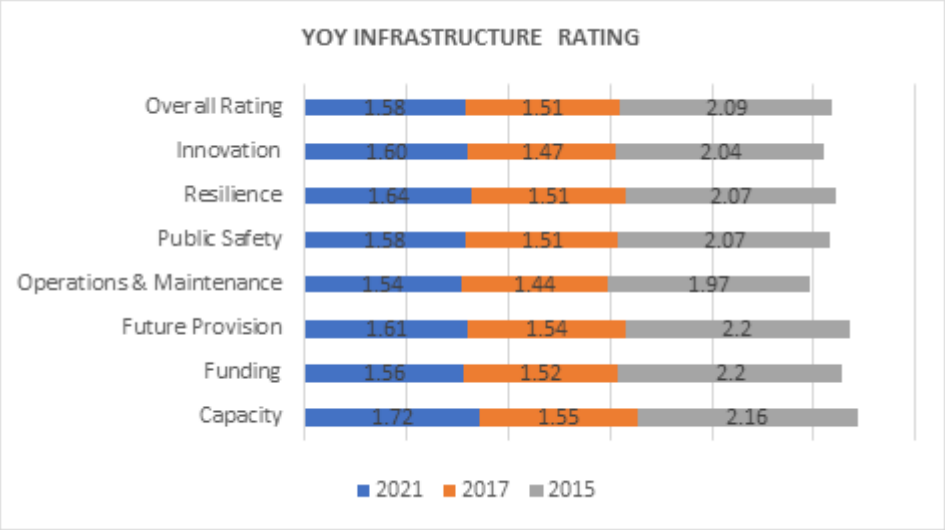


Figure 8-6: Year-on-year infrastructure rating

In summary, there seems to be a general perception of decline in the quality and state of our infrastructure from the first time this initiative to rate infrastructure provisioning was initiated. This calls for the need to ramp up several initiatives currently being implemented by government to address these gaps.

8.6 AGRICULTURE

8.6.1 BACKGROUND

Nigeria has a total agricultural area of 70.8m hectares; an arable land area of 34 million hectares, 6.5 million hectares for permanent crops, and 30.3 million hectares on meadows and pastures. Only about 45% of the arable land available is cultivated. Meanwhile, the country is a leader in various types of agricultural production, such as palm oil, cocoa beans, pineapple, and sorghum. It is the largest producer of sorghum in the world just after the United States and ranks fifth in the production of palm oil and cocoa beans and the world's largest cashew nuts producer.

As of 2020, Agriculture in Nigeria provided employment for about 35% of the population and is the main source of livelihood for most Nigerians, despite the presence of oil in the country.

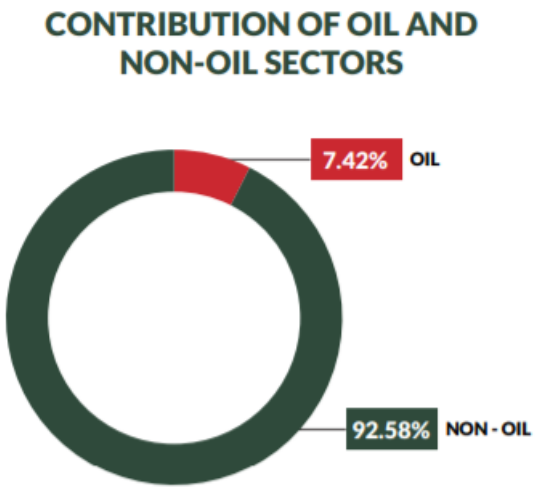


Figure 8-7: Contributions of oil and non-oil sectors

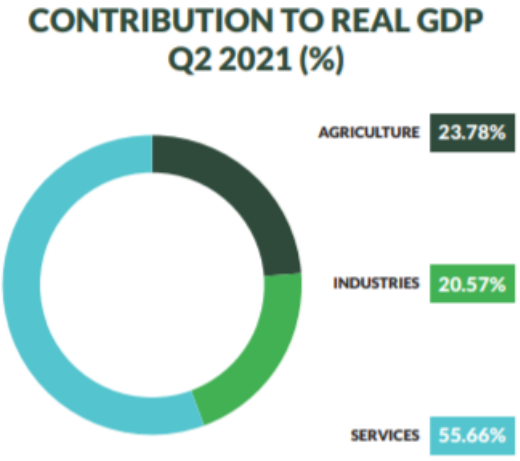


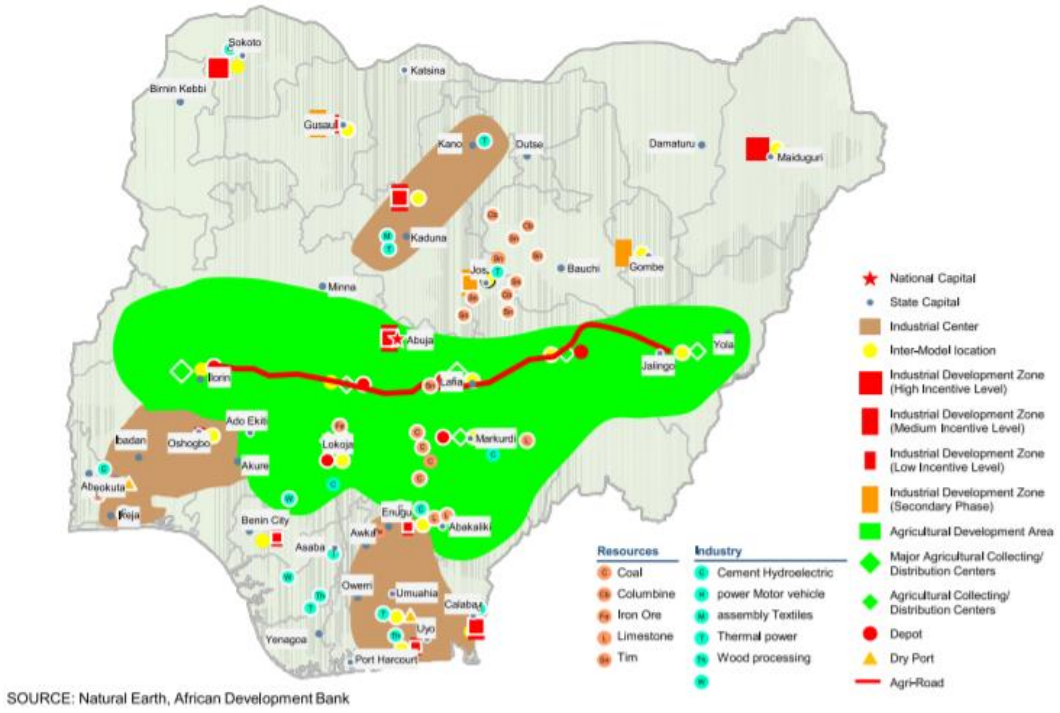
Figure 8-8: Contribution to real GDP Q2 2021 (%)

According to the NBS, Agriculture accounted for 23.78% of Nigeria's GDP, as of second quarter of 202, higher than the 21.42% recorded in the first quarter of the year, although lower than 24.65% recorded during the same period last year. Of the four sub-activities of the sector - Crop Production, Livestock, Forestry and Fishing - crop production remained the major driver of the sector, accounting for 68.60% of overall nominal growth of the sector.

The SDG 2 Goal by UN is set to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture” by 2030. Africa keeps losing $48 billion annually due to high post-harvest losses, as research has shown that the food lost can feed up to 300 million people and save about $35 billion which is spent on food importation annually. Despite Nigeria’s massive production of food, the country generates some 32 million tonnes of waste annually.

There is, however, a huge potential for the infrastructure to grow and transform into a highly commercial and profitable business. To combat some of the challenges encountered in the Agriculture Sector, several programmes have been initiated and implemented by the Federal Government.

FIGURE 3.12: AGRICULTURE IN NIGERIA



SOURCE: Natural Earth, African Development Bank

Figure 8-9: Agriculture in Nigeria

In 2016, the Agriculture Promotion Policy was founded to drive 11 priorities, some of which are agriculture as a business, food as a human right, prioritizing crops etc.

In 2017, the Economic Growth & Recovery Plan was drafted with one of its major Strategic Plans being economic growth and diversification through moving Nigeria towards becoming self-sufficient in food production, launching of the Anchor Borrowers Programme for farmers and promoting the Made in Nigeria campaign to encourage local production. Some other programmes are the APPEALS programme, which is in conjunction with the World Bank, Zero Reject to name a few.

8.6.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The Agriculture Infrastructure is rated for the second time, with the overall rating of F1 – 1.61 in 2021, indicating that the infrastructure is unfit for purpose. This is a slight improvement from 1.55 rating in 2017. The Federal Government over the past few years has initiated several programmes to improve the state of the infrastructure, however a lot of the activities in the sector were disrupted by the local and global lockdowns which were because of COVID-19.

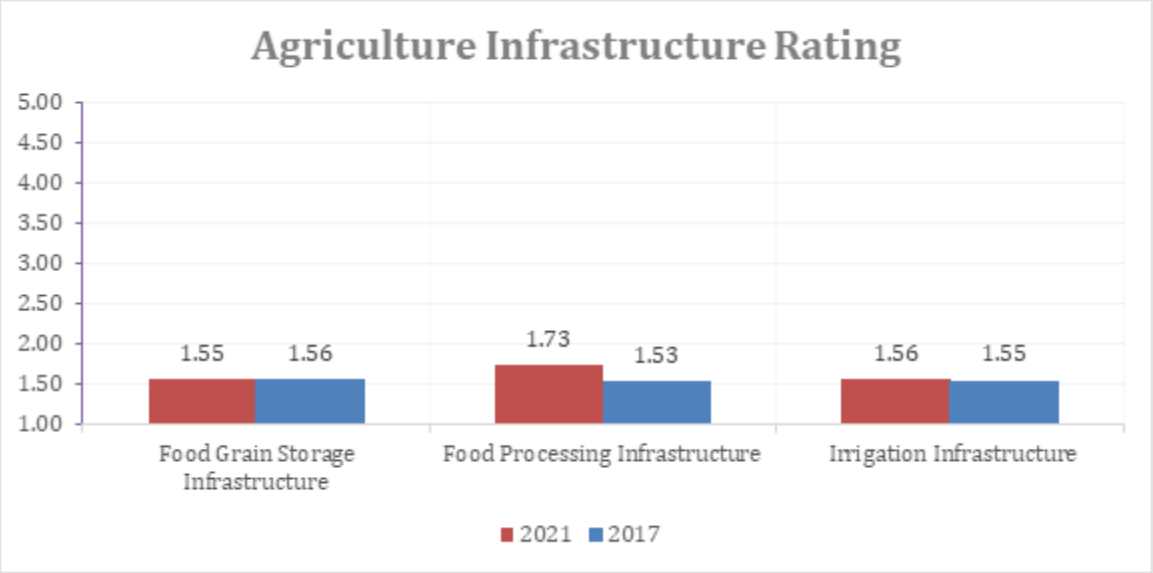


Figure 8-10: Agriculture Infrastructure Rating

Food processing infrastructure rating increased by 0.2 between 2017 and 2021, as the rating went from unfit for purpose to poor state. The ratings for the food grain storage and irrigation infrastructures had no significant increase or decline.

In 2021, participants rated the Agriculture Infrastructure Resilience the highest at 1.71(E2) within the rating system parameters. although other parameters are rated within the same grade. While funding and public safety and operations & maintenance were the lowest rated parameters.

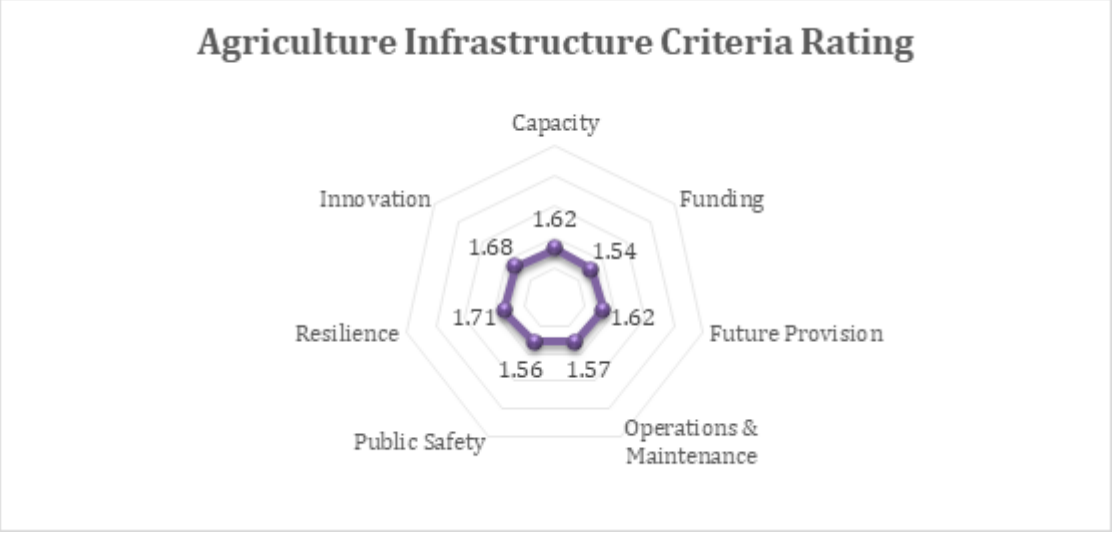


Figure 8-11: Agriculture Infrastructure Critera Rating

In the last 20 years, the highest budget allocations received by the agriculture infrastructure was N2.92 billion, which was 5.41% of the total budget in 2008, and in 2009, N3.101 billion was budgeted at about 5.38% of the total budget.

The budget allocation in 2020 was N79.79 billion budgeted for agriculture, which was less than 1 per cent of the total federal budget.

On the other hand, the Central Bank of Nigeria has staged several financial interventions even as the institution recognises the role of Agriculture in economic growth and development. One of the interventions of the CBN in the agricultural sector, the Agricultural Credit Guarantee Scheme Fund (ACGSF) started in 1977. The fund was designed to encourage banks to lend to farmers, which according to the Apex Bank has facilitated 1.180 million loans valued N122.632 billion to farmers across the country.

One other intervention worthy of note is the commercial farming on a large scale, of the CBN in collaboration with the Federal Ministry of Agriculture and Water Resources (FMA&WR) established in 2009. The Commercial Agriculture Credit Scheme (CACS) provides finance for the country's agricultural value chain namely production, processing, storage and marketing. Under the CACS, loans are provided to commercial farmers at a maximum interest of 9% as data shows that as at January 2021, banks under the CACS have disbursed N672.9 billion loans to fund 636 commercial farming projects while total loan repayment stood at N443.9 billion.

8.6.3 FOOD GRAIN STORAGE INFRASTRUCTURE

Food grain storage infrastructure in 2021 was rated 1.55(F1) – unfit for purpose. The rating remained consistent, as the rating for 2017 was 1.56(F1) which shows that users do not perceive any improvements made by authorities in this direction. In the 2021 rating, infrastructure users rated the innovation and resilience of the infrastructure the highest at 1.66(F1). Though the highest, they are deemed unfit for purpose. Nonetheless, the lowest rating went to the operations & maintenance criteria.

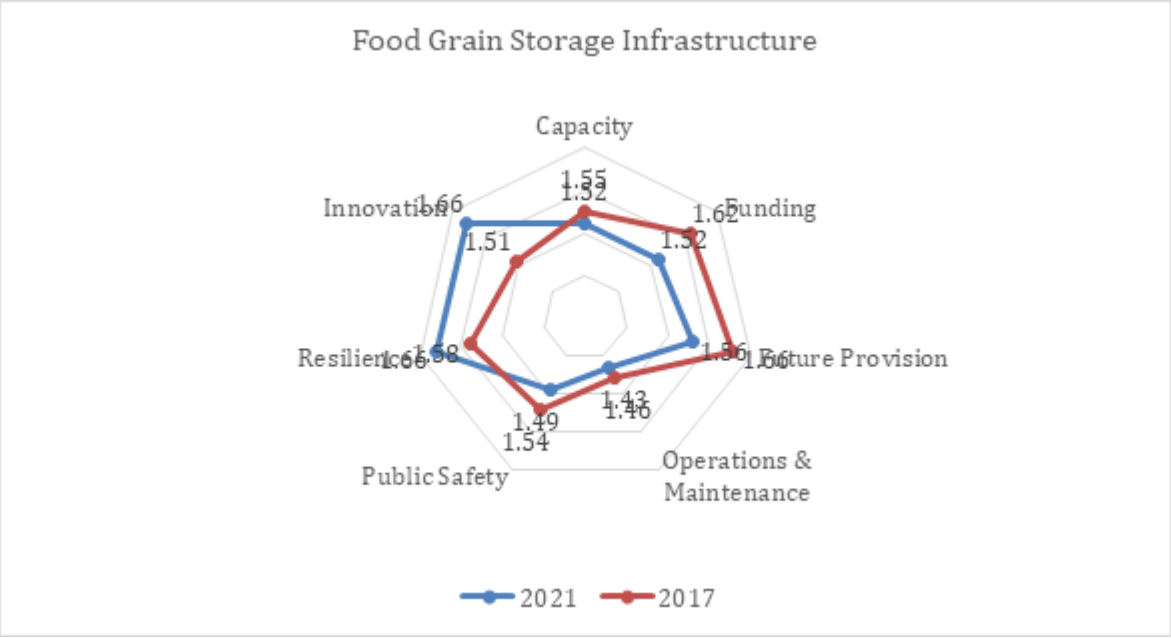


Figure 8-12: Food Grain Storage Capacity

In 2014, the country's post-harvest loss rate was 40% for perishable crops, and 15% of food grains, causing an urgent need for an intervention. By 2016, the Federal Government began to concession the operations and management of storage infrastructure for grains, to the

private sector. The silos will serve to increase storage utilization and the efficiency of grain trading and post-harvest services. As a service provider, the silo operator could allow smallholder and commercial farmers, traders, and processors to use the handling and storage facilities in the silo complex for a fee.

Out of 33 grain silos, the federal government concessioned 20 silos, with a total capacity of 711,000 metric tonnes to private partners. The silos retained by the government had a combined capacity of 225,000 metric tonnes, from Lokoja, Yola, Ilesha, Lafia etc. 7 silos with the capacity of 400,000 metric tonnes are yet to be concessioned.

8.6.4 FOOD PROCESSING

The 2021 rating for the food processing infrastructure showed that the rating went from being unfit for use in 2017, at 1.55(F1), to being in poor state at 1.73(E2) rating. The infrastructure though still not impressive, improved by 0.2. Based on the criteria rating -capacity, resilience and innovation were rated the highest, while the funding of the infrastructure was rated the lowest.

One of the ways with which the Federal Government is addressing the food storage and preservation challenge is through food processing and packaging. This process ensures that food is properly preserved, and wastage is reduced. The Federal Government established various Staple Crop Processing Zones(SCPZ) to attract private practitioners to the sector. Between 2015 and 2016, thirteen private sector mills with a capacity of 240,000 metric tonnes were established, to boost export of food.

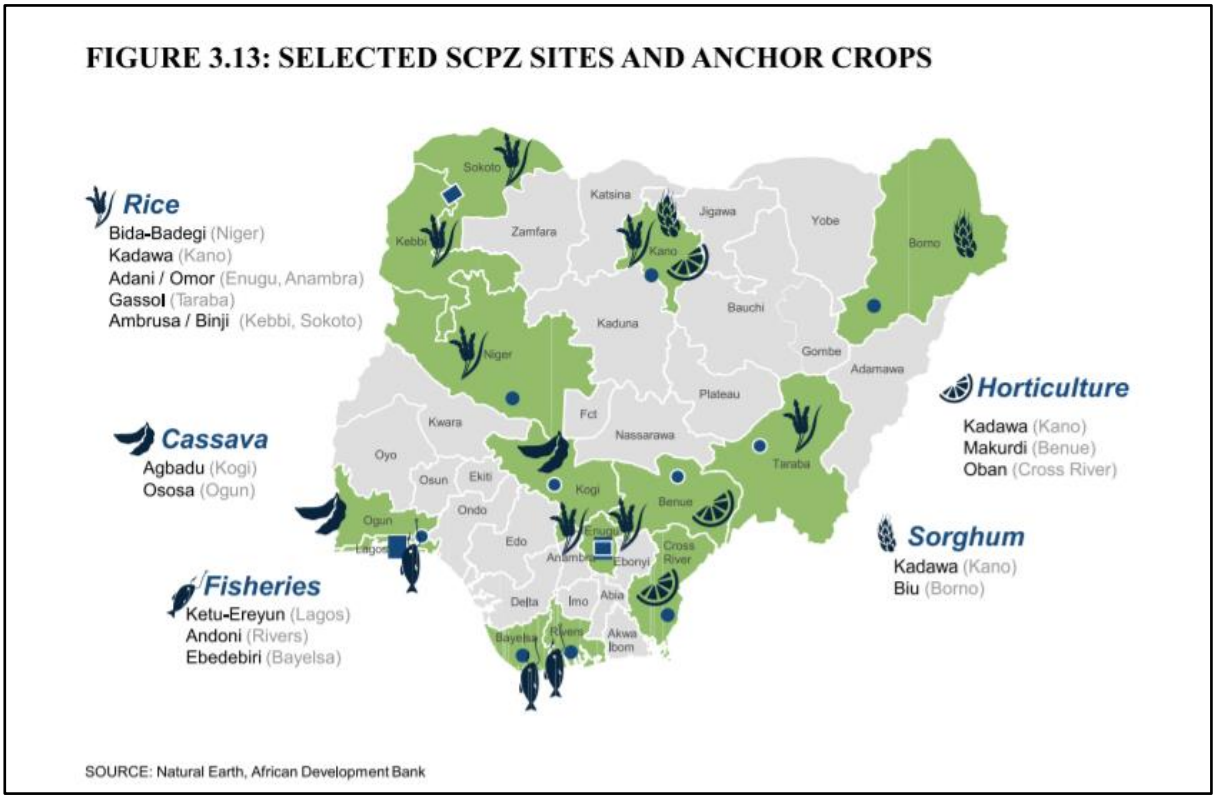


Figure 8-13: Selected SCPZ sites and anchor crops. (Source: Natural Earth, African Development Bank)

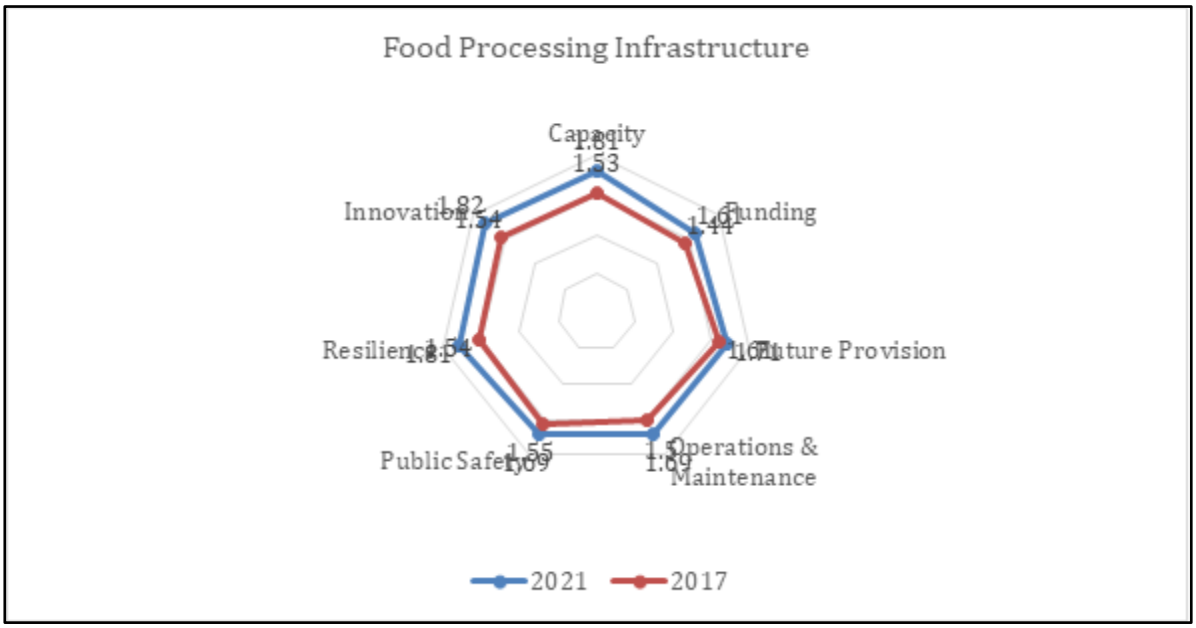


Figure 8-14: Food processing infrastructure

In 2017, Nigeria Sovereign Investment Authority and the Old Mutual Investment Group invested a total of $200 million processing facilities, grain storage, irrigation infrastructure, water reservoirs etc.

In the same year, the Federal Government launched 40 large scale rice processing plants and 18 high quality cassava flour plants, through a credit facility provided by the China Export & Import Bank at 85% and Bank of Industry at 15%. These initiatives paid off, as the production of local rice increased by 60% to 4 million metric tonnes in 2017.

By 2018, the Federal Government went ahead to set up an intervention fund called the "Special Rice Processing Intervention Fund" to support rice farmers and marketers. The fund has since been utilized to set up 10 rice processing plants. The total costs of the projects were awarded at N10 billion.

8.6.5 IRRIGATION

The 2021 overall rating for the irrigation infrastructure was 1.56(F1), indicating that the infrastructure is unfit for purpose. There was no significant improvement from the rating in 2017, which was 1.55(F1). The highest rating from the criterial parameters went to future provision at 1.59(F1), while the lowest rating went to funding at 1.48(F1).

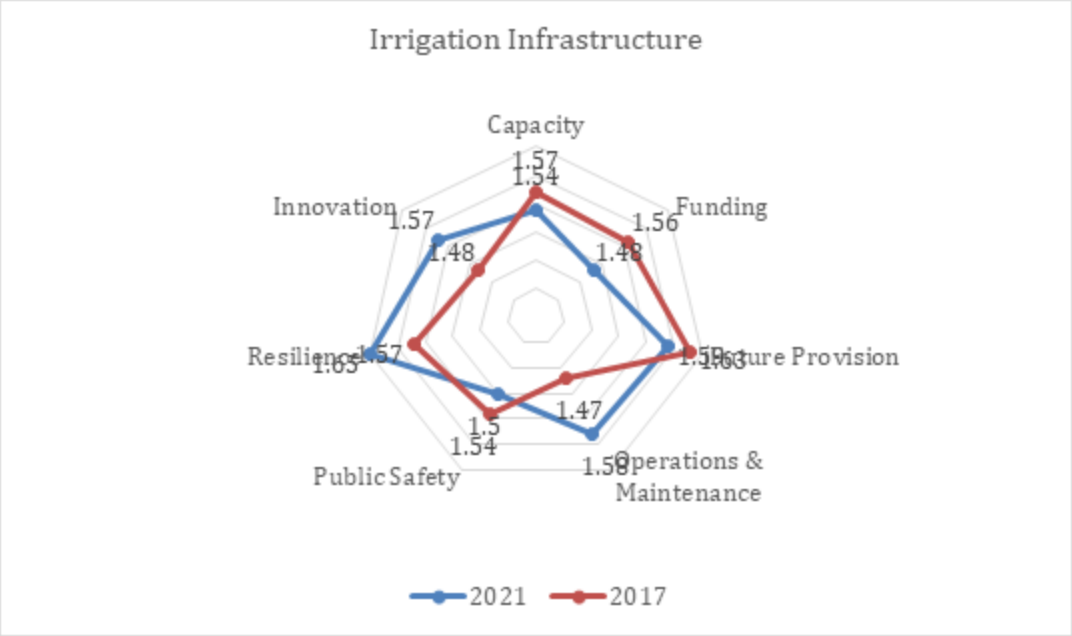


Figure 8-15: Irrigation infrastructure

Irrigation annual water demand is about 1.926 BCM comprising of irrigation in wet and dry seasons as well as Fadama lands. 96,000 Ha have been developed out of about 3.14 million Ha of the National irrigation potentials as of 2021. It is expected that by 2030, a total of 500,000 Ha would be developed. Participation of private sector and State Governments would provide additional 1,000,000 Ha of irrigable land by 2030. Seven irrigation projects were completed between 2016 and 2019. It is expected that by 2021, 5 projects will be completed and 13 irrigation projects to be completed between 2022 and 2023.


The Federal Government's National Irrigation Policy was drafted to overcome the current irrigation challenges. The development of the country's irrigation system has been hampered largely due to unavailable funds to complete the projects.

TRIMING which is a World Bank Intervention Programme is focused on six major Irrigation projects. The programme aims to improve the management and provide access to productivity-enhancing services for 130,000 farmers within and near the following four rehabilitated irrigation schemes in Northern Nigeria: Bakolori Irrigation Scheme in Zamfara state, Middle Rima Irrigation Scheme in Sokoto state, Kano River Irrigation Scheme, and Hadejia Valley Irrigation Scheme in Jigawa state. The project will provide technical assistance to establish a Farmers' Management Center (FMC) at each irrigation scheme and to initiate strong forward and backward linkages along the value chains, using the productive alliance model.

8.6.6 EXECUTIVE INSIGHT

Speaking on the country's irrigation systems, the Honourable Minister of Water Resources, Engr Suleiman Hussein Adamu, stated that only about 2% of the arable land in Nigeria is irrigated by the Federal Government, as there has been little or no participation by the State and local governments. All the major irrigation facilities, except for Kano River irrigation which was started by Kano State Government are managed by the Federal Government.

He went ahead to mention that under the Transforming Irrigation Management In Nigeria project (TRIMIN project), between 40,000 and 45,000 hectares of land are to be added to the existing irrigated lands. The rehabilitation of existing facilities is also ongoing, in Kano for example, where an additional 5,000 farming hectares are being rehabilitated and another 3,000 hectares introduced and handed over to the farmers, already rehabilitated.

For a more long-term plan, the National Irrigation Master Plan 2016-2030 was established to ensure that at least 50% of 3.4 million hectares of arable land are irrigated by 2030. To achieve this project, a total on N250 billion is required. Due to the inadequate funding of the projects, the State Governments and private sector players are being encouraged to take part in these

projects. What we are working on at Federal Government is we are going to do 500,000 and then 1 million. We are trying to encourage the private sector and the state governments to key in.

8.6.7 INTERNATIONAL BENCHMARK

Indices	Nigeria	Africa Benchmark			Global Benchmark		
		Ghana	South Africa	Egypt	US	UK	UAE
Population (million)	212	31	59	104	333	68	9

8.7 AVIATION INFRASTRUCTURE

8.7.1 BACKGROUND

Aviation infrastructure facilitates flows of goods, investment and people into an economy. In 2019 alone, over 14 million passengers passed through Nigerian airports, with domestic travel accounting for over 10 millions of these passengers.

Aviation industry's contribution to the country's Gross Domestic Product has risen to N198.62bn in 2019 from N149.35bn in 2018 contributing 0.14% to GDP in 2019. The aviation sub-sector recorded the fastest growing activities in the transportation sector in the fourth quarter of 2019.

In 2018, there were about 234,367 domestic aircraft movements across the 31 airports domestically. This number increased from 210,693 domestic aircraft movements recorded in 2017 and a drastic drop observed in the first half of 2019 data released by the Nigerian Bureau of Statistics which recorded 31,175 domestic aircraft movements. (National Bureau of Statistics, 2019) (National Bureau of Statistics, 2019)

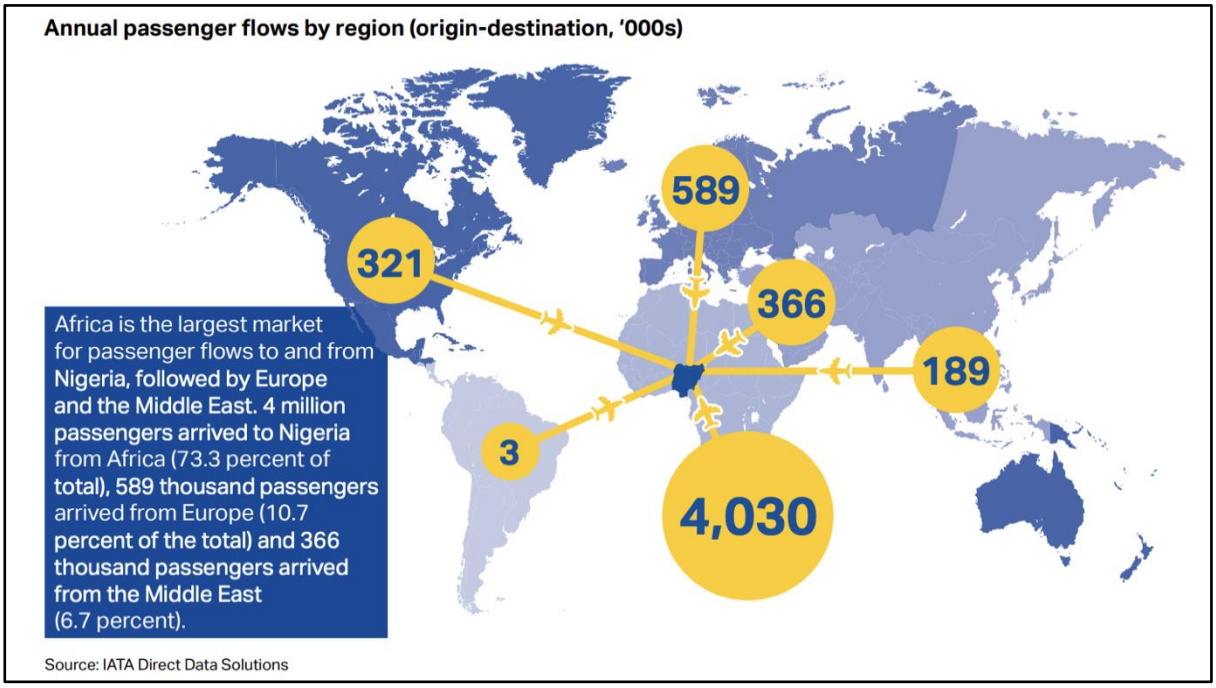


Figure 8-16: Passenger Flows from the World to Nigeria

Experts believe however, that air travel in the country is on the rise. Air transport market in Nigeria is forecast under to grow by 174% in the next 20 years. This would result in an additional 9.4 billion passenger journeys by 2037. If met, this increased demand would support approximately US$4.7 billion of GDP and almost 555,700 jobs. (IATA, 2018) This has created demand for more aircraft, as well as standard infrastructure to meet the needs of passengers as we witness more government and private sector participation in the sector. In the recent years, new airlines have been added to the sector such as United Nigerian Airlines and Ibom Air.

Nigeria's top 4major airports according to capacity and volume include:

1. The Muritala Muhammed International Airport, Lagos with capacity of 6.7 MPPA
2. Nnamdi Azikiwe International Airport, Abuja with capacity of 4.2MPPA
3. Port Harcourt International Airport, Port Harcourt with capacity of 1.1 MPPA
4. Mallam Aminu Kanu International Airport, Kano with capacity of 0.5 MPPA.

In 2018 alone, the total number of passengers who passed through Nigerian airports reached 17,230,438, out of which 4,438,799 were international passengers.

However, Nigerian airports are currently operating in a suboptimal environment due to several challenges which has bedeviled the sector for decades. For instance, the Muritala Muhammed International Airport, Lagos terminal was initially built in 1979 to carter for about 200,000 passengers but as at 2018, over 4.2million passengers had used the facilities. Some of the other challenges include:

- Urgent need of infrastructure investments and modernization. All Airports require investments in runway maintenance, navigation aids as well as terminal facilities.

- There is need to modernize and upgrade infrastructure and equipment such as terminal buildings, control towers, conveyor belts, instrument landing systems, communication equipment, runway lighting and fire tenders
- Relatively low asset utilization due to the limited opening hours of other smaller Nigerian airports
- Lack of terminal capacity as the Airports fall short of gates, stands and check-in desks
- The Airports have not been designed as international hubs but operate separate international and domestic terminals.

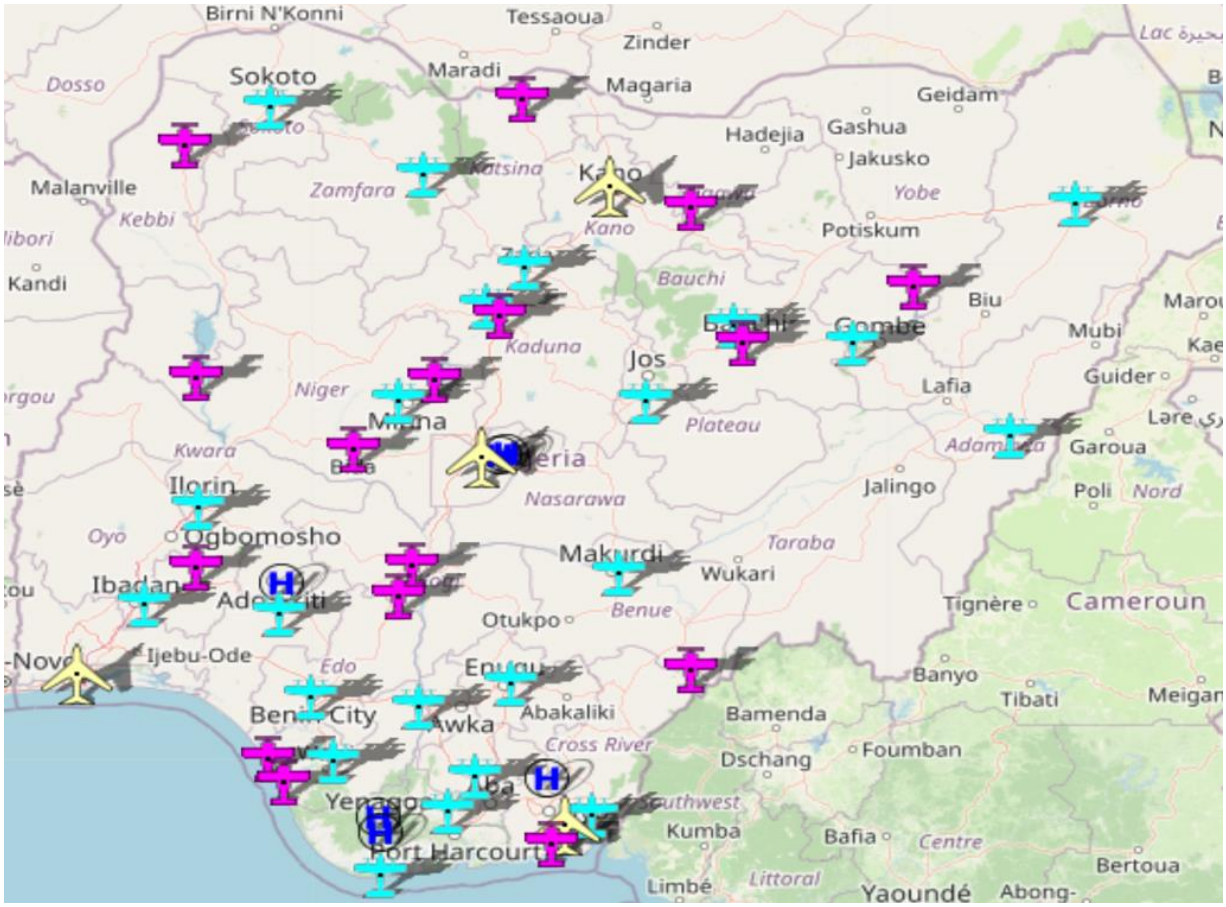


Figure 8-17: Airports in Nigeria (Source: Our Airports, 2021)

The revised National Integrated Infrastructure Master Plan recognizes Aviation as a critical element of Nigeria's transportation system with growing contribution to GDP but also recommends that improvement is needed to its current infrastructure as well as management practices, quality of policy initiatives and ensure enabling business and investment environment to enable private sector participation.

In terms of institutional structure, there are three (3) major institutions responsible for the regulation of different aspects of the aviation industry in Nigeria:

1. Nigerian Airspace Management Agency (NAMA) responsible for providing navigational facilities, air traffic services, aeronautical information services including aeronautical search and rescue.

2. Federal Airports Authority of Nigeria (FAAN) responsible for managing all commercial airports across Nigeria and the provision of services to both passenger and cargo airlines.
3. Nigerian Civil Aviation Authority (NCAA) responsible for the safety and economic regulation of the aviation industry and ensuring compliance with government policies and International Civil Aviation Organization (ICAO).

INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The nation's airport infrastructure was rated E2 (2.01) a slight jump from 2017 rating which was E3 (1.94). Even though this is way lower than 2015 user rating of D2 (2.67), it shows that users are beginning to appreciate the work put in by authorities to improve existing airport infrastructure in the country.

Analyzing infrastructure rating for 2021, airport infrastructure was rated higher than 2017 rating in terms of capacity, funding, future provisioning and operations & maintenance.

Figure 8-18: Airport Infrastructure Rating - 2015, 2017, 2021

Over the last couple of years since the last report, government have taken steps to enhance domestic capacities for air traffic management and safety. One of the notable enhancements to air traffic management has been the communications systems with the enhancement of the Total Radar Coverage of the Nigerian Airspace (TRACON) project. The objective of the TRACON project is to provide total radar coverage for the Nigerian Airspace to enhance civil and military surveillance of aircraft operating into the Nigerian Airspace. NAMA also acquired the motorized air traffic control tower for air traffic management under emergencies which can be configured with the state-of-the-art Global Positioning

System receivers to keep the system current and ready for when Nigeria decides to adopt the GPS mode for air navigation.

> ***"Nigeria is gradually making some progress in rail and airport infrastructure but we still have a long way to go in road development"***
> ***Engr Ndianabasi Asuquo***
> ***Civil Engineer***

> ***"Due to years of neglect, the rail sector is far behind. This has resulted in greater dependence on the road sector. … We have done well in our air transport infrastructure. We have largely ignored or neglected the inland waterways potentials. This sector should be given more due attention, especially to bring down further the cost of freight."***
> ***Engr Muhammed Yusuf***
> ***Managing Director***

> ***"The air transport sector seems to be growing well with standards being ensured. Need for quick growth in the rail system as it could ease the incessant wear and tear of our roads. I also believe that the federal government should hand all roads to the state government with adequate funds back up. The states are nearer to these roads and would ensure proper supervision of their construction."***
>
> ***Olanrewaju Adebayo***
> ***Project Director***

Nigeria has about 39 Air Operator's Certificate for schedule and non-schedule flight operations while about 28 foreign airliners are operating to Nigeria. According to the Nigerian Civil Aviation Authority (NCAA), Nigeria has 23 active domestic airlines; 554 licensed pilots; 913 licensed engineers and 1700 cabin personnel and currently operates Bilateral Air Services Agreements with over 78 countries. (Nigeria Civil Aviation Authority, 2020)

By August 2010, Nigeria achieved a Category 1 air safety rating from the U.S. Government under the Federal Aviation Administration's (FAA) International Aviation Safety Assessment (IASA) program. This means that Nigeria complies with international air safety standards set by the International Civil Aviation Organization (ICAO), the United Nations' technical agency for aviation that establishes international standards and recommended practices for aircraft operations and maintenance.

Apparently, infrastructure users tend to recognize the efforts made towards the improvement of the nation's aviation infrastructure compared to other modes of transportation in the country. This can be seen in many comments extracted from our extensive survey. On government's part, there have been significant achievements which have impacted the infrastructure users in one way or the other. For instance, in 2019, the Ministry of Aviation and Transportation completed the reconstruction of the Abuja Airport Runway. In the last few years, there have been construction of new terminal buildings at the International Airports of Abuja and Port Harcourt as well as the installation of new category III Instrument Landing System (ILS)/Distance Measuring Equipment (DME).

In 2020, only 43% of budgeted funds for Aviation was utilized which was equivalent to the sum of N21.2bn. Therefore, Federal Government has recognized the need to involve private sector funding in the development of Aviation infrastructure. Recently, it announced that it will be concessioning 4 international airports to private sector individuals under a Public-Private Partnership (PPP) arrangement to Repair, Operate and Transfer for 20 - 30years.

8.7.2 EXECUTIVE INSIGHT ON AVIATION

Excerpts of interview conducted with Capt. Fola Akinkuotu, Managing Director, Nigerian Airspace Management Agency (NAMA) by Chinedu Eze published on ThisDay Newspaper of May 21, 2021.

AIRSPACE COMMUNICATION:

Well, if you are looking at voice communication, it can be broken into three parts. We have ground to ground and ground to tower which are very good. We have approach, which is very good. But the challenge is the upper airspace, which we are working hard on. Maybe in the past we did not keep pace with the growing demand to continue to upgrade our equipment. So we didn't try to cope with the increase and the demand in the upper air space. The VSAT (Very Small Aperture Terminal) system was a system that was donated to Nigeria may years ago. And I guess we just didn't keep up with the times. Yes, and we didn't think about the fact that things depreciate. Things need to be replaced, traffic grows, and that is why we started having problems with our VSAT. This is because the extended range VHF rides on the back of the VSAT system for reliable and extended coverage.

AIRSPACE COMMUNICATION COVERAGE:

I will give it more than 75 per cent and as we drive closer to the conclusion of the AIS project on whose back our extended VHF range communication is going to ride, by that time, we expect to have a 100 per cent in both quality, clarity and range…The challenge is with the upper airspace communication; as upper airspace communications rides on VSAT which is being fixed. That was our Achilles heel but is being fixed.

TRACON SPARES:

Well, the situation now has improved considerably, definitely far from where we were in 2017…We have gotten to the point where we are able to get spares.

AERONAUTICAL INFORMATION & INSTRUMENT LANDING SYSTEMS

I will not say we are deficient in Instrument Landing System, but we are modernising. Being electronic hardware, there are age limitations and depreciation on these equipment and new technologies are coming up every day. So because of that you continue to have to replace them and since I have been here we have done a lot of replacements. And we are still in the

process of replacing more. As of now, I don't believe we are deficient in ILS. We are not deficient in ILS systems.

Don't forget that in years past a category I ILS was highly admired. You would be commended if you had that. But now everybody is looking out for CAT 3. And virtually all our ILSs in Nigeria are a minimum of CAT 2. We have also introduced e-clearance platform. We have trial version of the app for e-flight plan, which can capture the passengers onboard and you can pay on the platform. Right now the e-flight plan on the NAMA platform is on trial. We are working to have the app on smart phones, tablets and computers.

ONBOARD AIRCRAFT COMMUNICATION EQUIPMENT

When we install ILS category 3, the lightning system, and the power system are there. We expect the airlines, to take advantage of these things. For example, we put the Controller Pilot Data Link Communications (CPDLC) because it reduces voice communication and it puts data communication in place between the cockpit and the tower. So what that does is number one, it takes away any errors in understanding in language communications. It reduces the amount of talk time in the air. So, it enhances safety indirectly. When we can put these things in place; the regulator will decide the equipment that must be carried onboard an aircraft if they want to benefit from it…if you look at the non-scheduled area, the executive airplanes have a lot of capabilities, so they benefit from it. The domestic airlines are gradually getting there. I am not saying the regulators cannot make laws to that effect, but the airlines gradually within the limits of their economic buying power are modernizing. You recall that many years back, I think before 2004, a lot the Boeing 737s that operated did not have flight management system. But today, virtually all of them have flight management systems.

I believe that the airlines, the entrepreneurs, and the operators want to take advantage of the new technologies, because it reduces operational cost in terms of fuel saving which is significant. So, if you can do a PBN (Performance Based Navigation) approach, it might mean that you will be able to get into places that you may not ordinarily have access to. If you have capability to do a CAT 3 approach and the weather is not that good, you can still get in. So I believe that the operators will gradually take advantage of the new equipment that the Aviation agencies are putting in place.

SECURITY OF AIRSPACE:

I will say yes. We have surveillance capability to detect aircraft that have primary, secondary or both transponders that transverse our airspace. Enforcement belongs to the military and today we have improved cooperation between the civil and the military.

AIRFIELD LIGHTING AND 24-HOURS OPERATIONS:

You cannot have night flight without airfield lighting. Now, NAMAs revenue is based on how many flights operate. So the more airlines operate, the more revenue NAMA earns. It is in our interest to have 24/7 operations and such operations will not be possible without airfield lighting. However, we are not here just because of revenue alone; we are also here because

of safety. It is good for us to have airfield lighting everywhere, such that we can enhance safety of flight operations, both day (during adverse weather) and at night.

8.8 CULTURE & TOURISM INFRASTRUCTURE

8.8.1 BACKGROUND

The OECD's defined the tourism competitiveness for a destination as the ability of a place to optimize its attractiveness for residents and non-residents, to deliver quality, innovative, and attractive (e.g., providing good value for money) tourism services to consumers and to gain market shares on the domestic and global marketplaces, while ensuring that the available resources supporting tourism are used efficiently and in a sustainable way. (Dupeyras & MacCallum, 2013)

Nigeria's tourism sector has been experiencing a gradual decline in multiple key indices for a number of years now even though it witnessed an increased activity in 2016 and 2017 after which the decline continued. According to World Data Atlas, Nigeria received a total of 1.47million US Dollars from tourists receipts in 2019 which was a 25.59% decline from receipts in the previous year. (World Data Atlas, 2021)

Tourism alone, boosted by the availability of the necessary infrastructure like parks and recreational facilities provide an opportunity to promote the wellbeing of the populace; provides employment and can contribute significantly to the GDP of the nation when properly developed.

In 2019, contribution of travel and tourism to GDP (% of GDP) for Nigeria was 4.4% declining to 2.8% in 2020. The reason for the decline was obvious, as global economies contracted due to the effect of the pandemic.

In 2019 alone, the travel and tourism industry contributed a total of 3.33 million jobs which is about 4.8% contribution to total employment in the country. The number declined to 2.56million jobs and equivalent of 4.0% of total employment in 2020.

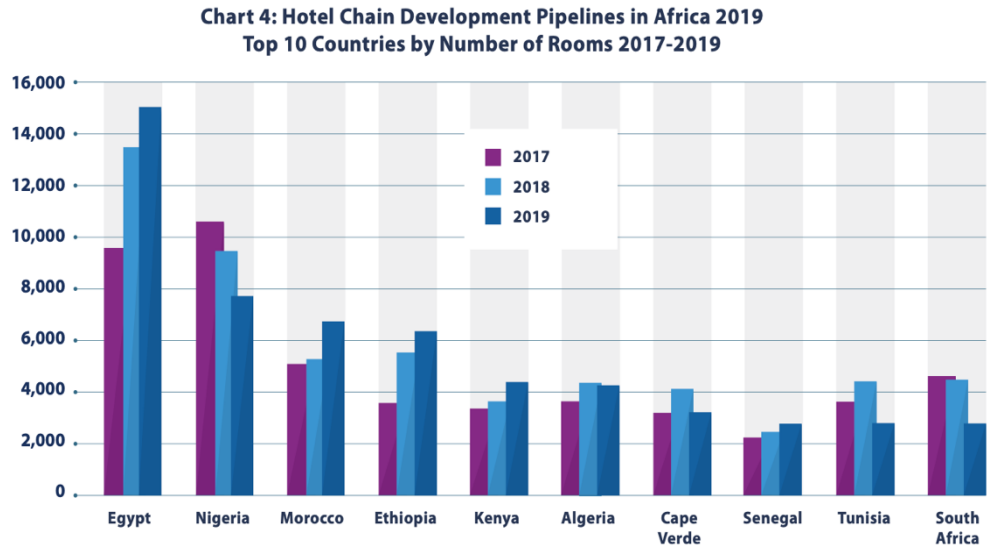


Figure 8-19: Hotel chain development pipelines in Africa 2019

International tourists have injected up to N570.7bn into the economy in 2019 which is valued at about 2.6% of the country's total exports while domestic tourist have spent about N3.67bn in the same year. These numbers declined by 83.5% and 41.8% in 2020 respectively largely attributed to lockdowns and travel restrictions as observed globally.

This shows that the culture and tourism sector of the economy is a viable means of income generation for the Nigerian economy and could be a veritable means of diversifying the economy away from oil as desired by the Federal Government. According to the OECD, Tourism exports are economically significant, and have a larger impact on the domestic economy relative to other export sectors. Every dollar expended by international tourists in OECD countries on average generates an estimated 89% of domestic value added, compared with 81% for overall exports. (OECD, 2020)

"You can have a perspective of infrastructure just as an asset. You can have infrastructure as also a projection of sovereignty and national might. You can also have infrastructure as an economic enabler in terms of helping efficient business activities, and but you can also look at infrastructure as an economic driver creating employment because the process of building it, procuring it, designing it, planning it and even after construction, maintaining and cleaning it keeps people employed"

– His Excellency, Babatunde Raji Fashola, Honorable Minister of Works and Housing, Federal Republic of Nigeria.

From private sector – led initiatives, there has been huge foreign investment in the hospitality industry, with more to come. There were 49 hotel chain development in the pipeline translating to about 7,940 rooms in view, only second to Egypt in Africa in a 2019 projection. The report noted a considerable level of uncertainty within the sector for the future. (2019 Hotel Chain Development Pipelines in Africa, 2019)

8.8.2 QUALITATIVE/INFRASTRUCTURE PROVIDERS PERSPECTIVE AND RATING

Culture and Tourism infrastructure in Nigeria was rated by infrastructure users F1 – 1.38 (Unfit for Purpose). This rating was a slight drop from 2017 rating which was (F1 – 1.48) and a massive decline from 2015 rating of E2 – 1.95. This trend shows that users feel our infrastructure has been on a steady decline since 2015.

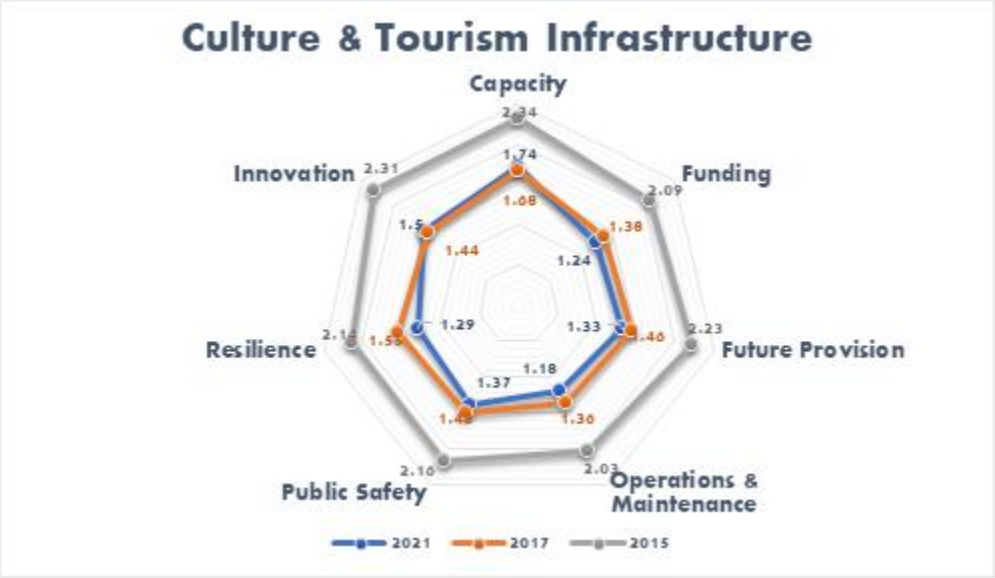


Figure 8-20: Culture and tourism infrastructure

Sharp declines in rating can be seen in the area of funding where the users rating has dropped from 2.09 in 2015 to 1.38 and 1.24 in 2017 and 2021 respectively. The lowest rated area in 2021 was Operations and Maintenance which declined from F1 - 1.36 in 2017 to F2 – 1.18 in 2021. This speaks to the decaying infrastructure as a result of poor operating and maintenance standards of some of our tourist sites.

While the contribution to domestic tourism may be low, the sheer size of Nigeria's population ought to be an advantage as it could help in steering demand for tourism services from domestic travel activity. The government of President Olusegun Obansanjo recognized this and instituted the project on the Nigeria Tourism Master Plan in conjunction with the United Nations World Tourism Organization (UNWTO) in 2016 to focus on institutional and capacity strengthening support to the tourism sector. The objective was to promote the sustainable development of the tourism industry through capacity building in the area of human resource development and promoting tourism development at the community level by encouraging local community participation and ownership/management of the tourism sector.

In 2017, Nigeria Tourism Development Corporation (NTDC) also released the CHIEF (Corporate Governance & Regulations, Human Capacity Development, Infrastructural Development, Events and Marketing, and Finance & Investment) strategy which was geared towards promoting domestic tourism and encouraging the ease of doing business in Nigeria.

Government seems to be focused on different directions when it comes to tourism infrastructure development. Recently, the Lagos State government launched a 20year master plan and policy to boost tourism as Lagos is recognized as the most visited location for both domestic and foreign visitors.

In the recent IRASA report by the Nigerian Society of Engineers, it was noted that Abuja, Lagos, Akwa Ibom and Cross River rank among the best states in Nigeria as far as the combined category of parks, recreational facilities, culture, and tourism goes. Aside from the existing facilities in these states, the authorities have also put in place policies to enhance the category in the states. This is evident from their respective websites. Most of the other states do not have much to show in this regard.

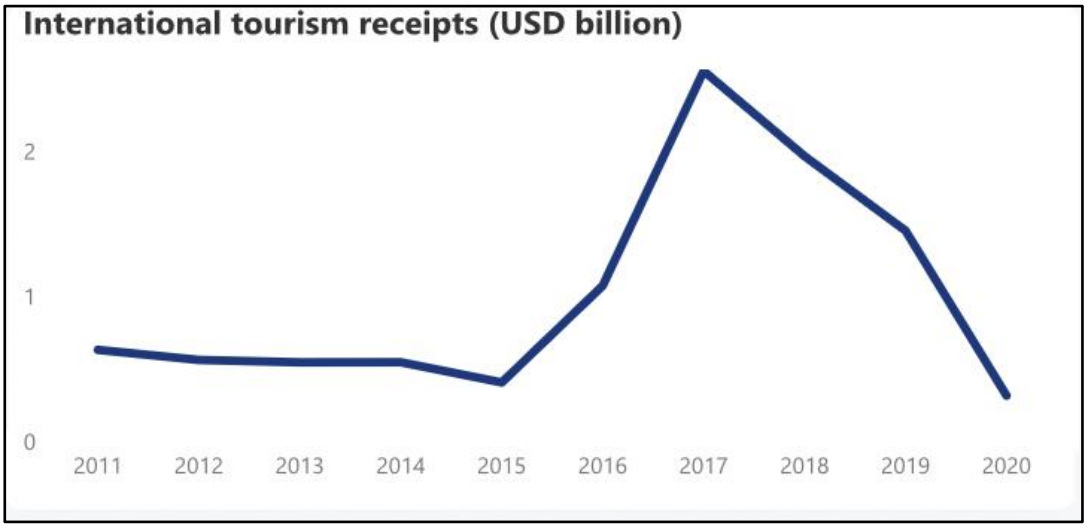


Figure 8-21: International tourism receipts (USD billion)

In almost all the states of the Federation, there are important tourists attraction that is able to sustain some level of revenue for government and generate employment for its citizens both at national and sub-national level if properly promoted and effectively managed and maintained.

Table 8-6: Available attractions

States	Some of the Available Attractions
Benue	More than 7 parks within the capital and some local government areas also have small parks. One of the 2 major rivers in Nigeria - the River Benue - and famous yam markets, etc.
Kogi	Huge potentials - confluence of the 2 major rivers - Niger and the Benue, etc.
Kwara	Owu Waterfalls, abandoned Ilorin Amusement Park and poorly managed zoo.
Niger	Kainji Lake Reserve mostly in Niger state. Recent incident of banditry in kainji, Gurara Waterfall (1,105 Acres)
Nasarawa	Eggon Hills, Farin Ruwa Waterfall, Usuma dam, Retro Art Gallery
Plateau	Dam, myriad of recreational facilities, hills, weather, etc.
Abuja	Boosts of several parks and lots of recreational facilities strewn across the Capital City.
Adamawa	Wetland Park & Garden - the only one in state, Sukur Cultural Landscape (recognized world heritage). Gashaka-Gumti - the largest and most diverse National Park.
Taraba	Mambilla Plateau houses Chappal Waddi mountain considered the highest point in Nigeria. Excellent weather, waterfalls, caves, rare species
Bauchi	Yakari Game Reserve turned National Park in 1991
Borno	Lakes, wildlife, Sanda Kyarimi Wildlife Park, Historical sites, also has Sukur heritage Site being destroyed by BH
Yobe	Mainly revolves around Chad Basin National Park, under-developed wetlands (Hadejia-Nguru Wetlands)
Gombe	Yankari is within reach, but that is about it. Recreational facilities very poor.
Jigawa	Natural wetlands
Kaduna	Impressive list of parks and recreational facilities (https://www.finelib.com/cities/kaduna/recreation), Polo, Kofar Gamji park (in heart of Kaduna, Anara forest reserve, etc. This state is about the most naturally endowed in Nigeria in terms of parks.
Kano	Large Forests. Poorly maintained zoo, many privately owned parks and other tourists' attractions. Public Parks are not mentioned much.

Katsina	Declining forests. Ruma/Kukar Jangari and Kabakawa Forest Reserves in Katsina State. Reserve de-gazetted in 2009. Least tourist attractions in Northern Nigeria.
Kebbi	Agricultural state. Argungu Fish festival, museums, Historic tomb (Dan Fodio), ancient shrines and Karishi people of the hills.
Sokoto	Few amusement parks, Museum, Dam, Zamfara Forest Reserve, etc.
Zamfara	Agricultural State. Zamfara Amusement Park, Kwiambana Forest Reserve (potential world heritage center).
Abia	Tourists' attractions like Ojukwu Bunker, War Museum, Azumini River, Graceland Amusement Park
Anambra	Ogbunike Caves and others, lakes, proposed https://www.awkamillenniumcity.com/recreational-area/
Ebonyi	Caves, lakes, waterfalls, and forests
Enugu	Crème de la crème of SE: Golf, stadium, amusement parks, recreational facilities, lakes, forests, hills, museums, etc.
Imo	Amusement Park, Palm Plantation, Oguta lake resort, zoo, stadium, Museum, and forests.
Akwa Ibom	Golf, recreation centers, plazas, stadium, cinema, museums, and the most beautiful state parks, etc.
Bayelsa	Peace Park, Oxbow Lake Resort, a National Forest, tallest lighthouse, museum, a few parks, several historic sites
Cross River	Museum, marina resort, forest reserves, Tinapa resort, etc. This is also the best in the country, Obudu Cattle Ranch, even better than Akwa Ibom
Rivers	Managed by NCF. Beaches, resorts, amusement parks, golf and polo clubs, stadium, forests, zoos, etc.
Delta	Amusement parks, golf clubs, cinemas, forest, tourist attractions (Chief Nana, Mungo Park, Lander Brothers Anchorage, etc.), adequate stadia, small zoo.
Edo	National Park, Forests, Tourist Attractions (Benin Moth, Oba's Palace, Benin Bronze, etc.), cultural centers, golf club, stadium, Holy Aruosa Cathedral, cinemas, Wildlife Sanctuary (run by NCF and State), fitness centers, etc.
Ekiti	Ikogosi Warm Springs, fitness centers,
Lagos	No place in Nigeria boosts of more parks and recreational facilities. Beaches, parks, forests, etc. (https://laspark.lagosstate.gov.ng/responsibilities-2/)
Ogun	Golf club, forests, amusement parks, fitness centers, tourists' attractions like Olomo rock.
Ondo	Golf, Hills, museum, caves, Ebomi Lake, historic sites, forests
Osun	Golf, Waterfalls, sacred grooves, resorts, museum, Ooni's Palace, stadium, game reserve, forests.
Oyo	Forests, Museum, Stadia, Parks, Zoo, golf, recreational facilities, palaces,

8.8.3 INTERNATIONAL BENCHMARK

Nigeria ranked 129 out of 140 countries ranked in the latest WEF Travel and Tourism Competitive Report of 2019 with a score of 2.8 out of 7. Essentially, Nigeria is below the global average of 3.8 and sub-Saharan average as well. A detailed analysis of the ranking indicators showed that the country was in the bottom 20% in all parameters of ranking such as Enabling Environment, Travel and Tourism Policy & Enabling Conditions, Infrastructure, Natural & Cultural Resources. Nigeria also ranked well below other African countries and West African neighbors.

8.9 EMERGENCY RESPONSE INFRASTRUCTURE

8.9.1 BACKGROUND

Emergency management in Nigeria can be classified as still in its infancy level as the country still suffers from several deaths caused by the delay in access to healthcare services which if eliminated can greatly reduce the high mortality rate currently experienced in the country today.

Nigerians suffer significantly from various types of disasters. Disasters such as floods, landslides, tidal waves, coastal erosion, sandstorms, dust-storms, locust/insect infestations, and other man-made disasters have claimed many lives in Nigeria and rendered many homeless.

Historically, salient disasters in Nigeria include the yearly epidemics such as cholera, measles and cerebro-spinal meningitis. There was drought in the Sudan-Sahel zone of the country in 1972-74 and 1982-84. There were flood disasters in Ogunpa (Oyo State) in 1982, Lagos Bar Beach in 2001, Shiroro and Kaduna in 2003, Gombe in 2004, Jalingo in 2005, e.t.c. Others include the 2008 landslide in Agwu LGA (Enugu state);

and 2005, 2006 and 2009 landslide in Agwagune (Cross River State). Also, Nigeria experienced numerous ethnic, political and religious violent conflicts in Kaduna, Lagos, Kano, Plateau, Bauchi, Borno, Taraba, Benue, Delta, Anambra, Ondo, Osun, Ogun, etc.

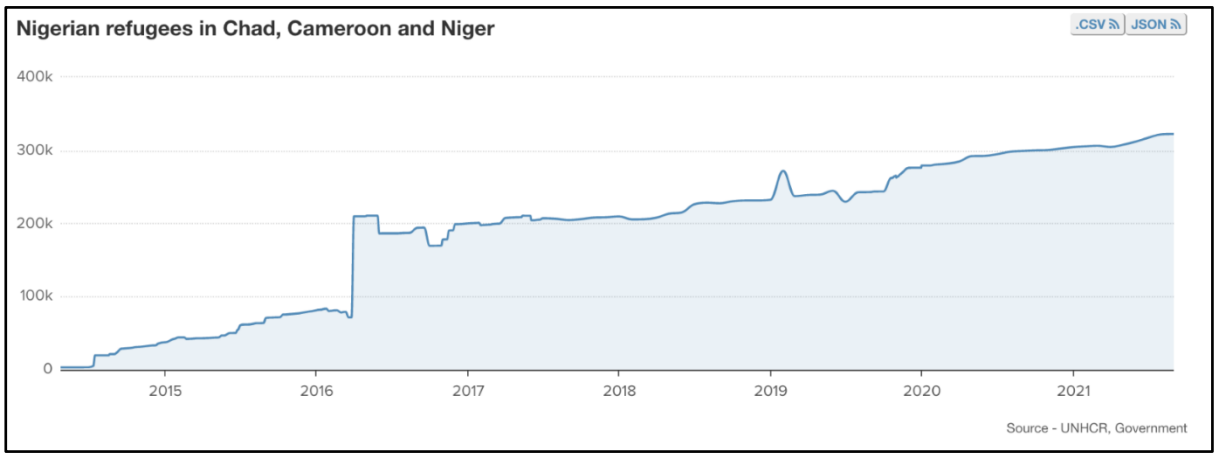


Figure 8-22: Nigerian refugees in Chad, Cameroon and Niger

There are also technological disasters ranging from, the 2002 Ikeja bomb explosion; the 2002 West African Rubber Product Company fire in Ikorodu; the 1992 Hercules C-130 military air-crash at Itokin-Lagos; the 2002 ADC air-crash at Ejirin - Lagos; the EAS air-crash in Kano State; the 2005 Bellview air-crash in Lisa village (Ogun State); the 2005 Sosoliso air crash in Port Harcourt; the ADC air crash in Abuja. Other technological disasters include the several pipeline explosions and vandalization in the Niger Delta, and series of road traffic crashes among others.

A study, some years ago on the challenges of vulnerability in Lagos Megacity revealed that respondents identify road transportation accidents as the most prevalent man-made disasters in Lagos. In fact, the Lagos State Emergency Management Agency, LASEMA, has revealed that it responded to 822 various emergency incidents between January 1, to June 30, 2021, across the state. Indeed, Nigeria has had its share of disasters in recent times that has led to loss of lives, displacement of families and loss of properties.

The United Nations High Commission for Refugee (UNHCR) has reported over 2.1 million internally displaced persons in Nigeria due to the ongoing insurgency in the North.

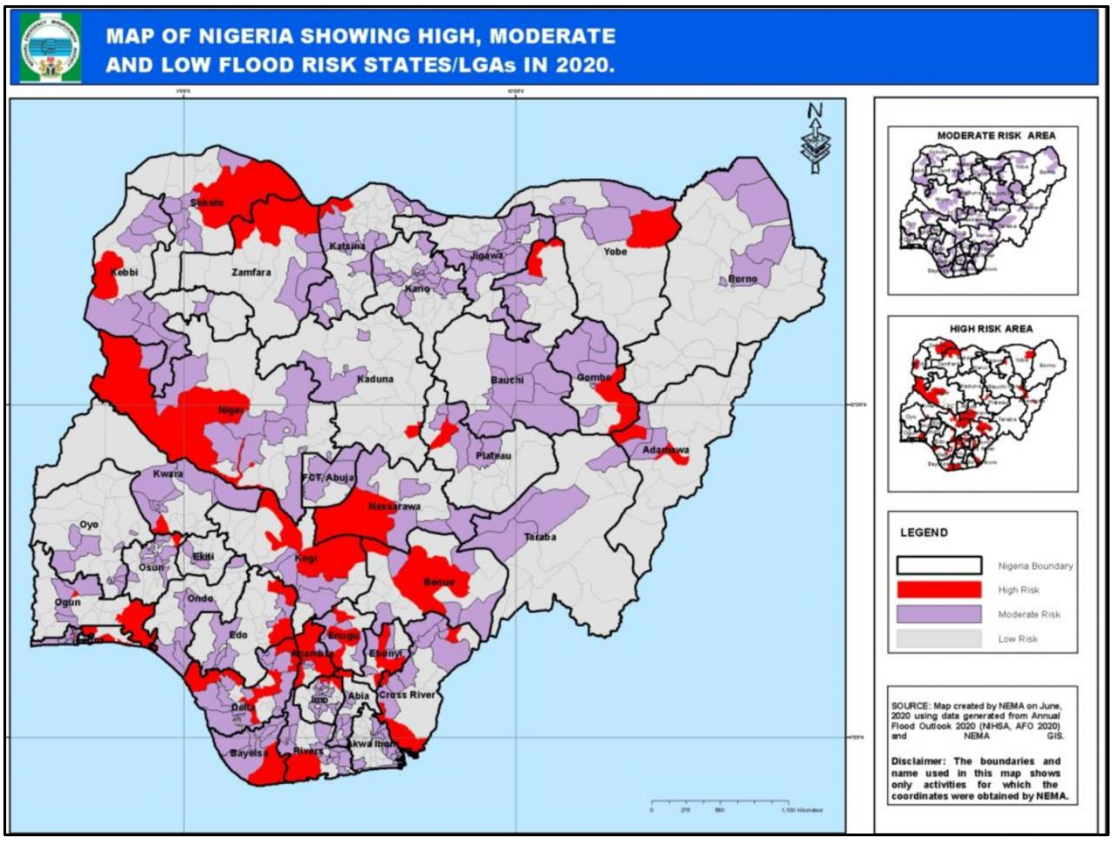


Figure 8-23: Map of Nigeria showing high, moderate and low flood risk states (Source: NEMA)

Nigeria's emergency management system has undergone tremendous changes in recent times. These include better organizational structure, more funding, curriculum development in emergency management education programs, increased training of emergency personnel, and more collaboration with other countries on emergency management issues but there are still many concerns about its effectiveness to addressing risks and disasters as they occur in a timely fashion.

Recently, the Minister of Health noted that the lack of provisioning of the National Emergency Medical Service and Ambulance System has led to delay in access to healthcare services which has increased mortality rate in some cases.

> *The country needs to come up with a clear and transparent policy on emergency response as is obtainable in advanced countries. It is not enough for one state like Lagos to be used as a reference point whereas the rest of the country is not accountable.*
>
> ***Engr Declan Ugah***
> ***Project Engineer***

8.9.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The nation's emergency response infrastructure was rated F3 (1.25) – Unfit for Purpose and has remained constant since 2017 which itself was a dip from the 2015 rating from E3 (1.79). The trend in rating from 2015 is discouraging and perhaps shows the frustration of infrastructure users to the lack of development and probably the declining attention given to this important sector.

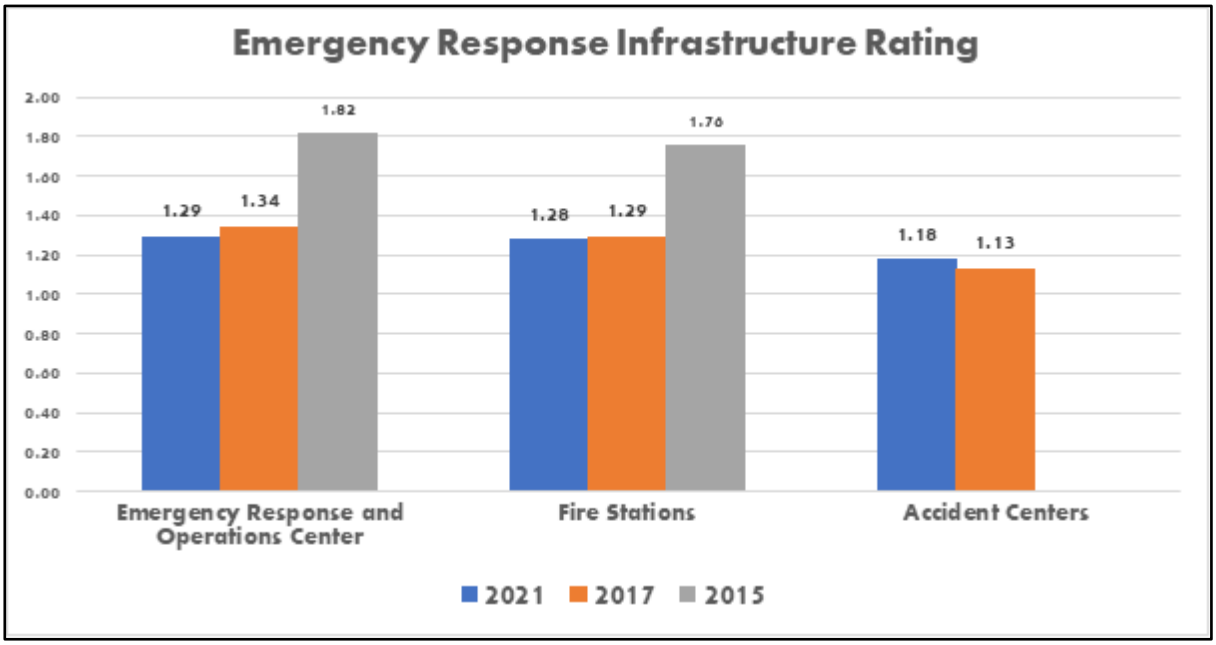


Figure 8-24: Emergency response infrastructure rating

As noted in the introductory section of this infrastructure rating, Nigeria has witnessed increased threat to life and livelihood in the recent times which has assumed greater dimension without corresponding provision to handle these disasters. Just some months ago, the Senate have been considering making laws to support 112 Toll-free number as the officially designated National Emergency Number. NCC earlier launched this number in a number of states to support the COVID-19 containment efforts, but it is unclear how the operational structure of this service works.

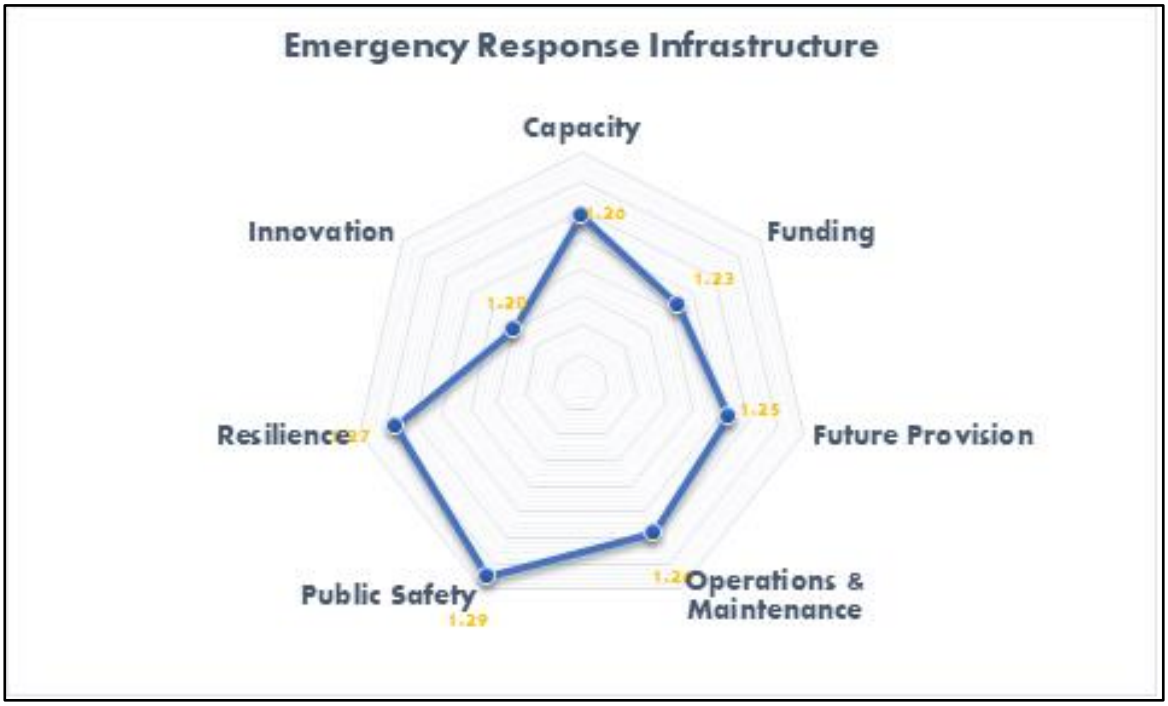


Figure 8-25: Emergency response infrastructure

In all aspects of rating such as capacity, funding, future provision, operations and maintenance, resilience, innovation and public safety, users rated this infrastructure category very low and "Unfit for Purpose". The lowest rating received was in terms of innovation despite structures that are beginning to emerge about the use of technology by setting up a National Emergency Number.

Also, the various infrastructure classes rated in this category all had reduced rating compared

8.9.3 EMERGENCY RESPONSE & OPERATIONS INFRASTRUCTURE

The Emergency Response & Operations Infrastructure was rated F3 (1.29) – Unfit for Purpose in the 2021 Infrastructure Scorecard rating. The infrastructure rating declined from 1.34 in 2017 and 1.82 in 2015. One possible reason for this decline could be the lack of attention given to developing this infrastructure category at the National level.

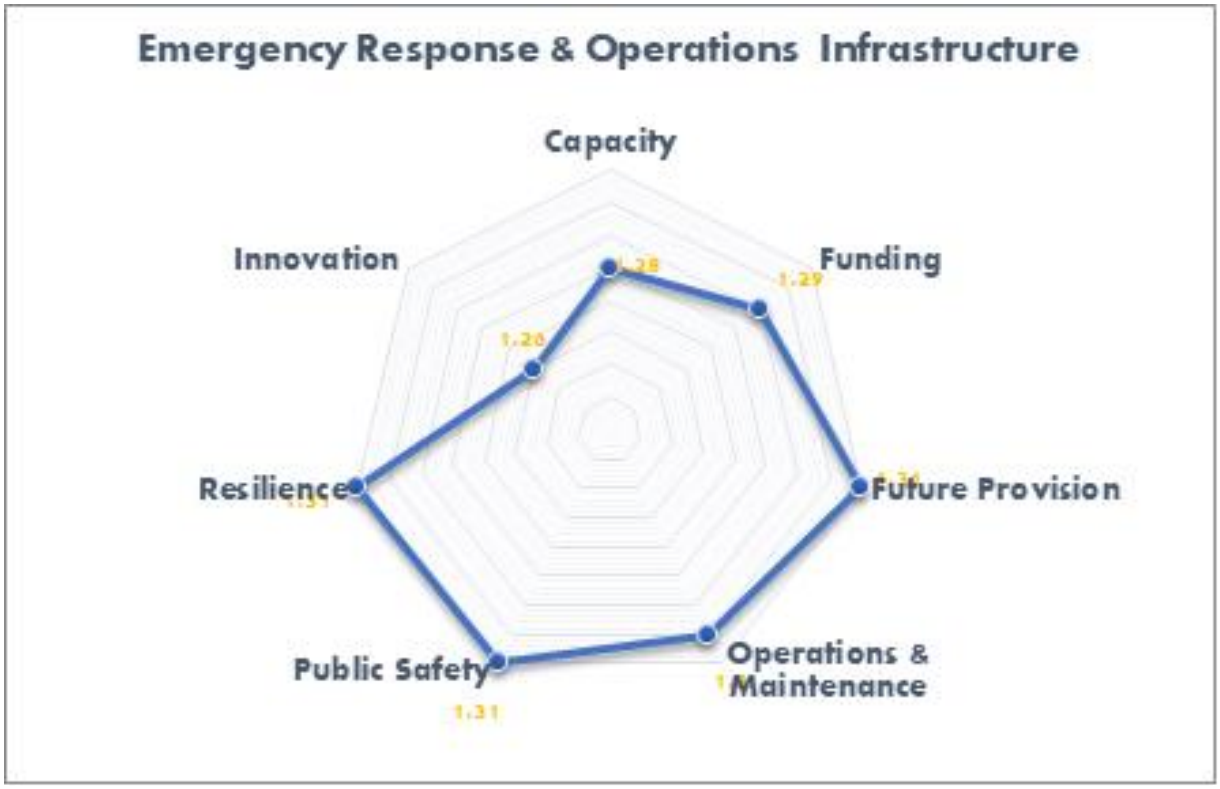


Figure 8-26: Emergency response operations infrastructure

Till date, only Lagos State can boast of a functional emergency control center with published emergency numbers to enable users call and receive assistance when needed. During the COVID outbreak, the USAID supported Nigeria to upgrade Emergency Operation Centers in Cross River, Adamawa, Akwa Ibom, Bauchi, Bayelsa, Edo, Kano, Niger and Oyo States to enable the country tackle the menace of the pandemic more efficiently. Users believe the capacity to respond to emergency is actually and at times there is this general resorting to self-help methods in such times.

8.9.4 ACCIDENT CENTERS INFRASTRUCTURE

Accident center infrastructure was rated as unfit for purpose also at F3 (1.18) which is one of the lowest rated infrastructures in this edition of the Infrastructure Scorecard Report. Respondents can hardly feel the impact of this infrastructure, if at all it exists. Lagos State has an Accident & Emergency Center that is operated by the State Government and other similar infrastructure managed by the Federal Road Safety Commission but it appears these centers are not able to deliver according to expectation. As at Q3, 2020, the Nigerian Bureau of Statistics noted that there were 17,022 persons involved in road accidents with up to 1,236 causalities. As noted by the Minister of Health during the commissioning of the Ambulance Service for the country for the first time this year, the number of fatalities to these incidents could significantly reduce if there are prompt and accessible medical service at the time of incident.

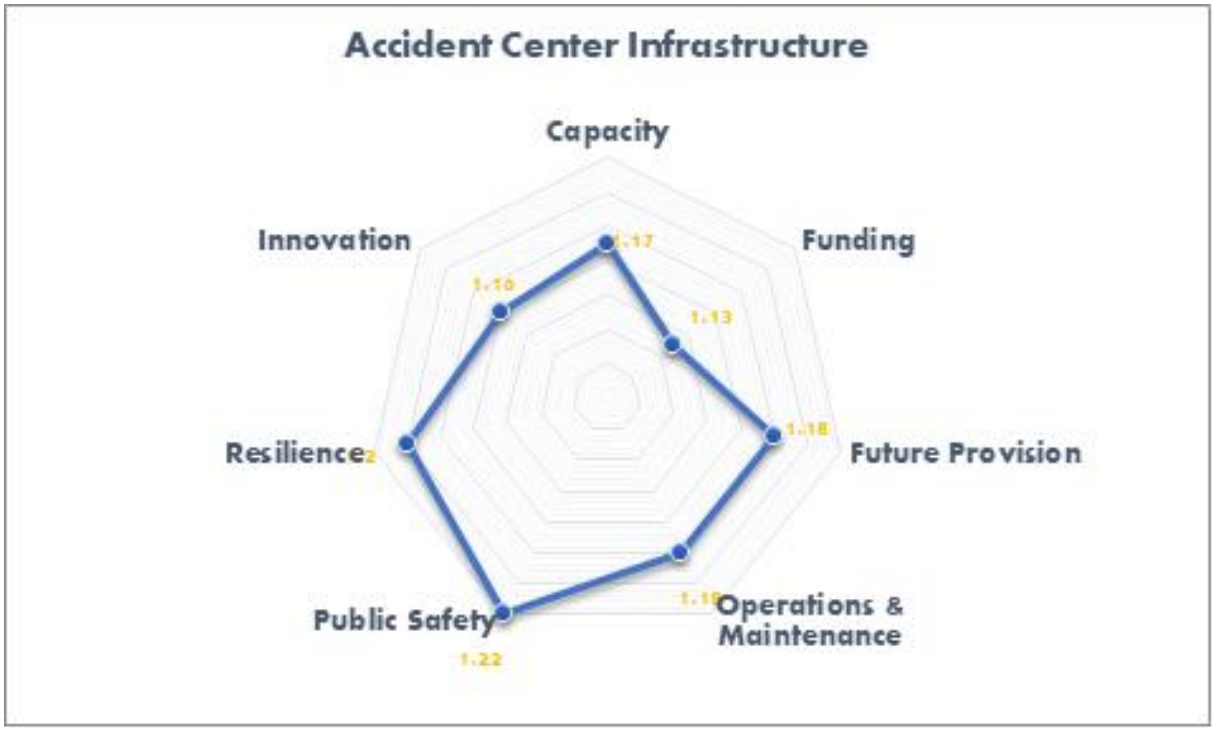


Figure 8-27: Accident centre infrastructure

Medical Emergency requires getting to the centre, no plan for evacuation exists in many locations, fire emergencies are responded to according to available vehicles and hoses, which are many times not properly maintained and therefore not fit for use, emergencies of civil unrests always lead to loss of several lives and loss of more properties due to unprofessional management teams and improper information coordination, flooding emergencies are also not fully planned for, alert of security threats by Fulani herdsmen, Bokoraham milittia and other violent groups as well as kidnappers and armed robbery cases are seriously inadequate, those on suicide missions are not even considered and multiple shooters can be placed under terrorists, all these are presently not properly considered in planning, especially using the information dissemination and communication platforms and responses are very slow and poorly managed for all emergencies

Olatoye Olubukola Betty
Technical Director

Very poor! The current state of insecurity is a clear indicator that there's no emergency response infrastructure in Nigeria. The little available has been overstretched and consequently there's no impact.

Kingsley Nwagu
General Manager

8.9.5 FIRE STATIONS INFRASTRUCTURE

Fire Stations Infrastructure was rated F3 (1.28) which is classified as 'Unfit for Purpose'. This rating has remained unchanged from the previous rating in 2017 indicating that users do not feel there has been any improvement in the fire stations infrastructure over the last 3-4years.

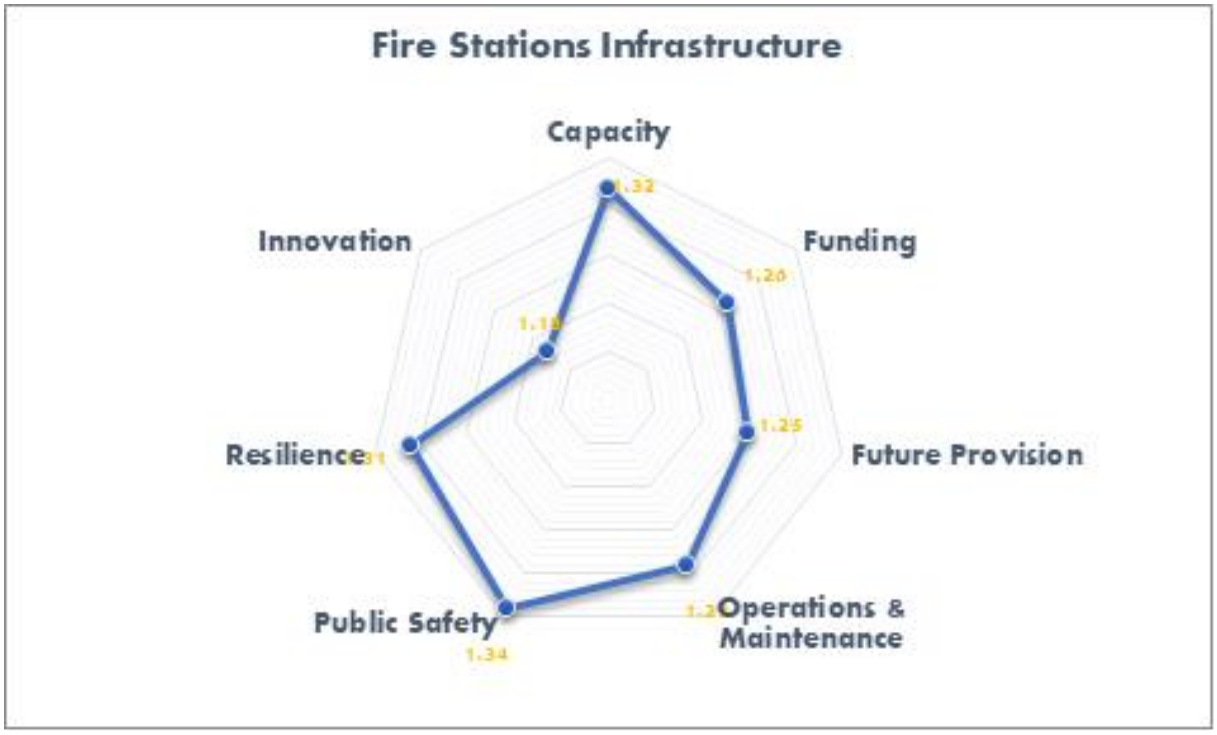


Figure 8-28: Fire stations infrastructure

In all the parameters rated, users tend to rate the capacity and public safety of the fire infrastructure higher. The Federal Fire Service in its website stated that the service has presence in 36 states of the federation with about 104 modern appliances. This seems grossly inadequate to contain the spate of fire incidents that have been plaguing the country in recent years.

Recent newspaper reports suggest up to N41.54b have been lost to market fires alone in a space of two years. Between 2020 and 2021, the fire service department have received over 4,541 calls related to fire incidents while there has been 31 officially reported fire incidents within the last 18months. Reports also notes that over 2,668 persons have lost their means of livelihood due to fire related cases too. (The Guardian, 2021)

Expectedly, because of the huge gap in infrastructure provisioning, several private sector players have set up a parallel fire service department to prevent losses that may accrue to their business or community due to inadequate infrastructure to respond to fire emergencies. Some of the private sector – led fire departments include Eko Hotel, Shell Nigeria, UBA Fire Department and a host of many others.

While emergency response has improved in Lagos, it remained very low in other parts of the country.

Fred Idaewor
Head, Risk Management & Internal Control

8.10 OIL AND GAS INFRASTRUCTURE

8.10.1 BACKGROUND

Nigeria's Oil and Gas infrastructure is divided into three main segments: the Upstream segment (production of crude oil and gas mostly for exports); the Midstream segment (refining and gas processing) and the Downstream segment (includes oil refineries, petrochemical plants, petroleum products distributors, retail outlets and natural gas distribution).

Nigeria remains one of Africa's key oil producers, producing high-value, low-sulphur content crude oil (7th largest oil producer and 9th largest gas producer in the world with proven

reserves of about 36.6 billion barrels and gas reserve estimated at 182.8 trillion cubic feet (tfc). (Ajayi, Ibeneme, & Adediran, 2021)

However, the country is currently struggling to cope with depleting revenues, occasioned by the twin shocks from oil price crash and the COVID-19 pandemic which adversely influenced demand and supply of crude oil in an unprecedented

manner; thus leading Nigeria into its second recession in six (6) years. The country is now desperate to overcome economic downturn and exploring various alternative revenue sources, especially through gas commercialization and infrastructure development. Authorities are now focused partly on exploring approaches to improve production of condensates to enable the country recover lost revenue for the purpose of long-term sustainability mainly because condensates don't come under the OPEC regulatory regime.

The diversification strategy of the nation's oil and gas assets is expected to ensure business

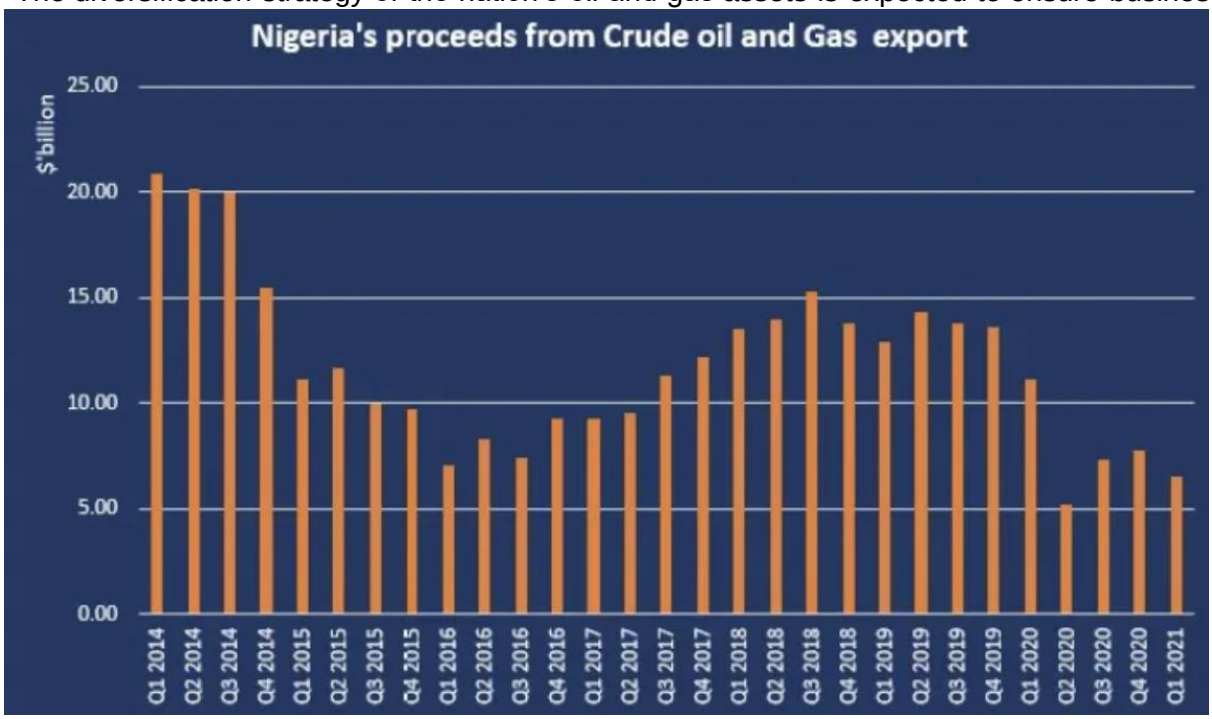


Figure 8-29: Nigeria's proceeds from crude oil and gas exports Q1 2014 – Q1 2021 (Source: Nairametrics)

and revenue continuity in the Nigeria economy. In 2020, net revenue from oil & gas activities accruing to government stood at N2.88trn marginally higher than revenue realized in 2019 even though revenue from core oil & gas sales dropped by almost half according to data from the Office of the Accountant General of the Federation (OAGF) and the Budget Office of the Federation. A recent report in July 2021 indicates that Nigeria's crude exports fell by a whopping 42% year-on-year in the first quarter of 2021 (Oyeakanmi, 2021). Crude oil and petroleum products exports accounts for approximately over 95% of total foreign earnings by government and 70% of government revenue which makes the country almost totally dependent on oil and gas revenue for national development.

Lack of infrastructure, uncertainties in regulations, and security concerns have led Nigeria to underutilize its refining capacities, thereby pushing the country to become a net importer of

refined petroleum products. This could soon change as Dangote is set to alter the supply dynamics of refined products in the region with the help of the upcoming Dangote Refinery, and it is expected to become the regional refining hub in the coming years. This, in turn, is expected to attract foreign players to tap into the country's downstream market soon.

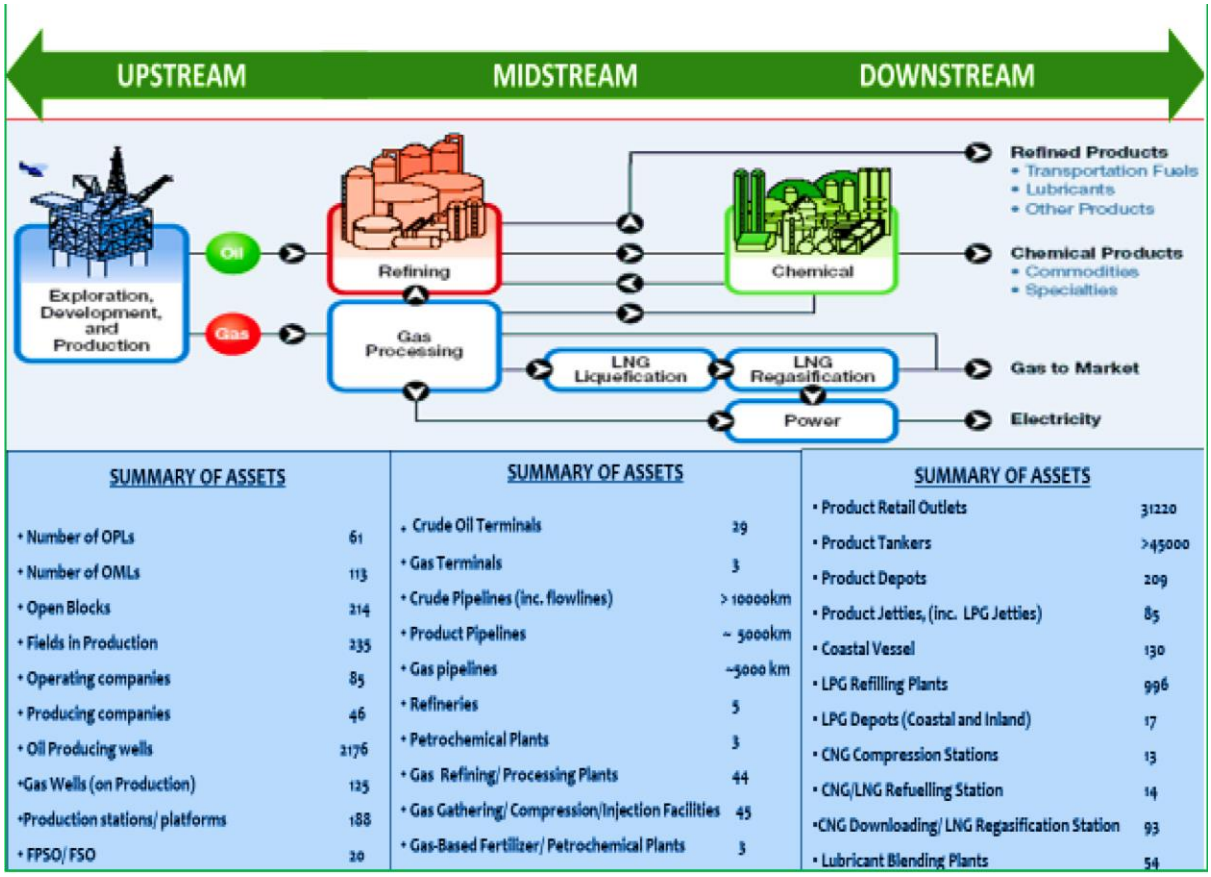


Figure 8-30: Oil & gas processes and summary of assets (Source: DPR)

In keeping faith with its strategy to prioritize gas production and gas – based infrastructure, government had reached final investment decision (FID) on the $12billion train 7 LNG gas project expected to deliver 22 million tons per annum (mpta) to 30 mpta. The Engineering, Procurement and Construction (EPC) Contracts has been signed with the SCD JV Consortium, comprising affiliates of Saipem, Chiyoda and Daewoo expected to trigger the commencement of the Detail Design and Construction phase of the project. Also, in recognition that flared gas could be harnessed to stimulate economic growth, drive investments and provide jobs in oil producing communities and indeed for Nigerians through the utilization of widely available innovative technologies, the Nigerian Gas Flare Commercialization Program (NGFCP) policy to guide the industry has also been effected.

In June 2021, the government through the Department of Petroleum Resources awarded the rights to develop marginal oilfields to 50% of the 161 firms shortlisted after they met all conditions. This was last carried at some 18years ago but now Nigeria is looking to produce from these fields to bolster revenue and increase local participation in the oil sector.

The government also has ambitions to supply gas to Europe through the proposed Trans Sahara Gas Pipeline (TSGP) project. This has already commenced with the inauguration of

the 614-kilometer first phase $2.8 billion Ajaokuta-Kaduna-Kano (AKK) Gas pipeline, touted to be one of the nation's biggest domestic gas transmission infrastructure.

In terms of governance and institutional framework, the President has finally signed the Petroleum Industry Bill (PIB) into law, 20 years after it was first introduced. This is expected to transform and overhaul the oil and gas sector and encourage more investment in the sector.

8.10.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

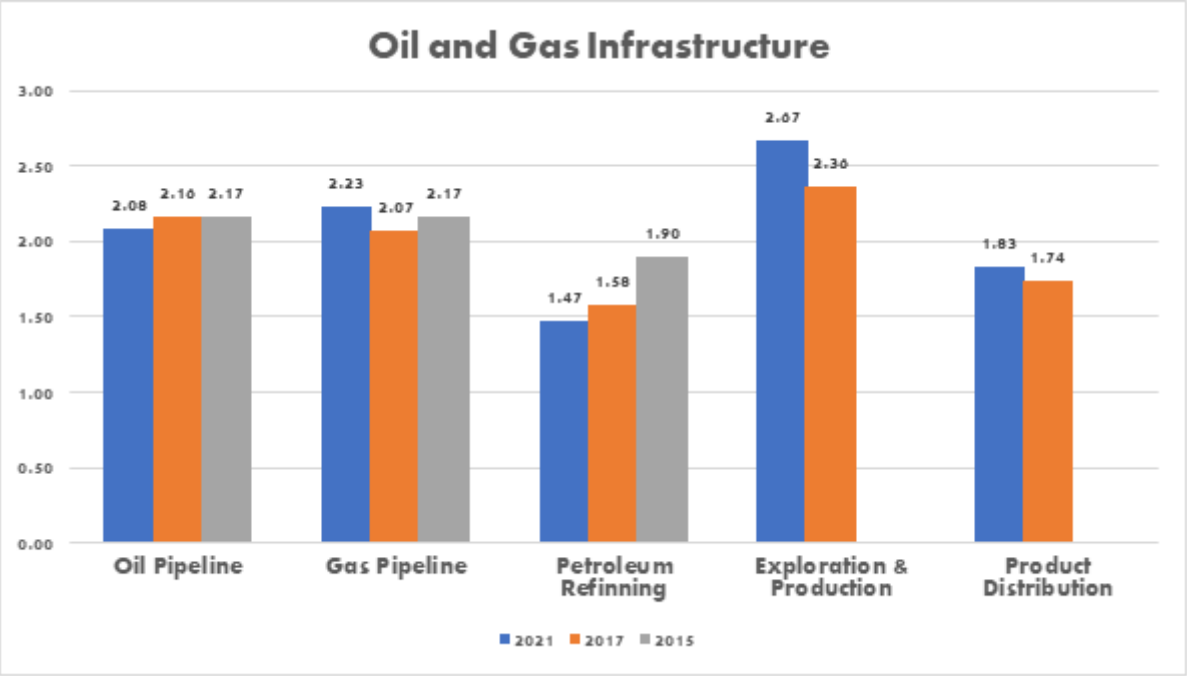


Figure 8-31: Oil & gas infrastructure rating (2021, 2017, 2015)

The overall rating for the nation's Oil & Gas Infrastructure is E2 (2.06) which means this infrastructure category is still rated at Poor State and on the verge of failure. The infrastructure rating of 2021 is a slight improvement from the last rating in 2017 which was a step lower – E3 (1.98) but returns to the same rating category of 2015 infrastructure score with a slightly higher index by +0.03.

The 2021 rating shows that users are slightly hopeful and positive about the developments in the industry despite an unprecedented period of uncertainty caused by the global pandemic and oil price instability. Particularly driving the rating in the positive direction is Exploration and Production Infrastructure which showed the greatest improvement in rating from D3 (2.36) in 2017 to D2 (2.67) in 2021 which incidentally is the highest rated infrastructure in the nation. This is not surprising as oil and gas exploration is the major source of revenue for the Nigerian economy but must be noted that means the infrastructure is "still at risk" of failure or collapse according to the sentiments of respondents.

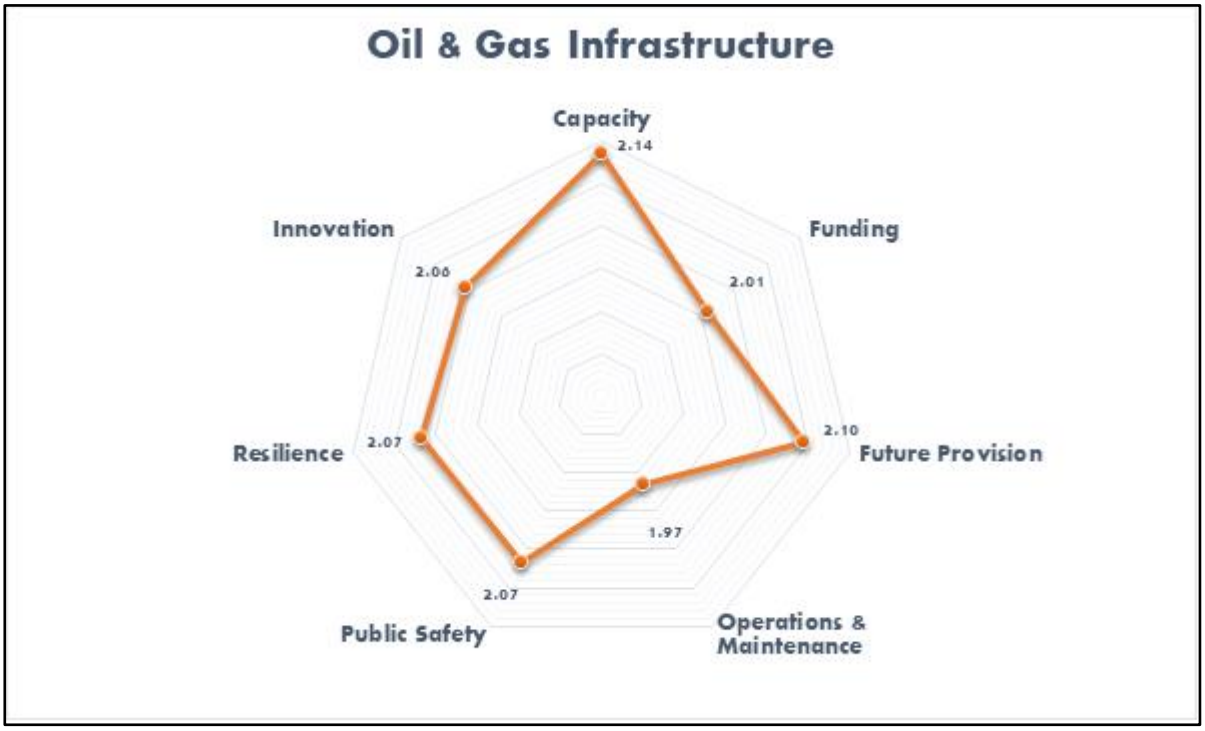


Figure 8-32: Oil & gas infrastructure

On the contrary, we have seen a steady and worrisome decline in petroleum refining infrastructure which has declined from "Poor State" to now "Unfit for Purpose". Respondent's rating must be connected to the declining state of our refineries which have posted declining output since 2015 to a point of zero refining output from the three combined refineries. Therefore, it's not surprise that the petroleum refining infrastructure received the lowest ranting within the oil and gas infrastructure category.

Responders rate Capacity of oil and gas infrastructure highest in all the rating parameters as well as modernization of infrastructure to meet the demands of the future. The oil and gas infrastructure holds a very important input into the energy and power sector thus making oil and gas an important key source of economic growth in Nigeria, being also the major source of government revenue.

> ***"Poor oil and gas pipeline infrastructure, inefficient refinery, refined petroleum distribution solely by road tankers with frequent mishap due to bad road networks. For the NNPC refineries, it should be privatized to eliminate bureaucracy and bottlenecks that hinders its turn around maintenance (TAM) in order to improve its refined capacity utilization (efficiency). Although for gas infrastructure which was very poor in time past as most of our gas resources were being flared and under-utilized, the government has keyed into projects such as the AKK project, NGTNC, WAGP. And for refined product distribution, most of the distribution is via road networks, hence the government should improve the condition of road networks. Pipeline vandalization could be stopped by engaging stakeholders (government, community, security and those with direct impact on the pipeline) and also by employing technology"***
>
> ***Emmanuel Akpanowo***

Chemical Engineer

The Oil & Gas infrastructure generally seem to be inadequate, especially when this is compared to the abundant oil and gas reserve the country is endowed with. However, looking at the gas sector for example, the Federal Government is embarking on robust strategies to leverage on Nigeria`s gas resources towards economic growth that will guarantee adequate supply to meet domestic gas demand and boost the domestic market. Example of such strategies is the Nigeria Gas Transportation Network Code (NGTNC developed by the Department of Petroleum Resources (DPR). Another example of gas infrastructure development project is the AKK gas pipeline. In terms of refining, the Dangote refinery project is a welcome development, and the planned revamp of the Port Harcourt refinery among others; will improve on the current oil & gas infrastructure deficit in the country. Nonetheless, there is still need to build more gas pipelines to increase geographic reach and link up offshore Production Sharing Contract (PSC) gas to the existing/ planned infrastructure.

Usman Muhammad
Delta State

8.10.3 GAS PIPELINE INFRASTRUCTURE

Gas pipeline infrastructure received a relatively good rating of E2 (2.23) – Poor State in the 2021 infrastructure rating, up slightly from E2 (2.11) rating received in the 2017 edition of infrastructure rating. Users believe that funding is a major setback in the development of this infrastructure despite its relative importance in solving the economic issues of the country bothering on energy shortages and powering industries. A rating of 2.1 (Fair) was given indicating a need for more funding for this infrastructure while also acknowledging the current efforts.

For instance, the 614-km Ajaokuta – Kaduna – Kano (AKK) gas pipeline project which is estimated to generate as much as 3.3gigawatts of electricity and support gas-based industries along the route has suffered a major funding set-back from the Chinese government who were expected to provide some form of counterpart funding for the project. Government is now seeking an injection of $1bn into the project which is expected to cost up to $2.8bn. The Nigerian government has been inundated with huge budget deficits which could rise up to N5.6trillion in 2022. Thus, government is seeking alternative funding sources to fund these projects.

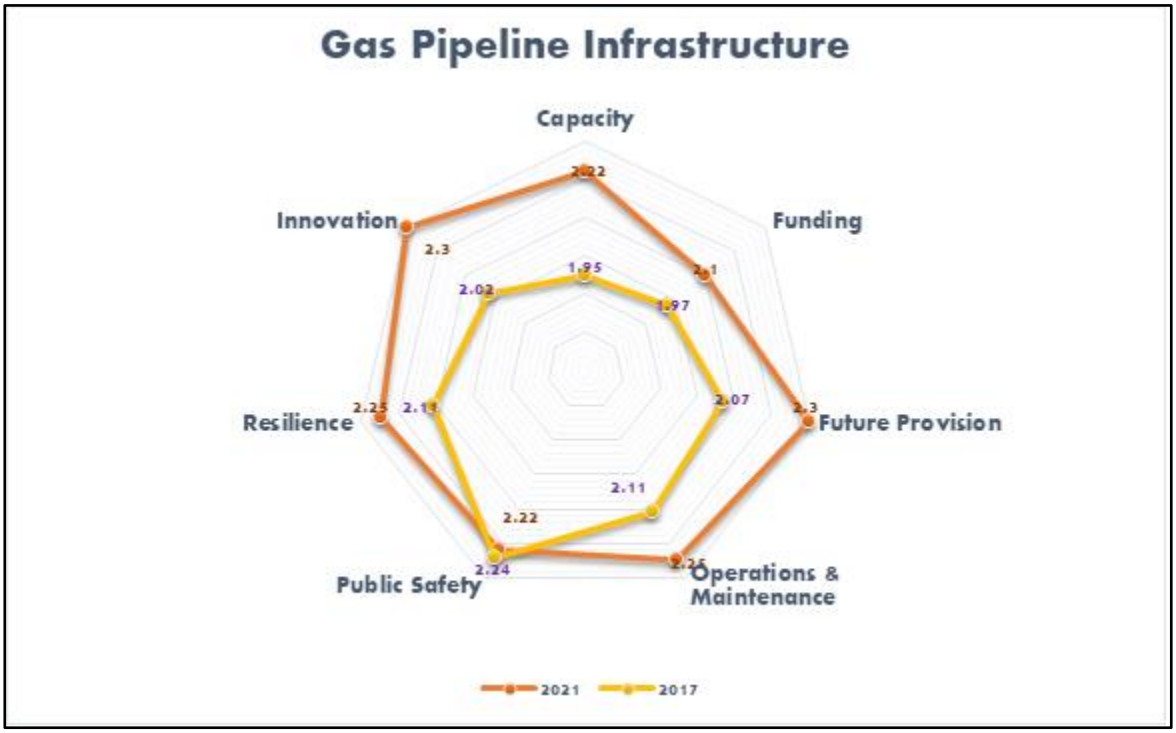


Figure 8-33: Gas pipeline infrastructure

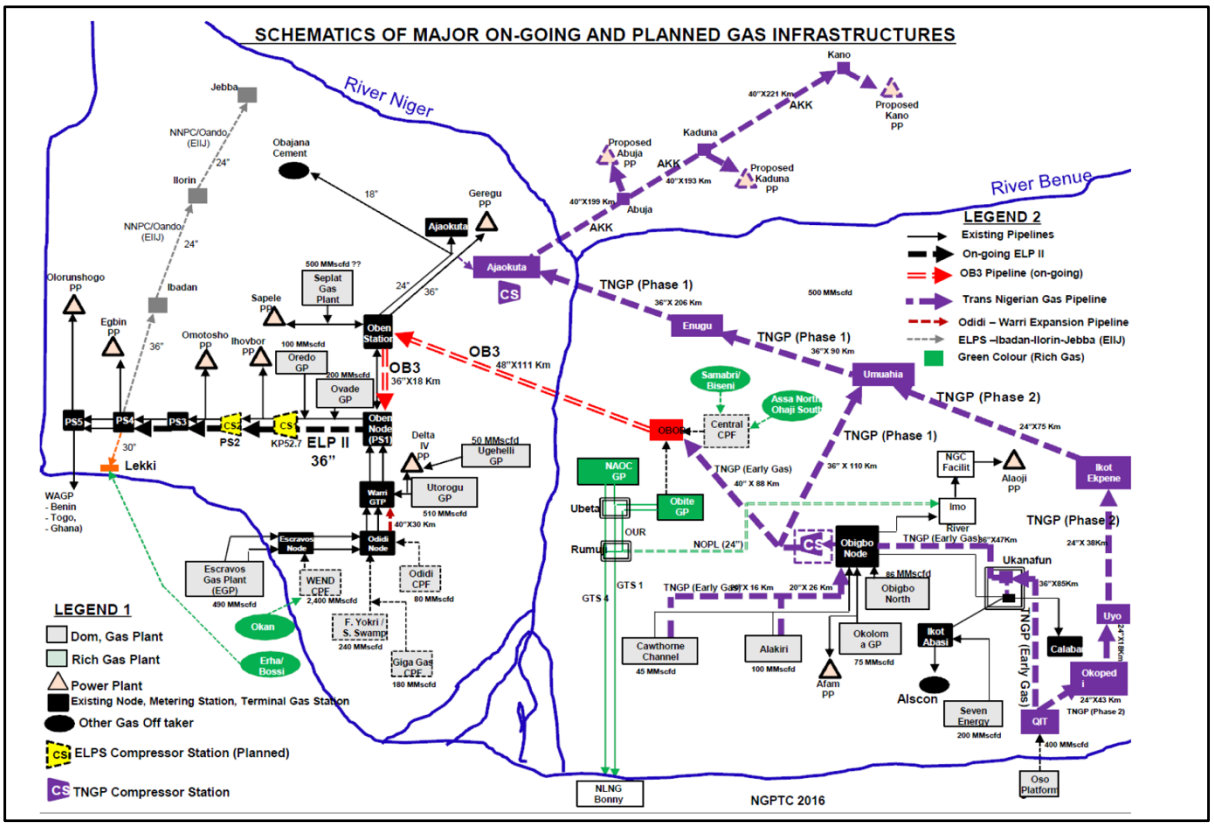


Figure 8-34: Schematics of major on-going and planned gas infrastructures

The nation's gas pipeline infrastructure capacity is rated 2.2 which is a significant increase from 2017 rating of 1.97. Obviously, this improved rating is an indication of the confidence of respondents in the direction of authorities in developing the nation's gas pipeline infrastructure although this is still a far cry compared to global best practice.

Source: Nigerian Gas Transport Company (2017)

Considering that 87.5% of power generation infrastructure in Nigeria constitutes fossil fuel, gas infrastructure is therefore critical if the nation is to achieve its desired goal of power generation. Also, the unprecedented growth in gas demand which is not effectively matched by growth in gas supply occasioned by weak infrastructure is already threatening the economic aspiration of the country and prompted the immediate development of the Nigerian Gas Master Plan. The Federal Government notes that only 9% of daily natural gas production is delivered to power plants and this is directly due to lack of transport infrastructure amongst other related reasons.

S/N	PROJECT NAME	LENGTH (km)	CAPACITY (MMscf/d)
1	Trans Niger Ga Pipeline (TNGP)	1300	
2	Ajaokuta-Kaduna-Kano (AKK) Pipeline	614	1600
3	Escravos Lagos Pipeline System (ELPS)	514	1100
4	West African Gas Pipeline (WAGP)	678	200
5	Aba-Owerri-Nnewi-Onitsha Pipeline		120
6	Calabar-Ajaokuta Pipeline		
7	ELP-Ibadan-Jebba Pipeline		
8	Obiafu-Obrikom-Oben (OB3) Pipeline	130	2000
9	ELPS Phase 2		1100
10	Oso Platform to QIT Pipeline		
11	Erha/Bosi Pipeline		

The Nigerian domestic gas market is regulated and most of the domestic gas supply pipelines are owned by NNPC through the Nigerian Gas Processing and Transportation Company Limited (NGPTC). The NGPTC manages about 2,800km1 of gas pipeline all over Nigeria and these facilities are grossly inadequate for effective distribution of gas nation-wide. Experts who have studied the system believe that in the short and medium term, Nigeria requires an additional 5,000km of gas pipeline which should then be upgraded to 10,000km in the long run. (Biose, 2019). As at 2019, government had set a target of achieving national pipeline capacity of 4.6Bscf/d. (Department of Petroleum Resources, 2018). According to NAPIMS, Nigeria already has over 80 gas processing facilities across the country with a combined gas production capacity of about 9 Bscfd

Respondents gave an improved rating for gas pipeline infrastructure from 2.07 to 2.3 in the area of future provisioning for the infrastructure. Even though this rating is still far from global standards, it is a recognition of the plans that are being touted in this sector which is expected to improve gas supply and delivery especially for power generation. Developments such as the Nigerian Gas Transportation Network Code to guide the use and operations of gas transportation and deepen the embrace, acceptability and utilization of gas in the domestic gas

market while positively impacting the growth and economic development. The Nigeria Gas Master Plan was also develop to provide the gas infrastructure blueprint with ambitions to supply gas to across Africa to Europe.

8.10.4 OIL PIPELINE INFRASTRUCTURE

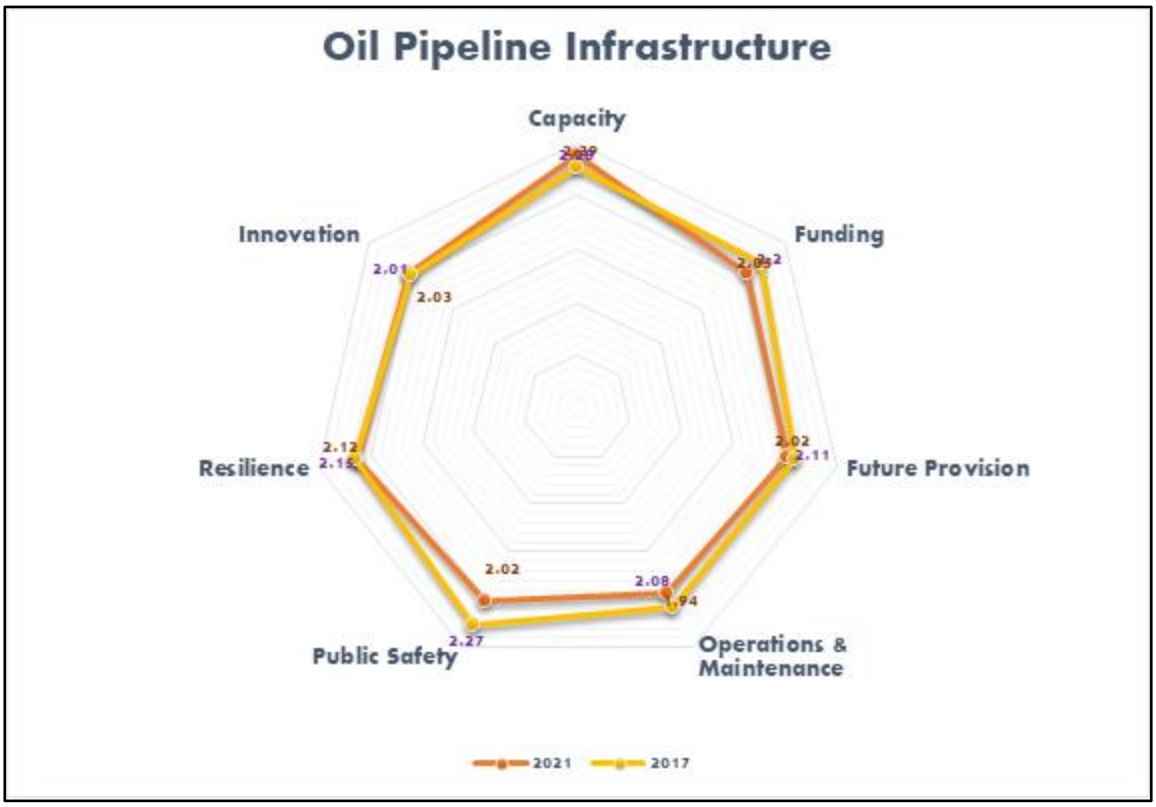


Figure 8-35: Oil pipeline infrastructure rating (2021, 2017)

The nation's oil pipeline infrastructure was rated E2 (2.08) – "Poor State", a decline from the rating of E2 (2.16) in 2017 obtained from same infrastructure. The result shows that respondents are not satisfied with the state of oil pipeline infrastructure and cannot readily associated much positive developments towards improving this infrastructure since it was last rated 4years ago.

A careful look at the oil pipeline infrastructure rating showed that the infrastructure lower in all parameters in 2021 except for capacity and innovation the highest drop being in Operations and Maintenance of the infrastructure. The highest improvement in rating was in terms of capacity.

The nation owns about 5,120km network of oil pipelines to and from the nation's refineries which supplies crude oil to the refineries and can also evacuate refined products for distribution across the storage depots. The pipeline network has remained unchanged unfortunately since 2017 when it was last reported in the 2017 edition of the Nigerian Infrastructure Report Card.

In 2020, NNPC spent a total of N33.5billion to repair pipeline as well as management costs for pipe breaks. There were over 441 pipeline vandalization across NNPC lines in 2020 as recorded by NNPC.

8.10.5 EXPLORATION AND PRODUCTION INFRASTRUCTURE

Exploration and Production Infrastructure of the nation's oil and gas industry has seen improved rating in all rating parameters by respondents. The rating for 2021 edition of the National Infrastructure Scorecard Report was D2 (2.68) – "At Risk". This rating is a slight upgrade from 2017 rating of D3 (2.36). The country's exploration and production infrastructure are the highest rated infrastructure in this year's infrastructure rating which is a repeat of similar pattern in 2017. Not surprising as the nation depends on the revenue from this sector to funds its annual budget and there are many multinational operators who have invested massively in the infrastructure required for this sector.

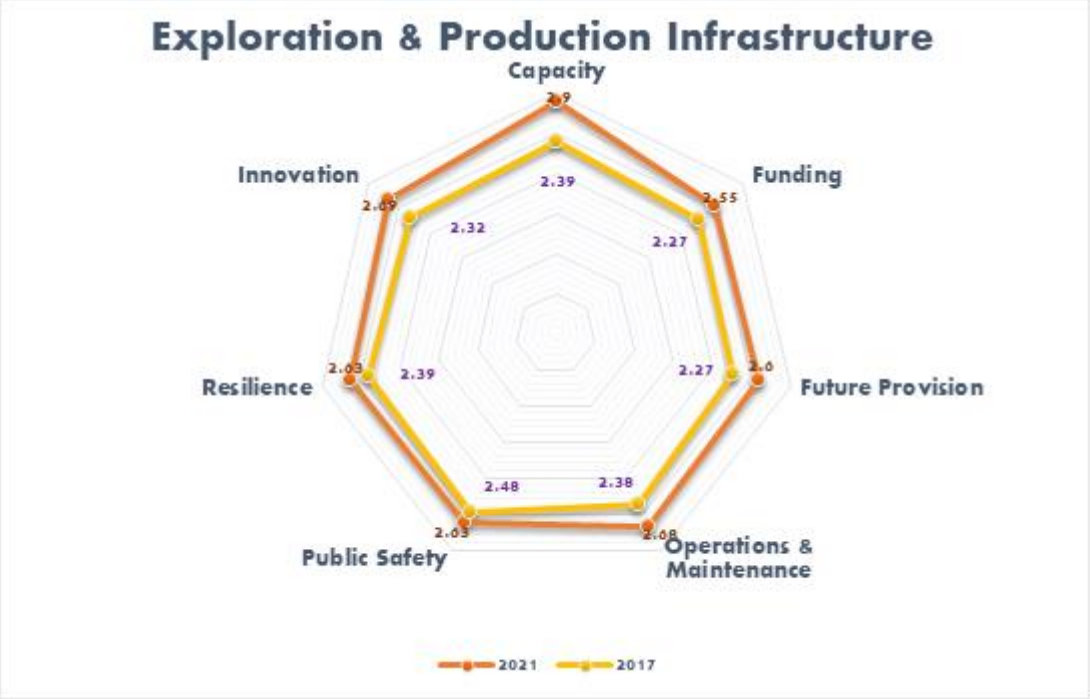


Figure 8-36: Exploration and production infrastructure rating

In terms of capacity, the rating was 2.9 (D2), an improvement from 2017 rating of 2.39 (D3) which also is the most significant improvement in all the parameters of rating. Respondent's rating matches current realities as Nigeria has capacity to produce up to 2.5million barrels per day of crude oil but due to OPEC+ cuts is currently producing an average of 1.65mpd of crude oil and condensates as at March 2021. (Nigeria National Petroleum Corporation, April 2021). It is likely that this daily production volume will go up as OPEC+ production cut has been upwardly revised from 1.4mpd to 1.8mbpd. The country has a proven crude oil reserve capacity of about 36.6 billion barrels and is regarded as the 7th largest oil producer in the world.

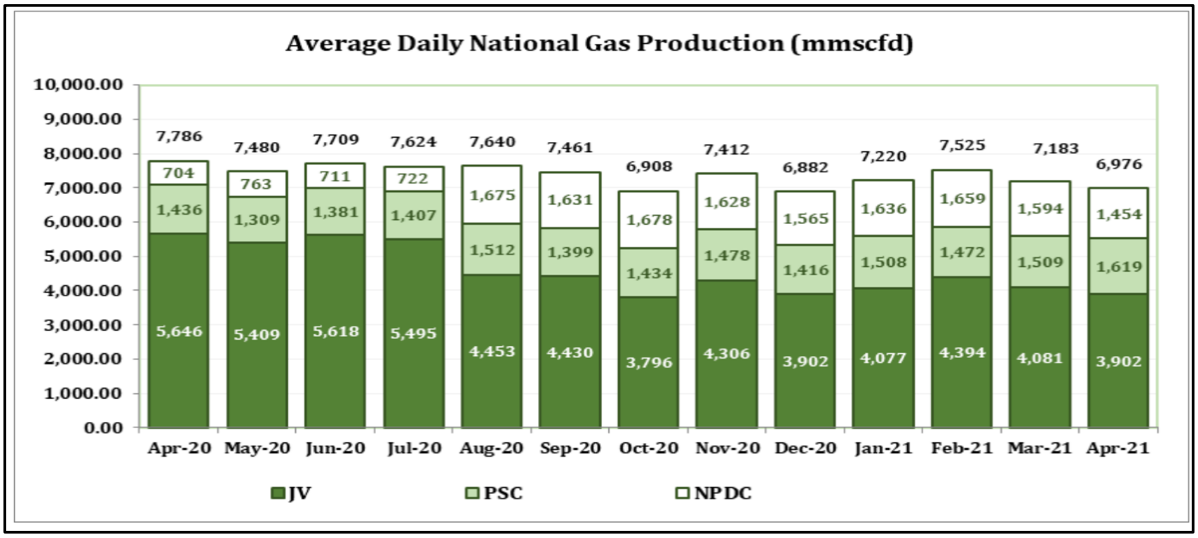


Figure 8-37:Average daily gas production (MMFCSD) (Source: NNPC)

Perhaps more significant pointer to the upgraded rating in the exploration and production infrastructure is the increased output in gas production with increased gas handling capacity. Nigeria has a proven gas reserve estimated to be about 206.53trillion cubic feet (tcf) which puts her amongst the top six countries in the world with the largest gas reserves. Nigeria's gas production rose marginally by 0.3 per cent quarter-on-quarter, QoQ, in the first quarter of 2021, Q1'21, to 639.16 Billion Cubic Feet, bcf, compared to 637.24 bcf produced in the fourth quarter of 2020.

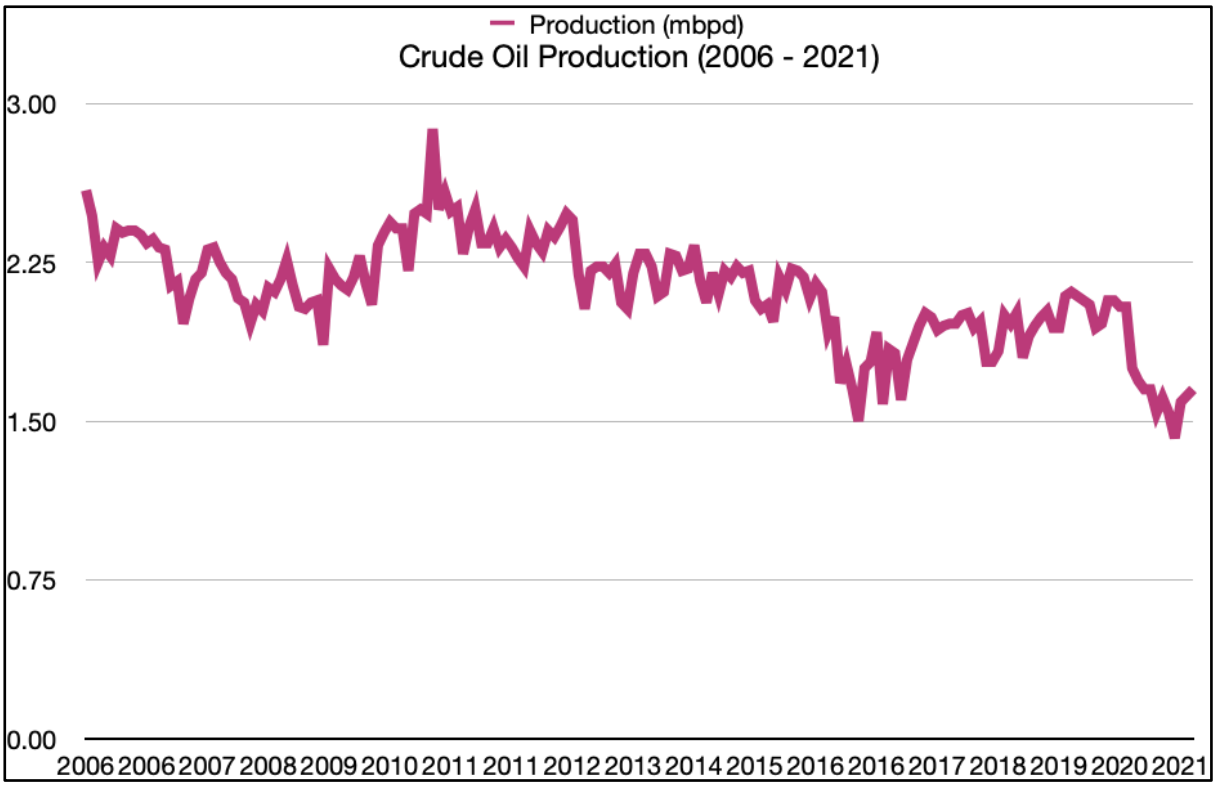


Figure 8-38: Crude oil production (2006 - 2021) (Source: CBN)

On the contrary, Nigeria is losing as much as 1,720 Gigawatts equivalent of power to gas flaring in two years. Nigeria has however been putting in efforts to reduce and eliminate gas flaring and has achieved significant progress over the past 15years, reducing gas flaring volume by 70% to just 7 bcm in 2020

8.10.6 PETROLEUM REFINING INFRASTRUCTURE

The petroleum refining infrastructure was the worse rated infrastructure in the oil and gas infrastructure category and shows the greatest and steepest decline from 2015 to 2017 and in 2021. In 2021, the petroleum refining infrastructure was rated F2 (1.47)

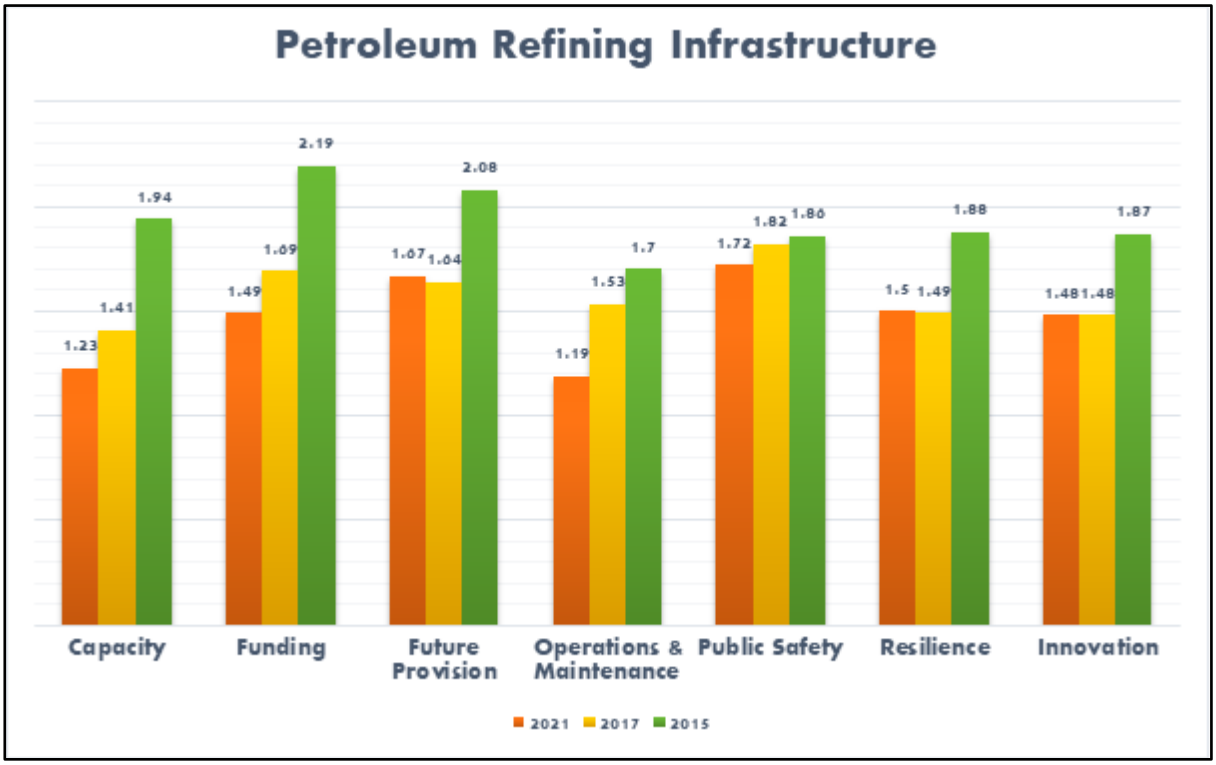


Figure 8-39: Petroleum refining infrastructure rating (2021, 2017, 2015)

There was also decline in all parameters of rating for successive editions from 2015 to 2021. Expectedly, in terms of operations and maintenance, the greatest decline was observed from 1.7(E3) to 1.19(F1) which is the lowest grade possible in the infrastructure scorecard grading system. This rating mirrors the situation on ground with the refineries as most of them have not been operational over the last couple of years.

Nigeria has combined refining capacity of 445,000 barrels per day from four refineries: one in the north at Kaduna and three in the oil-rich Niger Delta region at Warri and Port Harcourt. As of April 2021, the NNPC reported that the refineries in the country processed no crude oil and combined yield efficiency was 0%. This situation has remained since 2018 when the data was tracked. Between August 2017 and August 2018, the refineries had a combined capacity utilization of 12.41% which is not able to carter for Nigeria's daily petrol supply need

of 51.6million litres4 although the Department of Petroleum Resources (DPR) estimates this to be 38.2m litres. This situation has led to 100% dependence on finished petroleum product importation for use which in the past has led to fuel shortages and scampering for petrol which Nigerians depend to power generators and transportation.

In terms of funding, the rating of this infrastructure has also seen a decline, perhaps due to failure of authorities to provide the necessary funding to jumpstart the refineries back to life again or because there has been no fruit to show for the funds that have been spent so far. In the last 20 years, the refineries became comatose, as successive governments failed to bring them up to their installed capacity due to the abandonment of the required Turn Around Maintenance, TAM, as at when due.

Occasionally, there has been promises of pumping the desired funds to revive these refineries, but its capacity utilization has been declining from 18.16% in 2017 to 2.15% in 2019 and currently 0%. Recently, government approved the sum of $1.5billion for immediate commencement of rehabilitation work on the Port Harcourt Refinery while also proposing to sell or concession the other refineries.

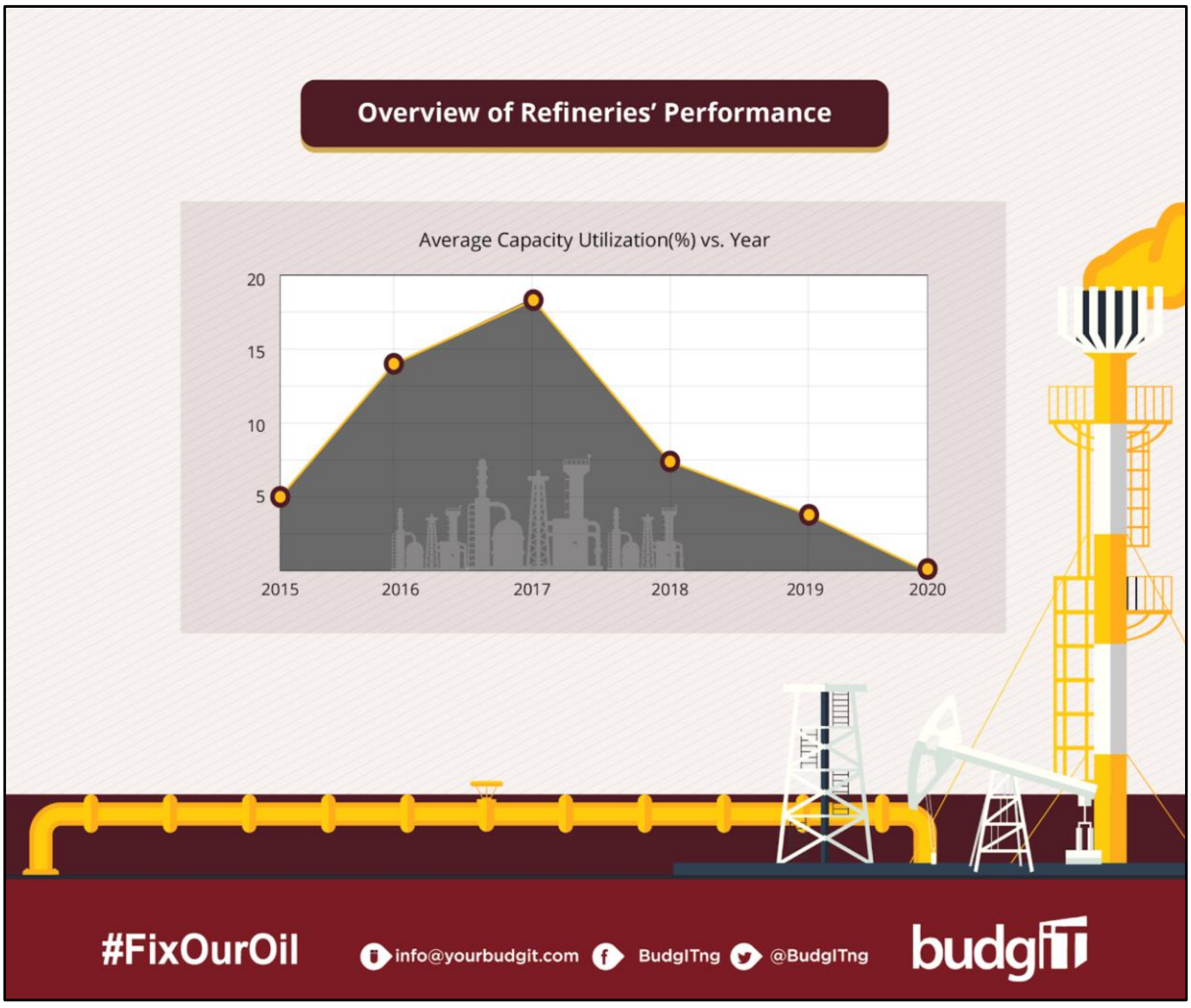


Figure 8-40: Average capacity utilisation (%) vs year

Given the issues faced by government monopoly in the sector, experts have been calling for the full deregulation of the market and increased private sector participation to bring market forces competitiveness and efficiency. Government, in 2018 had granted 13 modular refineries licenses5 with Waltersmith Modular Refinery in Imo State with capacity of 5,000 barrels per day already starting operations as at November, 2020. Another well anticipated project is the Dangote Refinery in Lagos, touted to be the largest refinery in the world when completed. Upon completion, the refinery is expected to have an annual refining capacity of 10.4 milion tonnes (MT) of gasoline, in addition to 4.5 MT of diesel and 4MT of jet fuel amongst other products.

8.10.7 REFINED PETROLEUM PRODUCT DISTRIBUTION INFRASTRUCTURE

Refined Petroleum Product Distribution infrastructure was rated E3 (1.83), one step improvement from rating of 2017 which was F1 (1.58). In all parameters of rating except in the area of public safety, respondents rated our distribution infrastructure higher than in 2017.

The rating shows improved confidence in petroleum distribution infrastructure even though this infrastructure is still classified as being in "Poor State". The country has gone through several holiday and yuletide periods in recent years without experiencing the usual shortages associated with such festive seasons.

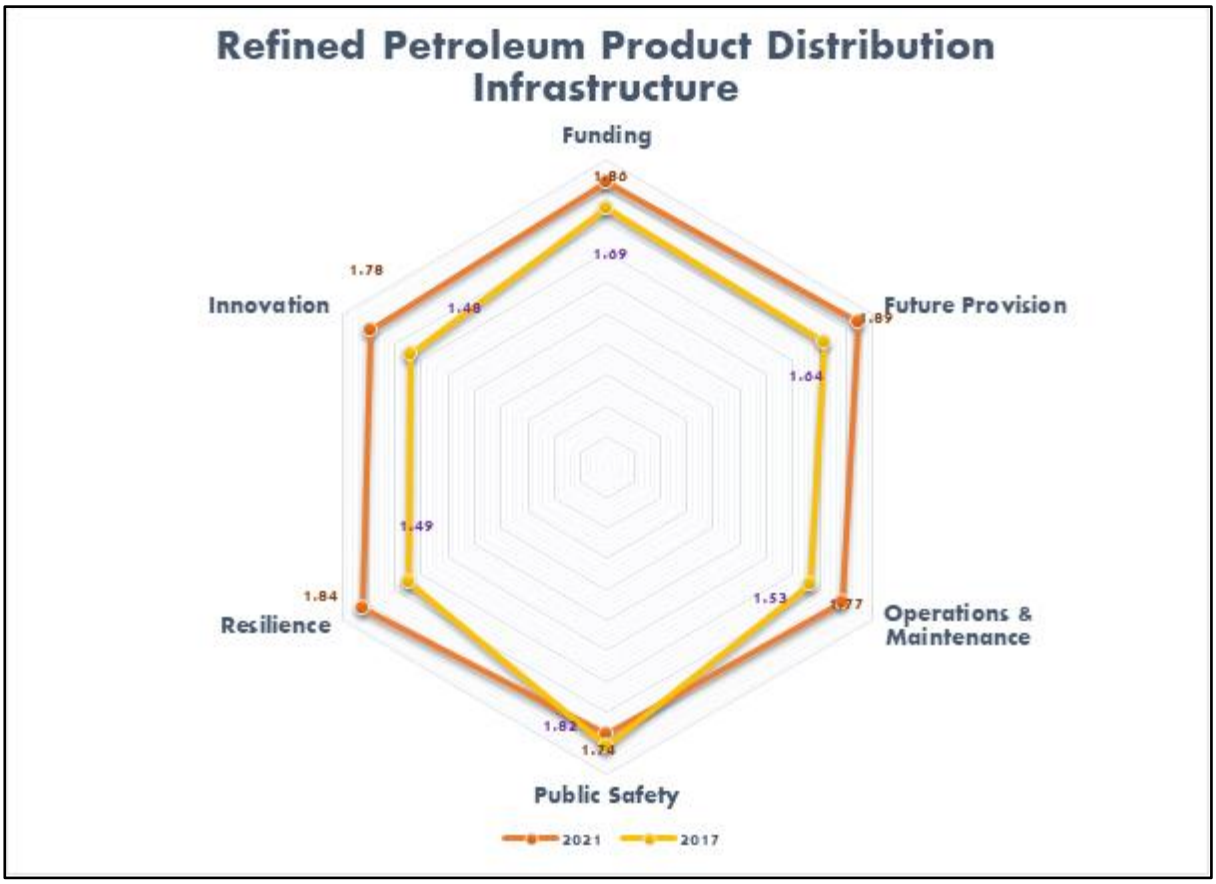


Figure 8-41: Refined petroleum product distribution infrastructure

For now, the NNPC controls importation of petroleum product into the country while distribution includes some major downstream sector private players. The NNPC owns 37 Mega stations and 12 floating stations, 258 tanks in 21 storage depots, 1 product terminal at Atlas Cove and 1 Crude Oil Terminal at Escaravos; 3 Jetties in Apapa, Calabar Jetty, New Atlas Cove Jetty (NACJ) and Single Point Mooring (SPM); all with a combined holding capacity of 2.6 billion litres of PMS and 8 Pump Stations to ensure desired flow rate and pressure for transmitting the products.

Most product distribution is by roads through trucks delivered to over 33,000 product retails outlets across the country. The downstream sector involves many private sector players called independent marketers with over 72 depot facilities. The Department of Petroleum Resources coordinates the discharge of fuel across these depots to ensure stock cover of at least 30days is maintained. There are also 55,000 MT storage capacity of LPG across the southern part of Nigeria operated by private product marketing and distribution companies.

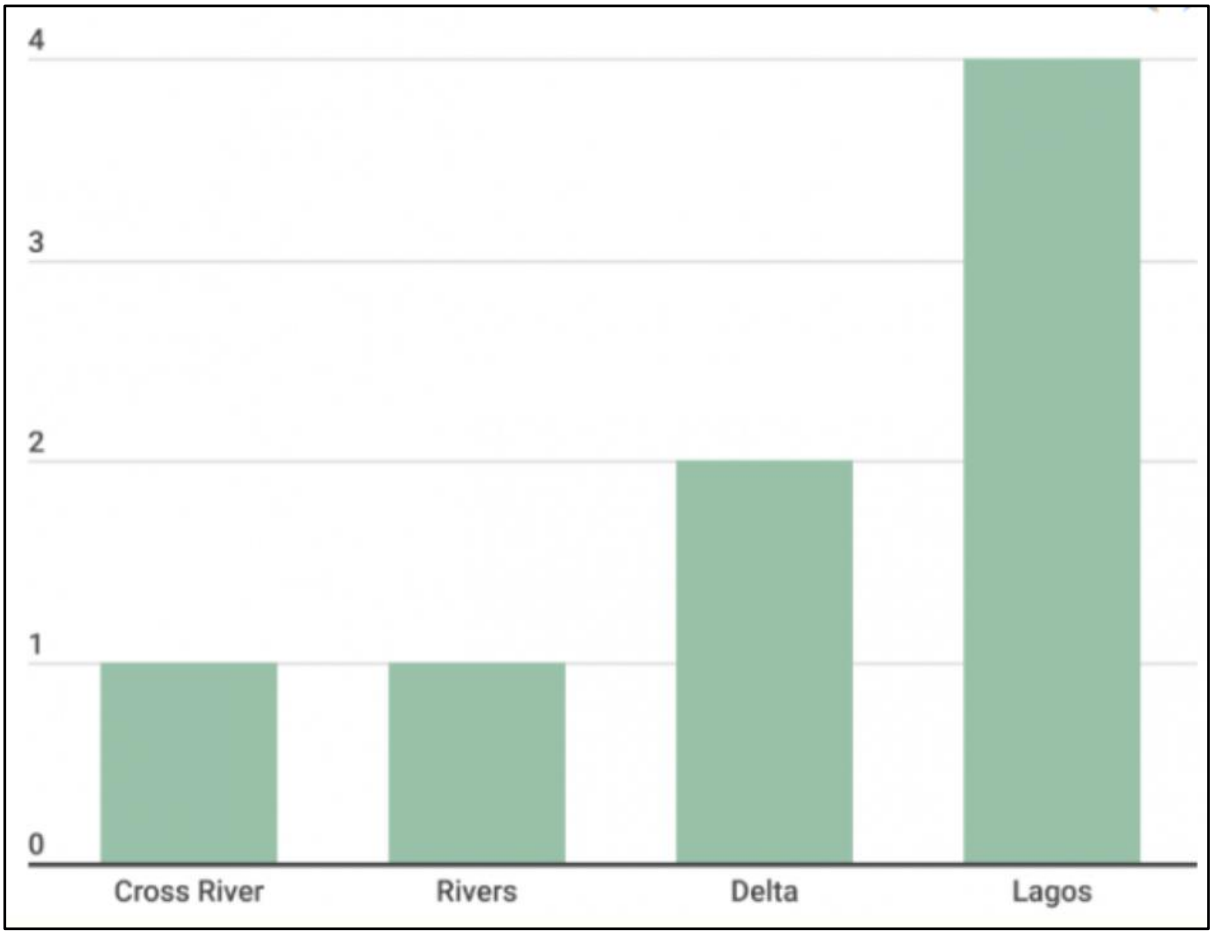


Figure 8-42: Source; Kiakia Gas Datapitch

Government should do something about revamping our refineries to start refining operation to optimum capacity. Bridging depots caused by pipeline vandalism like Enugu depot should equally be revamped to ease the difficulty experienced in petroleum product distribution in the east. Government have given much talk and excellent ideas. action and implementation is required now.

The bureaucratic bottlenecks in Petroleum industry should be discouraged for reasonable results to be recorded.

Obodoechi Callistus
Crude Oil Terminal Operations

Nigeria needs to revamp many of the valuable structure of the infrastructure on ground and work immensely hard to infuse and develop them into newer technologies and systems to make the oil and gas production and all entities around it more profitable and safe for Nigerians.

Ishola Ajao
Engineer, Abuja

8.11 ELECTRICAL POWER INFRASTRUCTURE

8.11.1 BACKGROUND

Existence of electricity power generation in Nigeria dated back to 1886 during the installation of two generating sets, providing 60 kilowatts of electricity to serve the then colony of Lagos (Ebigenibo, 2021). This clearly is an indication that the crave for electricity supply did not start today, but rather a long time coming; even after a century of its first appearance in Nigeria. Although the country has long moved from merely generating electricity to a section into all other sections of the country in commercial quantities, yet, the pace of electricity infrastructure development is terribly slow and power supply remains highly inadequate.

In 2013, two segments of Nigeria's power sector (generation and distribution) were privatised with the hope of tackling the challenges associated with the earlier domination of government in the power generation, transmission, and distribution sub- sectors, which was believed to have resulted into inefficiency of the sector. In fact, the 2005 power sub-sector privatisation is reputed to be one of the most ambitious privatisation exercises in the global power industry with a transaction cost of over $3.0bn (Nigerian Electricity Regulatory Commission, 2021). However, the privatization only changed the aspects of the challenges, while power supply remains poor, high-priced, and erratic (CSEA, 2021).

Presently, according to the World Bank's Press Release of 23rd June 2020, about 47% of Nigerians do not have access to the electricity grid. For those connected, uninterrupted power supply is a severe problem as about approximately 90% of total power demanded is not supplied, with the cost of power shortages put at US$28bn – this is equivalent to 2% of the country's GDP. Furthermore, the Ease of Doing Business Report of the World Bank ranks access to electricity as one of the major constraints for the private sector in Nigeria.

Failure of the Nigeria electric power sector to improve since the reform has posed a challenge to all electric power stakeholders (government, private investors, electricity experts, development partners, etc.) to find innovative solutions to the continuous problem impeding the attainment of electricity targets in Nigeria; even when the statistics have indicated that electricity demand will rise significantly. Specifically, household electricity demand, which has the largest share, is expected to rise due to growing urbanization (at a rate of 4.23% per annum) and population growth (estimated at 2.7% per annum, while global growth rate is 1.1%), at rates more than twice global averages. Industrial and commercial demand is also expected to increase as Nigeria slowly rise from the recent recession (with projected gross domestic product rates trending between 4.50% and 7% (CSEA, 2021).

This below section thus assesses the infrastructure providers perspectives vis-à-vis the qualitative perspective rating of the respondents on state of power infrastructure in Nigeria with the hope to identify a scope for intervention for the Authorities and relevant stakeholders.

8.11.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The country's electric power infrastructure as a total of power generation, transmission, distribution, and renewal energy was rated F2 – (1.36) - Unfit for purpose by respondents. This is same as the rating in 2017 F2 (1.36), but a sharp decline of 58.8% from the 2015 rating of E3(2.16). This implies that the nation's power infrastructure remained the same as in 2017 and has deteriorated from what it was in 2015. Although it was acknowledged that capacity, resilience, and funding of the sector has improved, the capacity, future provision, public safety and operations and maintenance of the current infrastructural provisioning is however in serious doubt. This is evident in terms of the huge gap between increasing electric power demands by citizens due to population growth and the actual amount of power generated and distributed for industrial and household consumption.

For instance, a review of the regular operational report of the Nigerian Electricity System Operators as reported by Dataphyte in April 2021 shows that electric power produced did not exceed 120,000,000 kilowatts hour (KWh) for any day in March 2021. More so, the electricity produced was less than 100,000,000 KWh for nine days in the same period. To put this in context, the average electrical energy produced in March 2021 was just enough to deliver 189W (three 60 watts bulbs) of electrical power to each of Nigeria's 24 million households with access to electricity. Thus, extrapolating Nigeria's overall population at 207 million and an average of five people per household, it will mean that Nigeria has about 41.4 million households in all. With the World Bank's estimation that only 56.5 percent of Nigeria's population having access to electricity, it then means only 24 million households in Nigeria have access to electricity.

It is worthy to note however that the current effort of the authorities to increase capacity and operation of power infrastructure in the country is evident in the increased budgetary allocation and other funding initiatives to revive the sector. For instance, the government, in partnership with the World Bank, initiated and signed a Power Sector Recovery Program (PSRP), in which about $500 million was approved to support the government to improve electricity distribution subsector, and help to boost electricity access by improving the performance of the Electricity Distribution Companies (DISCOs) through large-scale metering program desired by Nigerians for a longer time. Moreover, increasing shift toward renewable energy technologies is expected to strengthen the power market in the coming years. However, vandalism of gas infrastructure and statutory bottlenecks in the country are expected to hinder the growth of the industry.

8.11.3 POWER GENERATION INFRASTRUCTURE

In terms of power generation, significant improvement has been witnessed over the years; however, the rate of improvement is not commensurate with the increase ineffective capacity of this infrastructure to meet ever growing demands. Thus, power generation infrastructure was rated F1 – (1.42) - Unfit for purpose, below a similar F1 – (1.51) rating in 2017 and a significant decline from 2015 rating (2.20). Respondents however acknowledged the increased allocation and funding focus in power generation infrastructure (1.84) as well as future plans

of the Authorities to improve the sector, as evident in the upward trend of budgetary allocation and disbursements to the sector in 2019, 2020 and 2021 (Federal Ministry of

Finance, 2021).

While, in terms of the ability to operate and maintain the infrastructure properly, with compliance with government regulations (operations and maintenance), strategic use of innovative techniques and delivery methods (modernization) and the power generation infrastructure's capability to prevent against significant threats with minimum damage to public safety and health (reliability) of the current power generation infrastructure, respondents are in doubt and have rated the power generation infrastructure in these categories as 1.43, 1.38 and 1.27 respectively. This then partly explains the fact that the power generation infrastructure, like many other public infrastructures in Nigeria, suffers gross maintenance culture and lacks expected innovative techniques; particularly, in the aspect of generation and transmission of electric power.

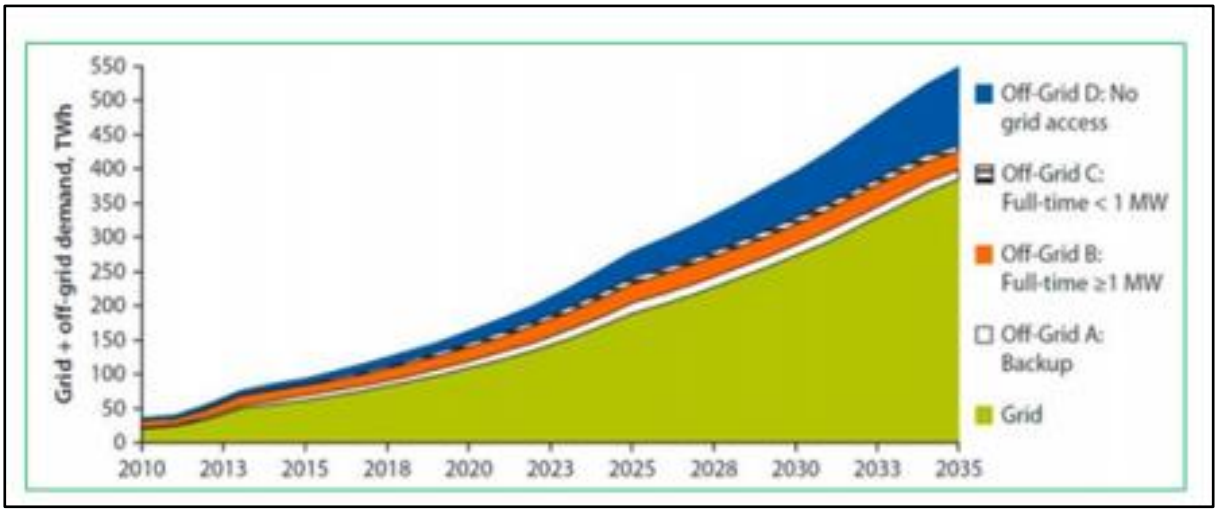


Figure 8-43: Projected Electricity Demand

Although it is important to note that currently only 3,500 MW to 5,000 MW is typically available for onward transmission to the final consumer due to recurrent challenges arising from gas constraint, maintenance and repair requirements, trips, faults, and leakages that make them unavailable for evacuation to the national grid. The country's energy sector is faced with huge challenges, with the extensive losses attributable to the non-availability of the installed capacity and very high occurrence of significant technical and non-technical issues through the power supply value chain. The supplied electricity delivered to Nigerians is connected to the grid, while the consumers suffer from extensive power outages a situation that results in annual consumption of electricity per capita being amongst the lowest in Africa, estimated at less than 150 kWh (IEA, 2020).

Nevertheless, there is high hope that emerging governmental policies and funding partnership, such as the World Bank and the USAID – Power Africa programs will go a long way to resolve some of the key issues holding the sector back, and lead to improvements in transmission and distribution – both financial and infrastructural. Additionally, grid demand will also be augmented by off-grid supply to meet consumption needs in the rural areas, while the recent passing of the Petroleum Industry Bill (PIB) will provide much needed clarity for the sector and

could unlock new gas supply to the domestic market, as will the construction of major gas pipeline projects. Combined, these may break down some of the major barriers.

8.11.4 POWER TRANSMISSION INFRASTRUCTURE

Power transmission sub-sector in 2021 was rated F1 – (1.43) – Unfit for Purpose. This is around the same range of rating for electric power generation stated above and a decline from 2017 rating which was (1.53) while also representing a considerable decline to the 2015 rating of E3 – (2.2). Generally, respondents noted a gradual dip across all categories of the power transmission infrastructure as depicted in the below chart, except for resilience (1.45) which was slightly rated above the 2017 rating of (1.41). This connotes the transmission infrastructure's ability to prevent against significant threats and incidents with minimum damage to public's safety, the economy and national security.

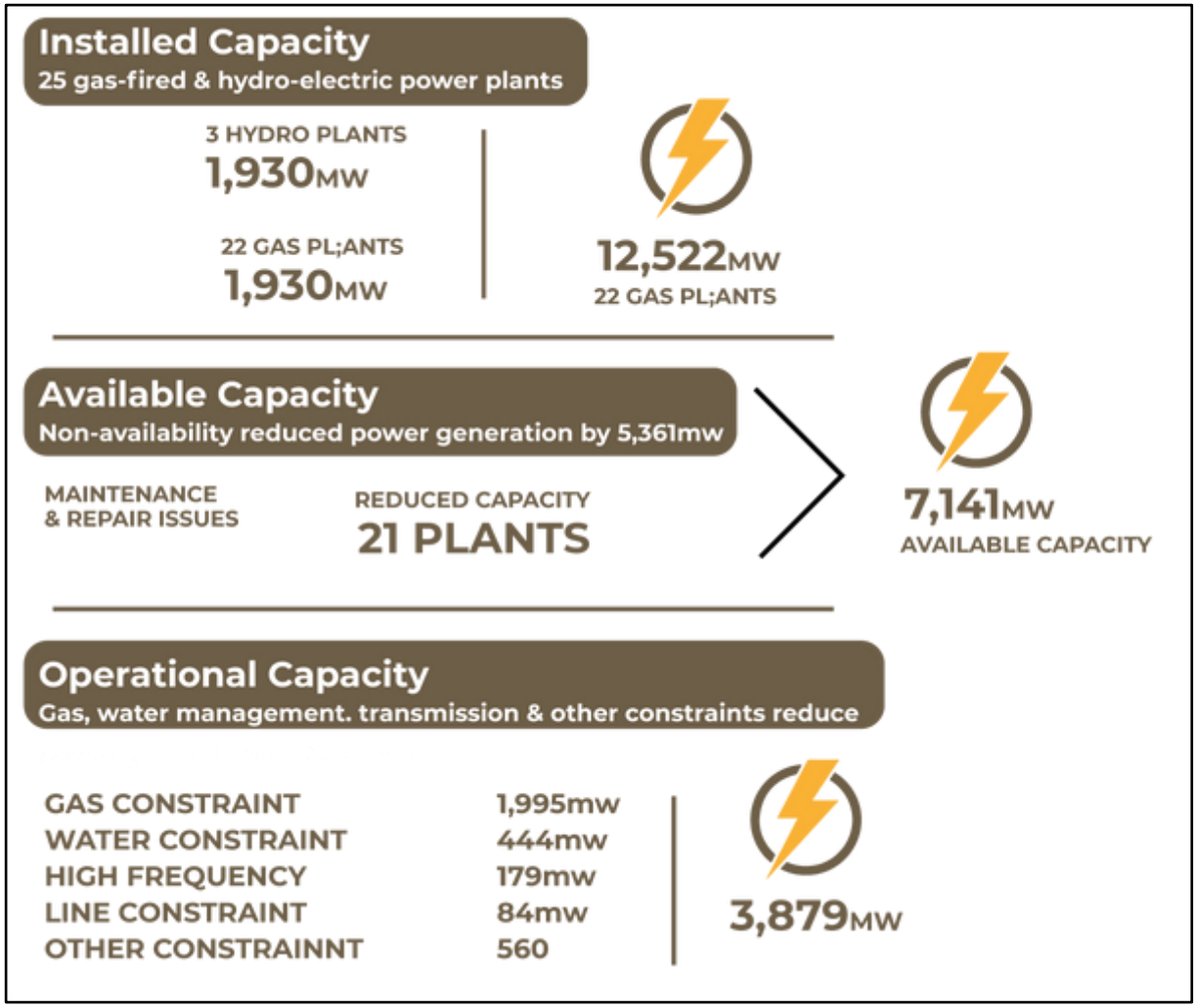


Figure 8-44: Power transmission Capacity

As of December 2018, available data shows that the national grid can transport 8,100 MW of power from the generation companies to over 759 trading points where the power is delivered to consumers and to distribution companies for onward delivery to consumers; while the Nigeria's transmission network has the capacity to wheel about 5,300MW of power, but, due to generation constraints, less than this capacity gets wheeled. Underinvestment in building

new infrastructure and lack of appropriate maintenance of the current infrastructure has constrained the transmission network expansion. An increase of 1,811.3 MW was recorded in power generation in 2019 which was harvested from the ongoing Nigerian Independent Power Projects (NIPP) to the national grid, as the Transmission Company of Nigeria (TCN) transmitted 127,157.7 MW as against 125,346.4MW in 2018. Presently, current transmission capacity and network operational capacity are 7,141 MW and 3,879 MW respectively.

Nigeria currently faces losses in energy transmission (including distribution) up to as much as 30% due to deteriorating transmission lines. There is a critical need for short-term investment and capability building to deliver immediate network improvements and the maintenance program to strengthen the grid. Getting the basics right, completing high-priority projects and delivering significantly more stable network capacity should be the focus in the short and medium term.

8.11.5 POWER DISTRIBUTION INFRASTRUCTURE

The prolonged inability of electricity distribution companies (DisCos) to match electricity supply with the demand of households, businesses and industries might not be unconnected to the respondents rating of F1 – (1.32) for the power distribution infrastructure in Nigeria, unfit for Purpose. Perhaps because this is the final delivery point of the power value chain that is in touch with the people the most. In terms of the rating perspectives, operations, and maintenance of the current power distribution infrastructure was rated slightly higher than 2017 but significantly below the 2015 rating. While respondents considered other perspectives of the power distribution infrastructure in the country to be below expectation as all the ratings fell below the 2017 and 2015.

While the Nigerian government and private sector are making efforts to address key challenges in the Nigerian Electricity Supply Industry (NESI), the efforts are slow- paced and insufficient. For instance, the government has inaugurated a several projects aimed at expanding thermal and hydro sources as well as extended two intervention facilities to GenCos and DisCos to ease their financial constraints. DisCos have also embarked upon mass metering of customers, as well as implemented maintenance and upgrades on their network by installing new transformers and building dedicated lines to commercial and industrial customers over the past years to reduce these losses and enhance service delivery. However, the investments are marginal compared to existing deficits and targets.

8.11.6 RENEWABLE ENERGY INFRASTRUCTURE

The Nigerian renewable energy infrastructure witnessed appreciable improvement between 2017 and 2021, as respondents rated the renewable sub-sector F2 – 1.29, although it is within the unfit for purpose rating criteria but a steady improvement from 2017 rating of 1.06.

In terms of rating per the available perspectives, a steady increase was equally witnessed across the board. For instance, the adequacy and capacity of renewable energy infrastructure to meet current and future demands moved from 0.92 in 2017 to 1.2 in 2021. The current level of funding (from all levels of government) equally increased from 0.95 in 2017 to 1.14 in 2021, while future plans, operations & maintenance and innovation of the Nigerian renewable energy infrastructure were rated moderately high in 2021. By implication, it means that efforts of authorities and allied partners towards steady adoption of alternative energy sources in Nigeria has pick-up and the current renewable energy infrastructure is beginning to witness

considerable development, as observed from an appreciable increase of 55% rating between 2017 to 2021.

This steady increase might then not be unconnected to some of the laudable effort of the authorities such as the Renewable Energy and Energy Efficiency Partnership project, which supplies about 261,938 citizens with clean renewable energy (USAID, 2020). This project was in partnership with USAID, private donors, government agencies, financial institutions, and non-governmental organizations.

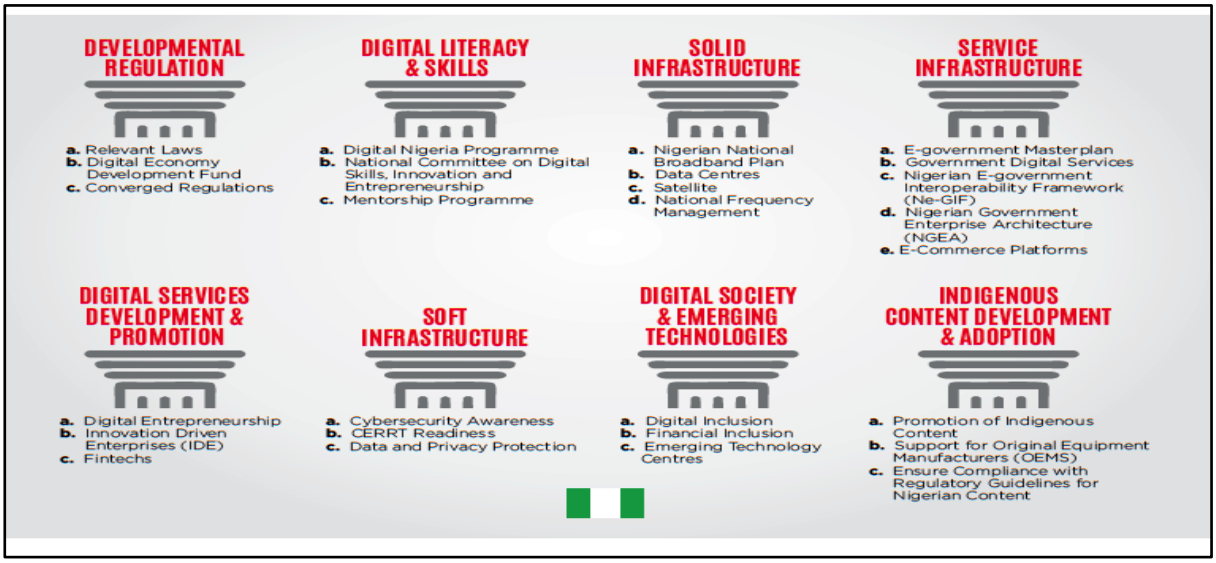
The goal of the project was to build connections to 2.5 MW of power through off and on grid sources, which will reduce carbon dioxide emissions by 4.5 million metric tons (USAID, 2020). Similarly, the Nigerian Energy Support Programme (NESP) was developed in conjunction with the German development agency Deutsche Gesellschaft-für Internationale Zusammenarbeit (GIZ) and International Finance Corporation. With this, nearly 16,000 people have gained access to solar power in rural areas, while a total of 3,147 households in five different states have also been provided with environmentally friendly power using six off-grid village electricity plants (referred to as mini-grids) funded by public-private partnerships. A further 100,000 people were equally provided with environmentally friendly electricity in 2020. Similarly, 11 laws and regulations have been introduced including, for example, the national directive for renewable energy and energy efficiency, a mini-grid regulation, a building energy efficiency code, and an energy efficiency label for household appliance, among others.

8.12 INFORMATION AND COMMUNICATIONS TECHNOLOGY INFRASTRUCTURE

8.12.1 BACKGROUND

ICT's contribution has been one of the fastest growing components of Nigeria's GDP and is emerging as its most important long-term growth prospect. According to the National Bureau of Statistics, the Information and Communication sector had an annual growth of 13.2% in 2020 while the sector contributed 15.1% to aggregate real GDP as at Q4, 2020 which was higher than its contribution to GDP in the same quarter of 2019.

Nigeria is still easily regarded as Africa's largest ICT market with 82% of the continent's telecoms subscribers and 29% of internet usage. Even as sub-saharan Africa is projected to be the fastest growing region, Nigeria is expected to account for 55% of this number. (International Trade Administration, 2020)



The government had articulated an 8-point strategy to accelerate the development of the Nigerian Digital Economy with the hope to double its contribution to the economy over the next 5years through the National Digital Economy Policy and Strategy (2020 – 2030)

To achieve this objective, the NCC had rolled out a new National Broadband Plan for 2020 – 2025 which is designed to deliver data download speeds across Nigeria for a minimum of 25Mbps in urban areas and 10Mbps in rural areas with effective coverage available to at least 90% of the population by 2025.

Also, Nigeria's international connectivity has grown over the last decade from a single international submarine cable system of 340GB total capacity installed in 2001 to five (5) cable systems with combined overall capacity of 40 terabytes. Inadequate distribution network is however causing underutilization of this capacity.

The explosion of data services and more tilt towards cloud computing has fuelled greater demands for reliable data services and has now over-stretched the current capacity calling for more investments in this area.

Nigeria's youthful population remains an asset, combined with the increasing smartphone penetration rate, Nigeria now boasts of a very thriving fintech industry with over 200 standalone fintech companies. (Kola-Oyeneyin, Kuyoro, & Olanrewaju, September, 2020). According to a recent report by the Ernst & Young, Nigerian FinTechs raised $439 million in 2020 alone, equivalent to 20% of the amount raised by all African tech startups.

The ICT sector has seen promising developments in recent times that has led to the emergence of several subsectors that are now rapidly gaining prominence such as Fiber on Air/Fibre to Home (FTTH) services, Cloud Computing, Fintech/Digital Financial Services, Smart Mobility and many others.

8.12.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The Information and Communications Technology Infrastructure is rated for the second straight time now with the overall rating of E2 – 1.82 (Poor State) in the 2021 edition. This is a

slight improvement from 1.79 rating in the 2017 report. Over the past 4years, the sector has witnessed considerable level of investment to improve and modernize technology and communications infrastructure.

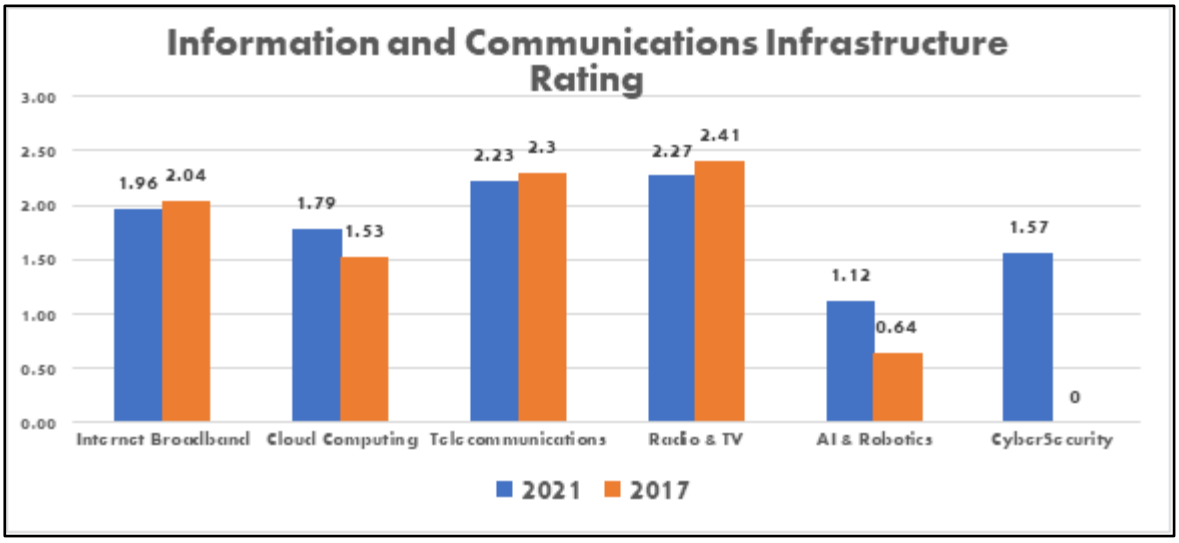


Figure 8-45: Information and communications infrastructure rating

For all critical infrastructures rated in this category, Artificial Intelligence & Robotics received the highest improved rating while there is also improvement in the areas of cloud computing following more private sector investments and subscription to cloud computing services such as platform as a service, server as a service, etc. Other infrastructures within the category dropped in rating within the 4-year period.

In the 2021 rating, infrastructure users rated the ICT Infrastructure Capacity and Innovation highest (E2 – 1.89) within the rating system parameters although other parameters are rated within the same grade. In the same vein, funding and public safety were the lowest rated parameters.

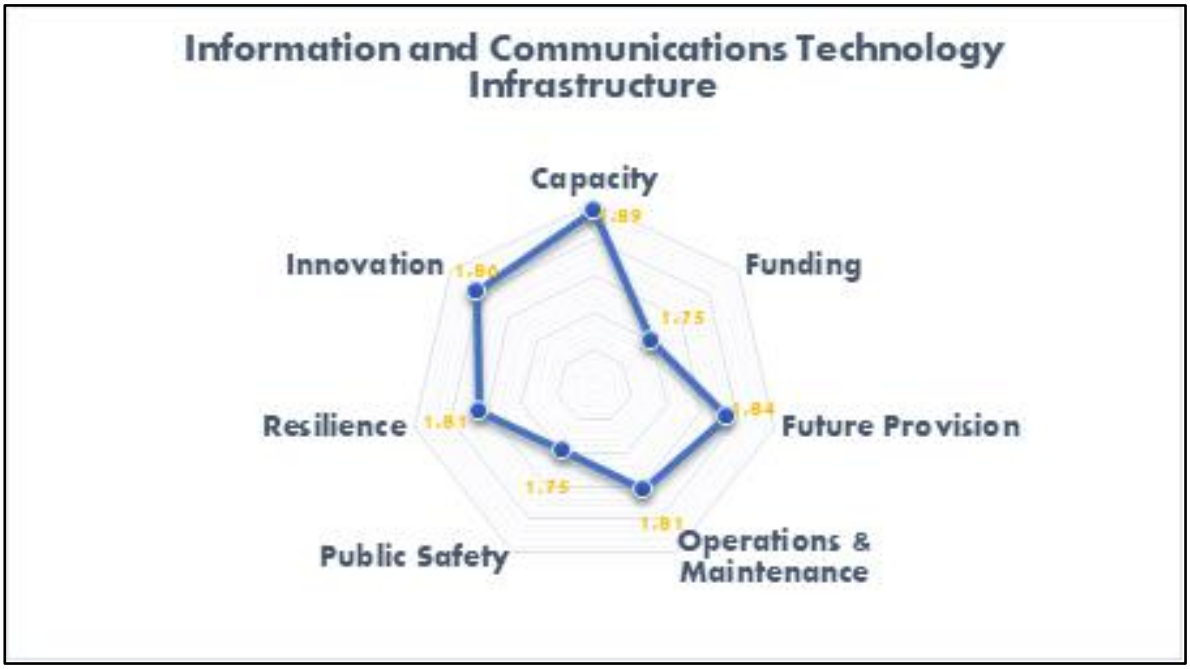


Figure 8-46: Information and communications technology infrastructure

In 2017, the Federal Government of Nigeria offered license to two regional Infrastructure Companies (InfraCos) to build a national broadband network and offer capacity to all service providers on a non-discriminatory, open-access and price-regulated basis which led to enhancement in service delivery in the sector. The following 3years, the sector witnessed significant infrastructure developments with the deployment of additional Base Transceiver Stations (BTS) which has now risen to 36,998 and 69,027.1km of fibre optics deployment and 151 gateways. Microwave coverage however declined from 302,036km recorded in 2019 to 289,720.99Km as at Year 2020. (Nigerian Communications Commission, 2021)

The authorities have been keeping faith with its National Digital Economy Policy and Strategy with significant developments in the deployment of a national fibre optic network that has connected the major cities of the country and the liberalization of the fibre optic infrastructure market.

In the 2020 revised edition of the National Integrated Infrastructure Master Plan released in January 2021, the Federal Government stated the need to spend at least 10% of required N36trillion investment in Infrastructure over the next 23year period on an annual basis. This comes to an investment of about N3.6trillion per annum and $253bn invested in the ICT sector alone. In 2020, a total of N5.7bn was released in capital expenditure for Communications Technology Ministry while N6.6bn was released to the Information ministry.

8.12.3 INTERNET BROADBAND INFRASTRUCTURE

Internet broadband infrastructure was rated E2 - 1.96 (Poor State). This infrastructure growth is still hampered despite enormous private sector participation and obvious market demand largely by governance and structural ideals that do not support its growth. For instance, the industry is still grappling with right of way charges which have remained largely not harmonised across states and regions.

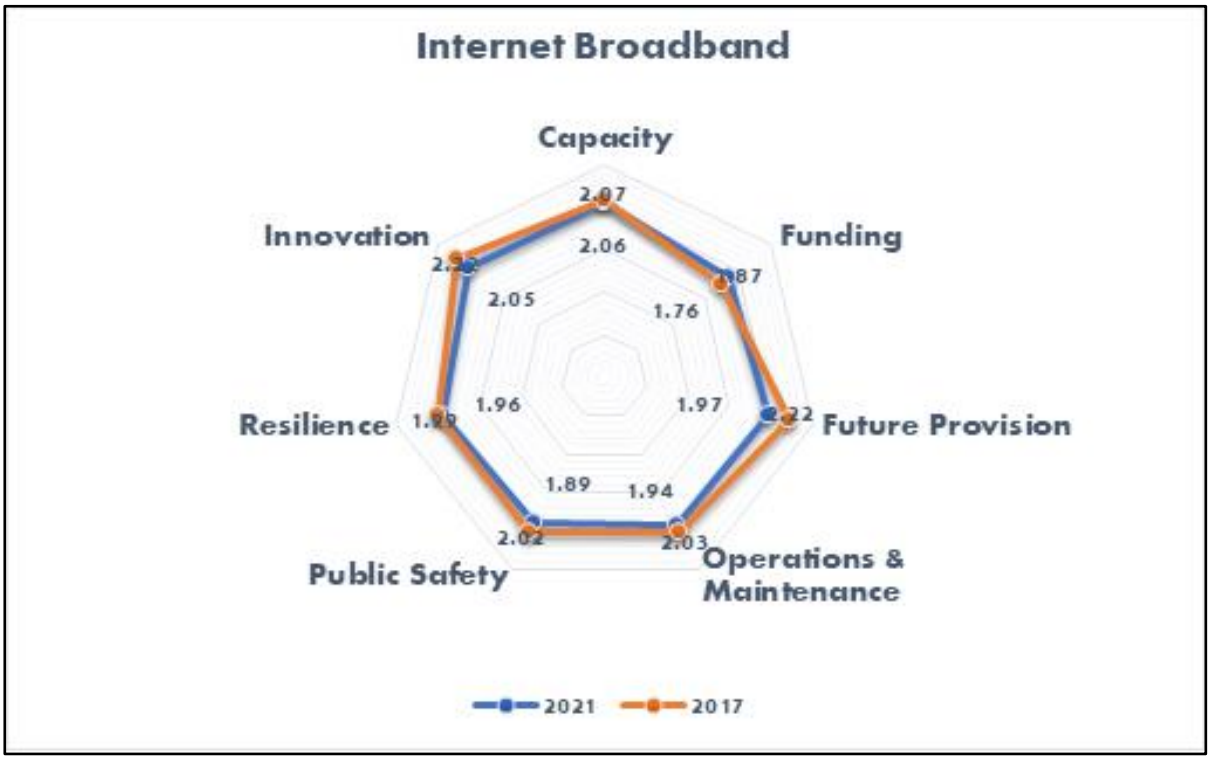


Figure 8-47: Infrastructure broadband

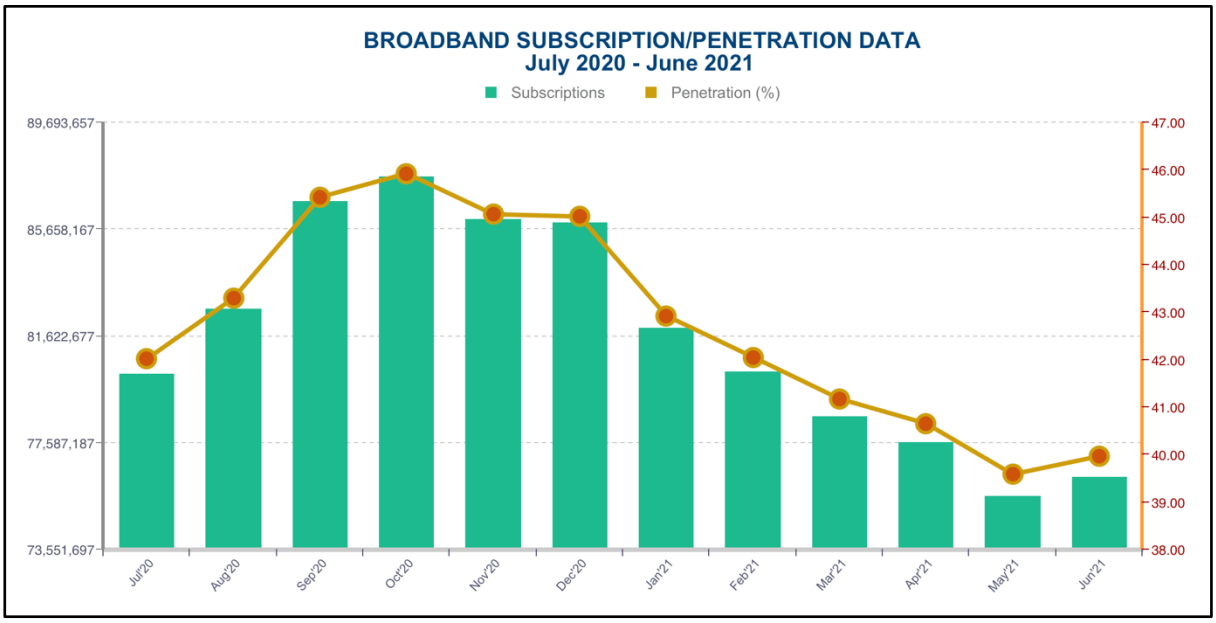


Figure 8-48: Broadband subscription/penetration data July 2020 - June 2021

Users agree that more funding has been committed towards the development of broadband infrastructure in the country over the past 4years even though funding has been below expectation. Thus, the rating 1.87(Poor) which is slightly higher than 2017 rating of

1.76 (Poor) but remains relatively poor. Obviously, given the policy of the Ministry of Communications and Digital Economy more funding needs to be devoted to improvement of e-government infrastructure and Fibre on Air/Fibre to the Home (FTTH) infrastructure due to increased demands for higher broadband speeds. The ministry plans an ambitious capital requirements estimated at a range of $3.5- $5 Billion to achieve effective execution over the five-year period of 2020 – 2025 which they have realized can only be achieved if Government and Private sector align and harmonize activities regarding spending and incentives to achieve optimal results.

In terms of capacity, the infrastructure users have maintained the same rating of 2.03 (Poor state) as 4years ago and this may be attributed to increased demand/appetite and requirements for broadband services as well as higher cloud computing needs and relative comparison with service levels obtained in other nations of the world.

The demand for broadband capacity was stretched during the COVID-19 lockdowns as private and public sector employees were confined to work from home and connect with other colleagues mostly via VOIP applications. The number of Internet Subscribers increased from 135,743,324 subscription as at March 2020 to 154,437,623 Subscriptions as at November 2020 representing an increase of 13.77%. Data usage also increased from 147,537.52TB to 196,163.42TB within the same period. Broadband penetration continued to increase within the year 2020 reaching a peak of 45.93% even though this has now declined to 40% as at June 2021. Experts say part of the reason for this decline could be attributed to the NIN registration mandate which led to the discontinuation of new SIMs. Nigeria's average internet speed is 13.03Mbps, ranked #20th in Africa and #142nd in the world.

The users' rating on Broadband Infrastructure funding is low – 1.76 (Poor), a slight drop from previous rating (1.87). This position is in sync with that of the Federal Government who have fallen short in their funding plan compared to expected funding as stipulated in the National Broadband Plan (2020 – 2025). Most investment in the sector is private sector driven with a total of $417.5m US Dollars in Foreign Direct Investment in 2020 which was a drop of 55.7% compared to 2019. Domestic investment was however N408m within the same year which was still a drop of 18.62% compared to previous year.

8.12.4 CLOUD COMPUTING INFRASTRUCTURE

Cloud computing made significant positive leap from 2017 rating of 1.53 now to 1.79 (E2). Infrastructure users consider this infrastructure in poor state still. In all parameters of this rating there were improvements observed from the users perspective. Cloud Computing is fast becoming a necessary aspect in the operations of large businesses and some government agencies in Nigeria. Nigeria currently has about 20 enterprise-grade Tier III and Tier IV data centers rendering any or all major data center offerings: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) and Back-Up as a Service (BaaS).

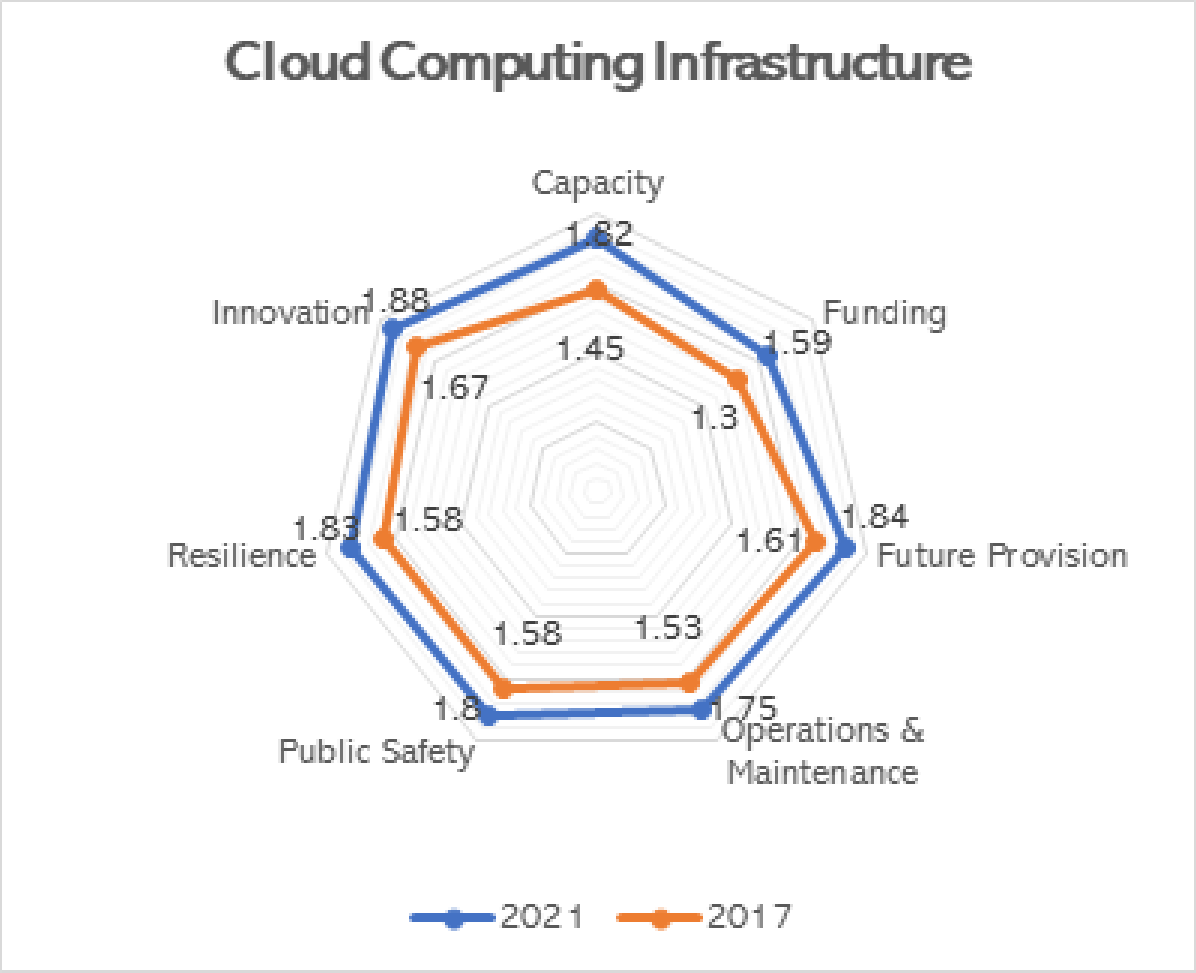


Figure 8-49: Cloud computing infrastructure

The data center market in Nigeria is among the fastest-growing markets in Africa. The Nigeria data center market investments are majorly driven by factors such as digitalization, advanced technologies, the presence of major operators, internet penetration, and government initiatives.

In 2017, Nigerian Government had one government data center and less than half of government institutions computerized and less than 10% of government services online. In 2020 through the Galaxy Backbone, the Federal Government claims to have commissioned a state of the art tier-III data center with the capacity and capabilities to serve both public and private institutions including the flagship Uptime Tier-III designed National Shared Services Center (NSSC) Data Centre.

There are now up to about 20 datacentres most belonging to private sector players in Nigeria currently.

The capacity of our cloud computing infrastructure was rated 1.82 (Poor State) all though there has been significant private sector investment in this category. This rating obviously shows an improvement from the 2017 rating at 1.3 (Non-Existent). Perhaps this stems from users' ignorance of existing infrastructure or lack of trust in infrastructure provided. For instance, the President, Institute of Software Practitioners of Nigeria

(ISPON) recently confirmed that the current utilisation capacity of our data centres is below 30 per cent. A recent newspaper post noted that 70% of government agencies hosts their data abroad despite huge investments in the sector. (Adepetun, 2021)

Cloud computing infrastructure was also rated poor in terms of funding (1.59) although this is an improvement on the 2017 rating too. It is not clear how much funding government has targetted towards development of cloud computing infrastructure even though it owns only one out of the 20 datacentres referenced. Most of the funding in this sector has been private sector led. Experts believe that the African data centre market is expected to grow to $3 billion by 2025, at more than a 12% growth rate per year. Thus, private sector players like Liquid Telecoms are already planning a $100m investment in the data centres in Lagos while Mainone is also spending millions of dollars in setting up and expanding its infrastructure in Lekki, Sagamu, etc. Industry players believe that over $220m has been invested on building data centres already.

8.12.5 TELECOMMUNICATIONS INFRASTRUCTURE

The users of the telecommunications infrastructure have maintained the same grade for this infrastructure at E1 – 2.23 even though it is a slight decrease on the same grade from 2.30 last year. Perhaps respondents are expressing the need for improved investment in infrastructure to improve both coverage and speed which are key elements of service quality.

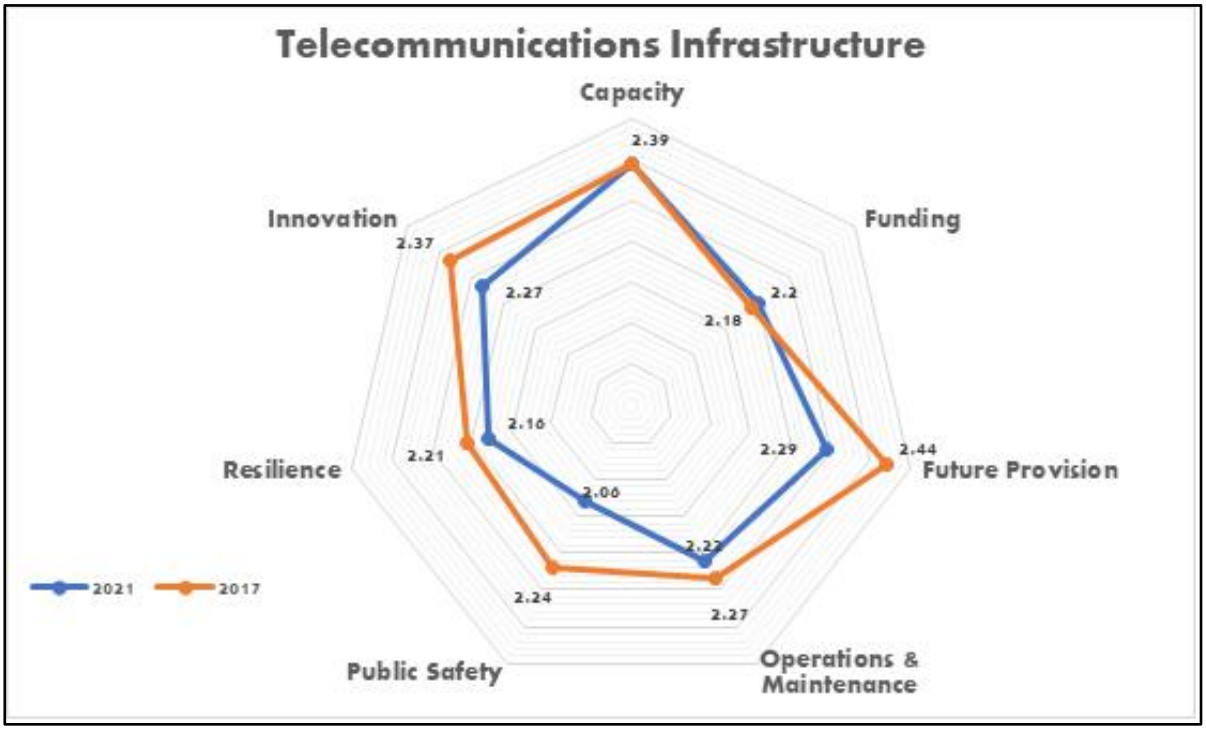


Figure 8-50: Telecommunications infrastructure

Subscriber ratings in all the rating parameters were depressed relative to the 2017 ratings except in the area of Capacity and Funding which both largely remained the same. Infact, according to Nigerian Communications Commission, both domestic investment and foreign direct investment into the telecoms sector suffered a setback between 2019 and 2020. As mentioned earlier, these may not be unconnected with the COVID-19 breakout in 2020 which affected many sectors of the economy. Interestingly, the telecoms sector remained alive and achieved one of its peak subscription levels in the year.

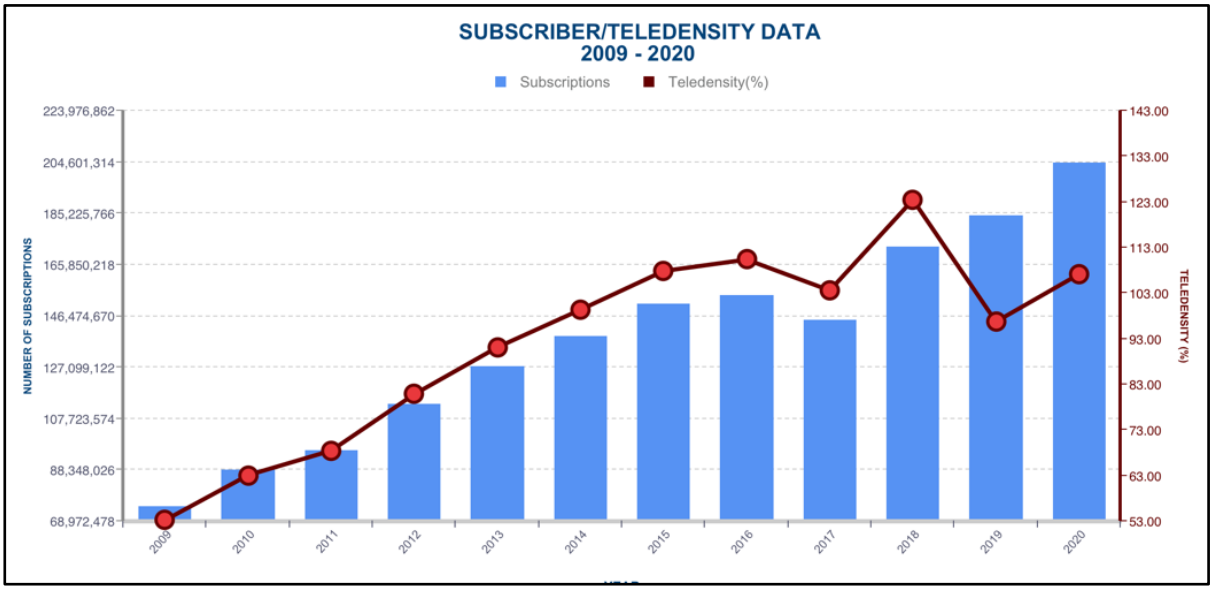


Figure 8-51: Subscriber/teledensity data 2009-2020 (Source: NCC 2020)

Since 2017, teledensity has remained roughly the same after an initial sharp rise to 123% in 2018 but currently stands at 107%. Number of subscriptions however have been going up since 2017 from 145m subscribers to 204m subscribers in 2020.

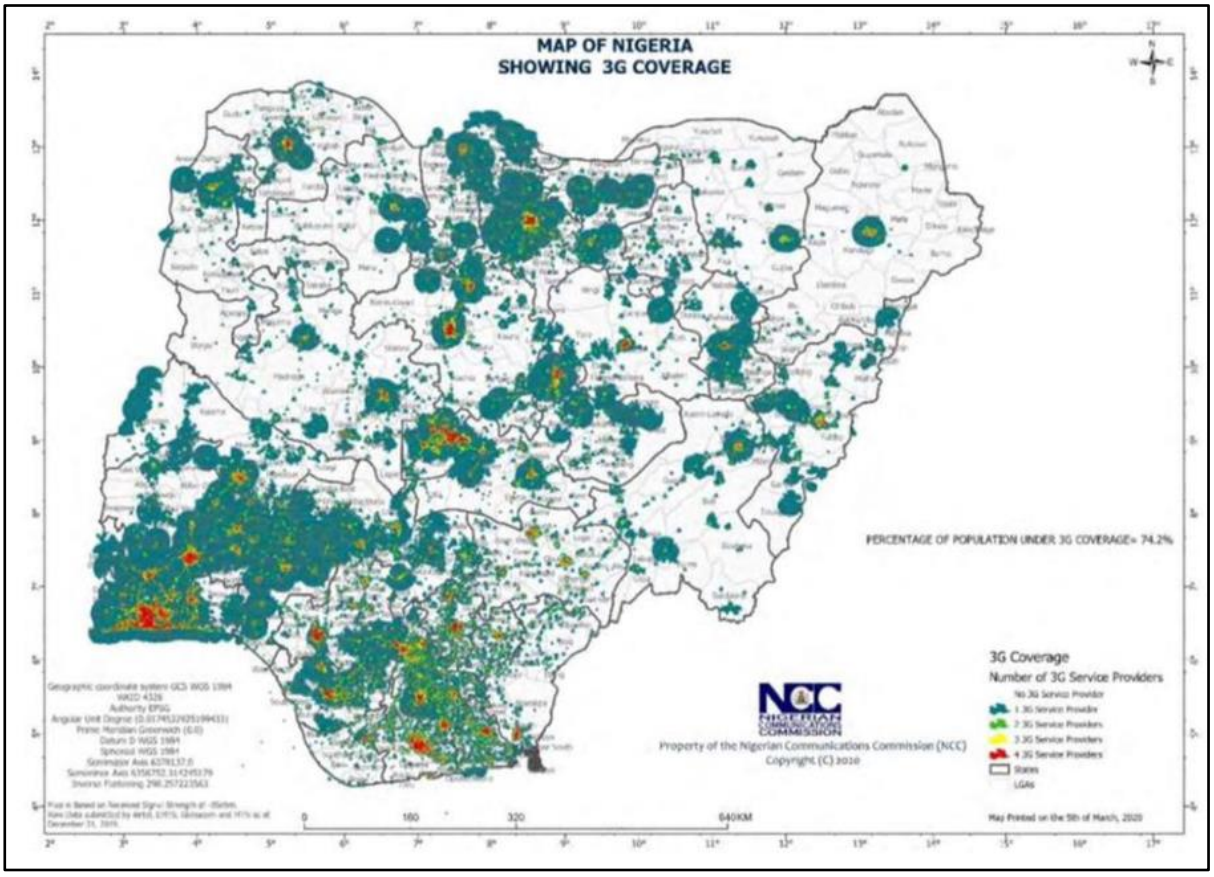


Figure 8-52: 3G coverage in Nigeria

In a recent national debate about transmission of electoral results electronically, the Nigerian Communications Commission (NCC) has come under serious criticism over its comments about necessary infrastructure coverage to guarantee quality network coverage across the country. In 2019, the NCC released data as at the fourth quarter of 2019 stating that 2G nationwide coverage stands at 89%, 3G at 74%, and 4G at 37%.

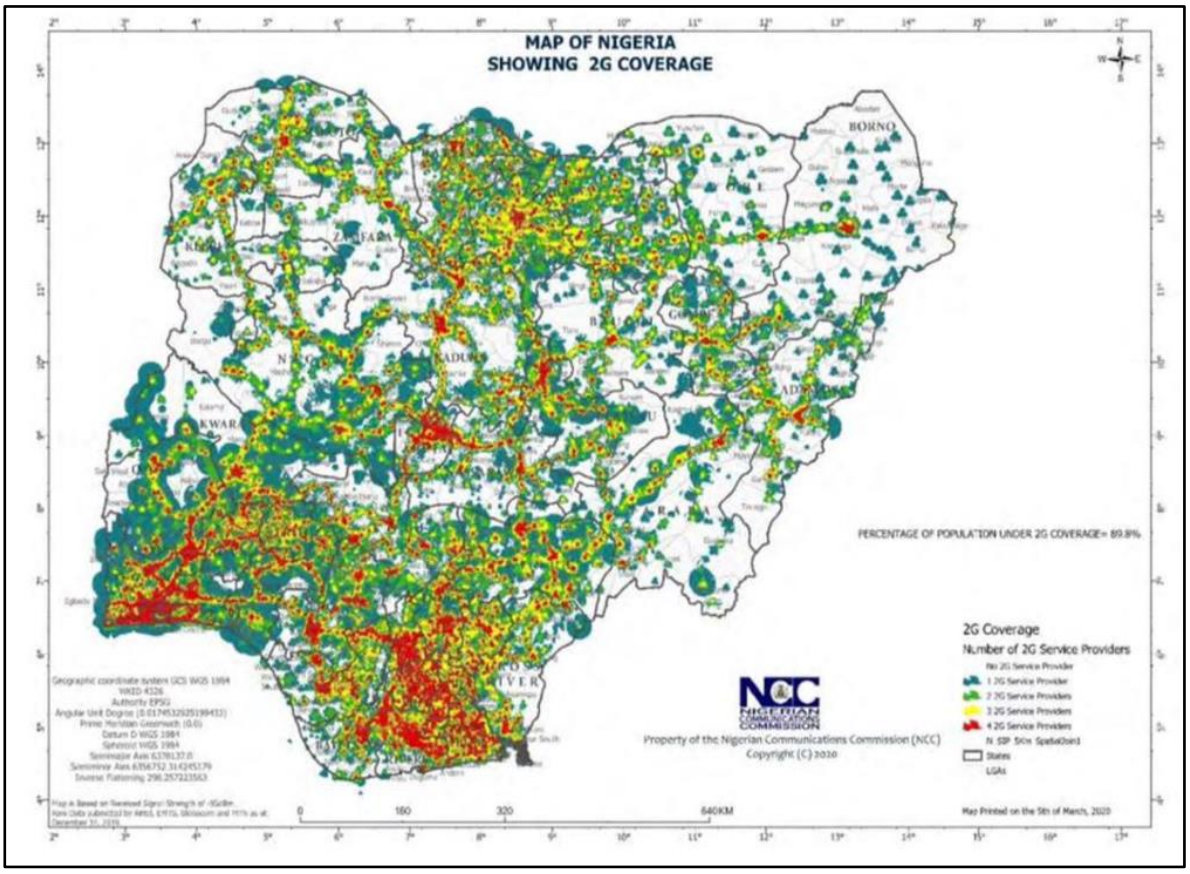


Figure 8-53: 2G coverage in Nigeria

This may be the sentiments behind the depressed rating for innovation and future provisioning of 2.27- Fair and 2.29 – Fair respectively which are lower than the 2017 rating.

In 2020 alone, Nigerian telecoms companies were able to process 150billion minutes of outgoing local calls and 151.9billion minutes of incoming local calls. International outgoing and incoming calls showed a significant spike from 2019 figures to record 127billion minutes of incoming international calls and 92billion minutes of outgoing international calls.

8.12.6 RADIO & TV INFRASTRUCTURE

Although still one of the best rated infrastructure in the country at E1 (2.27), the rating of radio & TV infrastructure took a dive from D3 (2.41) in the 2017 Infrastructure Scorecard rating. Nigeria also has the largest terrestrial television network in Africa which is the Nigerian Television Authority (with over 96 stations scattered around the country). Also, Nigeria has about 286 radio stations and 91 television stations all over the country most of whom offer 24hours broadcasting service. Most of the terrestrial television stations in Nigeria are government-owned at national and most sub-national levels of government.

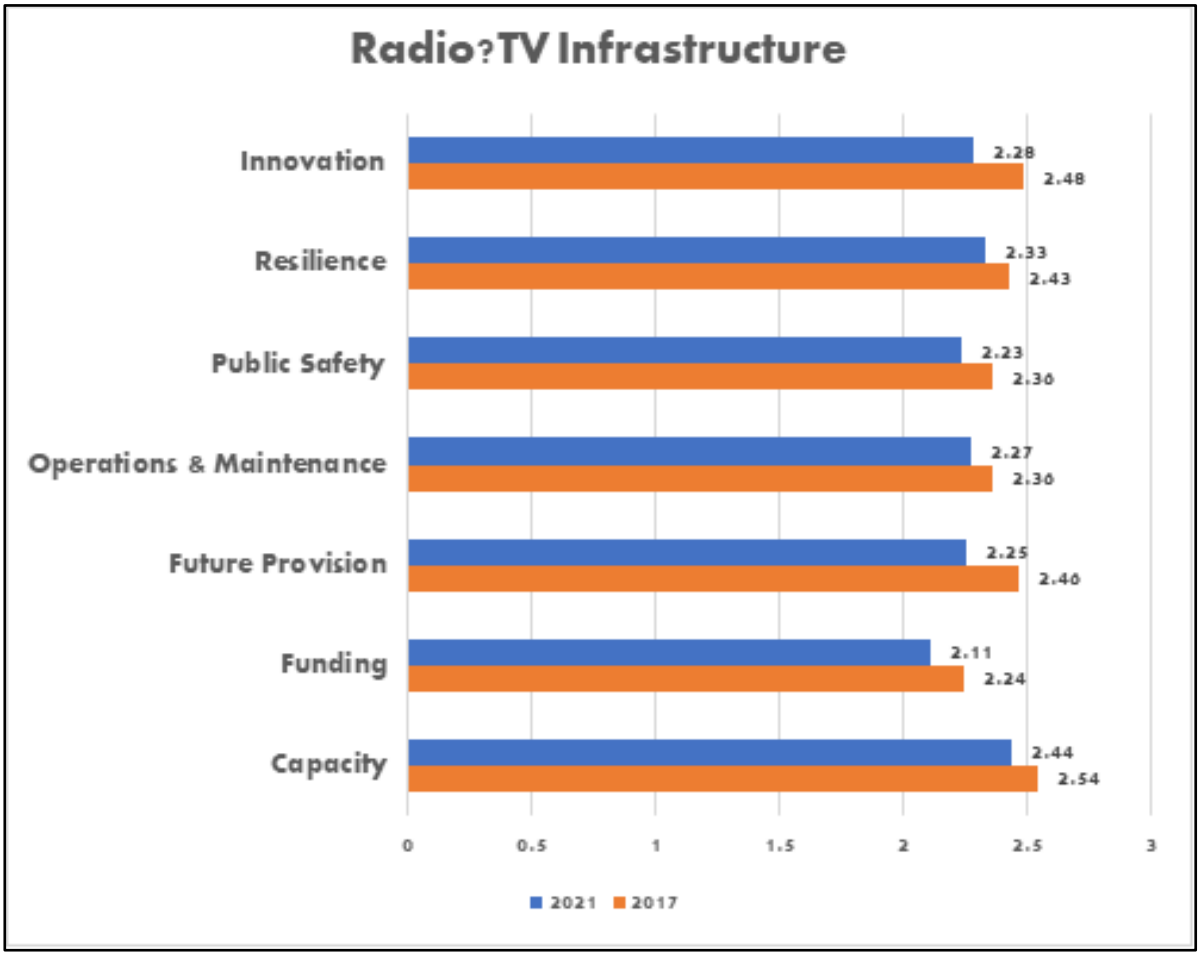


Figure 8-54: Radio and TV infrastructure

As we see in most other infrastructure classes in this category, the perception of respondents was somewhat lowered from 2017 rating in all parameters especially in terms of future provision and innovation. In the 2017 edition, we did note plans by authorities to effect the digital switchover and how this was very imminent. Unfortunately, even though there has been continuous work and progress in that direction, this is yet to be effected nationwide. The digital switchover is expected to aid digital television penetration and high-quality service. According to the Nigeria's National Broadcasting Commission the country's Digital Switch Over (DSO) project will now be completed by middle of 2022 when the country will fully shift from analogue to digital terrestrial broadcasting. The reason for the delay and long pause on this initiative have been attributed largely to lack of political will and financial constraints but this has become essential as there is an increasing need in other industries especially in the telecommunications sector for spectrum, more of which will become available after the switchover, potentially benefiting several players, including suppliers of mobile communications services.

According to the PWC, Nigeria's entertainment and media market has reached US$4.5billion as at 2018 and expected to rise at a 19.3% CAGR to reach US$10.8 billion in 2023. Radio is projected to grow to US$54 million while television could grow to US$904 million within this same timeframe. (PwC, 2019)

8.12.7 ARTIFICIAL INTELLIGENCE & ROBOTICS

Artificial Intelligence & Robotics Infrastructure rating was massively better than rating received in the last edition from F3 – 0.64 in 2017 to F2 – 1.12 both judged by respondents to be "Unfit for Purpose". Respondents' perception is a recognition of good developments in the sector albeit still far from expected level of development when compared to counterpart countries.

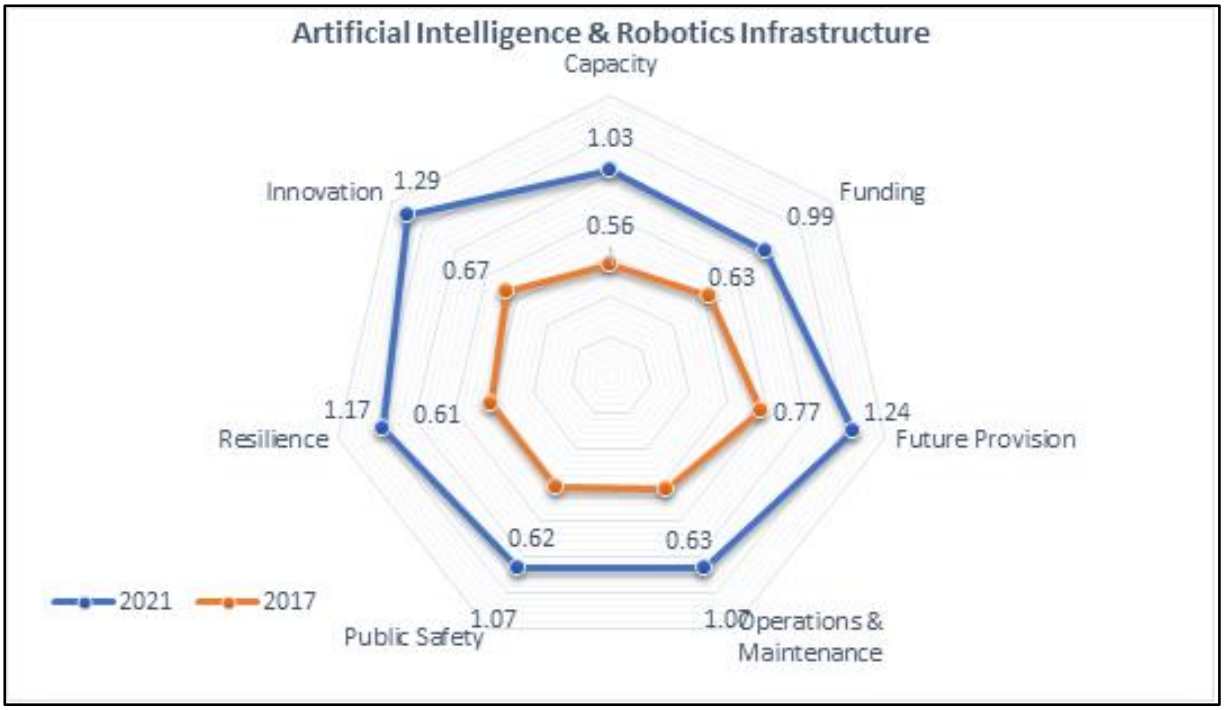


Figure 8-55: Artificial Intelligence & Robotics Infrastructure

There were improvements in all parameters of ranking of AI & Robotics Infrastructure possibly due to private sector led activities aimed at kick-started this sector. The NCC had noted the role of 5G technology in providing the platform for new and emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI) and Big Data but that no license for 5G in Nigeria has been issued and therefore the mobile network operators (MNOS) cannot switch on such technology. While many telecom operators are anticipating a roll out of the technology soon, NCC is technology-neutral as it does not license technology but assigns spectrum to operators for deployment of any service when allocated.

Our respondents consider the future of this sector positive as it received the highest rating in all the parameters. Private businesses are increasingly adopting IoT devices, AI and robots to empower their businesses as observed by IoT Africa recently. (Okonji, 2021). Recently, the Ministry of Communications and Digital Economy inaugurated the National Centre for Artificial Intelligence and Robotics which is a digital innovation and research facility focused on Artificial Intelligence (AI), Robotics and Drones, Internet of Things (IoT), and other emerging technologies, aimed at transforming the Nigerian digital economy.

8.12.8 CYBER SECURITY INFRASTRUCTURE

Cyber Security infrastructure was rated for the first time F1 – 1.57 (Unfit for Purpose) by respondents. The ratings indicate a need for authorities to devote funding to this infrastructure as well as more protection of users as cybercrimes tends to be on the increase

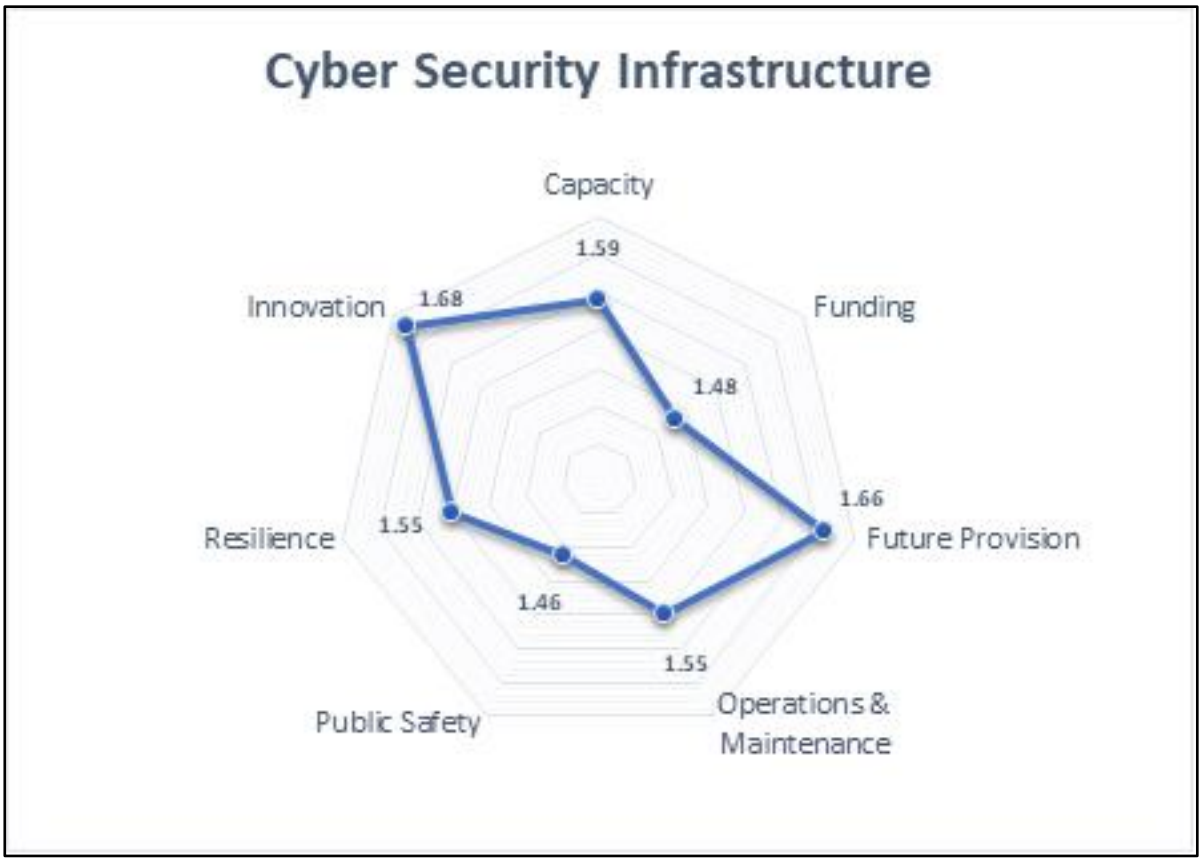


Figure 8-56: Cyber security infrastructure

Nigeria lags behind when compared to advanced economies in the provision of digital security infrastructure making it a safe target of cybercriminals worldwide especially due to the rapidly expanding digital infrastructure in Nigeria. Experts have noted that the attacks are not just at national and sub-national levels alone but highly proliferated at individual levels.

Some areas of vulnerability by Nigerians have been identified to include: IoT Attacks, Cloud Vulnerability, Weak passwords and password managers, Ransomware attacks, 5G to Wifi handover challenges, Remote work challenges.

Last year's #ENDSARS protests had shown that our governments are very vulnerable to attacks and hacks which affected both private and public web infrastructure. Government and public institutions are likely to face data leaks and sensitive information breaches motivated by local and foreign groups.

8.13 EDUCATION INFRASTRUCTURE

8.13.1 BACKGROUND

Education is one of the key sectors in any country that impacts largely on the economy in terms of growth and development. If a country therefore has a higher literacy rate, it will lead to a lower unemployment rate and greater GDP growth. As of 2020, the level of literacy according to the world bank data was 75% of the over 200million population size. This is a clear indication that the human capital development in Nigeria needs to improve because Nigeria is far behind in terms of literacy level when compared to countries like Egypt at 88%, Ghana at 92%, South Africa at 95% and UAE at 99% (World Bank Data, 2020). The Global Competitiveness Index 2017-2018 edition rated quality of education system in Nigeria as 117th out of 137 countries analysed.

Due to this low level of literacy in the country which could be traced to poverty, low income, inadequate or obsolete infrastructure, shortage of educational materials, inadequate funding, method of teaching, quality of teachers, to name a few; has led to Nigerians gradually tilting towards furthering their studies outside Nigeria. A recent data according to UNESCO (2021) records the number of Nigerians studying abroad at 76,338 students.

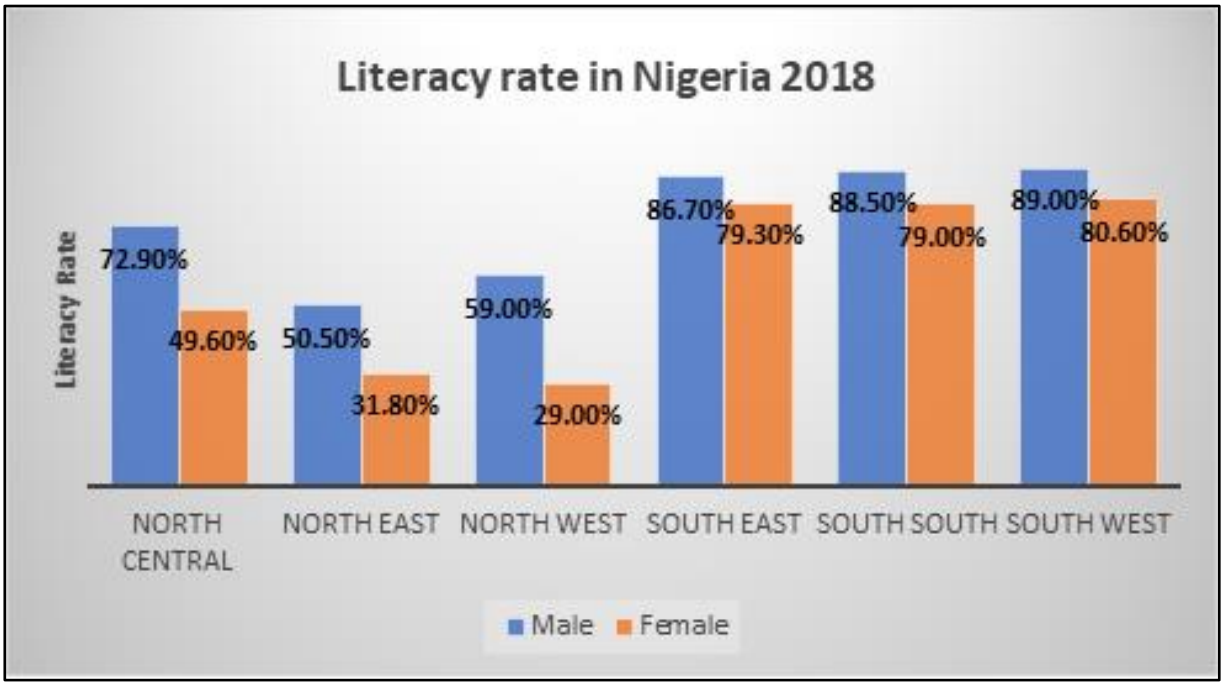


Figure 8-57: Literacy rate in Nigeria 2018

Covid-19 pandemic which led to the lockdown is also a factor that influenced the number of out-of-school children in Nigeria in 2020 because so many parents did not want their children to resume school after the lockdown with the fear of contracting the virus, while some others were indifferent. Nigeria's Ministry of Education has also said the number of out-of-school children stands at 10.1 million, an increase of more than 3 million from last year (2020). In March 2020, the UNICEF office in Nigeria received a GPE grant of US$140,000 to support the Ministry of Education with preparing a COVID-19 education strategic framework on continuity of learning.

According to the NIIMP 2020 report, The Federal Ministry of Education (FME) in order to actualize its development goals, developed a blueprint for the Education Sector tagged "Education for change: A Ministerial Strategic Plan (2016- 2022)" focusing on three priority areas in terms of:

- Access: which addresses Out-Of-School Children, Adult Literacy, Technical and Vocational Education and Training (TVET);
- Quality: which involves Basic education, Teacher education, Basic and Secondary Curriculum & Policy and Tertiary education; and
- System: strengthening which deals with Education data & Planning, ICT in Education &Library Service in education.

In addition to the initiatives for financing the educational system and infrastructure, during the Global Education Summit on financing Global Partnership for Education (GPE) 2021 to 2025 held in London (July 2021), the president of the Federal Republic of Nigeria, Muhammadu Buhari administration committed to ensuring that total education spending increases by 50% over the next two years and up to 100% within the next five years (2021–2025). He also said that the Government of Nigeria will ensure that every State in the Federation progresses towards or maintains spending levels above 20% of their total budget to achieve national minimum standards for education outcomes.

He further disclosed that the overall strategy is to adopt and implement educational policies that will foster gender inclusion, promote equity, deliver quality, and guarantee safe, secure and violence free schooling for all Nigerian citizens. While also stating that priorities for transforming education in Nigeria in the next 5 years include:

- Eliminating the out of school children syndrome by ensuring that all children of school age are enrolled. The target is to ensure that the 10million out of school children are exposed to some form of education over the next five years.
- To prioritize skills development to equip Nigerians with the right competencies for employment with special focus on Technical, Vocational Education and Training (TVET)
- To implement and enforce multiple programs on inclusive education for Girl-Child Education, Special Needs Education, Adult and Mass literacy and Alternate School Programmes with priority accorded to retention and completion rates in primary and secondary schools.
- Revitalizing the teaching profession in Nigeria by introducing incentives to attract and retain the best brains in the profession.

The state of educational institutions in the country is very deplorable.

Government must declare emergency in education for as a matter of urgency. Otherwise, the future of the country in all indices economic, industrial, social, etc. development is very bleak

Engr Prof Emmanuel Enyioma Anyanwu

Teaching and Research, Public

There is a major gap in the 7 indicators as the public sector is more interested in quantity rather than quality of schools at all levels. The private sector is

coming forcefully, and the experiences of the primary and secondary schools is inevitably going to shallow the tertiary educational institutions which would put the majority of out of school children at risk of not having access to education.

Prof Sadiq Z. Abubaka

Deputy Vice Chancellor

8.13.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The Education Infrastructure falls within the same rating for the second time now in a space of 4years, with the overall rating of F2 – 1.57 (Unfit for Purpose) in the 2021 edition. This is a slight rise from 1.44 (F2) rating reported in 2017, although still falls within the same rating category. The Tertiary institution with an overall highest rating of 1.81(E3) in 2021, has sustained its overall position as the highest rated compared to the other subcategories for the past 6years of the NSE reporting and this clearly indicates that the government has been investing more in the development of Tertiary Universities Infrastructure compared to the other categories; while the lowest rating in 2021 is the Primary School Infrastructure at 1.46 (F2) although there is a slight improvement from 1.34 (F2) rating in 2017.

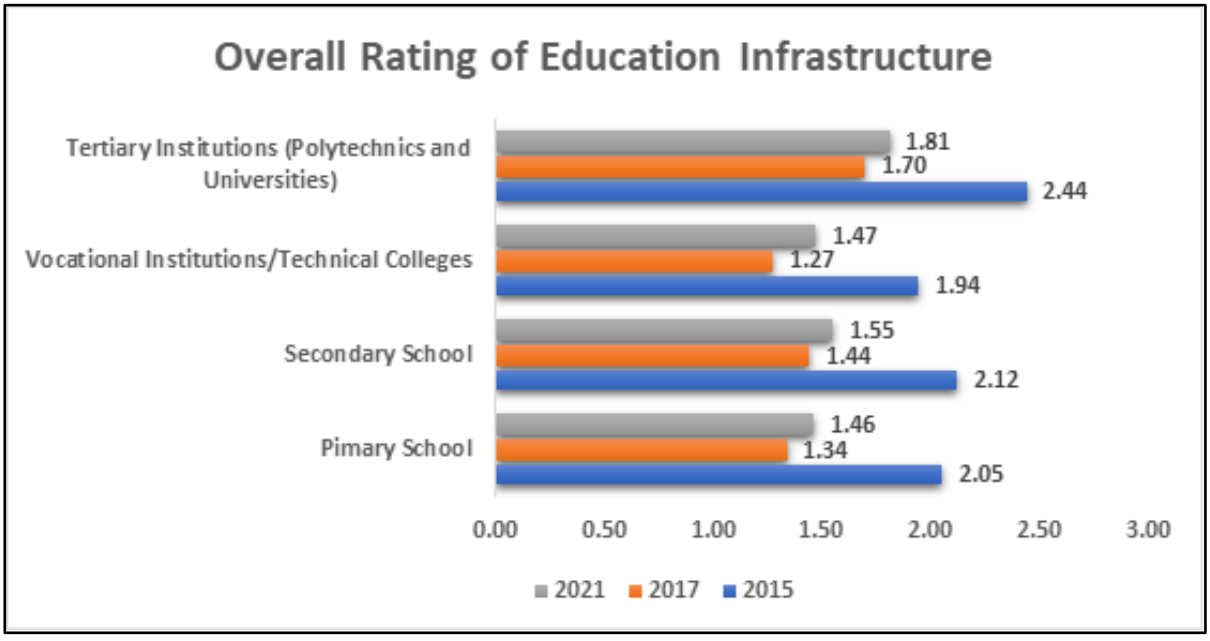


Figure 8-58: Overall rating of education infrastructure

The respondents overall rating of the tertiary institutions therefore aligns with a report by the National Universities Commission (NUC) in 2019, where the Federal Executive Council (FEC) approved the establishment of 20 new private universities in Nigeria bringing the total number of private universities in the country to 99.

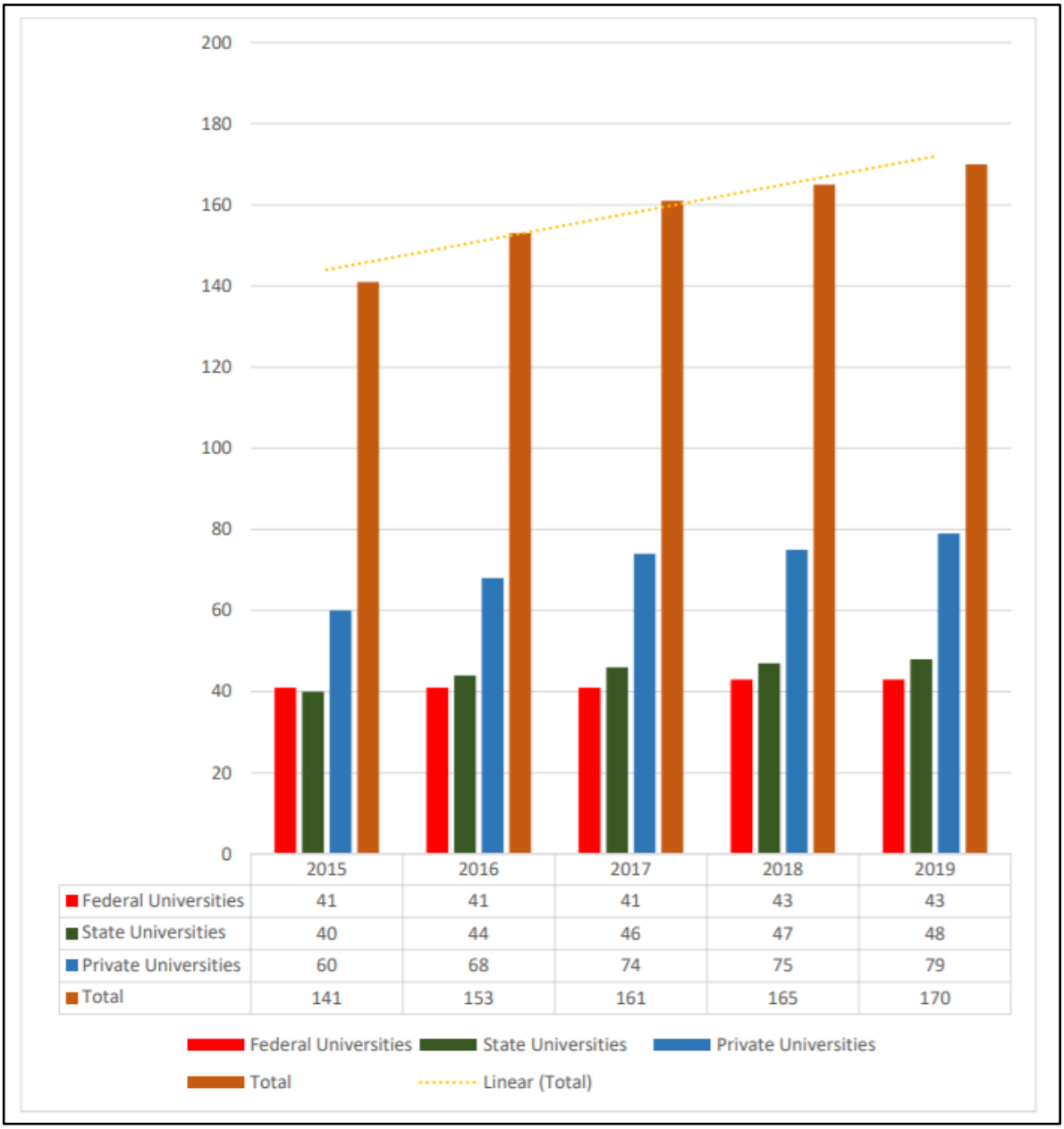


Figure 8-59: Source: Nigerian University System Statistical Digest (2019)

In the 2021 rating, infrastructure users rated the Education Infrastructure Capacity highest (1.77 - E3) which falls within the poor state while other parameters are rated within the unfit for purpose category. In the same vein, the lowest rated parameters were funding and operations & maintenance. This resonates with the low maintenance of infrastructure in public schools especially primary schools in the country, largely due to inadequate funding and support from the government.

Education Infrastructure	Capacity	Funding	Future Provision	Operations & Maintenance	Public Safety	Resilience	Innovation	Weighted Average
Pimary School	1.67	1.42	1.4	1.35	1.37	1.67	1.35	1.46
Secondary School	1.78	1.51	1.49	1.46	1.46	1.46	1.67	1.55
Vocational Institutions/Technical Colleges	1.59	1.37	1.42	1.45	1.44	1.53	1.51	1.47
Tertiary Institutions (Polytechnics and Universities)	2.02	1.66	1.73	1.72	1.79	1.84	1.91	1.81
Total Score	**1.77**	**1.49**	**1.51**	**1.50**	**1.52**	**1.63**	**1.61**	**1.57**

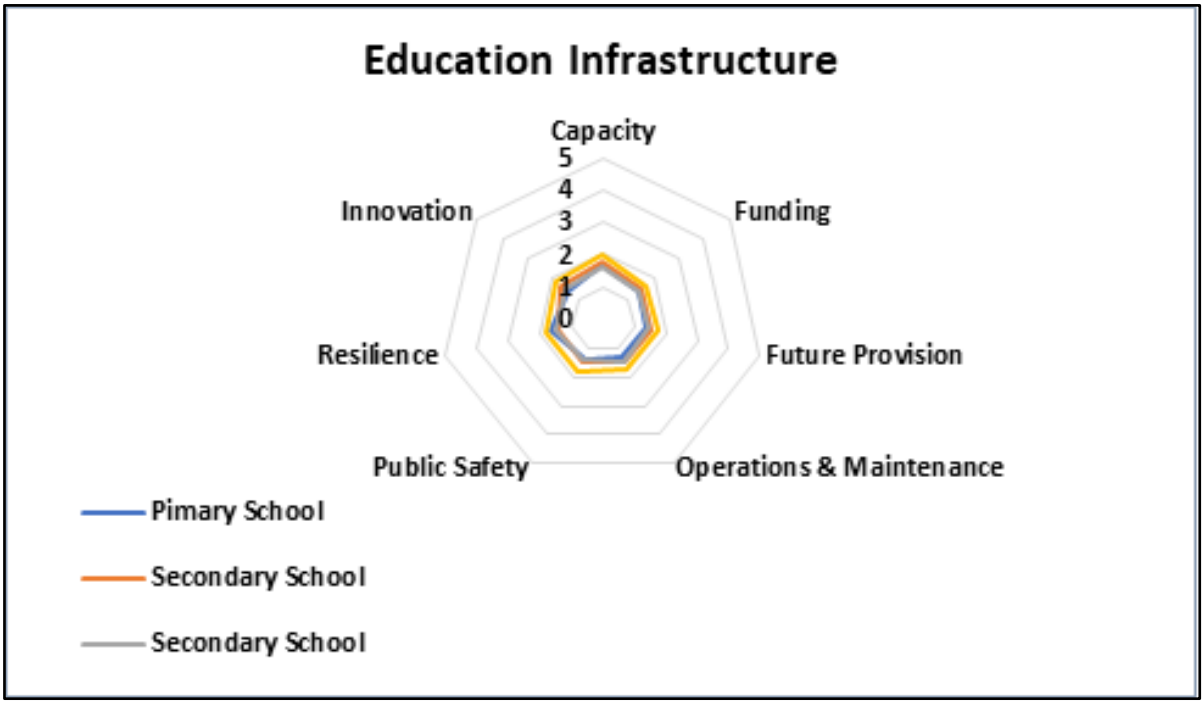


Figure 8-60: Education infrastructure

A report from the World Economic forum stated that prior to the current economic crisis, the education financing budget wavered around 9-10% of public expenditure between 2008 and 2014, against the recommended 15% to 20%. Despite an increase in the total budget by more than 255% between 2008 and 2020, the education expenditure as a share of the total budget has fallen from 9.64% to 6.32% within the same period. Public spending on education as a share of GDP has remained below 1% since 2010 against the recommended 4-6% and has decreased steadily since 2011, from 0.67% to 0.44% in 2020 (World Economic Forum, 2020).

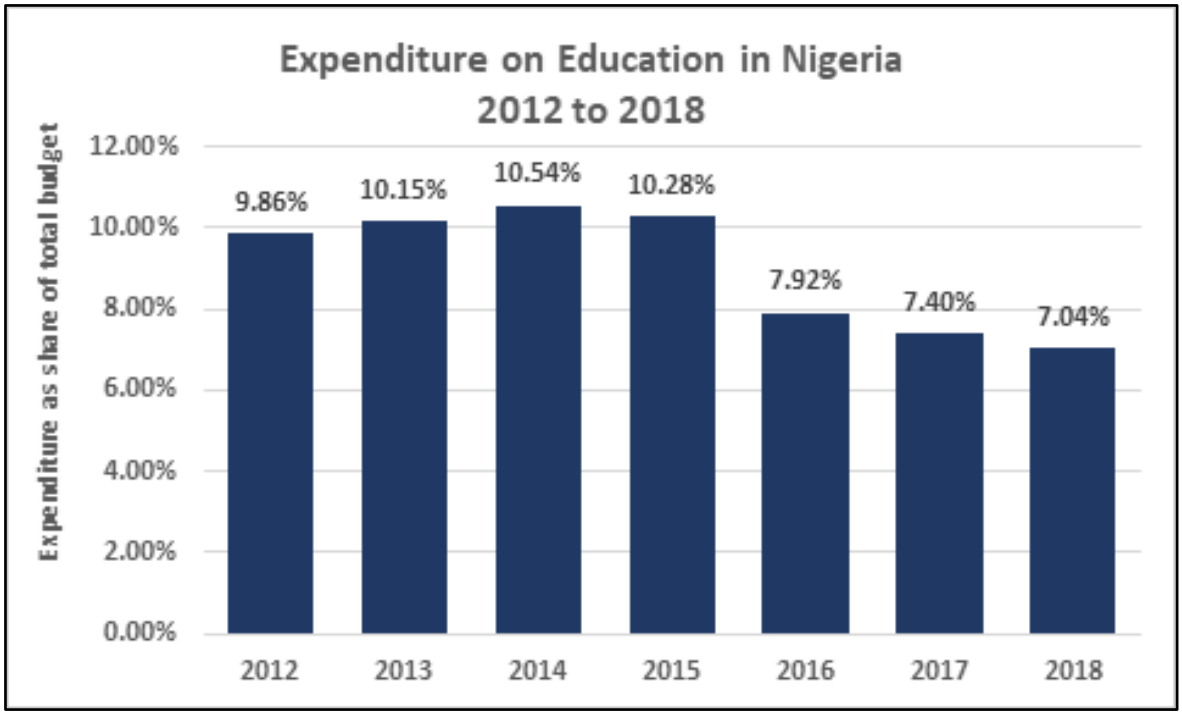


Figure 8-61: Expenditure on education in Nigeria 2012 - 2018

8.13.3 PRIMARY EDUCATION INFRASTRUCTURE

Primary Education infrastructure was rated F3 - 1.46 (Unfit for Purpose), a slight improvement from 1.34 (F2) in 2017 although it still maintained the same rating. The United Nations have emphasised on the importance of education and one of the Millennium Development Goal (MDG) is to provide universal primary quality education to all. A report from Education Profile Indicators (2018) published by the Universal Basic Education Commission (UBEC) stated that only 86.81 per cent of primary school entrants' complete primary school. While as of today, 250 million children do not have access to primary education. According to research, most of the schools in the country, from primary schools to universities, lack basic infrastructure, for instance, some pupils' study under trees, while in others, classrooms are often without roofs or desks to write on.

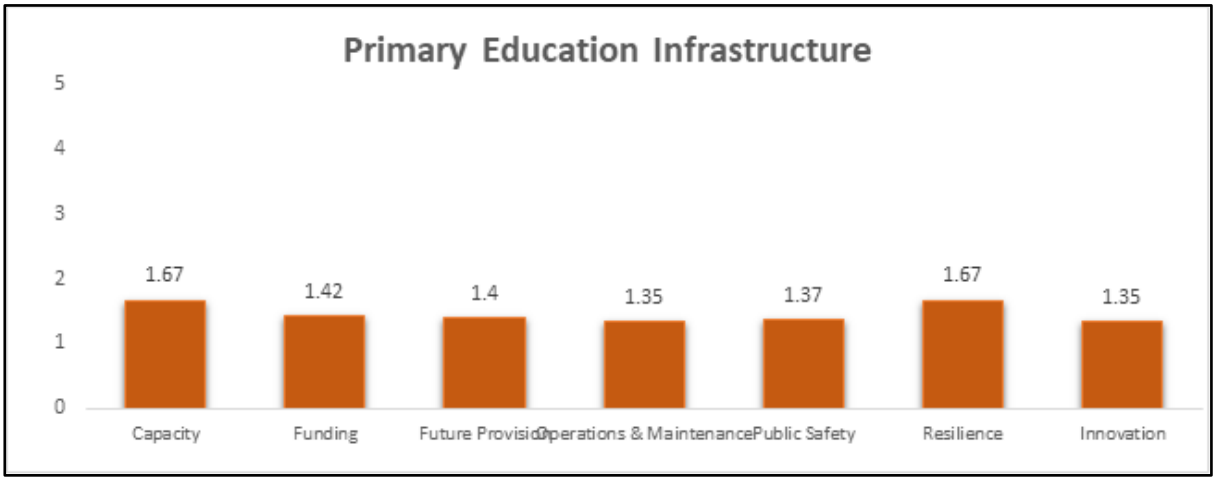


Figure 8-62: Primary educaiton infrastructure

In terms of capacity, the infrastructure users have maintained the same rating of 1.67 (unfit for purpose) as compared to 1.5 rating (unfit for purpose) achieved 4years ago. This clearly shows that the capacity of the primary school infrastructure in the country cannot accommodate the number of children requiring early education. According to Statista data, in 2018, 7.2 million children in Nigeria were attending early education programs. As of 2018, according to statista, in the whole country, there were 81.3 thousand public classrooms for pre-primary education, whereas the classrooms required were 146.5 thousand, which means that there was a lack of 65.2 thousand classrooms in Nigeria.

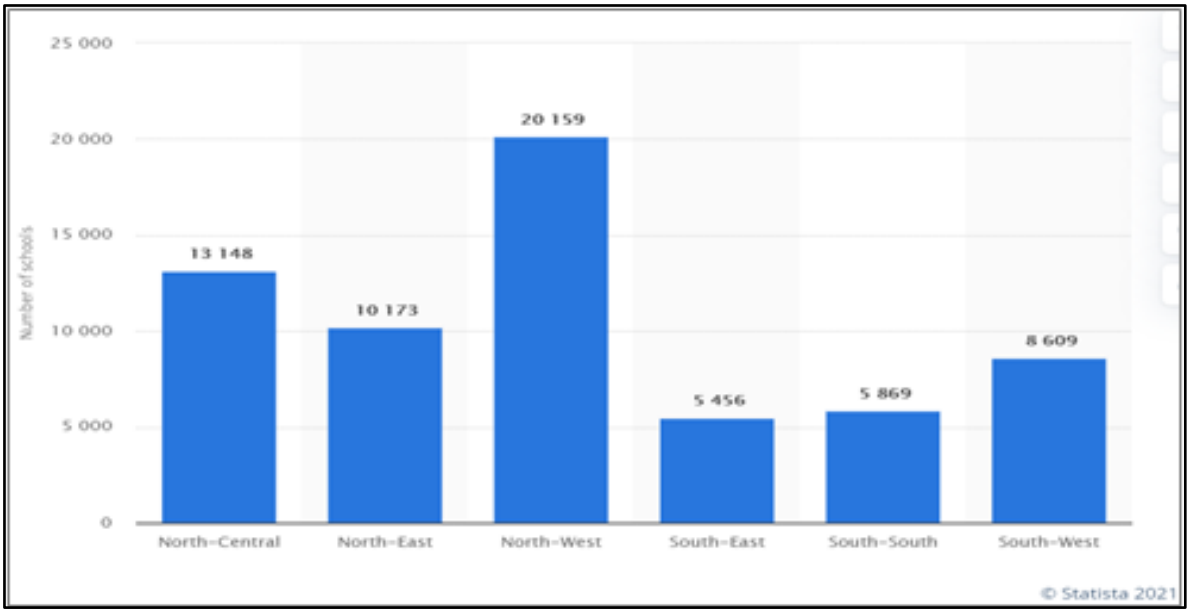


Figure 8-63: Number of public elementary schools in Nigeria as of 2018, by zone

Unfortunately, as of today, users of this infrastructure have rated funding and future provision under the Unfit for Purpose category (1.42 and 1.4 respectively). A quick review of the proposed 2021 budget conducted by BudgIT (2020), disclosed that N70.1billion was allocated for Universal Basic Education out of the total of N127.36billion allocated for the education

sector, we expect to have seen a lot of improvement in the primary school infrastructure. This shows that there is a gap in funds allocated versus disbursement.

Primary school enrolment has shown an increase in recent years, but net attendance is only about 70%, as of 2018. In the same year, UNICEF reported that Nigeria still has 10.5 million out-of-school children; the world's highest number and about 60% are girls. In northern Nigeria, the following states have however, shown commitment to improving their education systems; Jigawa, Kaduna, Katsina, Kano, and Sokoto, but they face severe challenges including high poverty levels, low enrolment, gender disparities, poor quality and relevance, poor infrastructure and learning conditions (UNICEF). Obviously, this aligns with the lowest rating by users for the Operations & Maintenance parameter of this infrastructure at 1.37 – F1 (unfit for purpose), although it was still a slight improvement from rating of 1.23 – F2 (unfit for purpose) given 4 years ago.

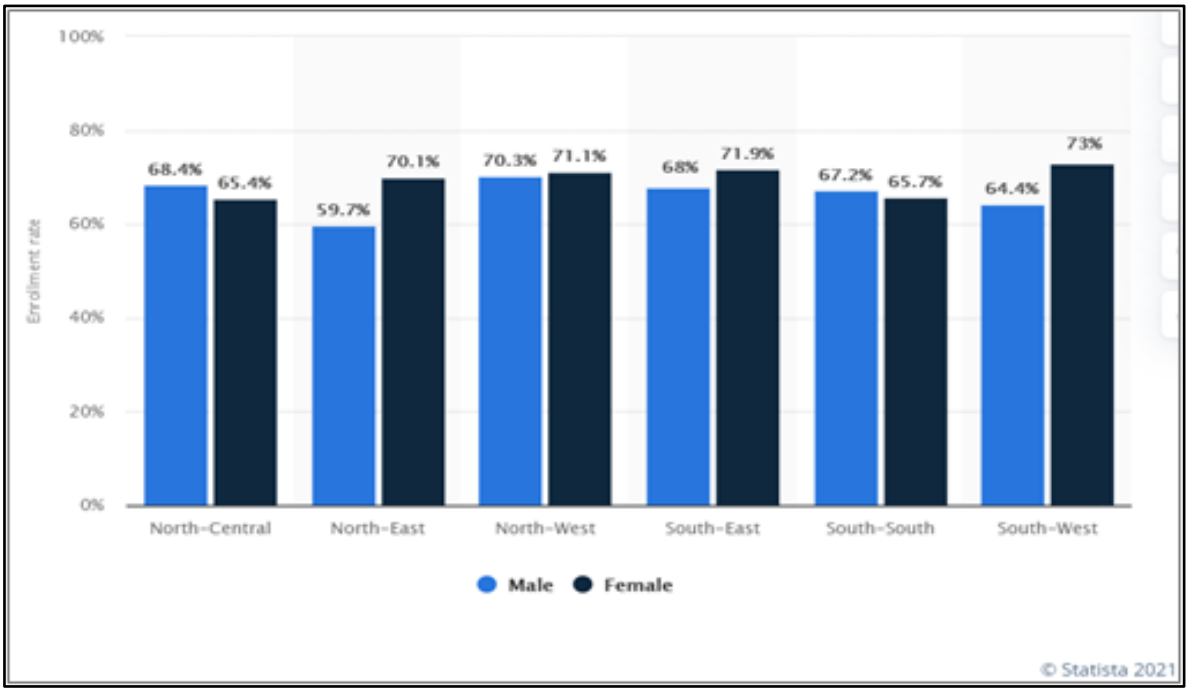


Figure 8-64: Gross enrollment rate in private and public elementary school in Nigeria as of 2018, by zone and gender

Based on the announcement by President Muhammad Buhari during the 2021Global partnership Summit, he noted that the current administration is taking steps to ensure free and compulsory basic education for the first 9 years of schooling; currently implementing social investment and school feeding programmes which have dramatically increased school enrolment, retention, and higher transition rates from primary to secondary and tertiary levels. We believe that the rate of enrolment in schools would improve drastically if these measures are sustained.

The privately owned institutions are the main stay of the primary

education system. The public primary schools in my area of coverage are poor. It gets 'better' as you up the ladder for public institutions

Engr. Olanrewaju Apampa

Chief Lecturer, Public

8.13.4 SECONDARY EDUCATION INFRASTRUCTURE

This infrastructure was rated F2 (1.55) – Unfit for purpose and maintained same rating as 2017 rating of F2 (1.44). This shows that compared to global standard, our secondary school is still lagging in terms of infrastructure development. Secondary Education in Nigeria covers ages 12 to 17 and is divided into two levels: lower secondary education and upper secondary education. As of 2018, in junior secondary school, the number of public secondary schools, was 13,581 and private -18,986, bringing the total to 32,567; while as of 2019, the total number of public secondary schools in Nigeria was 9,824 while private was 14,245 giving a total of 24,064 (NIIMP, 2020). This shows that government needs to invest in building more public-school infrastructure especially for the low-income earners to encourage free education and reduce the rate of out-of-school children.

On a positive note, According to data by UNICEF (2021), from 2000 to 2019, the number of out-of-school children of lower secondary school-age shrank from 99 million to 61 million, and the number of out-of-school children of upper secondary school-age fell from 177 million to 137 million.

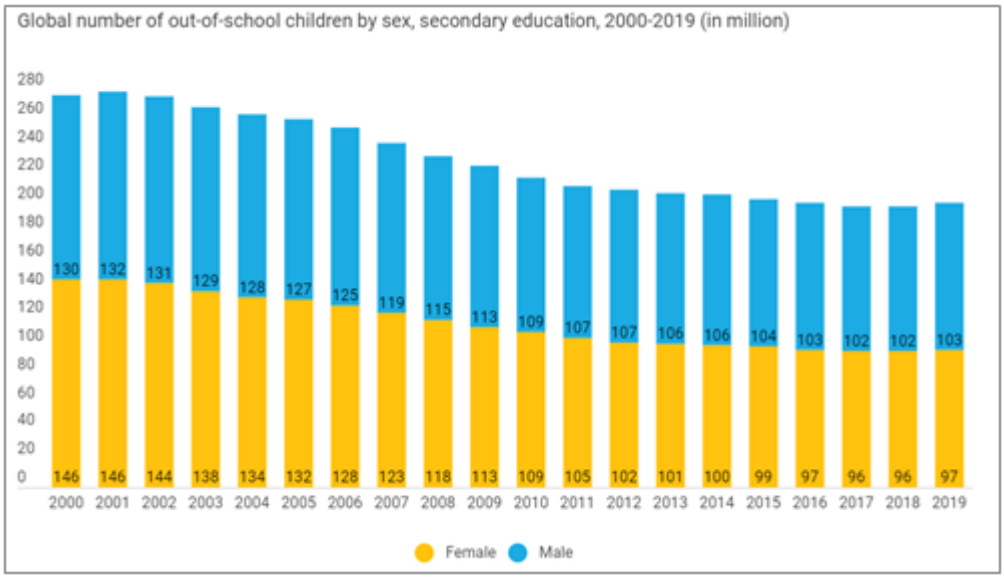


Figure 8-65: Source: UNESCO Institute of Statistics Global Database, 2020

In fact, all the parameters rated for this infrastructure class have shown improvements from the users' perspective compared to 4 years ago. The Global Competitiveness Index 2017-2018 edition rated quality of education in terms of Secondary school enrolment rate as 112th out of 137 countries analysed (Word Economic Forum).

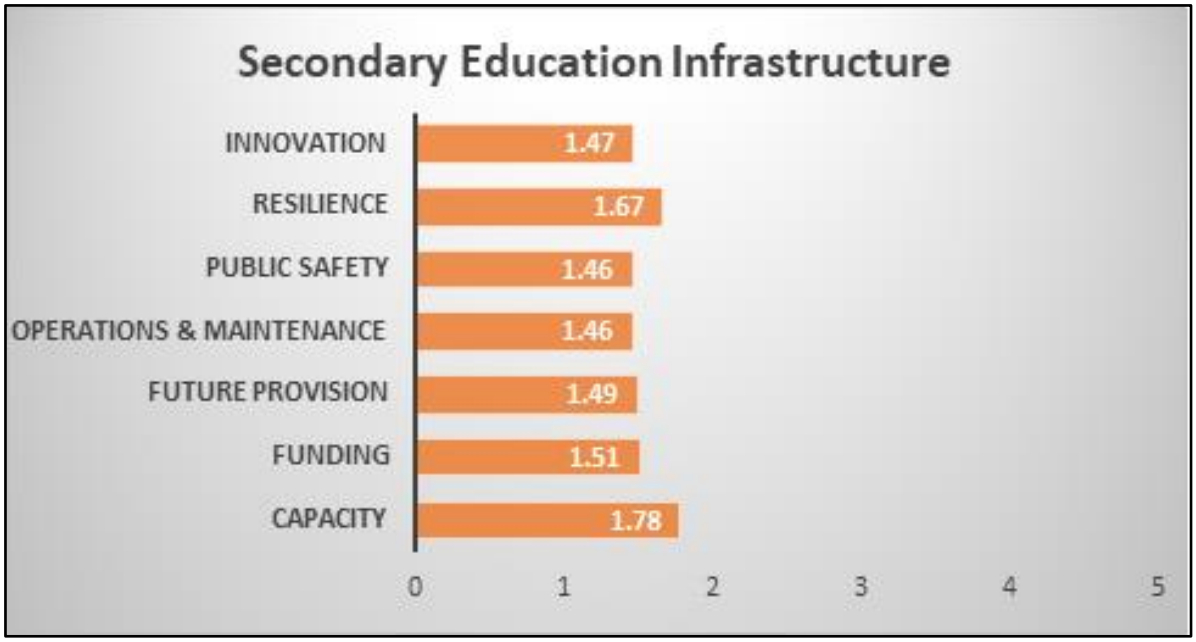


Figure 8-66: Secondary education infrastructure

In 2017, according to the Oxford Business group, the quality of primary and secondary education has lagged due to a lack of investment, poor teaching, large class sizes, rigid curriculum, and a lack of basic infrastructure. Consequently, respondents have rated Operations & maintenance and public safety lowest with a rating of 1.46 (unfit for purpose), a clear indication that the state of most public secondary schools do not yet meet global standard in terms of infrastructure and quality of teaching. The infrastructure however seems to be doing better in terms of capacity which was rated at 1.78 (poor state) compared 1.62 (unfit for purpose) rated 4 years ago.

Innovation parameter is also rated low at 1.46 (unfit for purpose). However according to the NIIMP 2020 reports, we can see that efforts are being made by the government to improve success at this level of secondary education in terms of:

- Procuring and disbursement of instructional materials in 36 states and FCT
- Introduction of open school system in six states: Kaduna, Kano, Kebbi, Niger, kebbi, Niger.
- In January, 2020 the National Commission for Colleges of Education approved additional six Federal Colleges of Education opened in the following states Bauchi, Benue, Edo, Ebonyi, Osun and Sokoto who had no Federal colleges of Education before
- Additional six Federal Colleges of Science and Technology were added in 2019 bringing up the Federal Unity schools to 110.

8.13.5 VOCATIONAL INSTITUITIONS INFRASTRUCTURE

Vocational and technical education is at the bedrock of developing countries and impacts greatly on the GDP growth rate. The more a country invests in equipping its people with essential vocational skills, the more productive the economy becomes in solving

both economic and environmental problems thereby increasing the market value of the country.

In 2017, the National Board for Technical Education (NBTE) recognized 107 polytechnics, 27 monotechnics, and 220 colleges in various specific disciplines. By 2018, the number of approved Innovative Enterprise Institution (IEIs) were 140 while approved Vocational Enterprise Institutions (VEIs) were 77 in number. Beyond the addition of vocational institutions, more efforts lie on the government in ensuring that such institutions are well equipped to produce graduates that would be able to meet up with the workplace demand.

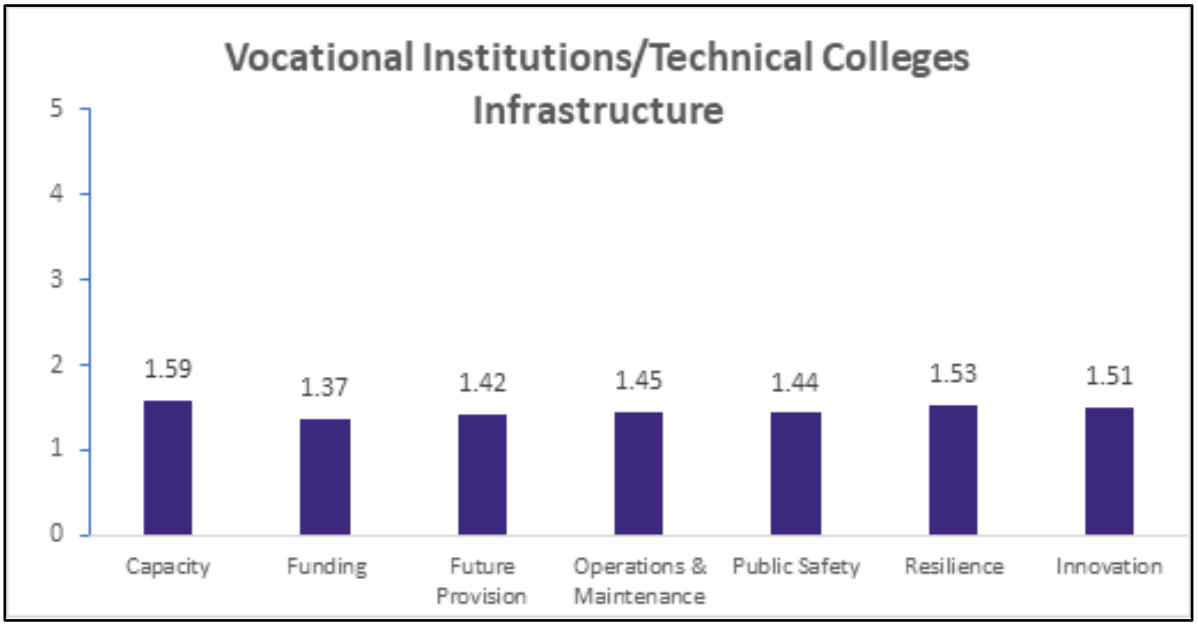


Figure 8-67: Vocational institutions/ technical colleges infrastructure

The admission data released by the Joint Admissions and Matriculations Board (JAMB) shows that only 1,377 students were admitted to innovation enterprise institution compared to a total of 444,947 students admitted to the nation's universities and about 96,423 students admitted to polytechnics and monotechnics. This data therefore is an indication that level of technical education enrolment is very low for youths in Nigeria and needs more awareness.

Vocational Institution infrastructure has maintained the same rating over the last 4 years at F1 – 1.47 even though it is a slight increase on the same rating scale from F2- 1.27 rated in 2017. This falls under the unfit for purpose rating which shows that the government needs to pay more attention to developing our vocational institutions to global standard and ensure that the quality of teachers employed meet up to these standards.

The capacity parameter rated at 1.59 (F1) is the highest rated out of the other parameters, showing a rise from 1.27 (F2) rated 4 years ago by respondents. This shows that the current state of the vocational infrastructure in the country is unfit for purpose and needs government's intervention. According to the National Board for Technical Education, TVET in Nigeria is facing the following challenges of gender inequality, inadequate financing and capacity development for teachers & trainers. The issue of

finance is obviously seen through the survey conducted as respondents have rated funding lowest at 1.37 – F1 (unfit for purpose).

Consequently, with the impact of COVID-19 pandemic on economies globally, the unemployment rate has significantly increased. The International Labour Organisation (ILO) from recent projections have estimated that 1.6 billion jobs may be lost worldwide. In addition, the Nigerian Bureau of Statistics reported a high unemployment rate of 27.1% and underemployment of 28.6% with an aggregate of 55.7% as of the second quarter of 2020. One of the education infrastructures that can cause a decline in the unemployment rate is vocational institutions. As students would be equipped with the skills required to create wealth and all together impact economic growth. The table below gives a clear view of the unemployment rate in the country that grew from 9.62% in 1999 to 17.69% in 2019.

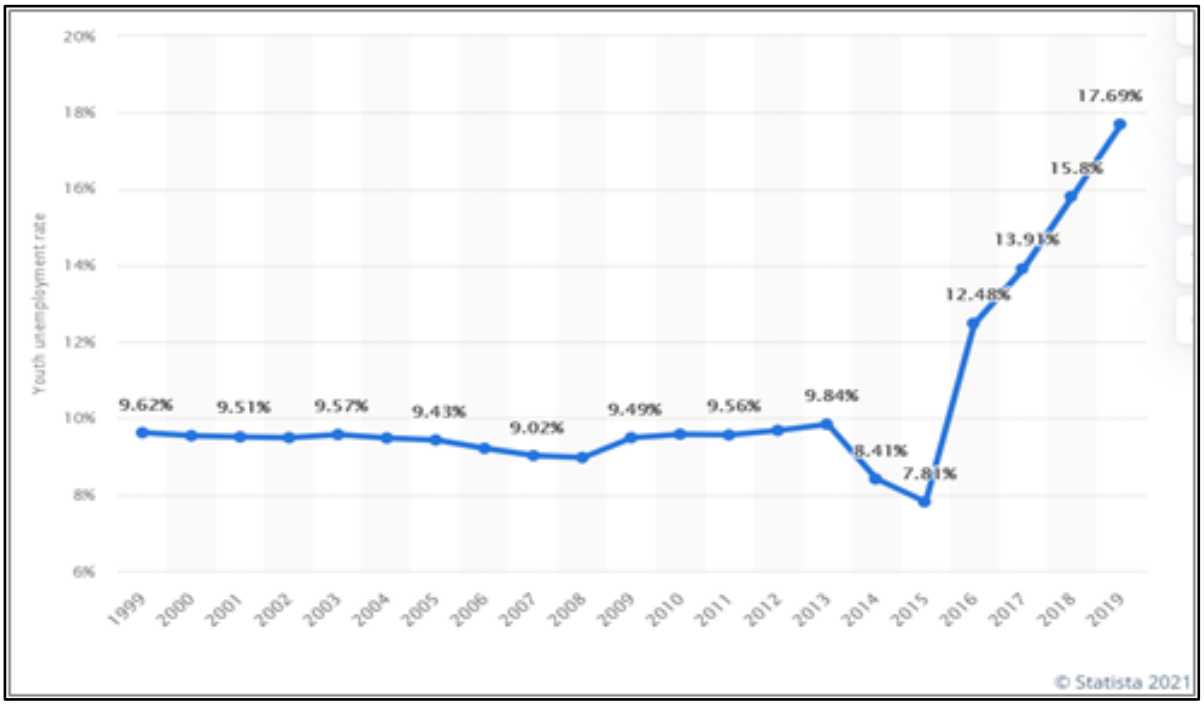


Figure 8-68: Labour force in Nigeria in 2020, by educational level (in 1,000s)

On the other hand, Funding was rated at 1.37 score, maintaining the same rating category (Unfit for purpose) for 4 years now. The federal government has however set up various youth empowerment programmes as alternative to encourage vocational training among Youths.

According to the NIIMP 2020 reports, Government has intensified effort for job creation by setting up series of programmes such as N-Power as part of the ERGP the National Accelerated Youth Development Programme (NAYDEP) with the aim of creating over 15 million jobs (an average of 3.7 million jobs per annum) during the period 2017-2020. The N-Power programme was also introduced in 2016 to provide short term employment opportunities for 500,000 youths in the education, health and agriculture sectors.

8.13.6 TERTIARY INFRASTRUCTURE

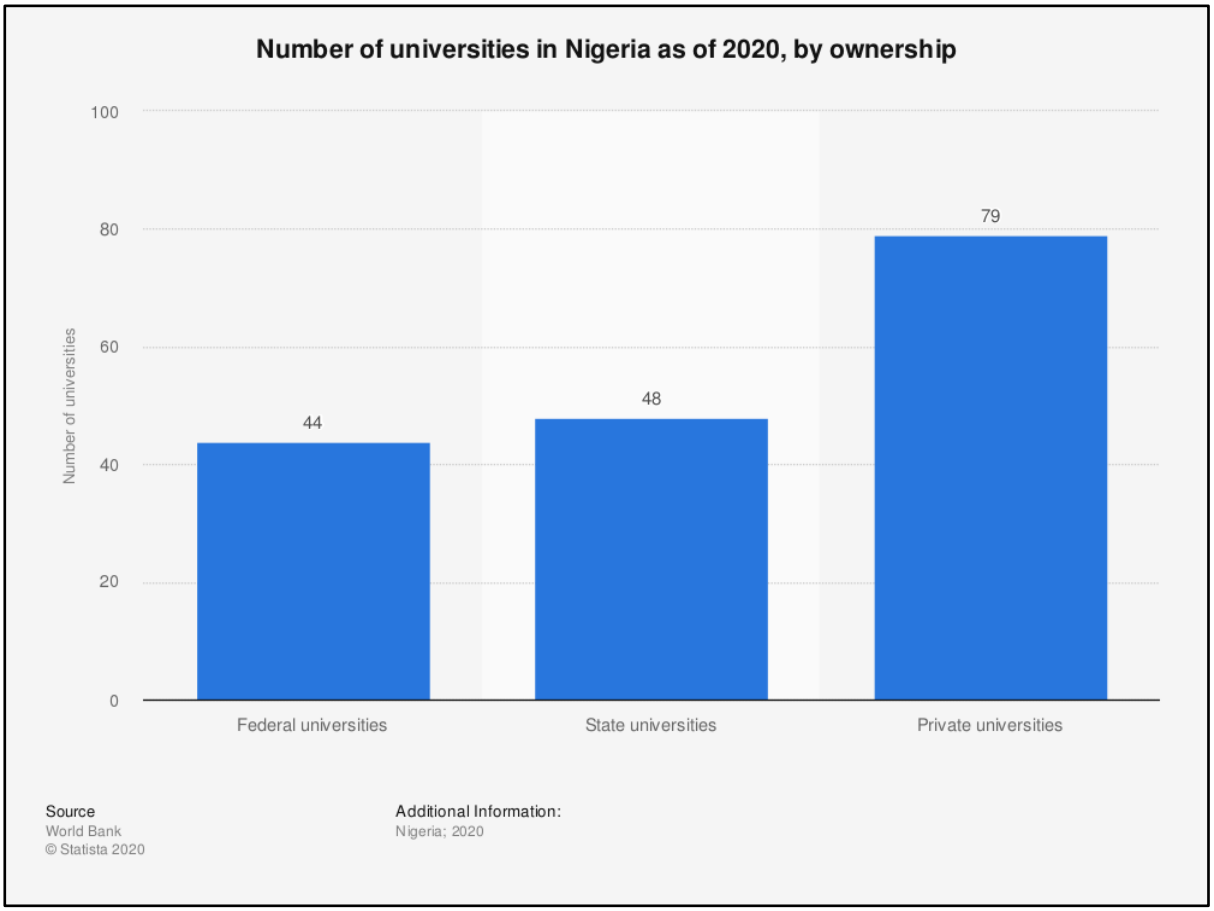


Figure 8-69: Number of universities in Nigeria as of 2020, by ownership

The global university ranking showed that Nigeria is low in performance at the tertiary level. Only three universities therefore made it to the list of best 1,400 universities in the Times Higher Education World University Rankings in 2019, as against one university in 2018. In 2019, 1,990,067 applied for admissions into 883 tertiary institutions through the Joint Admission and Matriculation Board (JAMB) examinations. However, only 612,557 applicants had provisional admissions out of which a total number of candidates admitted provisionally into universities were 444,947, comprising 235,333 (53 per cent) into federal universities, 181,401 (40.7 per cent) into state universities and 28,213 (6.3 per cent) into private universities (NIIMP Report, 2020).

This infrastructure remains one of the best rated infrastructures amongst other education infrastructure rated at E1 (1.81), a slight increase in rating from E2 (1.70) in the 2017 Infrastructure Scorecard rating. Although it falls within the same rating category of a poor state. This, however, is an indication for improvement by the government. All the parameters show an improvement from 4years ago in terms of the scores rated by respondents.

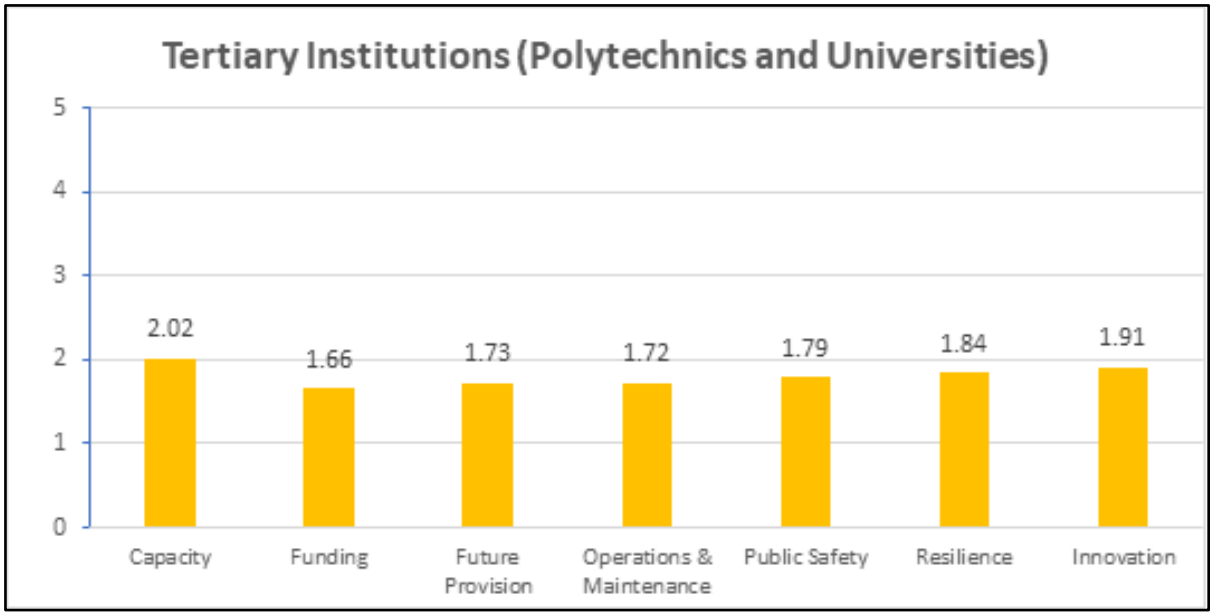


Figure 8-70: Tertiary institutions (polytechnics and universities)

According to our research, Nigeria's universities produce only 44% of the "scholarly output" of South Africa and 32% of Egypt. This is despite the fact that Nigeria has nearly four times more universities than Egypt and over six times more than South Africa.

For the capacity parameter rated highest at E1 (2.02), the infrastructure has shown an improvement from last year at E2 (1.85). This shows intentionality on the part of the government to increase tertiary infrastructure capacity according to the report from the National Universities Commission (NUC) in 2019, where the Federal Executive Council (FEC) approved the establishment of 20 new private universities in Nigeria bringing the total number of private universities in the country to 99. All the parameters rated fall within the same category of poor state except funding which happens to be the lowest rated parameter.

As mentioned, tertiary education infrastructure funding remains the lowest rated in this infrastructure class at 1.66 (unfit for purpose) but it's a slight rise from 1.60 (unfit for purpose) rated 4 years ago. In order to improve the current state of financing of tertiary institutions, some initiatives have been put forward by the federal government to improve this infrastructure according to the NIIMP 2020 report:

- Central Bank of Nigeria's Centre of Excellence project: The project estimated to cost over N63 billion (USD$206 million) involves the construction and equipping of nine centres. Three Centres were completed at the end of 2019 in University of Ibadan, University of Nigeria, Nsukka and Ahmadu Bello University, Zaria.
- Tertiary Education Fund (TETFund) High Impact Project: Fund finances wide range of projects in 85 universities, 66 polytechnics and related institutions, and 67 COEs as at 2019. Between 2009 and 2013, TETFund earmarked N1,469 billion ($4.8 billion), out of which N878 billion (42.8) was earmarked for infrastructure related projects. In 2016, N83.4 billion ($273.5 million) was earmarked specifically for physical infrastructure, of which N42.8 billion ($140.5 million) was disbursed to public universities, polytechnics and COEs. In addition, as at 2019, a total of N190.6 billion ($624.9 million) was

earmarked for the High Impact project, of which N136.3 billion ($446.8 million) was released. 25,000,000.00 was released in 2019 by TETFund to all the Tertiary institutions in the country.

There is the need to develop a sustainable funding model for the educational sector. In particular, the tertiary education sector should be remodeled towards supporting national development through research relevant to societal needs. Hence infrastructure development should be needs and industry collaborations/partnerships driven

Engr (Prof) Victor Oluwasina Oladokun
Professor, Public

Corruption is high amongst the workforce, laxity of learning due to exposure and encouragement to participate in malpractices by adults as well as misconducts of officials before, during and after examinations, will continue to make the education sector poorly rated globally, the workers poorly paid and the calibre of students produced ill equipped

Olubukola Betty, OLATOYE
Technical Director

8.13.7 INTERNATIONAL BENCHMARK

Education Indices	Africa Benchmark				Global Benchmark		
	Nigeria	Ghana	Egypt	South Africa	USA	UK	UAE
Literacy rate (%)							
Enrolment rate (%)							
Completion rate (%)							
Employment rate (%)							

Poor staffing, poor wages for teachers and lecturers, very poor welfare, poor teaching and lecturing materials, substandard accommodations for pupils and teachers and inspection of primary and secondary schools terribly bad. Since our future of this country resides with these young ones every thing must be done to improve the education system in this country

Engr. Prof. A. A. Asere
Retiree

Educational institutions should be adequately funded, linked to the industries, instructors adequately trained and renumerated, curriculum reviewed to meet the present day realities, practical oriented, vocational training emphasize

Engr Olowookere Kamaldeen
Principal Mechanical Engineer

Primary & Secondary Education must be strengthened, University management must be more innovative and proactive, Reward system to be introduced for very productive institutions, All educational institutions must learn how generate revenue from R&D and other entrepreneurial activities

Engr. Mohammed Dauda
Professor

Educational institutions are not properly funded and no adequate future plan for the incoming children. Maintenance of infrastructure is very poor in the primary and secondary schools, and fair in public higher institutions.

Engr. C Madu
Lecturer

8.14 HEALTHCARE INFRASTRUCTURE

8.14.1 BACKGROUND

Health infrastructure is understood in both qualitative and quantitative terms to mean the quality of care and accessibility to health care delivery within a country. It is judged by the quality of physical, technological, and human resources available at a given period. While the physical healthcare structure entails the buildings and other fixed structures such as pipe borne water, good access roads, electricity and so on within the healthcare environments, the technology is about the equipment meant specifically for hospital use including surgeries (Erinosho, 2006) and Ademiluyi & Aluko-Arowola (2009).

The Nigerian healthcare system is organized as a hub of the radial referral system of primary, secondary, and tertiary healthcare delivery. Primary healthcare services are domiciled within the purview of Local Governments. State Governments are solely involved in the delivery of secondary healthcare service, while the Federal Government is responsible for the development of healthcare policies, the overall coordination of the healthcare system, and the delivery of tertiary healthcare services. Currently, Nigeria has 23,385 public Primary Healthcare Clinics (PHCs) or an average of 30 clinics per Local Government Area, 963 Secondary Care Centres or about 27 facilities per State, 42 Tertiary healthcare institutions, and 13 specialist hospitals across the country. Also, there are 8,355 private PHCs and 3,030 private secondary facilities.

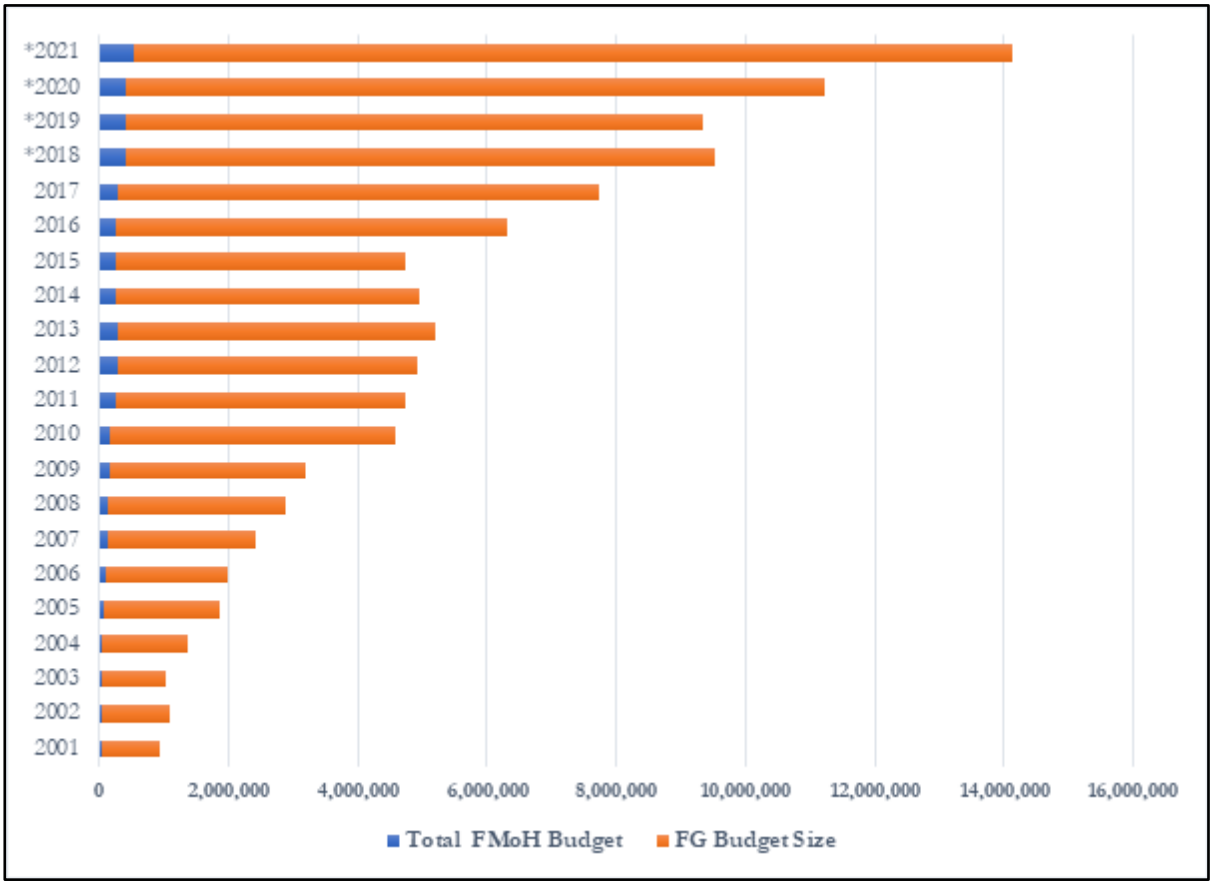


Figure 8-71: Figure 9 69: FMoH Budgetary Allocation (Billion Naira) (Source: Federal Ministry of Finance, Budget & National Planning)

As reported in the 2020 edition of the National Integrated Infrastructure Master Plan, of the Federal Ministry of Finance, Budget & National Planning; extended years of under-investment in healthcare delivery in Nigeria has resulted in poor and inadequate infrastructure, including hard infrastructure like buildings and modern equipment and technology, and soft infrastructure such as major underlying systems to support data management, business continuity, and even the adequacy, mix and distribution of healthcare workers. This has particularly resulted in the poor development of key specialties and loss of confidence in the general quality of healthcare delivery, especially in the management of non-communicable diseases; even though Nigeria has one of the fastest growing populations, globally.

While vaccine-preventable, and infectious diseases remain the leading causes of morbidity and mortality in Nigeria with 5.5 live births per woman and a population growth rate of 3.2% annually, the country is estimated to reach 440 million people by 2050 and over the past two decades the total health budget set by the Federal Government has not been more than 7% which is less than the pledge made at the World Health Organisation's, 2001 Abuja declaration to make the health budget 15% of total budget. (World Bank, 2021).

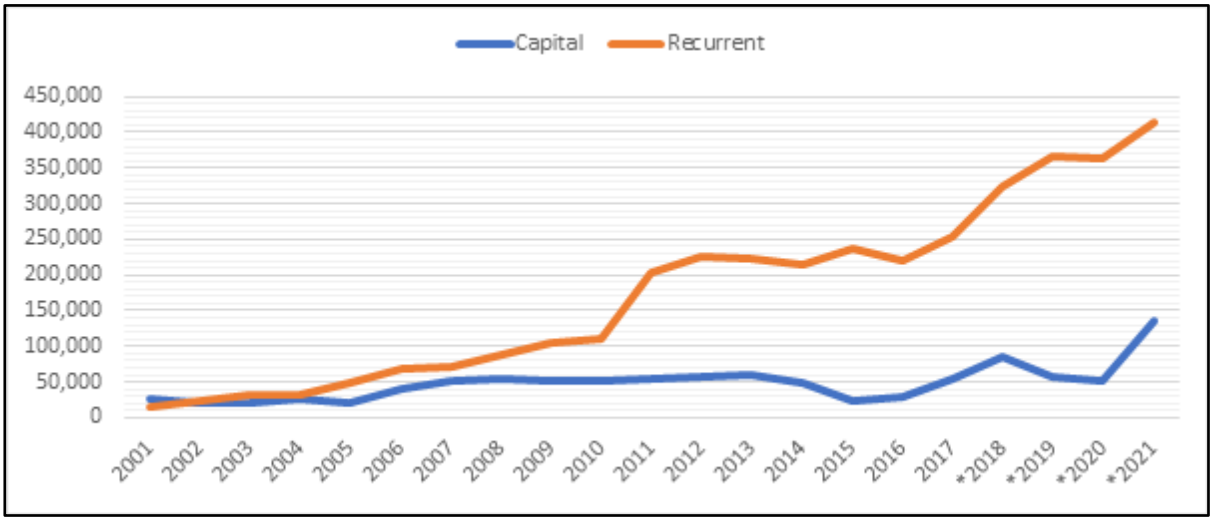


Figure 8-72: Distribution of FMoH Budgetary Allocation (Billion Naira)

Interestingly, a recent publication of The Guardian estimated that Nigerians spend over N576bn (US$1.2bn) on healthcare tourism in countries like United States, India, Brazil, and others every year due to the decrepit state of the healthcare infrastructure in the country. In addition, the poor state of the sector has led to severe brain drain with several healthcare workers seeking greener pastures in countries like Canada, USA, the UK, and Saudi Arabia, among others.

Key healthcare indicators for Nigeria are summarised as follows:

- Major causes of child mortality and morbidity are diarrhoea, acute respiratory infections, malaria, measles and other vaccine-preventable diseases, and the exacerbating effect of children's malnutrition.
- 74 deaths per 1,000 live births in 2019, a level above the target of 64 deaths per 1,000 live births agreed for the UN-SDGs (World Bank, 2021).
- 814 women died per 100,000 live births due to pregnancy related complications. The lifetime risk of a Nigerian woman dying during pregnancy, childbirth, postpartum or post-abortion is 1 in 22, in contrast to the lifetime risk in developed countries estimated at 1 in 4900 (WHO, 2019).
- Access to primary healthcare is currently about 61 per cent with only 15 beds available per 1,000 population and only 30 primary healthcare centres per 100,000 people.
- 52 years life expectancy in 2019 compared to Sub-Saharan African average of 62 years, and 69 years for Lower Middle-Income countries (World Bank, 2021).

8.14.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE & RATING

The overall rating of Nigeria's Healthcare Infrastructure is F1 (1.61) which means that the infrastructure is Unfit for Purpose and is on the verge of failure exposing the public to health and safety hazards. This is about the same line of rating compared to 2017 rating of F1 – (1.60) and a significant decline from the E3 rating in 2015. This is an indication of the opinion that the current healthcare infrastructure in the country has declined noticeably compared to 2015 (2.30).

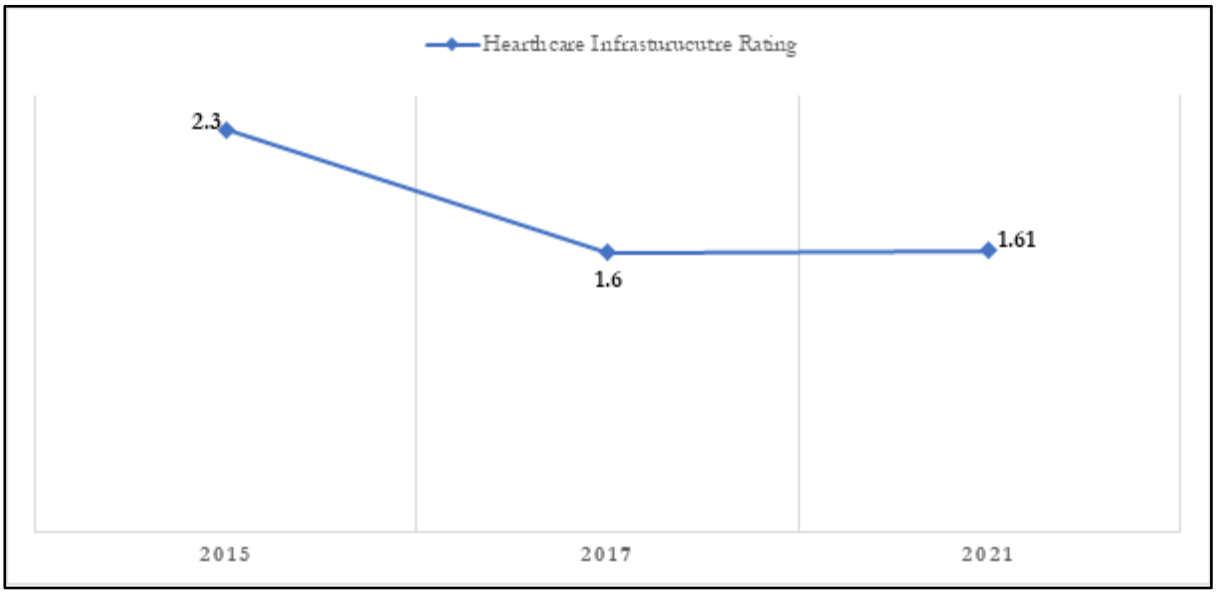


Figure 8-73: General Healthcare Infrastructure

Comparing this rating with the different sub-sectors of the healthcare infrastructure as identified in this report, primary healthcare Centres has the least rating of 1.38 compared with 1.52 and 2.23 rating in 2017 and 2015 respectively. The current General Hospitals infrastructure showed a slight increase over the 1.49 rating in 2017 to 1.51, while Specialist Hospital is considered to have improved significantly from the initial rating of 1.65 in 2017 to 1.88 in 2021, an indication of substantial improvement of the specialist Hospital Infrastructure in the country. Although the rating falls within the E2 – Poor State – implying that the infrastructure still requires urgent rehabilitation to avoid complete failure and restore to serviceable state.

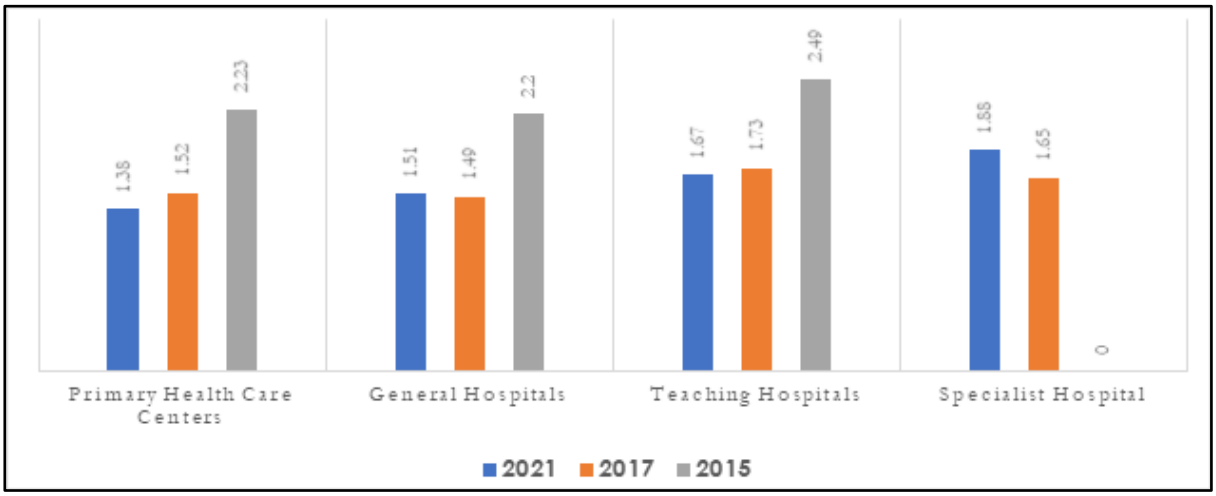


Figure 8-74: Health Infrastructure Rating (2015 - 2021)

8.14.3 PRIMARY HEALTH CARE CENTRES

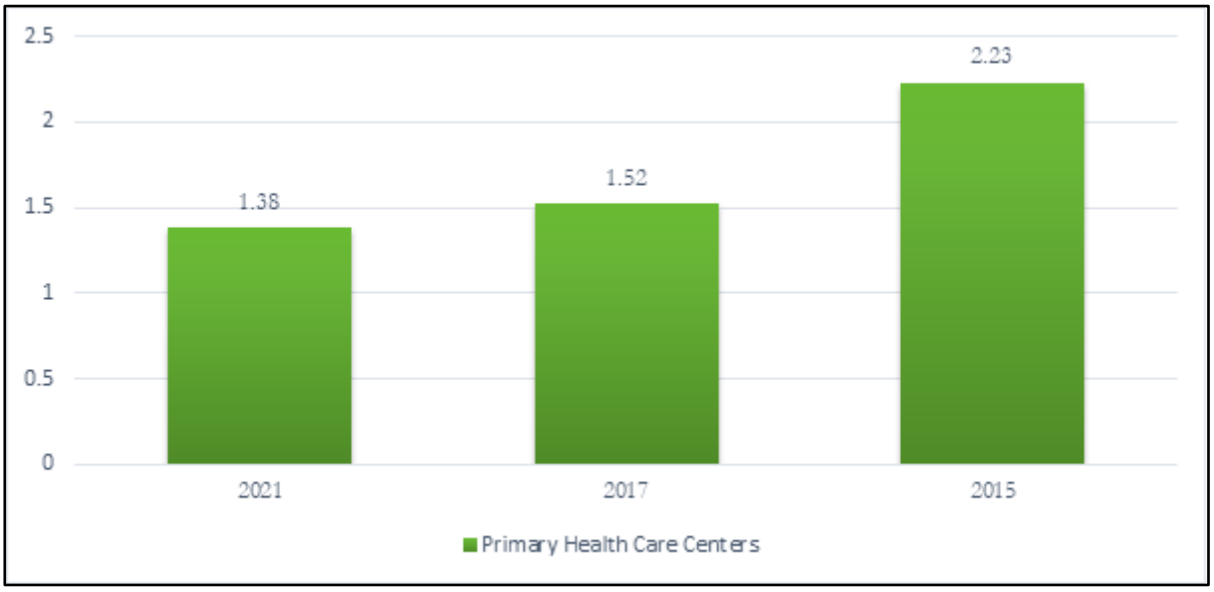


Figure 8-75: Primary health care centres (PHC) rating (2015-2021)

In Nigeria, the local governments oversee the operations of primary health care facilities within their geographic areas. This includes the provision of basic health services, community health, hygiene, and sanitation. The primary healthcare infrastructure received a rating of F1 – (1.38) from respondents – Unfit for purpose meaning the current primary healthcare centres infrastructure is on the verge of failure, exposing the public to health and safety hazards and thus require immediate attention of the authorities. More so, that the rating falls below the1.52 and 2.13 ratings in 2017 and 2015 respectively.

Although, the rates of the primary healthcare infrastructure in terms of capacity to meet current and future demands is 1.63 which is a slight improvement from the 1.57 rating in 2017, operations and maintenance standard (1.28) as well as innovation (1.28) as regards the use of modernized techniques and delivery methods were seen to be major problems of the current primary healthcare system in Nigeria.

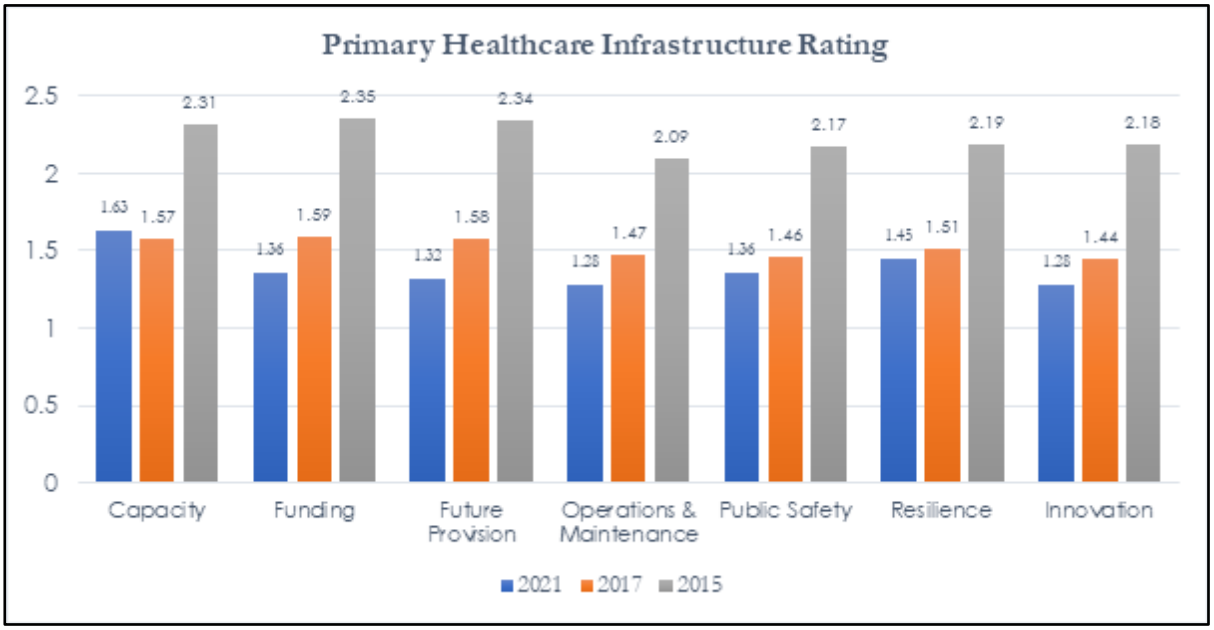


Figure 8-76: Primary Healthcare Infrastructure per Category

8.14.4 GENERAL HOSPITALS

General Hospitals were rated F1 – (1.51) – Unfit for purpose – indicating that the respondents believe the current general hospitals infrastructures have failed to live up to its expectations and clearly failed and require immediate attention. Although, this rating represents a slight improvement of general hospitals infrastructure from the E3 (1.49) rated in 2017. However, comparing the current rating to the F2 – (1.49) in 2015, respondents simply believe the state of the infrastructure has deteriorated more than it was in 2015.

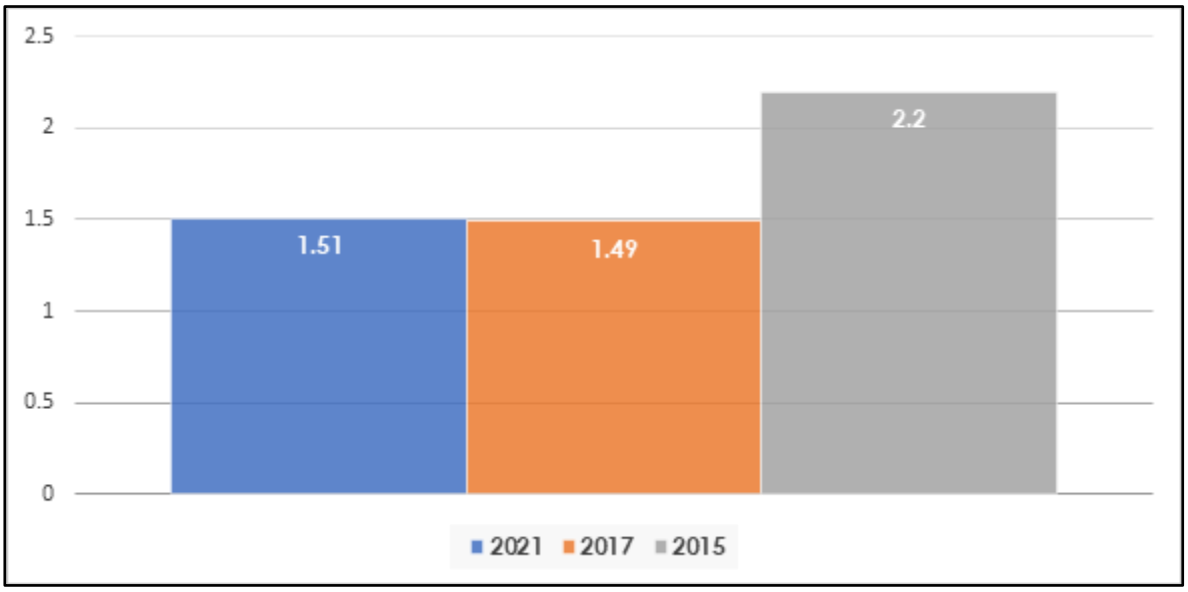


Figure 8-77: General Hospitals Infrastructure rating (2015 – 2021)

Looking at the rating category for General Hospitals, a broad decline across the rated categories was observed in 2021. For instance, respondents rated modernization (1.28), resilience (1.45), safety standard (1.36) and future provision (1.32) of the current general hospitals infrastructure below ratings in 2015 and 2017 as presented in Figure 5. The capacity of the current general hospitals in terms of its adequacy and capacity to meet current and future demands was however rated (1.63) which is a slight improvement from 2017 rating.

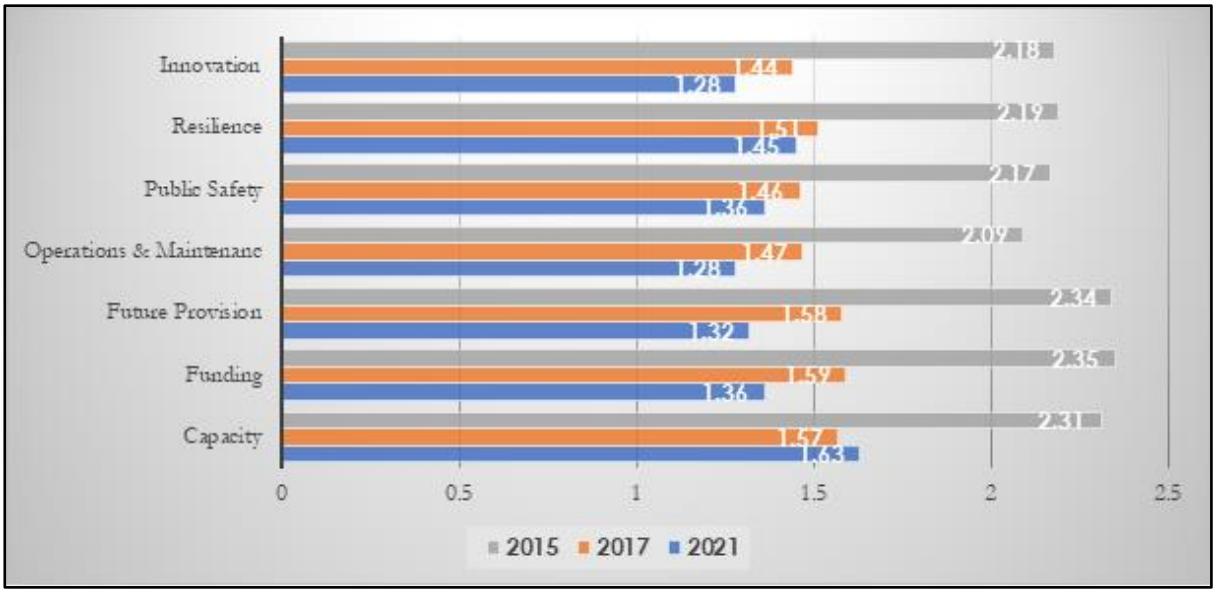


Figure 8-78: General Hospitals Infrastructure per Category

8.14.5 TEACHING HOSPITALS

Respondents rated the nation's teaching hospital healthcare infrastructure at a poor state – F1 (1.67). Even though this rating is not the least of the health infrastructure category, it is a significant decline from the previous rating of D1 from the 2015 Infrastructure scorecard rating, with future provision, i.e., cost to improve the infrastructure and determine if future funding prospects will be able to meet the need ranking least while, the infrastructure rating in terms of adequacy and capacity to meet current and future demands – i.e., capacity of the current teaching hospital shows a considerable improvement as respondents rated it 2.05 above the 1.88 rated in 2017.

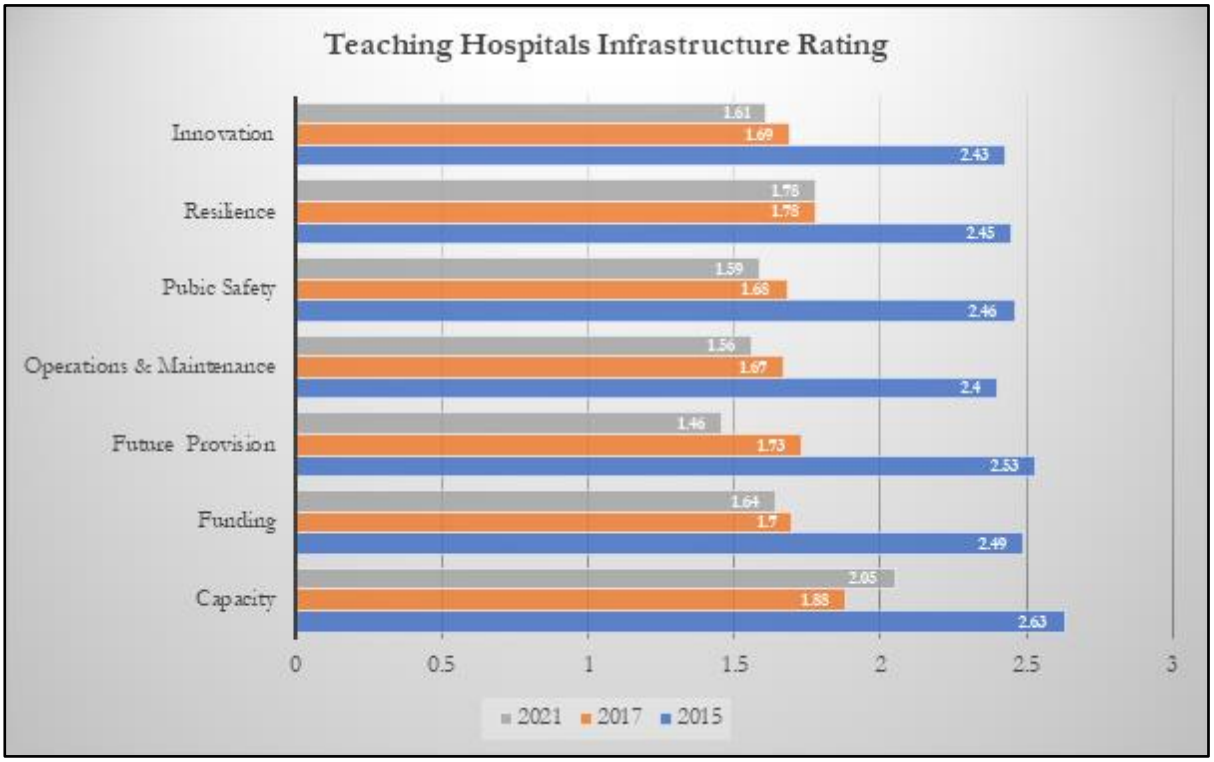
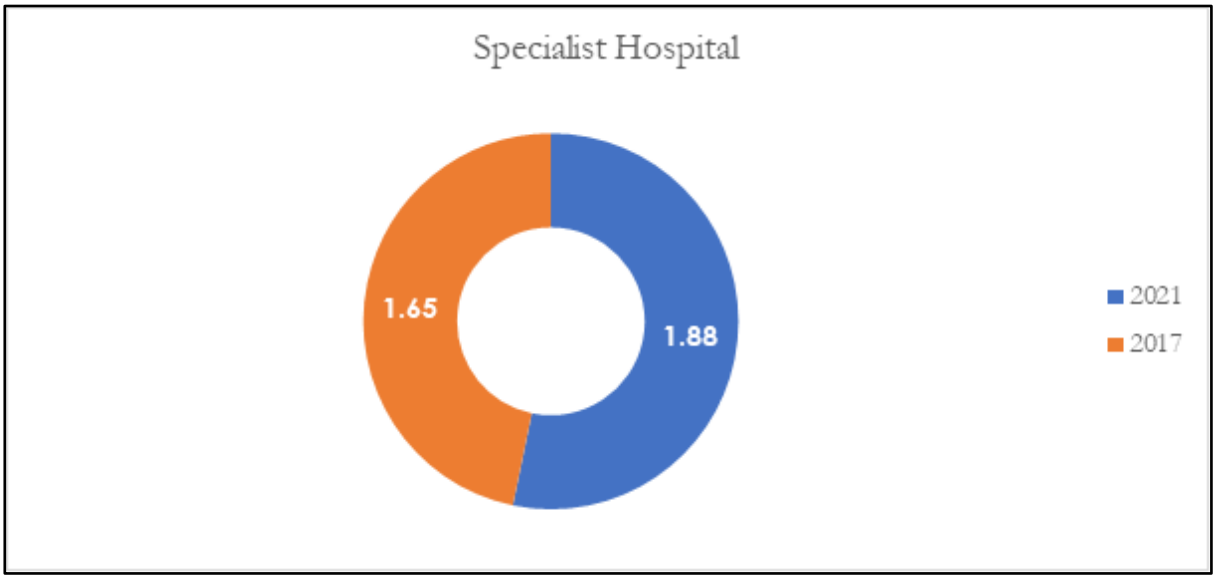


Figure 8-79: Teaching hospital infrastructure rating

8.14.6 SPECIALIST HOSPITALS

Respondents rated the nation's specialist hospital healthcare infrastructure at a poor state – E2 (1.88). Even though this rating is best within the overall healthcare infrastructure category and represented a significant growth from the previous rating of F2 from the 2017 Infrastructure scorecard rating.



In the face of all the challenges bedevilling the Nigerian healthcare infrastructure as enunciated in the survey outcome above; the authority's commitment to revitalizing its healthcare system is underscored

by a robust health sector reform. For instance, the National Health Act enacted in October 2014 and the revised National Health Policy (NHP) in 2016 to provide direction necessary to support and significantly strengthen healthcare delivery. The goal for healthcare infrastructure development in the NHP 2016 is to achieve adequacy in quality and network of healthcare services. Thus, the specific objectives of healthcare delivery include, to:

- improve availability and accessibility of high quality and functional healthcare facilities across the country to support affordable healthcare delivery.
- expand healthcare coverage to provide equitable access to healthcare services, especially in under-served areas.
- ensure that all healthcare infrastructure, including biomedical equipment, comply with very high-quality standards and requirements.
- increase access to ambulatory (outpatient) healthcare services; and
- ensure effective maintenance of healthcare equipment and infrastructure at all levels.

Considering the commitment of the NHP to promote multi-sectoral and public-private partnerships for health infrastructure development and maintenance, government is to provide policy support and incentives for private sector investment and foreign direct investment in healthcare service delivery. Further to the decision for Nigeria's Sovereign Wealth Investment to prioritize investment in healthcare development, priority would be given to the development of physical infrastructure and strengthening of underlying systems that support the equitable delivery of high-quality healthcare service, especially in areas of Research and Development. To further make healthcare services more available, considering that primary healthcare is the bedrock of national health development in addition to the provision of financial risk protection to citizens, especially the poor and vulnerable population, the following infrastructural priorities also relate to improving healthcare delivery services in Nigeria:

- Functional PHCs would be affiliated to a contiguous General Hospital;
- All States should ensure that there is a functional and equipped General Hospital in every LGA manned by qualified personnel, with a strong referral system to contiguous tertiary hospitals;
- Existing tertiary and specialist hospitals would be revamped to meet the needs of the local population;
- Diagnostic and quaternary mono-specialist centres should be distributed in a manner that ensures equitable access to all sections of the country;
- A robust integrated health management information system would be established to generate timely data for evidence-based healthcare delivery decision-making and service improvement;
- Institutions that conduct development research to address priority health needs of the country would be strengthened.

In line with the NHP, the benchmarks for financing healthcare development are as follows:

- Governments at all levels to spend at least 15.0 per cent of their annual budgets on health care development.
- Federal Government is to set aside at least 1.0 per cent of the Consolidated Revenue Fund for the establishment of the Basic Healthcare Provision Fund (BHCF), as provided for in the National Health Act 2014; and

- The allocation of 15.0 per cent from the BHCF for the maintenance of health infrastructure, equipment and transport for eligible primary healthcare facilities, in line with the National Health Act 2014.

8.15 MASS HOUSING INFRASTRUCTURE

8.15.1 BACKGROUND

Housing Sector is one of the sectors seen as important for promoting economic growth in most developing countries. Every country therefore seeking to provide shelter for its people, must ensure adequate, affordable, and quality housing units are available to the public, while targeting an increase in its GDP growth rate. In 2019, the housing sector in Nigeria accounted for only 3.0 per cent of Nigeria's GDP while construction stood at about 100,000 units a year (Agbugah-Ezeana, 2019).

Lagos State being Nigeria's economic and industrial hub and ranked as the 18th largest city in the world as at 2018, the urbanization rate is about 5.8% per annum while in this same year, it was reported that 55.3% of the world's 4.2 billion people lived in urban areas globally. In 2021, report has it that Nigeria's urban population already makes up over 50% of its 200 million plus population. It is therefore not surprising to see that the bulk of demand for housing, land, and rent is more in the urban areas of Lagos, Port Harcourt and Abuja, which has led to the housing deficit increasing annually by an estimated 900, 000 units and will require N6 trillion (USD 16 billion) of annual investment. This scenario thus suggests the need for private sector collaboration in tackling this problem under the right economic framework. (CAHF 2019, Understanding Nigeria's Housing Finance Report).

According to the UN estimation of the Nigerian population, 75 percent of the population will be living in cities by 2050 (Figure 1). This translates into an annual housing requirement over the coming decades of at least 700,000 units just to keep up with growing population and urban migration (Developing Housing Finance report by World Bank).

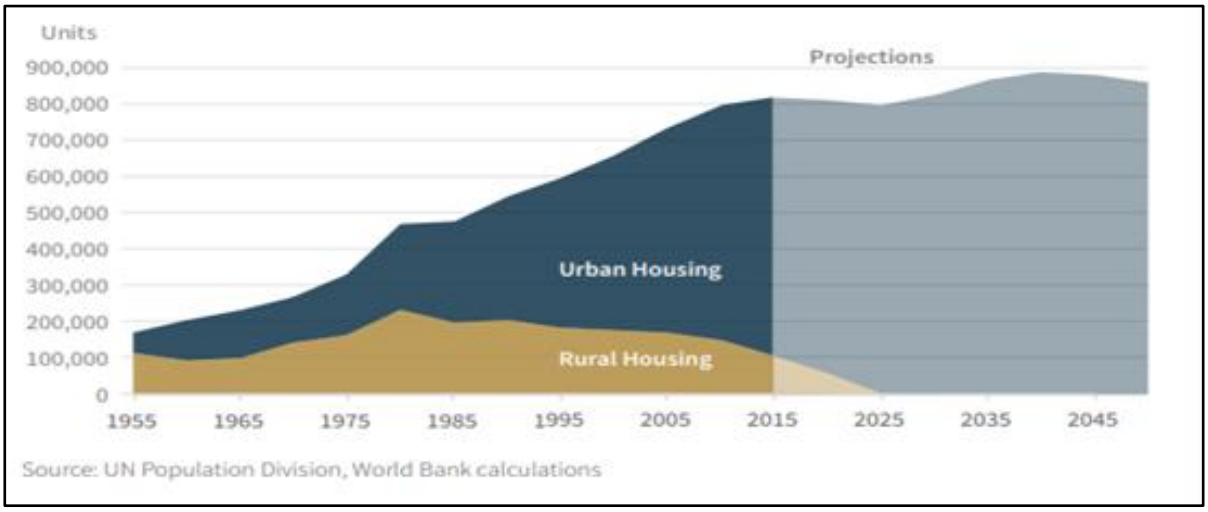


Figure 8-80: Nigeria annual housing needs 1950-2050

In addressing the housing deficit in the country, the Federal Government (2017-2020) and the Economic Recovery and Growth Plan [ERCG] proposed the setting-up of a Family Homes Fund (FHF), as an initiative that led to these key strategies: the construction of 2,700 housing units in the short-term to create 105,000 direct jobs a year and gradually increased the target to 10,000 housing units per annum by 2020; the construction of 20,000 pilot social housing units; and repositioning of the Federal Mortgage Bank of Nigeria by recapitalising it from N2.5 billion to N500 billion to meet the housing needs across Nigeria.

The Minster, Federal Ministry of Housing and works noted during an interview conducted within the period of this report, that the national housing programme has reached an advanced stage. He further disclosed that more than 2000 housing units have been completed; over 2000 units are on-going again in the first and second phases, all over the 34 states plus the federal capital except Lagos and Rivers.

In addition, significant progress made in the public sector has been geared towards ensuring access to housing: In June 2018, the Federal Housing Authority reported that it had invested N1trn ($3.2bn) in new housing projects in the country over the previous 45 years. The Federal Mortgage Bank of Nigeria (FMBN) in 2018 disclosed that it has processed N12.4 billion refunds to contributors of the National Housing Fund scheme and registered 224,752 to the fund while housing loans disbursed to 1,843 NHF contributors was N40.9 billion as at 2018. In November 2020, the Federal Mortgage Bank disbursed N265 billion under the National Housing Fund Scheme to boost the delivery of affordable housing to Nigerians

> **"*While the housing deficit is a problem that mainly afflicts urban centres like Abuja, Lagos and Kano, as a result of migration there are empty houses in both rural and urban areas. But they do not meet the needs of most buyers. This has led to the government's decision to develop a pilot housing project that is currently running in 34 states, responding to different buyer needs, financial capabilities and cultural attitudes to housing, as well as the different categories of land"***
>
> ***Minster of Housing and Works, Babatunde Fashola***
> ***Nigeria Report 2019 (Oxford group)***

8.15.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

In Nigeria, Lagos with the largest population, the cost of acquisition of land is very high and costs of building materials have been on the rise ever since the COVID-19 lockdown leading to a high inflation rate and GDP contraction as of 2020 (Fig 3). All these factors have affected the price tag on housing units leaving affordable housing to high-income earners only. This clearly indicates the need for the government to invest more in Mass Housing to address the problem of affordability for low-income earners thereby reducing the housing deficit.

> ***"The National Social Housing Programme (NSHP) which is a component of the national post-COVID Economic Sustainability Plan (ESP) is another area of partnership. The plan was created to accelerate ongoing efforts by the government to improve access to social housing"***
>
> **Vice President, Professor Osinbajo(2021)**

This is the first time Mass Housing Infrastructure would be analysed in the NSE scorecard and from the analysis, it falls within the rating of unfit for purpose at F2 (1.46). This result shows that the current Mass Housing infrastructure in Nigeria is unable to meet present need for housing Nigerians, probably due to low capacity compared to the high demand for housing in the urban centres, or lack of adequate supply of financing or lack of available land to real estate developers and the public who have resorted to build-to-own. The more Nigerians that are homeless, the more the increase in the housing deficit and the more impact it would have on the country's GDP growth rate.

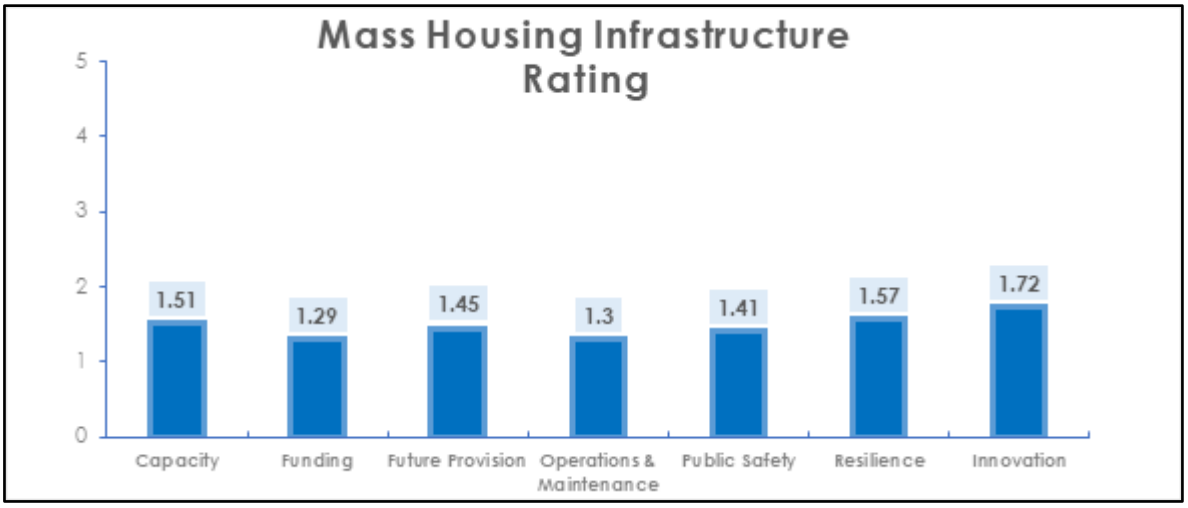


Figure 8-81: Mass housing infrastructure rating

The highest rating from the survey by respondents falls under innovation. This shows that the government strategic plans on improving the housing deficit in the country is clear to the public According to the report from the revised NIIMP team (2019), some of the following aspirations were noted by the Federal Government:

- Deliver 500,000 housing units by 2025, 1.5million housing unit by 2030 and 4.1million housing units by 2043.
- Develop Modular housing facilities across 36 States and FCT to have in 12 states by 2025, 24 states by 2030 and 37 states by 2043.
- Build 800,000 units of new affordable housing through private sector led initiatives: 4million by 2025, 8million by 2030 and 18.4 million by 2043.
- Reduce Mortgage rate to 30percent by 2025, 55percent by 2030 and 70percent by 2043.

Furthermore, from the analysis, capacity falls within the top 3 highest performing criteria analysed and this aligns with the reports of the update on the housing delivery by some states in the country. Respondents rated innovations around mass housing as the highest which also aligns with the current strategies in place by the government to resolve housing deficit,

although the challenge might eventually tend towards inadequate funding and full implementation of these initiatives.

In 2019, the Ministry of Works and Housing set aside a total sum of 19.8 billion Naira ($55 million) for the construction of 2,383 units of housing under the National Housing Program, across the 36 states of Nigeria. In 2020, the total budget allocation for the Federal Ministry of Works and Housing was ₦285.30billion and the sum of ₦14.79billion was allocated to Construction and Provision of Housing from this budget. In addition, for provision of infrastructure for social housing, the total sum of ₦454.16million was allocated to staff housing project in the following states such as Abia (ongoing), Uyo (ongoing), Sokoto (ongoing), Anambra (ongoing) and Niger (new project).

In addition, in the NIIMP (National Integrated Infrastructure Master Plan) report, the Federal Government budget implementation reports (2009 to 2018) for Housing was targeted at ₦175.59billion while ₦97.7billion actual was disbursed achieving only 1.63% disbursement. Despite all these funding plans lined up, funding for mass housing still fell under the lowest rating. This indicates that there is clearly a need for government to direct more funds to housing viz-a-viz budget provided; otherwise, the construction of mass housing projects as planned would not meet up with the timeline given.

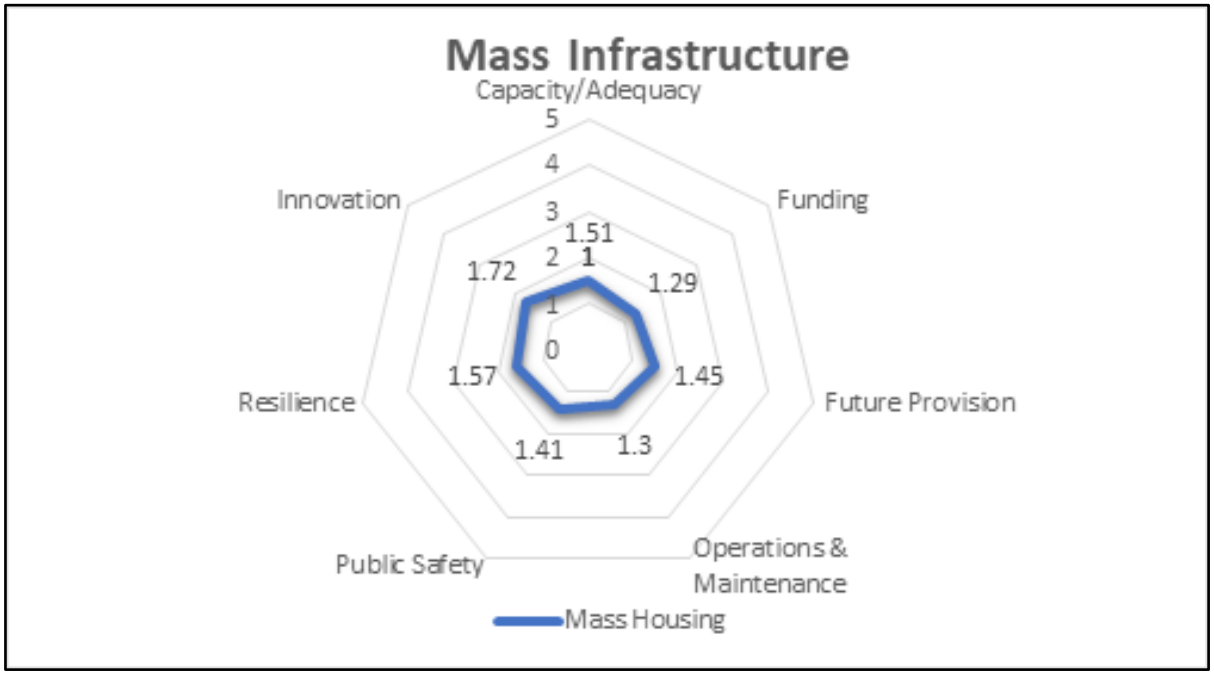


Figure 8-82: Mass infrastructure

Operations and maintenance of the mass housing infrastructure rating falls within one of the lowest after funding which is the lowest rated criteria for the analysis. Currently, many mass housing estates, especially the ones provided by the government years back are starved of maintenance. In 2020, an analysis was carried out by IRSA infrastructure on social housing exposing the state of most of our current federal housing estates which fell within the poor rating. An example of this is the FESTAC housing scheme in Lagos; It was noted that the funding provided to maintain this estate is very poor, while operations and maintenance was

reported to be poor thereby exposing the residents to public hazards of natural disaster and insecurity. The only estates doing better in terms of maintenance and operations are the ones managed by Facility companies (IRSA 2020). One of the solutions therefore proposed is for the federal government is to revisit the terms and conditions of awarding a contract and engage professionals such as facility management companies to ensure the sustainability of these infrastructures.

The impact of COVID-19 on the housing sector also led to downward pressures on rent in leading cities with mortgage and rent defaults with landlords taking on a more tenant-friendly stance. However, there is still need for more future funding to be made available by the government to the public through mortgage financing and other funding schemes to ensure that there is access to affordable housing, funding and quality homes that would withstand the effect of natural disasters.

> ***"The Federal Government would continue to collaborate with states to ensure more Nigerians benefit from the Social Housing scheme and that under the Social Housing Programme, the Federal Government plans to support 1.5 million Nigerians to acquire low-cost houses through mortgage options and Rent-to-Own option. Overall, the Financial System Strategy (FSS2020) still sets homeownership at about 10.0 per cent. In order to achieve providing housing for a population of over 315million people, it is expected that over 1million housing units would be delivered annually as stated in the plan and placed as a priority for implementation"***
>
> ***Vice President, Yemi Osinbajo (May 2021)***

8.15.3 INTERNATIONAL BENCHMARK

Home ownership is also an area that has a high impact on the economy in developing countries because it drives GDP growth. The current home ownership rate for the countries benchmarked and the reporting year as follows:

Table 8-7: Source: World bank

Home Ownership	Africa Benchmark				Global Benchmark		
	Nigeria 2020	Ghana 2020	Egypt	South Africa	USA 2020	UK 2020	UAE 2018
Home Ownership Rate	25%	47.2%		56%	65.4%	65.2%	28%

Comparing the Population growth rate in Nigeria to other countries gives us an insight into the likely trend in terms of housing demands per country. Nigeria with the highest population growth rate (Fig 1&2) at 2020, is an indication for government to pre-empt that there would be more demand for housing by the public in the nearest future and make provision for it.

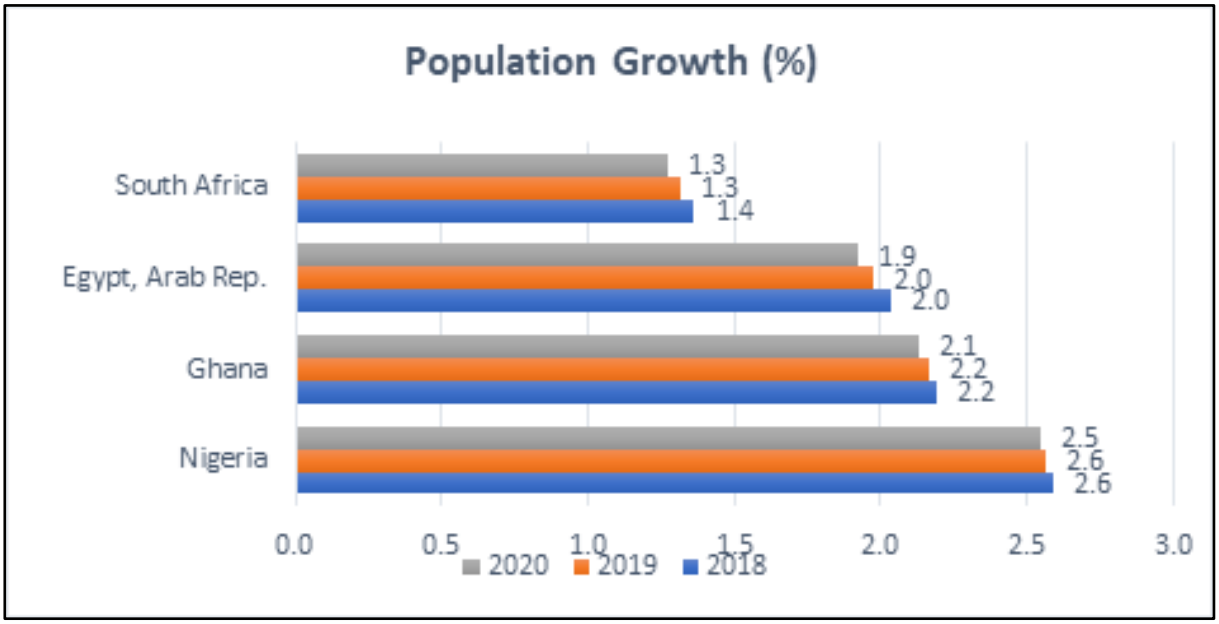


Figure 8-83: Population growth for Africa benchmark (2018 to 2020)

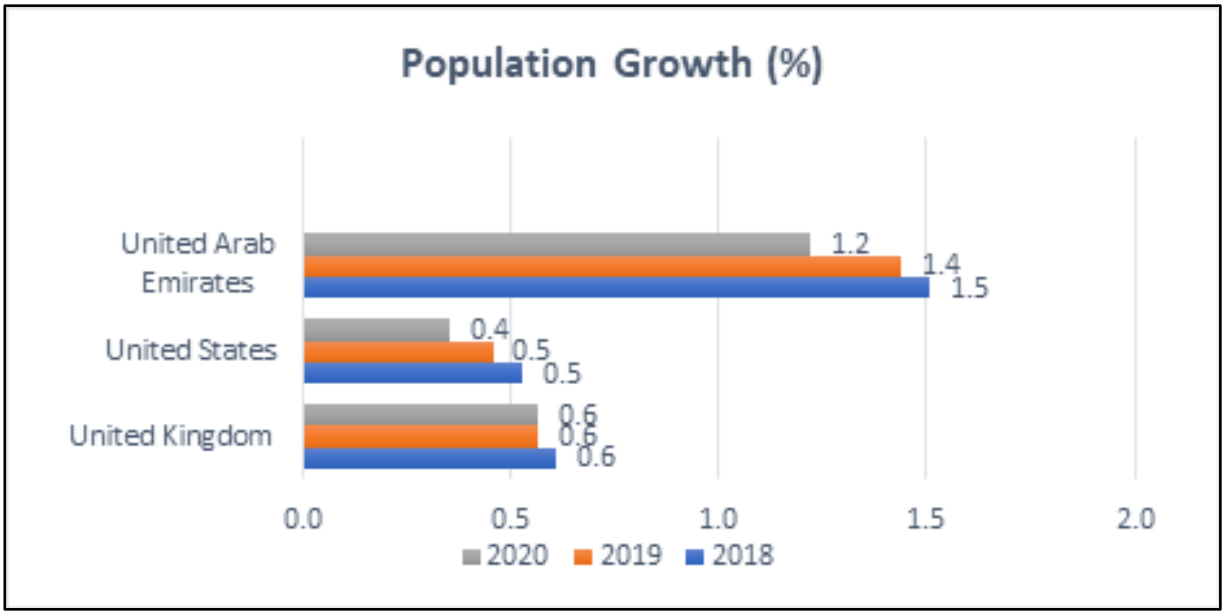


Figure 8-84: Population growth for Global Benchmark (2018 to 2020)

Table 8-8: Source: NumbeoData 2021

Property Pricing Indices	Africa Benchmark				Global Benchmark		
	Nigeria	Ghana	Egypt	South Africa	USA	UK	UAE
Price to Income Ratio	15.84	85.43	12.35	3.22	4.01	9.28	4.43
Gross rental yield City Centre	32.75%	11.14%	5.75%	10.26%	7.80%	3.65%	9.47%
Price to rent ratio City Centre	3.05	8.98	17.38	8.67	12.82	27.39	10.56
Mortgage as a percentage of income	312.51%	2289.92%	174.72%	9.62%	29.13%	62.44%	32.34%
Affordability index	0.32	0.04	0.57	2.75	3.43	1.60	3.09
Mortgage interest rate	19.29%	12.62%	12.62%	36.33%	3.99%	3.12%	4.05%

8.15.4 EXECUTIVE INSIGHT

When it comes to Housing sector in the country, a greater onus lies with the Federal Housing Authority, Federal Mortgage Bank and Federal Ministry of Works & Housing for adequate disbursement of land required, effective disbursement of the National Housing funding scheme and construction of quality affordable houses for the public by approved Developers.

The Minister of State for Works and Housing, Babatunde Fashola (NSE Scorecard, 2021) while engaging with him within the period of this report, shed more light on the strategies put in place by the government to provide additional housing units in the country to complement the current demand for housing. He stated that the ministry is not involved in the construction directly; rather, sometimes they do the smaller scale. The template on which the ministry works is to ascertain the affordability and acceptability of that particular sample, after which the Federal Housing Authority (FHA) and Federal Mortgage Bank take up being the muscles in terms of building a larger scale housing project.

He further stated that the policy of the government now and the direction all over the world, most especially in Africa, is affordable housing whereby we capture the larger part of the society, and the low-income earners.

> ***You need to find a way to build those houses at very low cost that they can afford. Unlike before when money was not the problem but how to spend it, that was why we were able to build those houses. Even after that, we still had a lot of money only that we wasted it. Now we don't have that kind of money again, but we still do more with little resources at our disposal.***
>
> ***Minister of Works & Housing, Babatunde Fashola (2021)***

He further disclosed that after COVID-19 hit Nigeria, the government set up a committee to immediately look at the present situation and come up with solutions and a lot of funding initiatives were identified. One of the areas that we have enjoyed the patronage was the housing sector whereby family home was supported. Then, the National Housing Fund was also there too.

In the Ministry of Works and Housing, we have what we call the HDMI (Housing and Management Initiative). The vision is to create a self-resilient, large community, where we would have developers coming in to build houses all over the country. We have started in Gwagwalada, where we have 100 hectares of land where we intend to build about 3000 houses over some years.

He mentioned that the government have the PPP whereby we provide alongside infrastructure and lands at affordable cost. Then, allow the private investors to bring the finances. Then we have the site and services, where they provide sites, services and give out the land to the developers. Once the government takes up the road infrastructures and by the time the buildings are done, the cost will ultimately reduce since the cost of infrastructure will be removed. The government has reduced the equity for mortgages that are lower than N5 million so that we can take them up without providing any equity. These are some of the things that we have been doing to allow people own their own houses, so that the ownership rate will increase.

He however questioned the report that the housing deficit in this country is about 17 million units; claiming that there is no empirical data supporting that figure. According to him, in Nigeria there is about 45 million households for 200 million people.

Currently building is ongoing in Gwagwalada of about 3000 housing units and the plan is to replicate it all over the country. Affordable housing, and development and management initiative which is a PPP form of arrangement when the housing project kicked started years back but that time it was government funding, so we don't have the money now we need to bring people from outside to get involved. In the Light of this, there is need to reduce cost and engaging cement manufacturers directly to produce cement that will suit the strength requirements and the ones that will not jeopardise the quality integrity of affordable housing.

He further listed out some initiatives as the most successful: Sukuk, which involved the private sector, the tax credit scheme was successful as well. In the housing sector, a lot of people are keying in only that we need to work on cost of land because the state governments own the land which is a very significant factor in the housing construction. So many people are coming in especially those in the higher income level. We don't have deficit for the higher income level because you see a lot of houses being built and nobody lives in them.

Nigerians need to remove the belief that you have to buy the house before you own it, when you could rent it. If the rent is being negotiated in such a way that it is affordable instead of paying two years, or more in advance, an alternative could be made available to you to pay on monthly basis, or twice a year, then a lot of people will own their own houses as well.

There is another scheme which is as you pay the rent for a certain number of months, the house becomes yours. That is rent to own. These are some of the measures we can use to ease housing difficulty in the country.

8.16 LAW & SECURITY INFRASTRUCTURE

8.16.1 BACKGROUND

The increased rate of globalisation and economic activities expose a country's national security to potential internal and/or external threats. The relationship between economic

growth and national security in recent times has become more linked than ever. Nigeria's national security challenges have become a growing cause for concern as some of the consequences include disruption of economic activities, decrease in FDI, high rate of emigration, among others. The Global Peace Index ranked Nigeria 39 out of 44 sub-Saharan countries and 146 out of 163 in the world countries in terms of the state of peace across the world. According to the same report, in 2021 the economic cost of violence was 11% of Nigeria's GDP.

Over the past decade, the country has been faced with numerous security challenges ranging from the Boko Haram insurgence in the North-East, to the Niger Delta militancy, to the IPOB separatist movement in the South-East and most recently the rise in banditry, kidnappings and the clashes between herders and farming communities across the country.

A report by BBC, has said that in Zamfara alone, more than 3,000 have lost their lives since 2012. More recently at least 1,000 students have been kidnapped from their schools since December 2020, as the kidnapping industry in the country has become increasingly lucrative.

At of 2019, Nigeria was rated as highest in crime amongst other African countries according to the Statista Analysis (2021). This shows that the public's exposure to threats from criminal groups is on the rise and government needs to put the rightful measures in place to ensure that the life and properties of Nigerians are preserved.

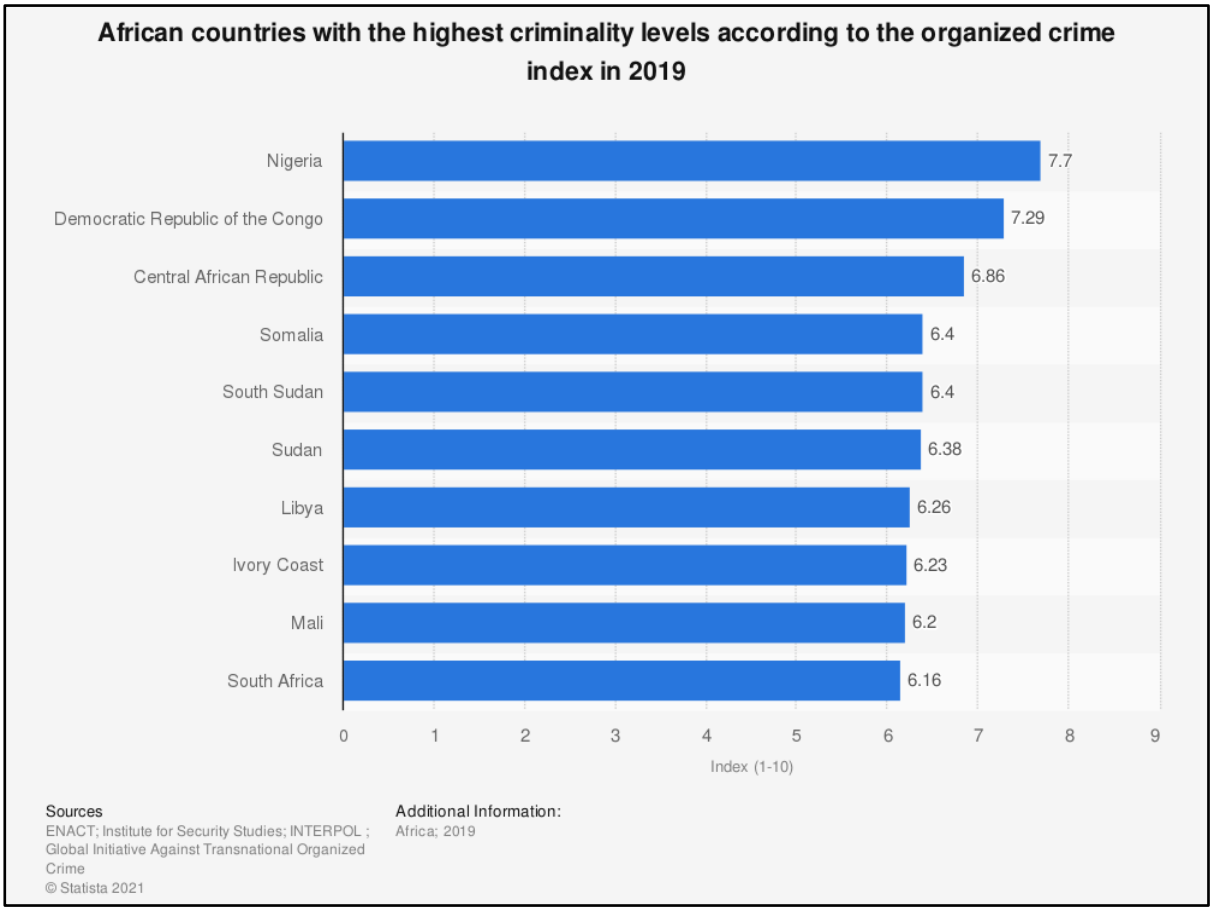


Figure 8-85: Criminality Index

President Muhammadu Buhari in 2019, separated the Ministry of Police Affairs from the Ministry of Interior, after merging both ministries at the beginning of his administration in 2015. The ministry, by Maigarai Dingyadi, will implement new initiatives that will address the security issues.

The 2021 approved budget for the Nigeria Police Trust Fund was N74 billion. The budget will go into training of the personnel, acquiring state of the art equipment for the Police Force amongst others.

The way the country's judiciary arm is handled also goes a long way in ensuring that the country is functioning appropriately. According to the WJP Rule of Law index 2020, Nigeria is ranked at 108th out of 128 countries and jurisdictions analysed globally. Comparing this data to other African countries, Ghana was ranked at 51st, South Africa at 45th, Egypt at 125th, while on the International level, the United States was ranked at 21st, United Kingdom at 13th and United Arab Emirates ranked at 30th. Furthermore, under the Order and Security parameter of the WJP Rule of Law Index which measures how well a society ensures the security of persons and property, Nigeria is ranked as 127th out of 128 countries analysed; this implies a wide gap globally.

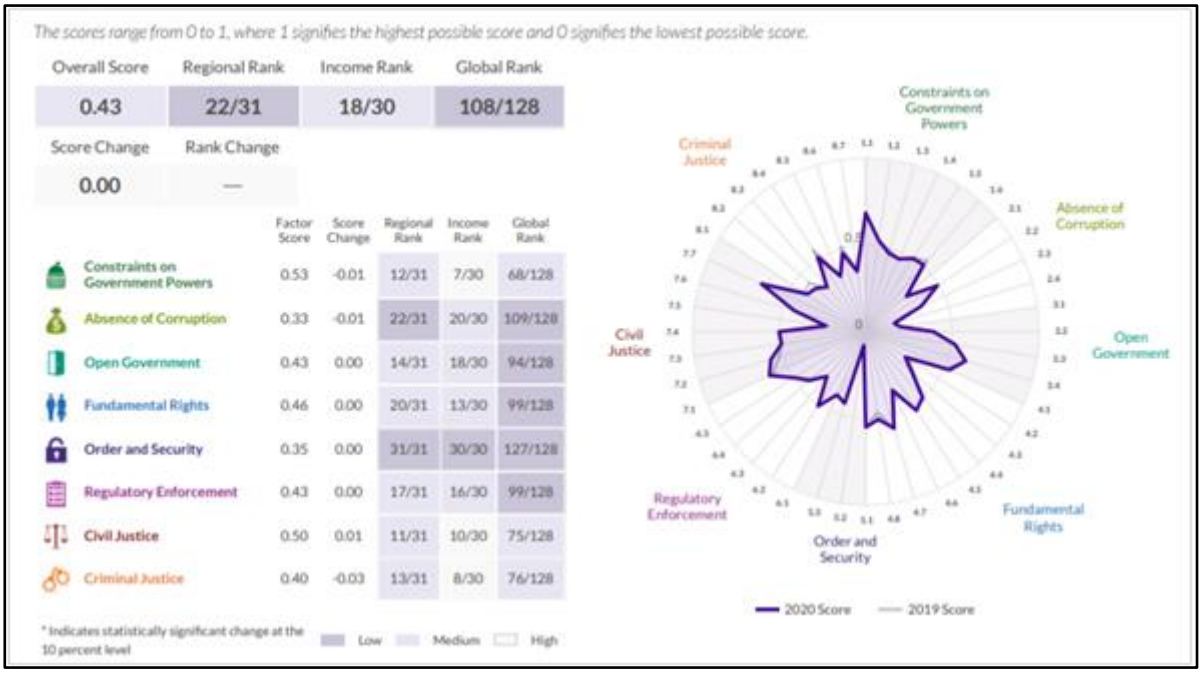


Figure 8-86: Source: WJP Rule of Law Index 2020

This report shows that the Nigerian government needs to put in more efforts to ensure that the Law and Security is priority to change the perception of the country when viewed globally.

8.16.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING – PRISON INFRASTRUCTURE

According to report published in June 2020 by Prison Insider, the global prison population has reached its highest level ever: more than 11 million people are imprisoned. This number has increased by 20% between 2002 and 2020. The United States has the highest absolute number of people in prison globally, with over 2.1 million people in prison at a rate of 655 people per 100,000 of the national population. China has the second highest prison population, with an estimated 1.7 million people imprisoned, followed by Brazil where, based on figures from June 2019, the prison population approaches 760,000. The number of female prisoners has increased by 50% since 2002. The Prison Policy Initiative in the US has noted that women continued to be the fastest growing segment of the country's prison population.

In Africa, the World Prison Brief (NCS) ranks Nigeria fourth in prison population in the 2021 data, but in terms of female prisoners to percentage of prison population, Nigeria sits at 47th position. Also, according to data from the Nigerian Correctional service (NCS), as of 19th April, 2021, there were 65,424 inmates across the country, out of which 64,214 were male and 1,210 female prisoners. See table below:

Table 8-9: Source: Ripple Nigeria, April 2021

Year	Total prison population	Number of female prisoners	Number of male prisoners
2000	44,450	709	43,741
2005	44,450	722	43,728
2010	44,450	897	43,553
2014	56,785	1,156	55,629
2020	66,216	1,415	64,801
2021(April)	65,424	1,210	64,214

According to figures provided by a global prison data organisation, World Prison Brief, awaiting trial inmates in Nigerian prisons has risen from 62 per cent in 2000 to nearly 70 per cent. The total prison population in 2000 stood at 44, 450 but had risen to 73, 248 by May 2019. Some of the factors resulting in these overcrowded prisons include delays in the administration of justice, overuse of prison sentences by judges, over-criminalization, and lack of adequate resources to build new prisons.

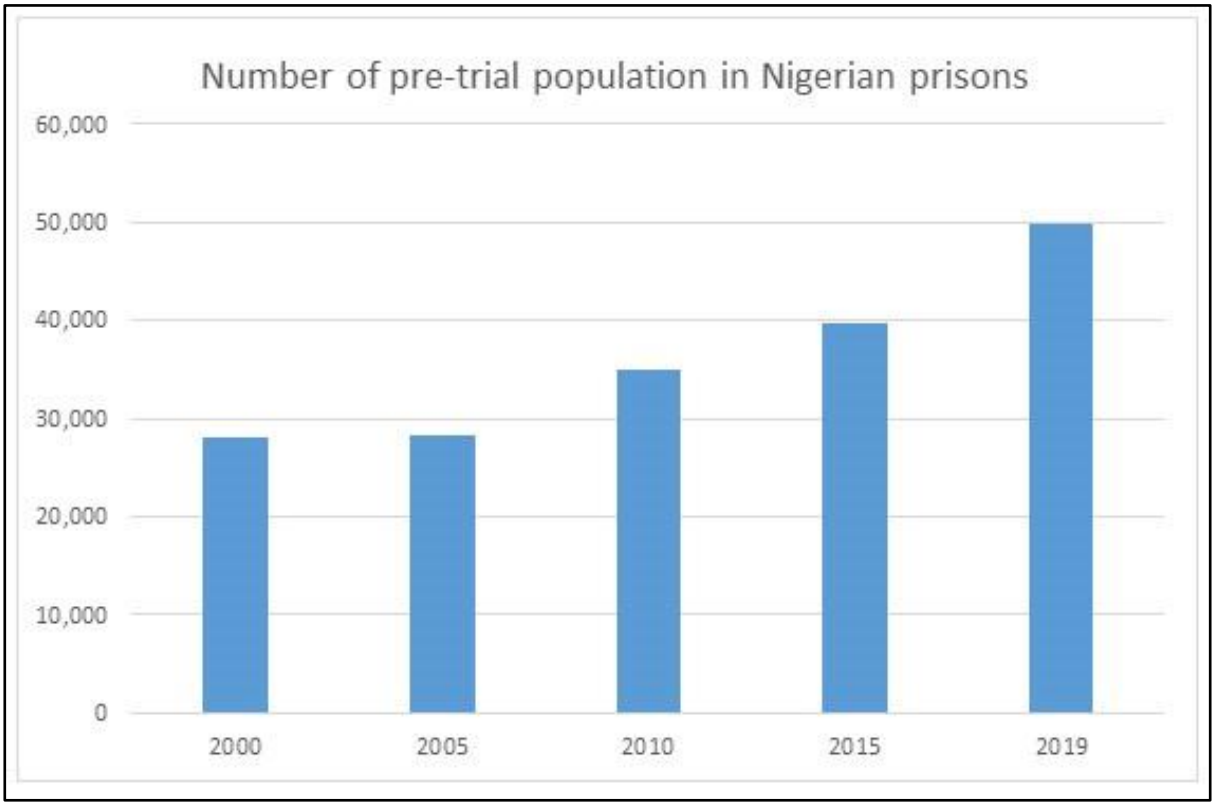


Figure 8-87: Number of pre-trail population in Nigerian prisons

One other factor that might have impacted the jump in the number of prisoners over the years is unemployment rate. The latest unemployed figures, as of the fourth quarter of 2020, shows over 10 million of the female labour population have no jobs. This is at least 35.2 percent of the total female labour populations, higher than the 31.8 percent for male unemployment. This is therefore an indication of the country being predisposed to more rates of crime especially among women and if the government does not intervene in earnest to address the nation rate of unemployment, public safety would be threatened thereby leading to an increase in the prison population. We hope the Nigerian government would prioritize channelling funds towards building new infrastructure especially the female infrastructure to reduce congestion due to the spike in numbers and thus reduce threat to the well-being and safety of inmates.

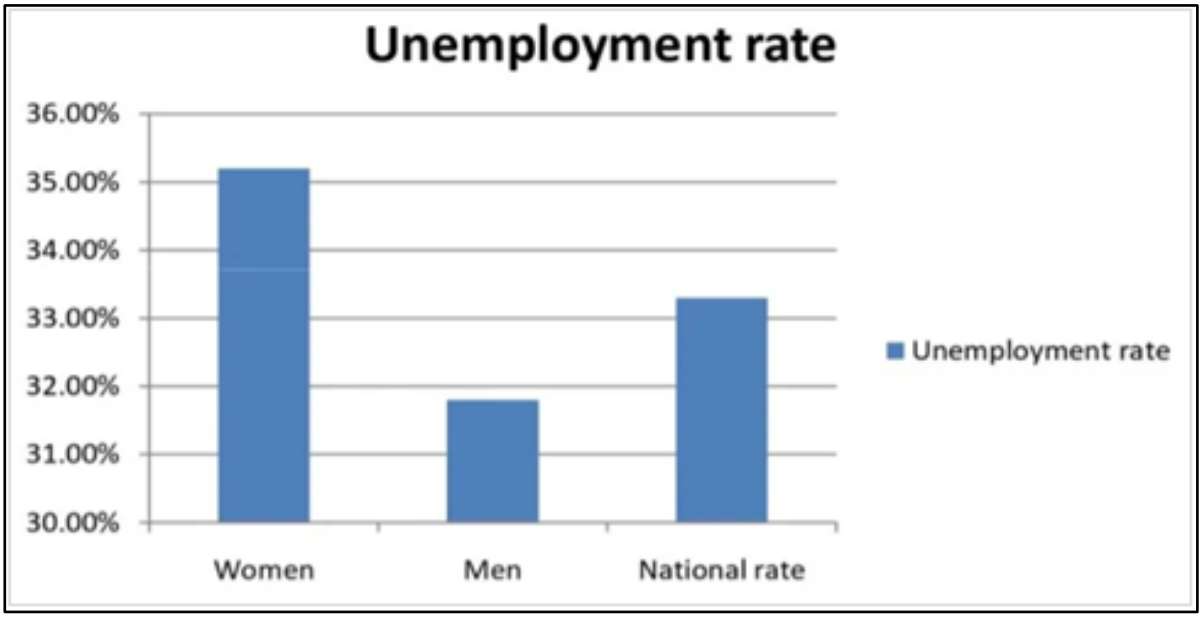


Figure 8-88: Unemployment rate (Source: Ripple Nigeria, Q4 2020 Data)

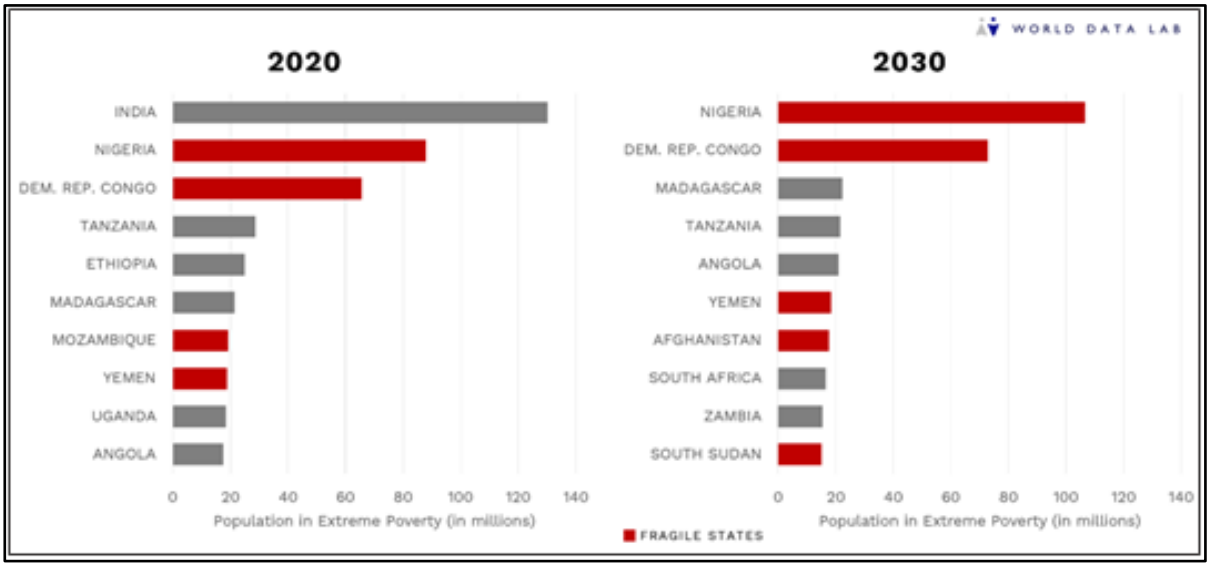
In other to boost the welfare of inmates by providing them with humane environment and facilities and improve the standard of the prison infrastructure in Nigeria, the Minister of Interior, has disclosed during the ground-breaking ceremony of a 3,000-capacity prison at Janguza in Tofa Local Council Area of Kano State that, the Federal Government is to construct six ultra-modern prisons in the six geo-political zones of the country.

> ***"The new prisons are in line with the United Nations minimum standard of prisons which was obtained from collaborative efforts of federal and state governments"***
>
> ***Minister of Interior, Lt. Gen. Abdulrahman Dambazau (retd)***

According to the 2021 Budget Signed, N84,472,723,136 was apportioned for the Nigerian Correctional facilities from the Total Budget passed. This therefore shows commitment from the government to improve this infrastructure in Nigeria.

8.16.3 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING – CCTV INFRASTRUCTURE

In the world at large, it is believed that Close Circuit Television (CCTV) plays an integral role in crime detection. The CCTV systems are generally used to monitor public areas for detecting incidents, record real-life events to be used as evidence and to inform investigations. It is serves as a form of direct surveillance of suspected offenders and dissuade criminal activity in public areas, such as car parks, highways, housing estates and town centres. Kidnapping and Assassination has also become very rampant in Nigerian especially in the southern area while in the northern states, abduction of school children has been frequenting in recent times.



Two major areas that impacts the level of crime in any society are poverty and unemployment and if not dealt with from the grassroot could lead to loss of lives and property. Based on the data according to world data Lab, Nigeria would move from being the second rated country in extreme poverty 2020 to being the first rated country with extreme poverty by 2030. In addition, According to the Nigerian Living Standards Survey report published by the National Bureau of Statistics, over 80 million Nigerians live in poverty out of 205 million people. The report also revealed that northern Nigeria had the most poverty headcount rate. Across geo-political zones, North-Eastern Nigeria had the most poverty average while South Western Nigerian had the least. The average poverty headcount rate by geo-political zone is North Central (42.7 percent), North East (71.86 percent), North West (64.84 percent), South East (42.44 percent), South South (21.28 percent), and South West (12.12 percent).

According to Global Peace Index 2021 report, Fifteen per cent of people globally feel that crime, violence, or terrorism is the greatest risk to their safety. In a bid to therefore monitor the insecurity situations in Nigeria and reduce the rate of crime, the House of Representative considered a bill called “Integration of Private Closed Circuit Television Infrastructure into the National Security Network in Nigeria Bill, 2019” to provide for the incorporation of private CCTV infrastructure into the National Security Network in Nigeria. The aim was to direct the federal and state governments to install Close Circuit Television (CCTV) cameras across the country.

In 2016, report has it that the government of Lagos State announced its plan to install 13,000 CCTV cameras across the state in order to increase & upgrade the security & surveillance within the metropolis. However, as of 2021, Commissioner for Science and Technology, Mr. Hakeem Popoola Fahm, disclosed that Lagos State Government has commenced the installation of 2,000 Closed-circuit television (CCTV) cameras across the state. He further stated that the number of CCTV cameras installed are increasing day by day, but, already, 100 CCTV cameras had been installed in Ikeja metropolis with the aim that, upon completion, the project would advance Lagos state economy by becoming a 24-hour driven commercial centre, which would allow companies to operate in a safe, secure, and smart environment.

8.16.4 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING – POLICE STATION INFRASTRUCTURE

The 1999 Constitution in Nigeria emphasizes that the security and welfare of the people shall be the primary purpose of the government and the government through the Nigeria police is able to fulfil its obligation of security the nation. The police force operations span across states in Nigeria and the FCT having a staff strength of about 371,800 personnel.

In recent times, the rate of insecurity in the country has grown at an alarming rate exposing the public to loss of lives and property. This insecurity is a huge concern at the heart of the public and has been expressed through several protests organized. The major protest occurred last year (2020) tagged ENDSARS Protest by Nigerian Youths to end the brutality from Police and SARS.

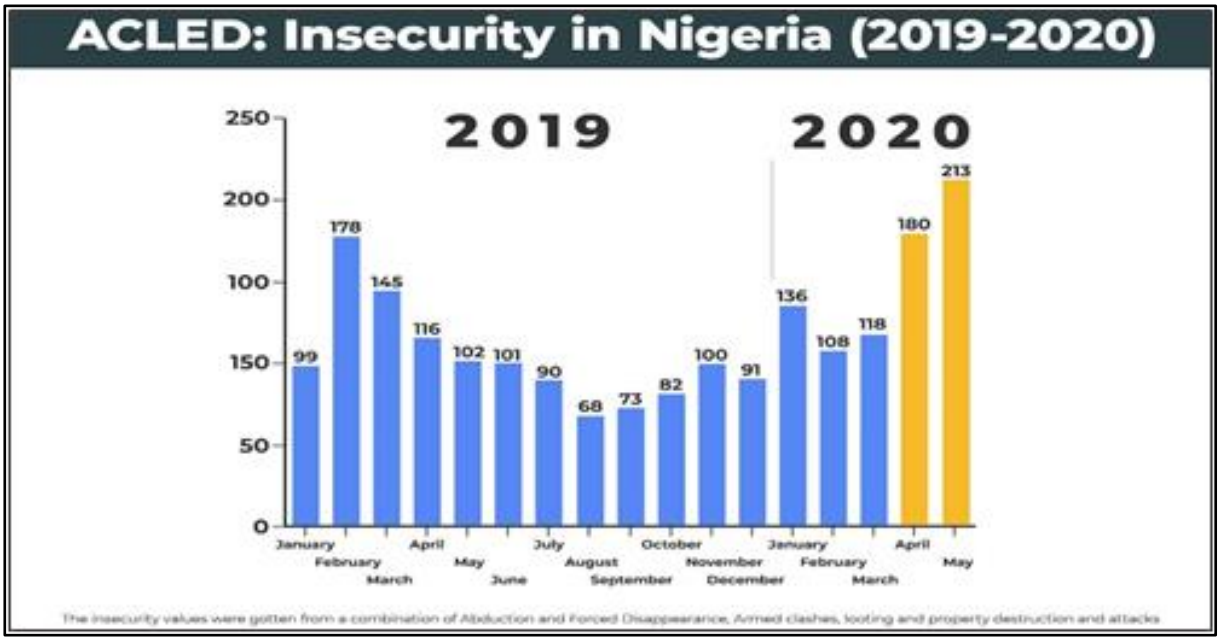


Figure 8-89: Insecurity in Nigeria 2019-2020 (Source: HumAngle)

There are several security challenges faced by an average Nigerian which cut across the nooks and crannies of the country. This has led to several deaths year in year out. The most common one is the terrorists' attacks in major parts of the Northern region. An analysis of the Nigeria Watch Data, a platform which monitors violence between, 2006 and 2020, recorded 27,584 cases of violence. These acts of violence led to 130,527 deaths. The number of deaths recorded was at an all-time high in 2014 with a record of 22,119 deaths. This, the 2014 statistic, represents 16.95 per cent of all deaths in the period under review.

The Lagos State Security Trust Fund was established in 2007 by the Lagos State Government, through the Lagos State Security Trust Fund Law 2007, to provide a pool of fund from which the Lagos State Government would provide money to the Nigeria Police Force in the state to procure equipment and other resources to combat crime. The Trust Fund is funded on a public-private partnership basis through monies and other donations from the public, private persons – both corporate and individuals. So far, report has it that the model has been a runaway

success, raising multiples of billions of Naira annually in cash and kind, with the Lagos State Government being a generous donor; the system is being replicated in some other states of the Federation.

According to an article release by Olubusola Oyeyosola Diya in 2019, the President of the Federal Republic of Nigeria assented to the Nigeria Police Trust Fund (Establishment) Act 2019 ("the Act"). These funds are to be used for training and developing personnel of the Nigeria Police Force ("the NPF"). The Trust Fund will also be used to buy security equipment and related facilities necessary for the dispatch of the duties of the NPF and improving the general welfare of the personnel of the NPF, both home and abroad.

8.16.5 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING – COURT OF LAW INFRASTRUCTURE

The role of the courts in the administration of justice is critical to any country. The way courts administer justice efficiently and effectively also stimulates public confidence in the judicial process. There are currently 8 types of court in Nigeria of which the Supreme court is the highest in ranking and we have just one in Nigeria comprising of 21 Judges and Chief Justice of Nigeria make up the Supreme court. As of 2019, according to the Supreme Court, the total number of legal practitioners in the country increased from 120,006 in 2017 to 190,000 in 2019, representing an annual growth rate of 32 percent, while as of 2021 report from The Whistlers has it that about 4,350 successful candidates of the Nigerian Law School's March 2021 Bar final examinations were called to bar leading to a total number of lawyers produced in the country to 197,015, according to official entries.

The Covid-19 Pandemic lockdown affected the judicial arm in Nigeria as court sittings were halted across states making several court cases to be delayed. This in return affected the income of lawyers as most hearings/trials were physically carried out and the resulting effect was an increase in fresh cases after the lockdown. Some other areas that influenced this delay were the EndSars protest and the Judicial Staff Union of Nigeria (JUNSUN) strike. Therefore, all these factors led to the delay of 155,757 court cases in the 2019/2020 legal year arising from the lockdown due to COVID-19 pandemic in Nigeria.

The effect of court cases being delayed was largely felt by the Nigerian Correctional Service (NCS) which experienced Congestion in prisons due to the 51,983 cases awaiting trial out of the 73,756 total population in custody reported. The NCS report also showed that only 21,773 of the total population in custody are convicted inmates. This delay in sitting has also resulted in the congestion encountered in most prisons in the country as a report by Nigeria's National Bureau of Statistics covering data from 2011 to 2015, said that 72.5% of Nigeria's total prison population are inmates serving time without being sentenced, spotting flaws in Nigeria's criminal justice system with proceedings often going on for years without conclusion. While other online sources as at 2020, reported that more than 70 percent of Nigerian prisoners are held without trial and being remanded in custody. Meanwhile, the issue of suspension of court sittings until further notice by the Chief Justice of Nigeria (CJN), Justice Tanko Muhammad, on March 23, 2020 is also adding to the issue of prolonged cases in Nigeria's jurisdiction system.

On major issue Nigeria is facing in the law system compared to other Jurisdictions is the length of time that court cases take to be completed. Despite having stated in Section 396 (3) of the Administration of Criminal Justice Act, 2015 which makes provision for trials to occur on a day-to-day basis, reports have it that some inmates have been in the correctional centres for up to eight years for minor offences, while many inmates make up to three court appearances in a year and sadly, other cases don't even get called in a year.

According to the UK Ministry of Justice's criminal court statistics, for all criminal cases in 2018, it took an average of 157 days between the offence being reported to the completion of the case. While in Nigeria, the average time a criminal trial proceeding takes prior to the enactment of the Administration of the Criminal Justice Act (ACJA) is four to six years. Also, between 2018 and 2019, the average time taken to complete magistrate cases in England has risen 6% from 151 days to 159 days.

During the Annual General Conference (AGC) of the Nigerian Bar Association (NBA) 2021 edition, President Muhammadu Buhari however, expressed his displeasure in the current Justice administration in Nigeria with what he described as a "terribly slow pace" and proposed that criminal cases from the high court to the Supreme Court should be concluded within 12 months. He also in addition stated that civil cases should not last longer than 15 months.

Furthermore, one of the contributory factors to the congestion of cases in courts leading to delays is caused by inadequate number of judges as stated by a lawyer in a report from daily trust. In July 2021, the Chief Judge of the Federal High Court of Nigeria, John Tsoho, in an interview with Premium Times Nigeria, mentioned that the judiciary has an information technology policy and a Committee (JITPCOM) mandated to take the entire judiciary along technological path so that in not too much in the distant future, all courts should actually be computerised, so as to reduce the strain of having to take manual proceedings which would aid more expeditious disposal of cases. With the development of technology, we believe that this would speed up the expected rate of cases disposal while the appointment of new Judges would also reduce the congestion of cases within their jurisdiction.

8.16.6 EXECUTIVE INSIGHT - CCTV

In an interview on Sunrise Daily on February 2021; a Channels Television programme, Muhammad Dingyadi, minister of police affairs, said that the federal government will install closed circuit television (CCTV) cameras on major highways across the country to curb the rising cases of kidnapping.

He also disclosed that the President Muhammadu Buhari has resuscitated the abandoned CCTV project in order to address the security challenges in the country.

Dingyadi said the federal government has entered a concession agreement with NPS technology company to refix the abandoned CCTV project.

"We are moving forward like you are aware that N470 billion CCTV project that has been abandoned, Mr. President has now given the go-ahead to resuscitate the project and we have entered a concession agreement with NPS technologies," he said.

They are trying to refix the entire system to resuscitate it, empower it and to ensure that they make the basis to generate revenue, that will pay this loan and give some revenue into the government coffers, so by the time the system is put in place, we would have a lot of technology to manage some of these crises and particularly issue of kidnapping."

In response to being asked whether the CCTV cameras will only be in the city centre in Abuja or major highways, the police affairs minister said: ''It is going to be on the major highways in all the city centres in all the states of the federation, it is everywhere in this country."

Dingyadi said the company in charge of the CCTV project is already purchasing the needed equipment for the project. We're trying to resuscitate it, this company is already going into action to ensure that they purchase the needed equipment that have been dilapidated or destroyed," he said. He further noted that the police will partner with any individual who has ideas that can help in intelligence gathering.

8.16.7 INTERNATIONAL BENCHMARK

In Nigeria, the number of prisoners keep rising year-in year-out. This is implying that the rate of crime is on the rise which could be because of increase in unemployment rate. Here are some indices are regards Prison infrastructure and usage:

	Africa Benchmark				Global Benchmark		
Indices for Law & Security	**Nigeria 2020**	**Ghana 2020**	**Egypt**	**South Africa**	**USA 2020**	**UK 2020**	**UAE 2018**
Population (million)							
Supreme Courts							
Courts of Appeal							
High Courts							
Prisons							
Prisoners							
Police Stations							
Police personnel							
Police to citizen ratio	1 to 540						
Displaced persons							

Deaths by insurgence							
Global Peace Index Ranking	146	38	126	123	122	33	52

8.17 SPORTS INFRASTRUCTURE

8.17.1 BACKGROUND

Sporting industry or sector plays a huge role in increasing the market value of most developing countries. In Nigeria Sports Sector according to a report from NIIMP 2020, there are currently six national stadia at the federal level and 4 training centres, with three in a state of disrepair. The federal government has 25 Grandstands (Mini Stadia) across the country, which have been poorly funded. This implies that over the years, the major issues centre around maintenance and funding showing that the government is not giving much attention to this infrastructure, while on the other hand, developing countries like United States, Europe, England; are exploring the many advantages of sport industry as revenue generating.

As reported globally, North - American sports market is the largest in the world, with revenues of over $ 50 billion of US dollars from major sports leagues - NFL, MLB, NBA. The importance of a government investing in ensuring sports infrastructure is well maintained and secured for both local and international sports events cannot be over emphasized because of the huge return on investment to the economy. Therefore, every nation's sports industry can enhance the GDP growth if invested in leading to foreign exchange earnings from foreign investors and tourists.

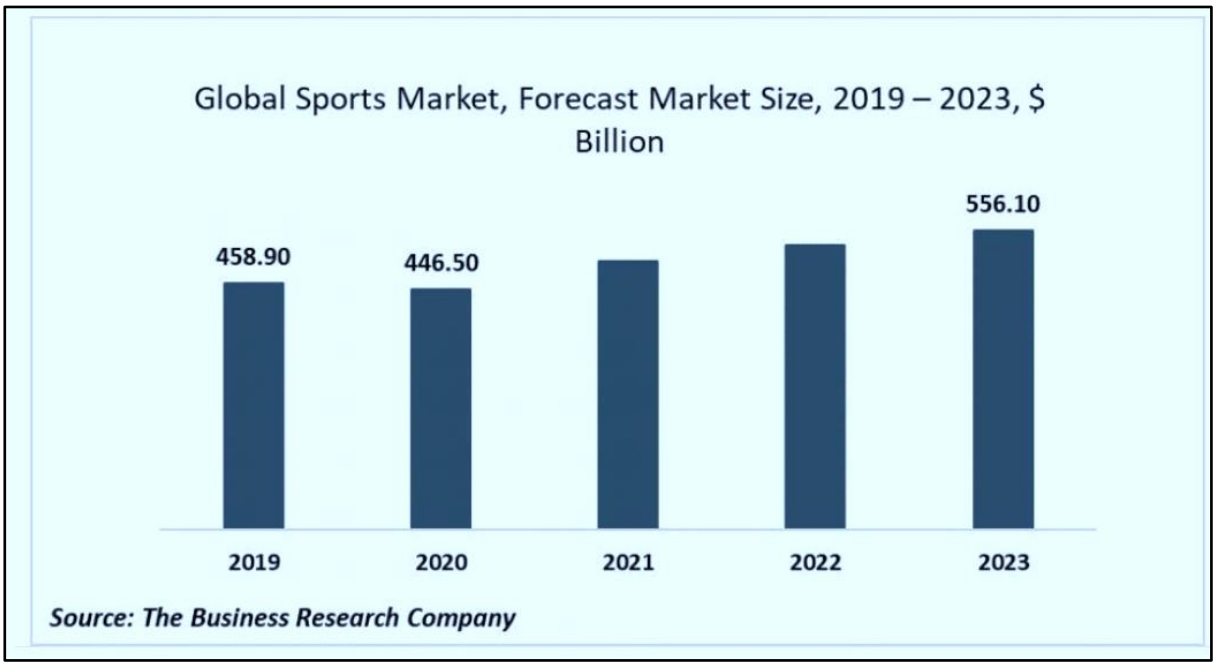


Figure 8-90: Global sports market

The Business research company global sport market also reported that, the global sports market reached a value of nearly $388.3 billion in 2020, having increased at a compound annual growth rate (CAGR) of 3.4% since 2015. The market declined from $458.8 billion in

2019 to $388.3 billion in 2020 at a rate of -15.4% in contrast to the forecast of $446.50 billion in 2020. Obviously, the circumstances that surrounded the lockdown in 2020 led to a decline in market value from 2019 to 2020 while on the other part, social distancing norms imposed by various countries across countries owing to the COVID-19 also impacted this decline. The sports market is however expected to reach $599.9 billion by 2025, and $826.0 billion by 2030.

During the 26th Nigerian Economic Summit pre-summit (2020), the Statistician-general of the federation emphasized that Sports is valued at $500 billion globally, whereas the sector accounts for 0.005 percent of Nigeria's GDP which is not good enough. In the same summit, the minister of Youth and Sports Development disclosed that the sports industry which is a labor-intensive growth industry is being re-categorized as a business venture beyond recreation based on its capacity to spur economic growth.

> ***"This move prioritizes the industry and fosters its eligibility for incentives, development of metrics for impact measurement, consideration for special funding by the Central Bank of Nigeria, creation of jobs and tax rebate, the sports industry can deliver N2 trillion revenue in the next 5 to 10 years for Nigeria and this can help to drive the largest real estate and infrastructure development in the country however it will require $500 million annual investment in sports infrastructure"***
>
> Minister of Youth and Sports Development – Mr Sunday Dare
> 26th Nigerian Economic Summit pre-summit (2020)

It is worthy of note that state governments are also taking measures to develop Sports infrastructure in their states for generation of state funds to runs state projects. Listed here are a few stadia in progress or completed to encourage sport tourism/events and generate revenue for the government:

- Nigeria Football Federation (NFF), Amaju Pinnick has disclosed that the Ongoing sports facilities construction in Osun state will aid sports development after completion.
- The Minna new stadium to be completed in 2023 at a cost of US $6.6m.
- The re-modelled Adamasingba Stadium in Ibadan

8.17.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

Reports have it that the Minister of Youth and Sports disclosed that there is a new Sports Industry Policy (SIP) that will replace the obsolete 2009 version and will address these four key areas "3 Is and 1 P" – Infrastructure, Investment, Incentives, and Policy, to propel sports in Nigeria to the next level. We are therefore hopeful that there would be improvement on this in the coming years before the next edition of this report takes place.

The Sports sector was also one of the most affected from the COVID-19 lockdown globally. The shutdown of most stadia facilities resulted in the reduction of tourists and slow-down of foreign exchange globally. Nigeria, however, was not left out as the little revenue generated from the facilities engagement by Sports teams, youths, athletes etc was halted due to the lock-down and restrictions. The picture below captures the state of stadia infrastructure in Nigeria from 2015 to 2021 showing a falling trend.

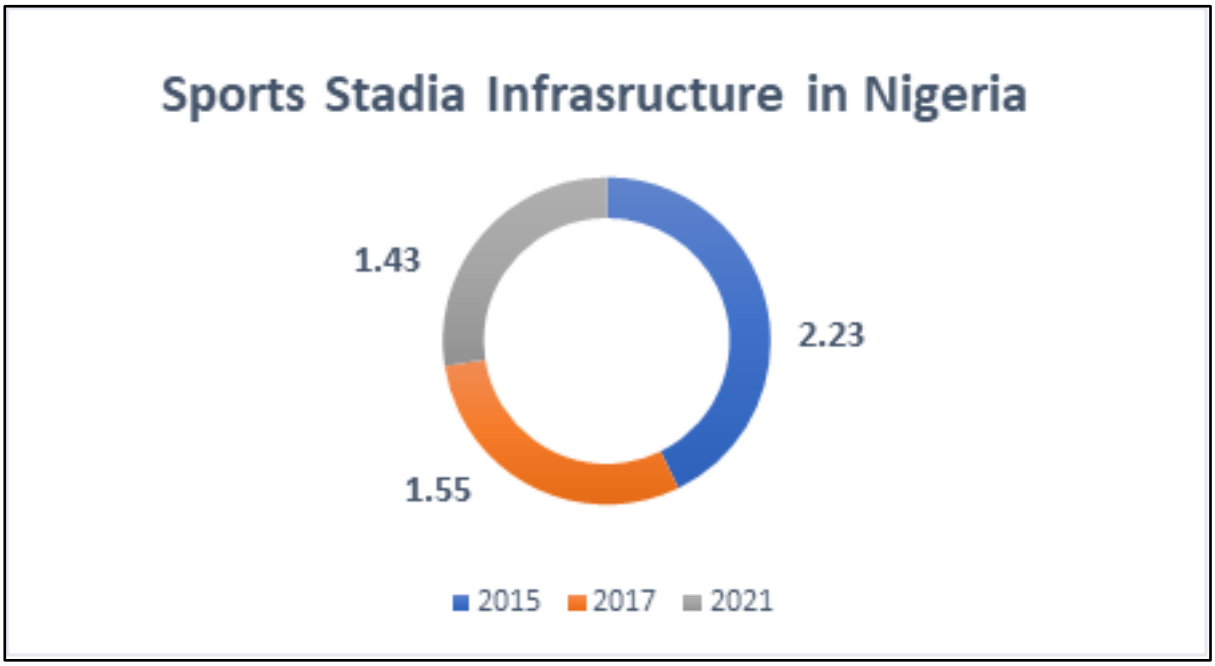


Figure 8-91: Sports stadia infrastructure in Nigeria

The Sports stadia infrastructure is rated for the second straight time as unfit for purpose with an overall rating of F1 – 1.43 in this 2021 edition, showing a drop in performance from 1.55 rating in the 2017 report.

In a bid to therefore upscale the current state of sports stadia infrastructure, according to source (all africa), the Federal Minister of Youth & Sports, Honourable Mr. Sunday Dare launched a project in 2019 tagged the 'Adopt an Athlete' and 'Adopt a Stadium' programme; to involve corporate Nigeria into the development of sports in Nigeria. He further stated that with the involvement of some business moguls in Nigeria, plans are ongoing to renovate the Moshood Abiola Stadium in Abuja and the National Stadium in Lagos.

Figure 8-92: Sports stadia infrastructure

In 2017 analysis, funding for developing sports infrastructure was unfit for purpose at a rating of 1.47. The 2021 analysis showed similar results as seen 4years ago in terms of rating at 1.45 (unfit for purpose) showing that the sports infrastructure in Nigeria as of today is not able to meet up to global standard. This performance is too low for an income generating sector explored in countries like the United States where their sports market value accounts for 32.5 percent share of the global sports market as of 2018 (Statista) where the global sports market experienced a spike in value at approximately 471 billion U.S. dollars from the market value achieved in 2011 at 324 billion U.S. dollars. However, from recent reports, the Lagos State Sports Trust Fund, (LSSTF) has recently disclosed plans to raise N10 billion that will be invested in sports infrastructure and development across the state.

The highest rating from the survey by respondents falls under Capacity at 1.95- E2 as against 1.88 – E3 in 2017 edition which shows that some level of work has been done to improve the capacity of the country's stadia infrastructure. The announcement from CAF and FIFA approving seven stadiums in Nigeria to host the Super Eagles 2022 World Cup Qualifiers home games, is a proof that capacity wise, progress has been made to these stadia infrastructure. However, the government would need to ensure the stadia are in the expected state to host these sports events and this will in return lead to revenue generation at the long run.

Operations & Maintenance parameter was rated lowest at 1.18- F2 (unfit for purpose), a drop in performance from 4years ago rated at 1.32 – F2. In a bid to therefore upscale the sports infrastructure, the Federal Ministry of Youth & Sports, Honourable Mr. Sunday Dare launched a project in 2019 tagged the 'Adopt an Athlete' and 'Adopt a Stadium' programme; to involve corporate Nigeria into the development of sports in Nigeria. For the 'Adopt a Stadium' programme, some business moguls have committed financially to renovate some stadia and thus help revive sporting infrastructure.

The impact of COVID-19 on the Sport stadia resulted in a considerable restraint on the sports market in 2020. This also led to the rescheduling of the 20th National Sports Festival (NSF) severally by the Minister of Youth & Sports, originally meant to take place in 2020 in Benin City, Edo State, but for the constraints of Covid-restrictions; leading to inability for the state to generate revenue from the investment in preparing the facilities for the festival.

> ***"Our short-term Sports Development Plan for the next 2 years gradually unfolds. It is focused on Infrastructure, Athletes Welfare, Grassroot Sports and Sports as a viable business. Abuja Stadium is on its way back, National Stadium Lagos is set for concession, Ahmadu Bello Stadium will soon undergo renovation. Talks are ongoing concerning the renovation of the Obafemi Awolowo Stadium, formerly,Liberty Stadium with government and a few private individuals "***
>
> ***Minister of Youth and Sports Development – Mr Sunday Dare***

8.17.3 INTERNATIONAL BENCHMARK

In Nigeria, the state of most of our stadia are nothing close to the international standard. This table gives an overview into this:

		Africa Benchmark				Global Benchmark		
		Nigeria 2020	Ghana 2020	Egypt	South Africa	USA 2020	UK 2020	UAE 2018

8.17.4 EXECUTIVE INSIGHT

Do we have enough, if you look at our population, with the size of the country, enough stadiums? Will there be need for additional stadiums or what we need is maintenance and proper usage of what is on ground?

We don't have enough sporting facilities in the country, and the ones we have are not being adequately maintained.

Sir, if I may ask, what model do you think we can implement to ease this funding constrain?

Well, you see, unfortunately, our private sectors have no different interest in sporting activities, not even maintenance of the facilities or even to sponsor athletes so that they can do well when they are outside the country. Not many of them are involved.

Why are they not involved?

Well, maybe it is because they are not interested or maybe they are not encouraged to do so. I remember even the government said that they gave them what is called tax of leave, if you contribute to the development of sports as a multinational; you would have a tax of leave. Unfortunately, maintenance culture is not properly established in Nigeria and majority of the African countries and we have to do that, it is very important.

How do we change that narrative sir?

The government has provided some money for maintenance, and the private sector must come in, for example the current minister was able to convince Dangote. Dangote is now doing the scoreboard, the football pitch, and the maintained of the Abuja Stadium while Baba Ijebu is doing the stadium in Lagos. It is through the efforts of the sports minister he was able to do that, maybe there is need to convince more private sector players to be involved because government cannot do it alone. This is because there are so many sectors that the government is looking out to.

In other words, the minister is doing the right thing?

Well, I can say he is doing his best; he has made some private sector players to adopt some athletes; released some money for their training, coaching them so the athletes will be able to excel.

In terms of the maintenance you talked about, when we do a contract model that brings in the private sector, such that they kind of own the facility and they can fix it, maintain it, and will be able to hand it over. It is a performance based that if you make this works because the athletes

for instance if they don't have facilities where they can practice, they will not put in a better performance so people need to invest in them.

Can we adopt that model where its performance based?

You know right from the beginning when we are starting the project, this mental issue should come in right from the beginning down to the end of it. I was involved in the construction of this national stadium Abuja in 2003, and after we completed it, after the whole African games, the government handed over the facilities to Julius Berger to maintain the main bowl of the Abuja Stadium.

And then weeks after that they were asked to maintain the sporting facilities, after one year, they decided to withdraw from maintenance in the budget, but unfortunately, they now have to carry all the facilities. At that time, we had dealings at Ibadan, Enugu, Kaduna, etc., and so the money was not enough. The facilities continued to deteriorate.

The government cannot do it alone, there are so many sectors the government is looking at, and so the private sector must come in.

Do we even have a master plan? Where people can look and say there are opportunities here?

No, but you see because the private sector do not believe or they don't prepare to support us. In South Africa, they have a legislation where the multinationals give money at the end of the year, they give some small percentage of their profit for sporting facilities and again, their trust funds; they too they give some money to the sports. The trust fund, the ACT says it is for you to intervene with the money in health, other natural disasters. A lot of money is needed to develop sporting activities. So, the government cannot do them alone.

8.18 TRANSPORTATION

8.18.1 BACKGROUND

Transportation is a requirement for every nation, regardless of its industrial capacity, population size or technological development. Since a well-developed transport system is critical for any nation's growth and development. In particular, transport infrastructure is an essential enabler of development that has a far-reaching impact on all other sectors of any economy.

Owing to this, Nigeria, according to the Oxford Business Group (2019), has an expansive road network spans nearly 200,00km, the rail network is 3500km, while the country is home to about 853km of Atlantic Ocean coastline in seven southern states and according to the Nigerian Civil Aviation Authority (NCAA), Nigeria is equally home to 32 airports, 26 of which are operated by the Federal Airports Authority of Nigeria (FAAN), and five of which are functional international airports. It also has a state-owned airport located in Akwa Ibom State. In addition, there are airstrips or airfields scattered around the country, built mainly by the Nigerian Air Force and multinational oil companies. Although, compared to many of its African peers; Nigeria has relatively advanced infrastructure networks that cover extensive areas of the nation's territory, but existing stock of transportation infrastructure in the country is not sufficient to support the nation's current and expected growth aspirations, urbanization, and general infrastructure

financing deficit, as estimated by the Moody's Investors Service to staggered at $3trillion over the next 30 years (African Business, 2021).

Still, many are of the opinion that the problems go beyond funding. For instance, billions of dollars have been sunk into transport infrastructure projects that have failed to see the light of day or have been abandoned after construction has started because of weak institutions, lack of accountability and limited policy consistency across different administrations. The situation is compounded by graft and the limited maintenance of existing transport infrastructure. In addition, a rapidly growing population is putting added strain on the already inadequate infrastructure stock, said Kunal Govindia, vice-president and senior analyst at Moody's Investor Service, at the time the consultancy released its estimate.

This problem has been further worsened by the COVID-19 nationwide lockdown in 2020, leading to drastic revenue plunge in the sector. To be specific, the aviation sub-sector alone was estimated to have lost over N21billion in monthly revenue. On the other hand, most road and rail projects across the country were stalled. The below table presents key elements of the country's transportation infrastructure system.

Table 8-10: Key Elements of Nigeria's Transportation Infrastructure System (Source: Ministry of Transportation cited in the 2020 National Integrated Infrastructure Master Plan)

Modes	Infrastructure	Vehicles	Services
Air	Airport infrastructure, Aerodromes, Air Navigation Infrastructure	Airplanes, Helicopters	Airline and air freight services, Airport services, Training
Land (Road)	Roads, Bridges, Terminals	Motorized Vehicles, Non-motorized vehicles	Passenger services, Road Haulage, Informal services, Training
Land (Rail)	Railways, Rail Stations	Trains	Passenger services, Freight services (Urban) Mass Rapid Transit, Training
Land (Pipelines)	Pipelines	Line Pipes	Pipeline services
Water	Waterways (Inland and Sea), Port Infrastructure, Navigation Infrastructure	Ferries, Ocean-going vessels	Stevedoring services, Shipping/Barge services, Training

The priorities of the transport infrastructure development of the Authority as enumerated in the 2020 National Integrated Infrastructure Master Plan is provided below:

- Increase emphasis on rail transportation - both passengers and freight.
- Rehabilitating rail network in some of the major cities across Nigeria.
- Building new standard gauge railway lines in some major cities across Nigeria;
- Increasing the capacity of inland waterways transportation – dredge 1000Km plus of inland waterways – build riverbank protection.

- Enhancing the performance and competitiveness of seaports – build three new deep seaports (Lekki, Olokola, and Ibom).
- 2000km of navigable waterways.
- 30,000 operational boats, vessels, and barges.
- 75.0 per cent of total ports operating 24 hours with patrol boats deployed.
- 2.2 km of roads rehabilitated and maintained between ports.
- Rehabilitation of existing airports and construction of a set of four new airport terminal buildings.
- Improving airport and airline safety/security.
- Procurement of private sector contracts based on fair and transparent competition, and decisions on the roles of public and private parties based on value for money.
- Developing a pool of well-trained professional for the transport sector.
- Creating an enabling environment for the emergence of Nigeria as a regional hub in West Africa for the different modes of transportation.
- Having an appropriate balance between public and private provided transport particularly in urban areas; and
- Enhancing inter-modal transportation in Nigeria to ease the load on the road's mode of transportation.

8.18.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE & RATING OVERALL TRANSPORTATION INFRASTRUCTURE

The overall rating of Nigeria's Transportation Infrastructure is F1 (1.58) which means that the infrastructure is Unfit for Purpose and is on a verge of failure - urgent rehabilitation is required to prevent complete failure or restore to serviceable state. This rating covers Roads & Bridges, Rail (commuter and National) and Seaports Infrastructure. The rating is below the 2015 rating of (2.32) – Poor State; and slightly below 2017 rating of 1.64, although airports infrastructure was considered part of transport infrastructure category in 2015 and 2017 respectively.

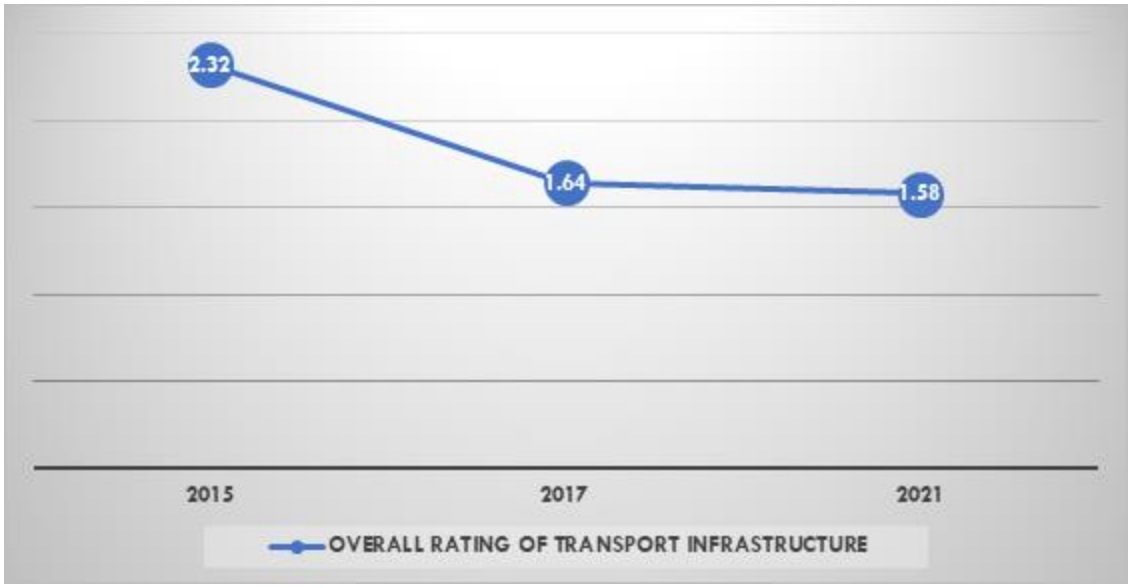


Figure 8-93: Overall Rating of Transport Infrastructure

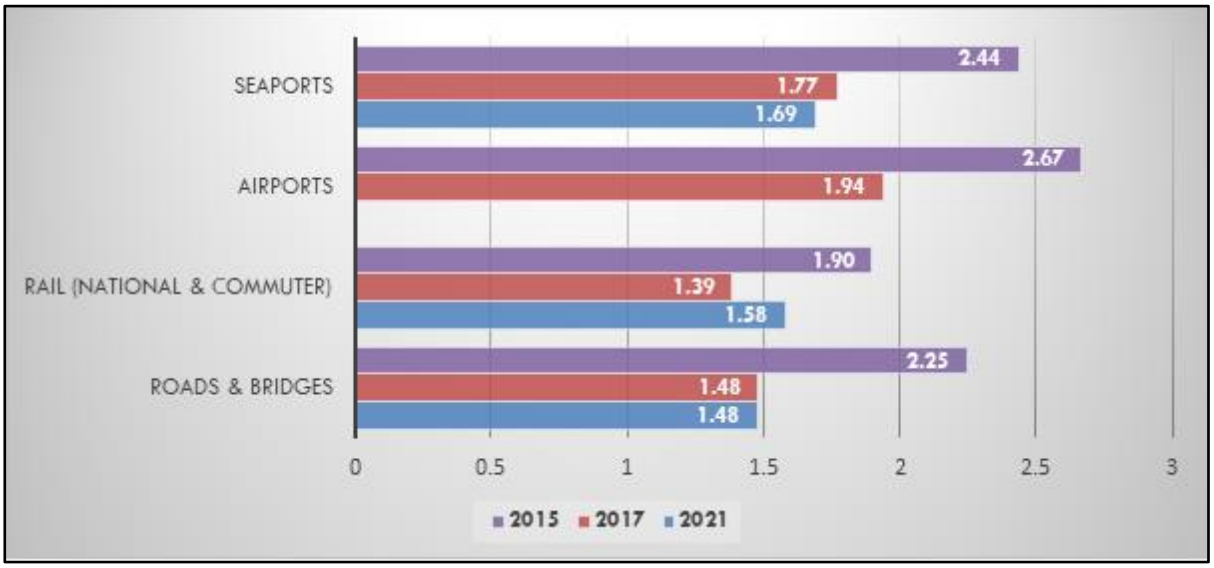


Figure 8-94: Transportation infrastructure rating (2015-2021)

Within other transport infrastructure sub-sectors, respondents agree the rail infrastructure ranks higher especially in terms of capacity and adequacy of the available infrastructure to meet current and future demands, resilience, current level of funding, and future provision of the sector; even though, it must be added that ratings in these areas are still considered at risk. Operations and maintenance, public safety, and innovation, in terms of deployment of innovative techniques and delivery methods of the current rail infrastructure in the country were nonetheless rated below expectation.

8.18.3 ROADS & BRIDGES

Adequate road infrastructure is central to Nigeria's economic growth; it is at the core of good governance and public welfare to the populace. Any improvement in road infrastructure in Nigeria positively impacts on the nation's output because it is the mainstay of country's

transport network. Nigeria has a total road length of 193,200 kilometres, comprising 34,123 km Federal roads – Trunk A, 30,500 km State roads – Trunk B, and 129,577 km Local Government roads – Trunk C, (Infrastructure Concession Regulatory Commission ICRC, 2021). Each tier of government has the responsibility for planning, construction, and maintenance of the network of roads under its jurisdiction.

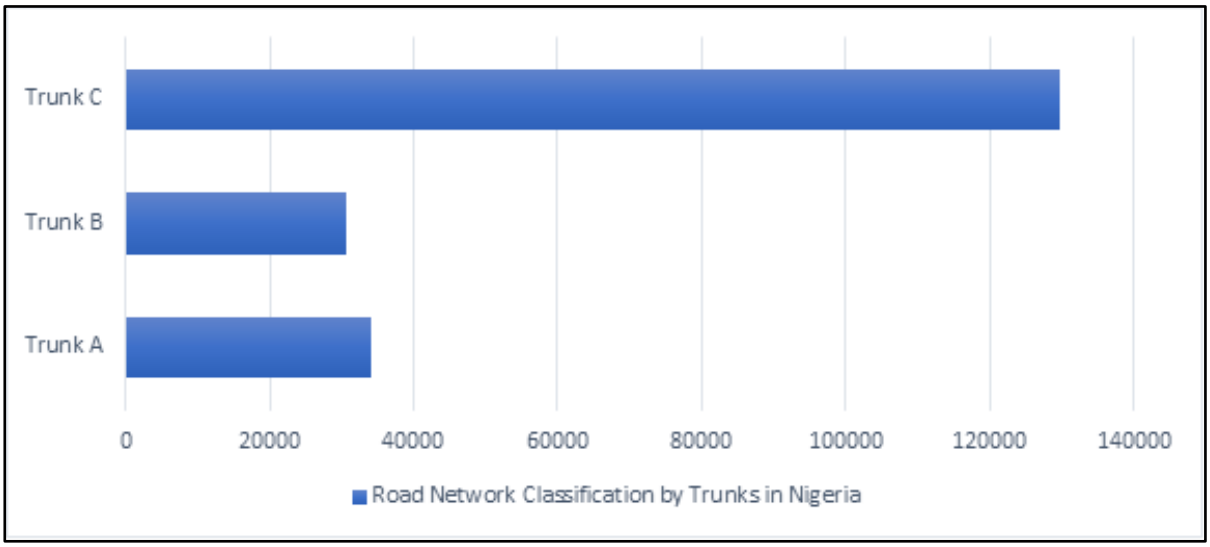


Figure 8-95: Road network classification by trunks in Nigeria

From the figure 3 above, federal government is responsible for nearly 17.6 % of the road in Nigeria, 15.7% are state roads and 66.7% are rural and local roads.

In terms of Respondents infrastructure perception and rating, the Road and Bridges was the least rated transportation infrastructure in Nigeria at F2 (1.48) – "Unfit or Purpose". This is about the same rating of F2 recorded in the 2017 Scorecard Report.

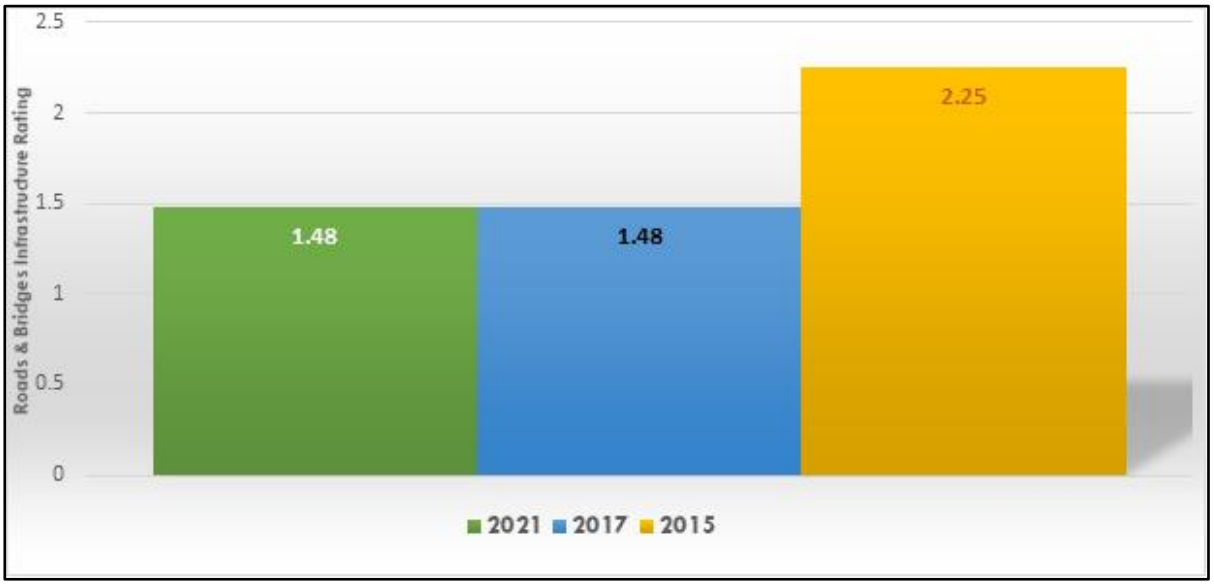


Figure 8-96: Roads and bridges infrastructure rating (2015-2021)

Looking at the rating category for Roads & Bridges, a broad decline across the rated categories was observed in 2021. Particularly, the weighted average rating for innovation (1.42), public safety (1.29) and funding (1.55) of the current roads and bridges was below the 2017 and 2015 ratings, as shown in Figure 5. The capacity of the current roads and bridges infrastructure in terms of its adequacy and capacity to meet current and future demands, and the operations and maintenance level of the current infrastructure were however rated (1.77) and (1.27) which represented a slight improvement from 2017 rating.

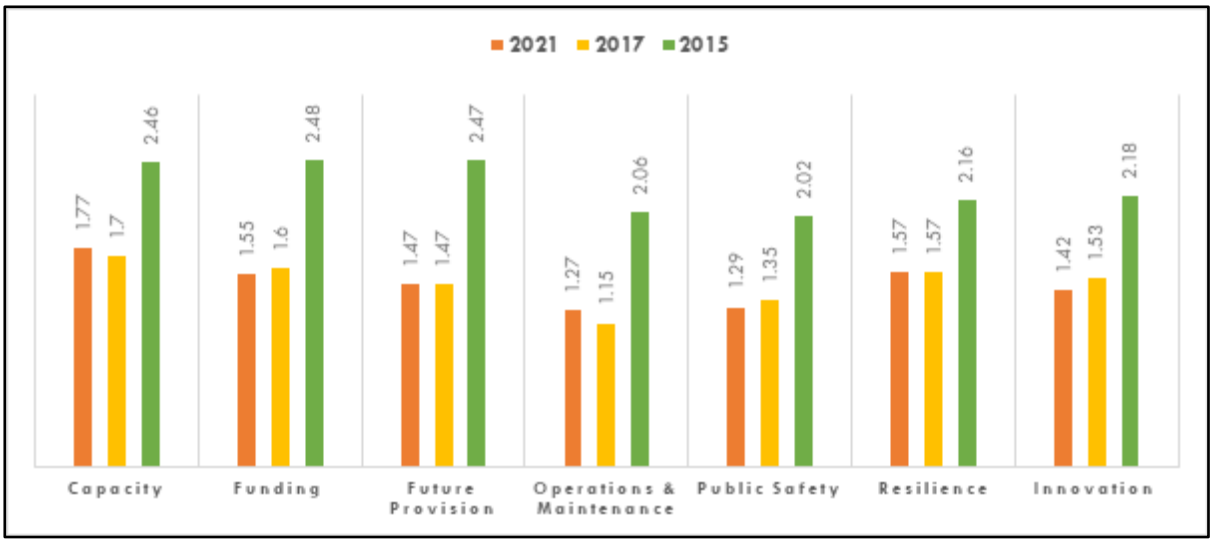


Figure 8-97: Roads and bridges infrastructure rating per category

This poor rating can be linked to the heavy burden and shift in inland transportation from rail and waterways to roads, as they have become the nation's primary mode of passenger and goods transport. For example, the high volumes of petroleum products transported on the national roadways, which are meant to be transported via pipelines, diminish the already limited lifespan of the roads, resulting in higher maintenance needs. Similarly, A historical trend of prioritizing new road construction over maintaining existing roads further exacerbates the deterioration of existing road infrastructure, while the concept of inter-modality which requires that the various means of transportation is interlinked has not been given serious consideration thereby limiting the efficiency of the road sector in terms of convenience, travel time, and cost.

The Government is however committed to completing the road sector reforms, particularly the establishment of Road Authority and Road Fund to engender best world practice in the administration of road network development and management in the country. Similarly, the recently announced Tolling Policy expected to be fast-tracked to pave way for the concession of the major dual carriageways, while the money to be realized from the concessions would be used for the development of other critical road infrastructure in the Federal Road network.

The Federal Ministry of Works and Housing is also currently working on the improvement of various sections of the Federal Highway network. This covers about 650 ongoing projects estimated at N6.3 trillion. As of August 28, 2020, the total sum of N1.991 trillion had already been certified for the works done while the sum of N1.6 trillion had been paid to the various

contractors. Also, the Public-Private-Partnership Department in the Ministry, has developed Outline Business Cases (OBCs) for viable and bankable major highways (brownfields) and proposed new alignments (Greenfields) to attract the private sector and foreign direct investment (FDI), (Federal Ministry of Works & Housing, 2021).

8.18.4 RAIL (NATIONAL & COMMUTER) INFRASTRUCTURE

Nigeria rail network consists of 4,332 track km and 3,505 route km, characterized by sharp curves and steep gradients in many sections. Only 137 km of the track is in the form of double track and all of that is in the Western corridor. The Nigerian Railway network runs from the Southwest (Lagos) to Northwest (Nguru) and from the South-South (Port Harcourt) through Kafanchan to the NorthEast (Maiduguri). The 3,505 km network is built on a Cape Gauge of 1,067 mm.

In summary, the Nigerian Railway Corporation's infrastructure and facilities include: 1,496 km of gauge rail line, comprising 827 km of narrow-gauge sidings and loops and 669 km of standard gauge rail line. 577 km of branch lines, made up of 304 railway stations (280 narrow gauge and 24 standard gauge) and 273 railway outstations, with 434 railway bridges across the entire track length (371 for narrow gauge and 63 for standard gauge).

Table 8-11: Nigerian Railway infrastructure System (Source: Federal Ministry of Transportation)

S/N	Section	Year Constructed	Distance	Type of Line	Status	Remarks
1	Lagos - Ibadan	1898 - 1901	193 km	Narrow Gauge	operational	Requires maintenance
2	Ibadan - Jebba	1901 - 1909	295 km	Narrow Gauge	operational	Requires maintenance
3	Kano - Baro	1907 - 1911	562 km	Narrow Gauge	operational	Requires maintenance
4	Jebba - Minna	1909 - 1916	225 km	Narrow Gauge	operational	Requires maintenance
5	Port Harcourt - Enugu	1914 - 1916	243 km	Narrow Gauge	operational	Requires maintenance
6	Enugu - Makurdi	1916 - 1924	220 km	Narrow Gauge	operational	Requires maintenance
7	Kaduna - Kafachan	1922 - 1927	179 km	Narrow Gauge	operational	Requires maintenance
8	Kafachan - Jos	1924 - 1927	101 km	Narrow Gauge	operational	Requires Rehabilitation
9	Kuru - Bauchi	1958 - 1961	166 km	Narrow Gauge	operational	Requires Rehabilitation
10	Bauchi - Gombe	1961 - 1963	155 km	Narrow Gauge	operational	Requires Rehabilitation
11	Gombe - Maiduguri	1963 - 1964	302 km	Narrow Gauge	operational	Requires Rehabilitation
12	Itakpe - Ajaokuta	1986 - 2020	277 km	Standard Gauge	operational	Newly Commissioned
13	Ajaokuta - Warri	1991 - 2020	275 km	Standard Gauge	operational	Newly Commissioned
14	Port Harcourt - Onne		19 km	Standard Gauge	operational	
15	Abuja (Idu) - Kaduna	2009 - 2016	186.5 km	Standard Gauge	operational	Newly Commissioned
16	Lagos - Ibadan (DoubleTrack)	2017 - 2021	156.5 km	Standard Gauge	operational	Newly Commissioned

17	Lagos - Apapa Port	2017 - date	6.516km	Standard Gauge		
17	Ibadan - Minna	To commence 2021	460 km	Standard Gauge	Aerial	Design and Preliminary Works ongoing
18	Minna - Abuja	To commence 2021	127 km	Standard Gauge	Survey	
19	Kaduna - Kano	To commence 2021	203 km	Standard Gauge	Ongoing	
20	Kano - Maradi (Niger Republic)	To commence 2021	212 km	Standard Gauge		
21	Itakpe - Abuja	To commence 2021	213 km	Standard Gauge		
22	Warri - Warri Town and Port	To commence 2021	214 km	Standard Gauge		
23	Branch line to Port Harcourt to Maiduguri:	To commence 2021				
a	Goniri - Gashua		216 km			
b	Elelenwa - Bonny Port		56 km			
c	Onne - Onne Port		8.7 Km			
d	Elelenwa - Owerri		85.4 km			
24	Coastal Railway Line: Lagos- Shagamu - Ijebu Ode - Ore - Benin City - Sapele - Warri - Yenagoa Port Harcourt -Aba - Uyo - Calabar and Section from Benin City Abudu - Agbor - Uko - Ogwashiukwu - Asaba - Onitsha	To commence 2021	1,402 km	Standard Gauge		

According to National Bureau of Statistics (NBS) data, the total number of train passengers in Q1 2019 increased from 723,999 to 748,345 in Q2 and further to 815,262 by Q3 2019. Within the same period, volume of goods and cargoes (tons) stood at 54,099, 79,750 and 55,630 respectively. By Q1 2020, it drops to 647,055 and further to 108,238 by Q2 2020; while tons of goods and cargoes equally fell from 18,484 in Q1 to 8,691 in Q2 2020. An upward trend as however been recorded since the start of Q4 2020 although Q2 2021.

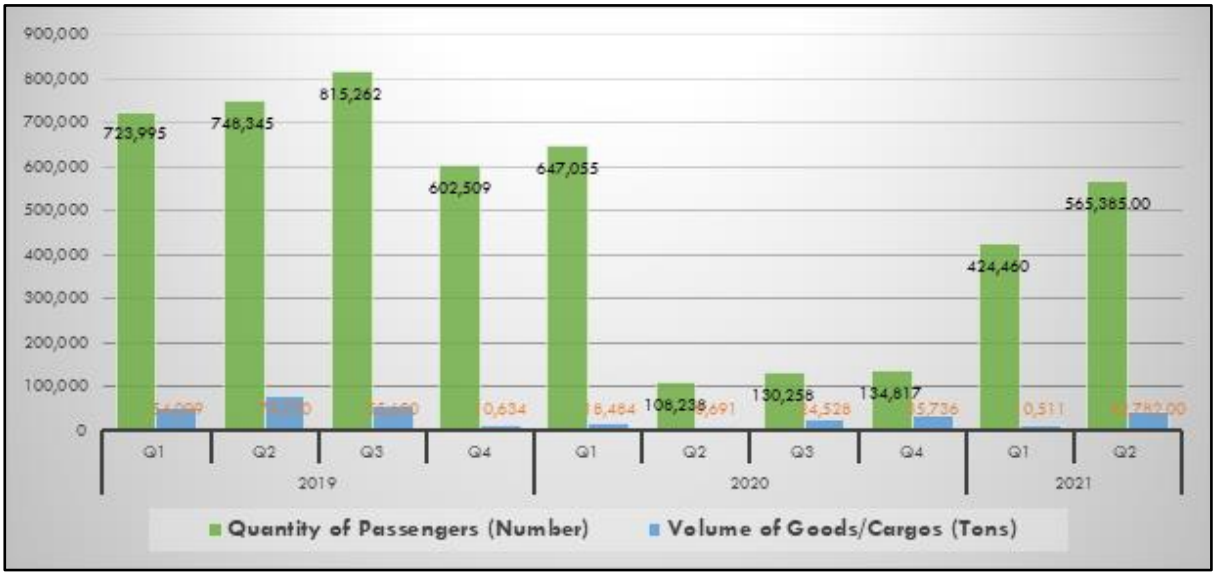


Figure 8-98: Number of Rail Transport Passengers & Volume of Goods/Cargoes: (Q1:2019 – Q2 2021) (Source: National Bureau of Statistics, 2021)

In terms of collections and revenue, a total of N520.79 million was generated as revenue from passengers in Q1 and N433.88 million in Q2 2019, while revenue generated from goods and cargoes within these quarters stood at N102.59 million and N131.27 million. As at Q2 2021, a total of N1.08 billion was generated from passengers, N71.56 million from goods and cargoes and about N32.9 million from other income receipts.

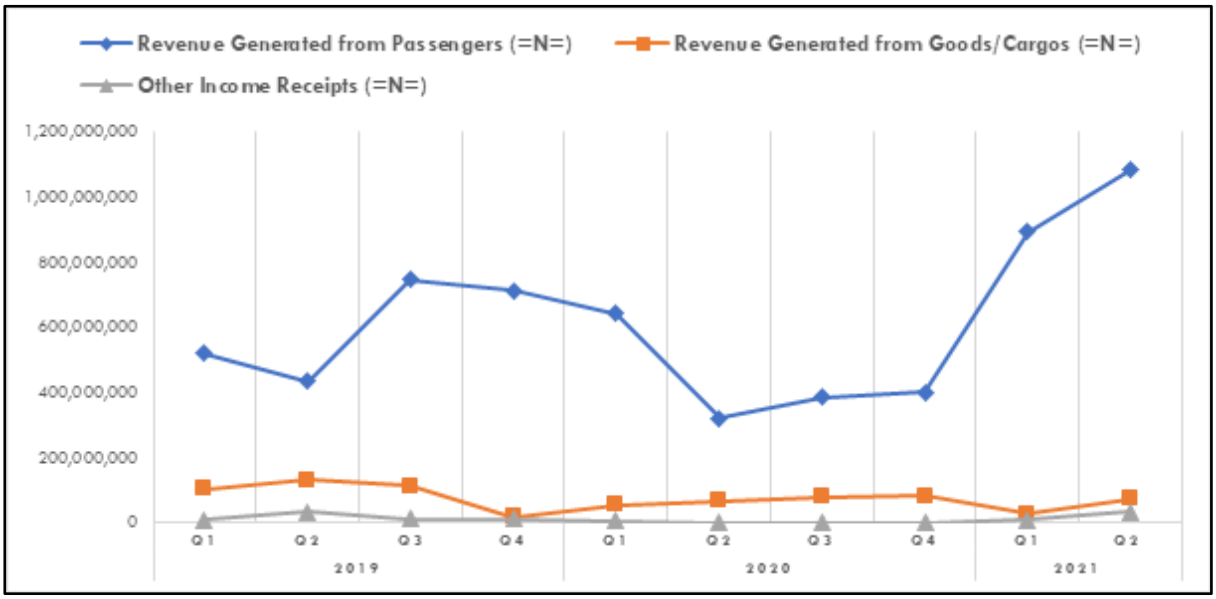


Figure 8-99: Generated Revenue from Rail Transport: (Q1 2019 – Q2 2021) (Source: National Bureau of Statistics, 2021)

With reference to current rating, Nigeria's rail infrastructure witnessed some level of improvement as Respondents rated it F (1.58). This rating which was an improvement from the previous infrastructure rating of (1.39), although within the “Unfit for Purpose” scorecard

rating in 2017, it indicates that the infrastructure received right attention and has begun to show considerable improvement in terms of capacity, adequacy, and operations.

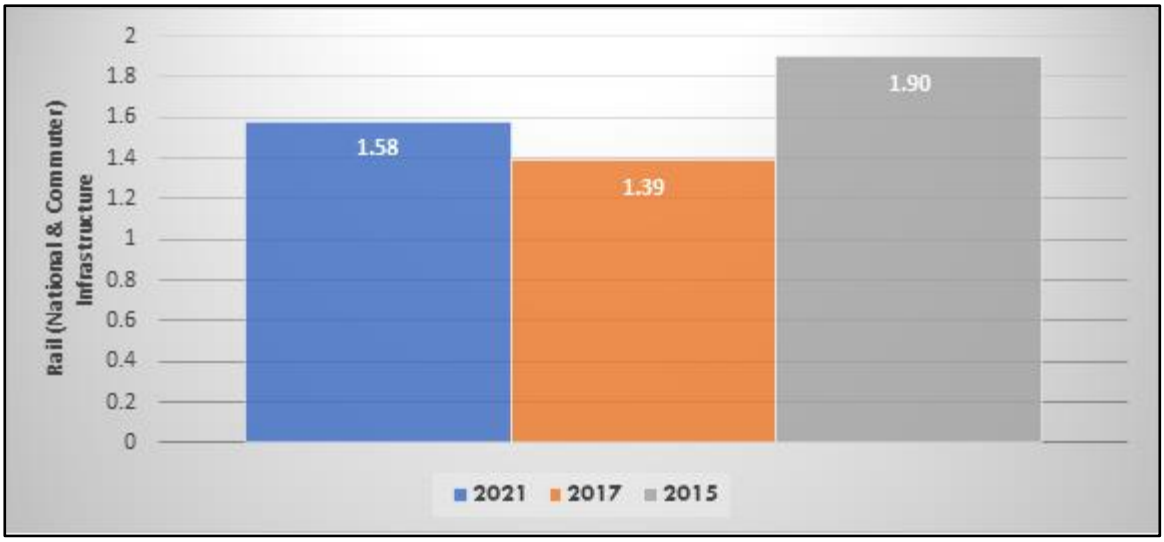


Figure 8-100: Rail (National & Commuter) Infrastructure Rating

Generally, respondents noted a steady growth across all categories of the rail infrastructure as depicted in Figure 7, except for future provision (1.68) which was marginally rated below the 2017 rating of (1.74). This improved rating further validates the increased attention the rail transport infrastructure seems to have gained from the Authority in recent times, particularly in the last 5 years; through the execution of various railway projects across the country under different financing methods. The investments in the sector are expected to make the railway sub-sector a leading means of transport in the Transportation Sector. Most of the Rail subsector projects largely consist of rehabilitation of existing narrow rail gauge lines and construction of new standard gauge rail lines, for instance, the Lagos-Kano and Abuja-Kaduna standard gauge rail lines. Efforts to expand train services to many more parts of the country received a boost with the completion of the Abuja Inter-City Metro railway line and the full commencement of Itakpe-Warri and Lagos-Ibadan rail lines. It is envisaged that full operationalization of the rail lines will further ease the movement of goods and passengers from the North to South and vice versa in Nigeria.

Figure 8-101: Rail (National & Commuter) Infrastructure Rating per Category

8.18.5 SEA PORTS

According to the Nigerian Port Authority (NPA), the country has six seaports: Apapa and Tin Can in Lagos, the Onne and Porthacourt Ports in Rivers State, the Warri Port, and the Calabar Port. But, by many accounts, only the Lagos ports are operating anywhere near full capacity, with the Apapa and Tin Can Ports accounting for well over 70% of the total imports into the country. Generally, the Nigerian Port Facilities have done better due to the concession of the ports and inflow of private capital following the major ports reform in 2004 where experienced private operators were engaged through Concessions to rehabilitate and Manage 26 Port Terminals under the Landlord PPP model.

The container traffic statistics across all the Nigerian ports revealed a steady increate in the numbers of inward laden and outward laden. Summary of container traffic between 2007 and March 2019 is provided in table 3.

Table 8-12: Container Traffic Statistics at Nigerian Ports: 2007- March 2019 (Source: Nigerian Port Authority, 2021)

	INWARD				OUTWARD			
YEAR	NO. OF EMPTIES	LADEN			NO. OF EMPTIES	LADEN		
		NO.	TONN.	T.E.U.		NO.	TONN.	T.E.U.
2007	979	407,828	2,697,353	356,551	382,481	247,076	298,627	75,399
2008	2,844	400,119	7,794,894	551,682	286,897	47,197	685,248	61,300
2009	177	416,351	5,802,550	577,267	376,276	57,830	897,994	76,317
2010	738	430,923	7,534,972	603,479	337,308	66,289	1,224,443	82,458
2011	97	536,719	9,252,781	753,411	435,134	66,202	1,239,600	86,566
2012	273	556,900	4,298,373	783,279	496,237	72,774	662,815	97,318

2013	437	623,409	10,729,910	887,211	503,225	79,718	1,435,972	105,455
2014	106	649,514	5,428,846	935,309	522,942	102,081	750,620	128,177
2015	126	534,223	9,419,672	771,130	417,627	128,687	2,263,594	168,249
2016	7,839	446,645	8,976,048	654,166	309,546	121,037	2,103,798	154,421
2017	85,263	442,290	10,379,152	667,826	207,539	116,319	2,325,091	154,880
2018	112	285,408	10,914,966	808,516	365,754	130,862	2,413,868	178,805
*JAN - MARCH 2019	2	122,787	2,818,990	192,164	95,447	28,162	486,978	37,733

Similarly, the total number and gross registered tonnage (GRT) of vessels that entered all Nigerian ports between 2007 and March 2019 is as follows:

Table 8-13: Number & Gross Registered Tonnage (GRT) of Vessels in Nigerian Seaports: 2007-2019 (Source: Nigerian Port Authority, 2021)

YEAR	NO OF VESSELS	GROSS REGISTERED TONNAGE
2007	4,849	84,806,792
2008	4,623	89,505,702
2009	4,721	90,603,611
2010	4,881	106,689,553
2011	5,232	122,614,716
2012	4,837	120,818,683
2013	5,369	130,628,057
2014	5,333	148,323,065
2015	5,014	141,250,703
2016	4,373	134,066,547
2017	4,292	130,357,357
2018	4,009	128,671,805
*JAN - MARCH 2019	1,045	32,974,368

With regard to the rating of the current seaport infrastructure in Nigeria, Respondents rated the seaport transport sub-sector E3 (1.69) out of an overall rating of 5. Although, the seaport was the highest rated transportation infrastructure in Nigeria in 2021, yet the rating is a major decline from 1.77 and 2.44 rating in 2017 and 2015 respectively. An indication that the current seaport infrastructure is in a poor state and urgently require a holistic and comprehensive approach that takes into consideration the peculiarity and interrelation of the seaports. This unfortunate state of the Nigerian seaport infrastructure can be attributed among others to; inadequate facility to accommodate the current and emerging traffic in the seaports and resulted into port congestion problems (a necessary evil with Lagos ports), a high rate of sediment build-up along navigable channels; Physical obstruction, including wrecks, rocks, outcrops, and aquatic weeds; and Poor communications and navigational aids.

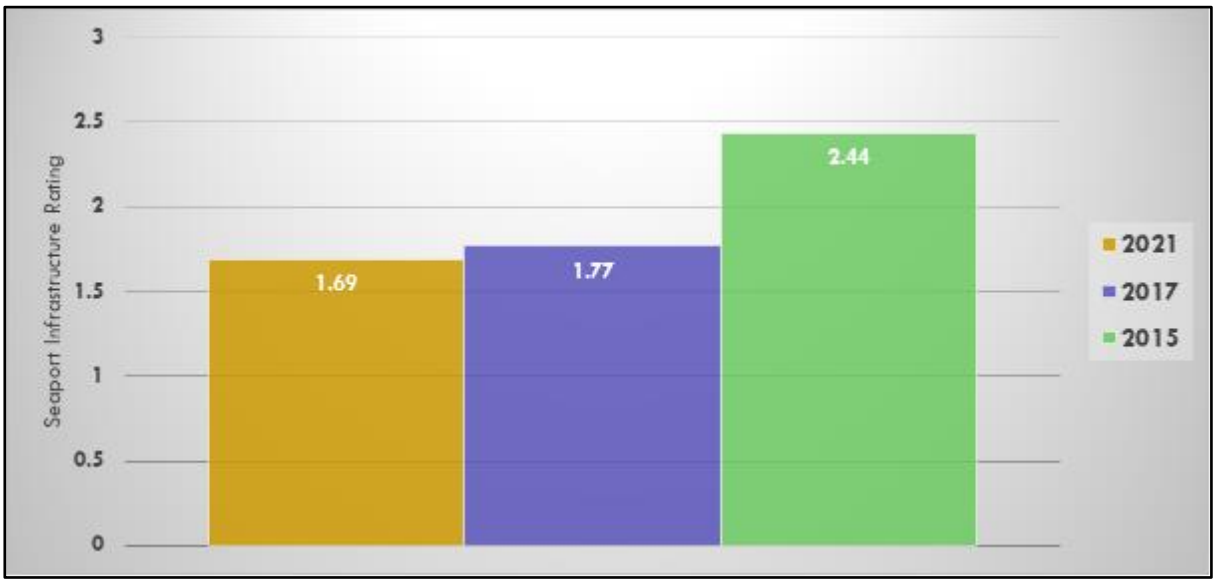


Figure 8-102: Seaport Infrastructure rating (2015 - 2021)

Rating per the available categories showed a downward trend, specifically, capacity, funding, innovation and operations and maintenance of the available seaport infrastructure in the country was rated below the previous 2017 and 2015, with the strategic use of innovative techniques and delivery methods – termed "innovation" being the least rated of these categories. The future provision however showed an inconsequential increase of 1.7 from 1.67 rated in 2017.

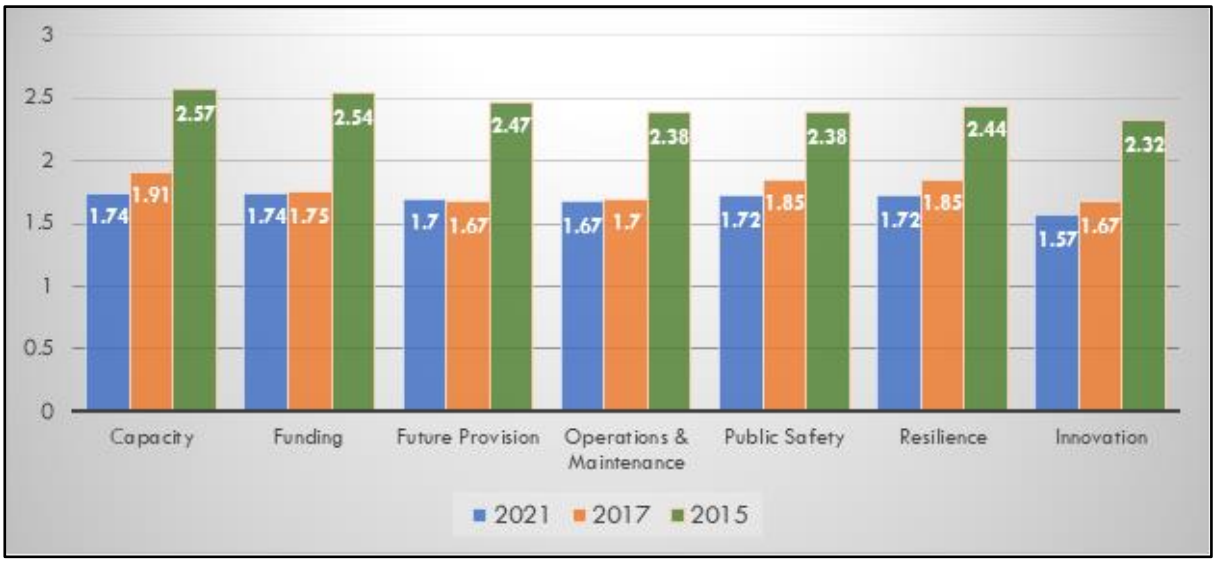


Figure 8-103: Seaport Infrastructure Rating per Category (2015 – 2021)

From the seaport infrastructure rating of the respondents, it is obvious that the transport sub-sector is characterised with overwhelming challenges, from infrastructural maintenance deficit, capacity funding and non-deployment of innovative techniques to ease daily operational stress that investors go through every day. In fact, according to Vanguard of 3rd, July 2021, the Organised Private Sector, OPS, recently admitted that the perennial gridlock in the Apapa

ports and its environs in Lagos State was making the Federal Government lose nothing less than N6 trillion annually across all sectors of the economy. To corroborate this assertion also, Mr. Aliko Dangote, the richest man in Africa, was cited to have said that not less than N20 billion is being lost daily to the deplorable state of the Apapa ports road in Lagos State, alone.

In a bid to quell these problems, the Federal and State Governments of Nigeria through the NPA is partnering with the private investors to develop six (6) deep seaports namely Lekki Deep Seaport, Ibaka Seaport, Age Deep Seaport, Badagry Deep Seaport, Olokola Deep Seaport, and Ogidigbe Port. While according to NPA, the Badagry Deep Seaport project will cost N216bn (USD1.35bn) and landmass of 90 hectares, with expected capacity to handle 4mn tonnes of cargo. In its first phase of the three phases, the container terminal at the new port would have two berths totalling 650m, with a draught of 14.5m of water alongside it. Its annual box-handling capacity would be 1mn twenty-foot equivalent units (TEUs) initially and to be expanded in subsequent phases. Further to the container handling facilities, the new port at Badagry would also be able to handle roll on-roll off (ro-ro) and general cargo and have a small free zone.

8.19 WASTE MANAGEMENT

8.19.1 BACKGROUND

Nigeria being the most populated country in Africa and the 6th most populated in the world, produces over 32 million tons of solid waste every year. (United States Census Bureau, 2021) (BioEnergy Consult, 2021). Out of this, only about one-third of the waste generated is collected which has resulted to blockage of sewers and drainage networks within most cities, and choking of water bodies, etc.

Up until the early 1970's, the management and consequences of solid waste did not gain much attention in Nigeria. As, the oil boom, emerging industrialization, and urbanization, caused a major increase in the volume of waste generated, causing waste management difficult to manage. Consequently, in April 1977, the first waste management outfit in West Africa was instituted, as Lagos State Refuse Disposal Board (LSRDB) in Nigeria. (Lagos State Ministry of Environment & Water Resources, 2021).

With the increasing population, Nigeria is faced with the difficult challenge of effectively managing up to 0.5 kg per capita of waste generated daily, in Lagos State alone. Unlike Lagos State, most states in Nigeria do not have any resources or systems to manage waste, leaving most individuals with the only choice of burning waste, which is equally harmful to the environment.

Solid waste is either biodegradable and non-biodegradable unwanted materials that are in a solid and semi-solid state that includes forms of household waste, refuse, construction and demolition debris, electronic waste, and other discarded materials. These wastes are from industrial, commercial, mining, agricultural, household or community operations. Most of these wastes are made up of paper, organic matter, plastics, metals, textiles, rubber, and glass. Plastics, glass, and most metals are non-biodegradable wastes that pose a major environmental challenge for as long as 400 years.

Meanwhile, sewage waste management is still a largely neglected topic of in Nigeria, as only Abuja and some parts of Lagos State have existing sewerage systems.

The Goal 6.3 of the UN SDG states that by 2030, countries should “improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally”.

The current waste management challenges being experienced in Nigeria need to be addressed immediately, to curb the environmental and health consequences; however, if they are properly managed, solid waste can be used to generate jobs and promote GDP growth through wealth generation mechanisms, as well as other environmental and social benefits.

To this effect, the Federal Ministry of Environment, recently in 2020 established two policies to restructure the country’s waste management system: the National Policy on Solid Waste Management and the National Policy on Plastic Waste Management.

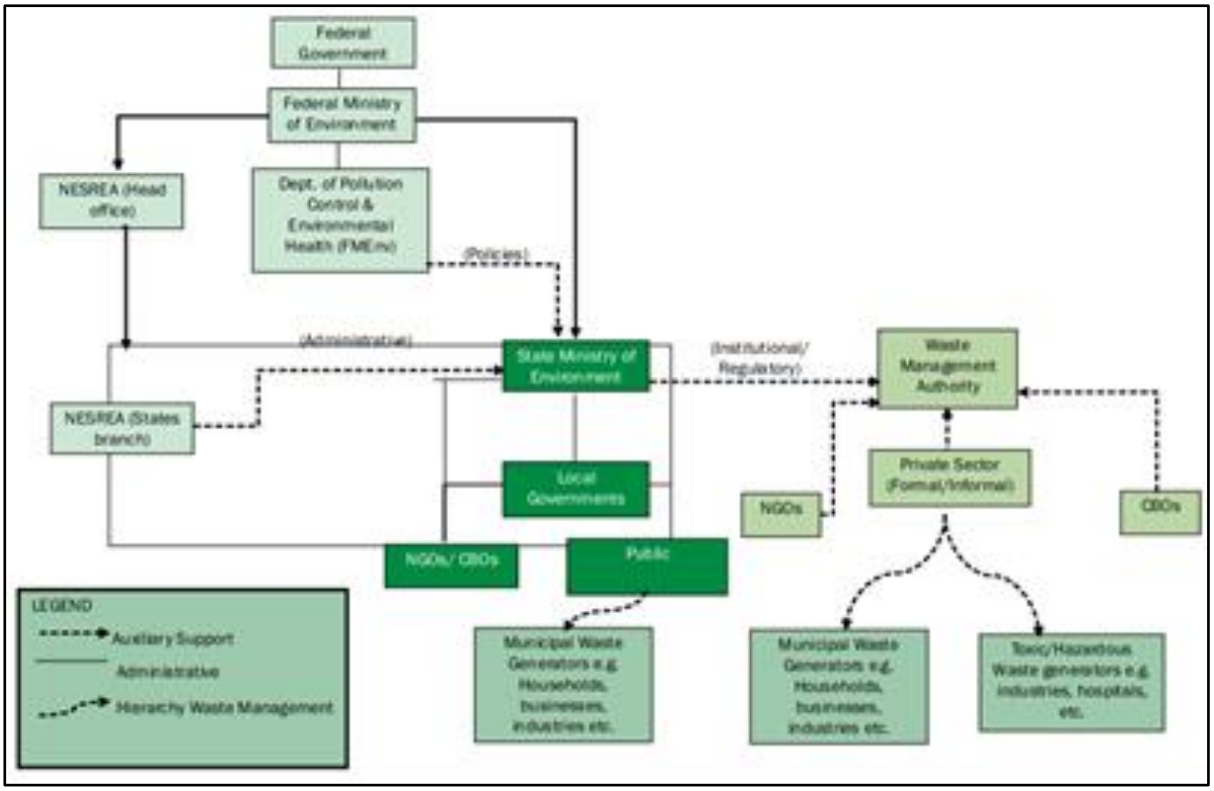


Figure 8-104: Plastic waste management

8.19.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The 2021 rating for the country’s waste management infrastructure was 1.41(F1), which indicates that the infrastructure is unfit for purpose, a slight improvement from reported in 2017. However, the rating showed a decline from 1.92(E2) in 2015. This points out that the participants acknowledge some improvements in the management of this infrastructure by the government.

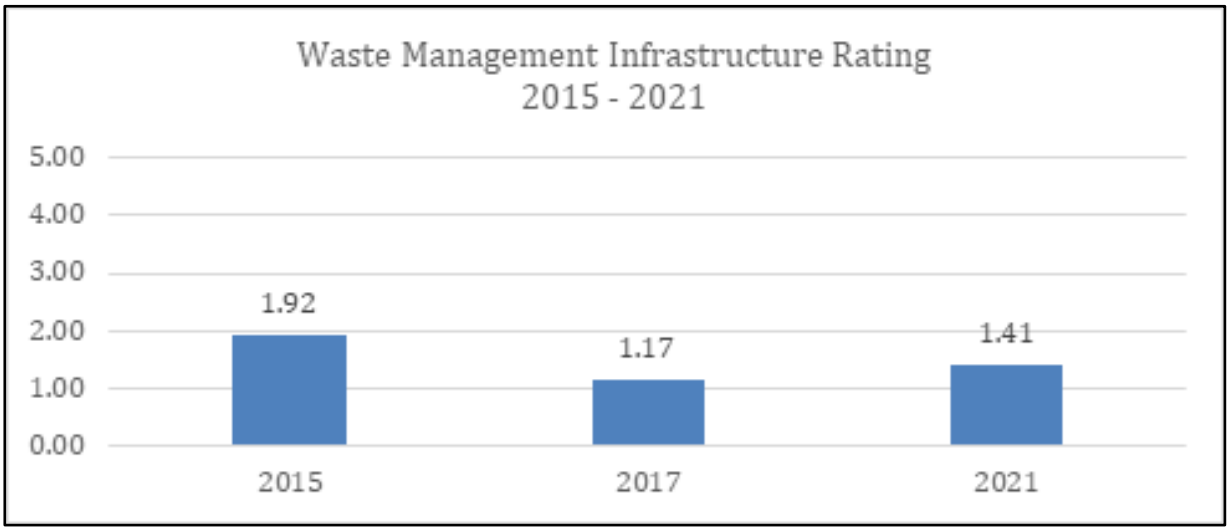


Figure 8-105: Waste management infrastructure rating 2015-2021

Figure 8-106: Waste management infrastructure

In the 2021 rating, infrastructure users rated the capacity of the waste management infrastructure the highest at 1.45(F1), all other criteria ratings indicated that the current infrastructure is unfit for purpose in the areas of funding, innovation, resilience, operations & maintenance, public safety etc. Despite the health and economic implications of a poorly managed waste management system and water pollution, it remains a major source of concern. The Federal Ministry of Environment has pointed out inadequate funding as one of the challenges that currently affect the sector and have encouraged private sector participation, even as States like Lagos, Cross River and Kaduna have taken advantage of

these opportunities. In 2020, the Federal Minister of Environment, Dr Mohammad Abubakar had noted that the estimated N8.9billion allocated to the ministry in 2021 budget was grossly inadequate to tackle environmental challenges in the country.

Only 30% of the 32 million tons of was waste generated annually, is collected. Most of the waste collected are dumped on landfills, leaving less than 20% are recycled. This has posed a major threat to health as some of Lagos State's coastal slums have run out of usable land and started filling in swampy areas with rubbish to live on. Several ailments and diseases still predominant in Nigeria, like malaria, yellow fever and lassa fever have been linked to poor sanitation and improper garbage disposal.

The largest landfill/dumpsite in Africa is the Olusosun dumpsite in Lagos. It is a 100-acre dump which receives up to 10,000 tons of rubbish each day, from around 500 container ships. Some of the waste collected on this site are treated with chemicals to extract reusable products. This process results in toxic fumes being released to about 1,000 homes that exist at the site. Most of these residents are workers at the site, that scavenging for scrap to sell. Other dumpsites in the country are Solous and Epe in Lagos, Awotan and Lapite in Ibadan.

Figure 8-107: Olusosun Landfill (the largest in Lagos) (Source: The Washington Post, 2017)

It is estimated that by 2025 Nigeria's population will grow to about 233 million, which will generate an estimated 72.46 million tonnes of waste yearly. At this rate, waste generated by capita by day will be 0.85 kg. This means that Nigeria annual waste generation will almost equal its crude oil production which currently stands at approximately 89.63 million tonnes per year.

(Bio Energy Consult, 2020), (Bio Energy Consult, 2020), (Wikipedia, 2021)

8.19.3 REFUSE COLLECTION

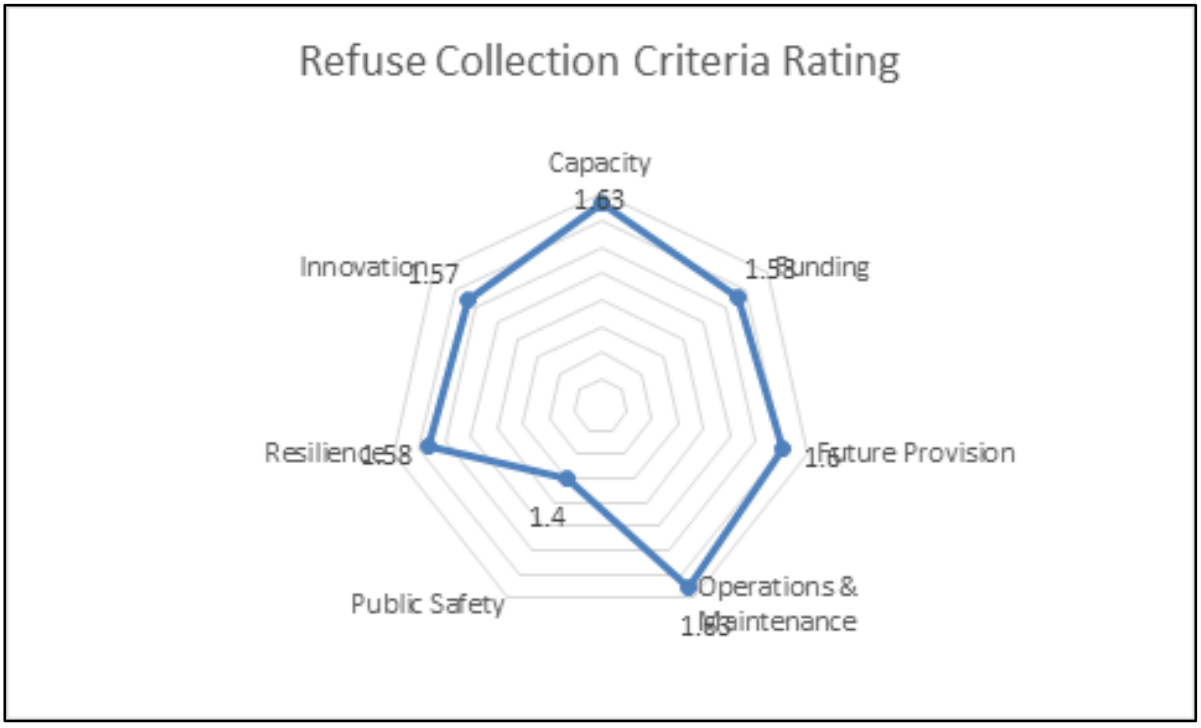


Figure 8-108: Refuse collection criteria rating

The refuse collection infrastructure is rated for the first time with the overall rating of 1.57(F1). This indicates that the infrastructure is unfit for purpose. The user rating for the capacity and operations & maintenance of the infrastructure is low at 1.63, although both criteria have the highest rating.

Of the 32 million tons of waste, only about 20% is being collected. According to the Federal Ministry of Environment, the country's current solid waste management system is affected by economic, institutional, legislative, technical, and operational constraints. Reckless disposal of refuse has led to blockage of sewers and drainage networks within most cities, and choking of water bodies, as most of the wastes being generated by households, local industries, traders and so on, litter the immediate surroundings.

One of the major materials that cause littering in Nigeria is plastic, as the use and demand for plastic has grown drastically over the years. About 70% of plastic raw materials used in Nigeria are imported and only 30% produced locally. Between 2008 and 2015, imports of plastic raw materials jumped from 464 kt to 754 kt, making Nigeria one of the largest importers of plastics in Africa's. The annual per capita consumption of plastics in Nigeria grew by 5% over the past 10 years from 4.0kg in 2007 to 6.5kg in 2017. Seasonal demand factors shortened product lifecycle fuelled by the growing use of 'single-use' plastics, have increased the consumption patterns of plastic goods.

8.19.4 SEWAGE

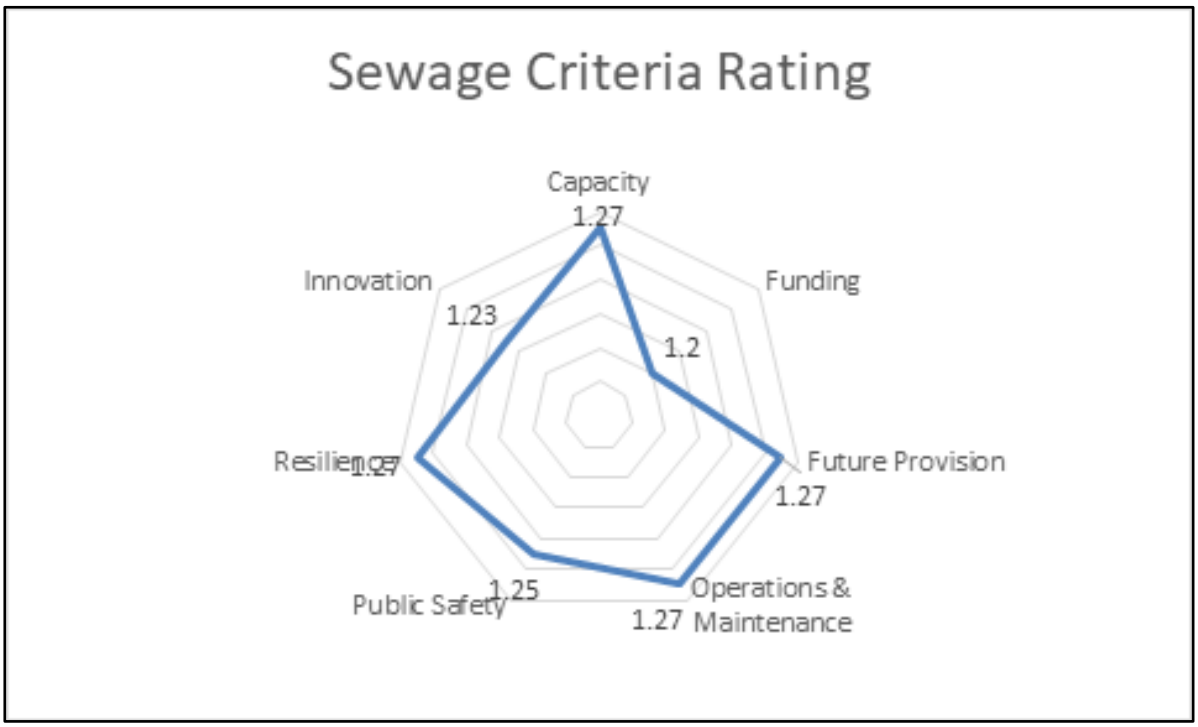


Figure 8-109: Sewage criteria rating

The sewage infrastructure in Nigeria was rated for the first time in 2021 with the overall rating of 1.25(F2). This indicates that the infrastructure is unfit for purpose. The user rating for all the criteria were especially very poor. The ratings are in line with the current realities in Nigeria as the current central sewage system only exists in very few cities in Nigeria, including Abuja, some areas of Lagos, Kaduna, River States.

Sewage is wastewater generated from human activities through excretion of urine or faeces. In Nigeria, sewage is often discharged through pit latrines in rural areas while it is discharged into septic tanks and soakaways in urban areas. After the discharge occurs, the soils become saturated with pollutants and effluents which causing environmental pollution and groundwater pollution.

A study in 2017 showed that in Nigeria, 44.2% of households used various kinds of pit latrines, followed by 10.3% households that used toilets to flush to septic tanks, while only 5.3% used toilets that connect to sewer systems, 31.5% lacked any sanitation facility and 8.7% used other types of sanitation facilities.

Sewage if properly treated can be a renewable resource as it used can be reclaimed and reused for other purposes. The quality of the once used wastewater and the specific type of reuse determine the level of subsequent treatment needed. The treated water can be used for purposes, other than drinking, such as irrigation, fire protection, as well as toilet and urinal flushing in public buildings.

At an investment forum in 2011, the Lagos State Government stated that to recycle 1.4 million gallons of wastewater generated daily, it would need about N75 billion.

8.19.5 SPECIAL WASTE (HAZARDOUS, MEDICAL, ELECTRONIC)

Special wastes are also forms of solid waste which have become a growing cause of concern due to increase in economic and developmental activities. Some of these wastes are generated from healthcare facilities such as used syringes, surgical gloves, chemical, and pharmaceutical materials, electronic waste generated from old or discarded mobile phones, electronic devices from homes, offices and wastes from construction works.

Healthcare services and activities often generate waste products, which can cause some environmental and health hazards. About 85% of waste materials from healthcare facilities usually belong to the general waste category, while the remaining 15% usually comprise of highly infectious or toxic radioactive materials.

A study in 2018 showed that 16.9% of healthcare facilities in Lagos State segregated their wastes, while healthcare facilities in other parts of the country did not have a colour-coded bins to segregate wastes. The Lagos State government established the Healthcare Facility Monitoring and Accreditation Agency (HEFAMAA) in 2006 and in conjunction with LAWMA has organized workshops, trainings etc to sensitize practitioners on the need to properly segregate and manage waste in their facilities.

Electrical/electronic waste also referred to as e-waste, also poses a major threat to the environment in Nigeria. About 500,000 tons of e-waste are dumped in workshops, landfills, and open spaces every month. More than 60,000 tonnes of used electrical and electronics equipment are shipped into Nigeria every year, with about 25% of the equipment, coming into the country in bad condition, hence they end up being dumped or burned, causing over 52,000 tonnes of brominated plastics, 4,000 tonnes of lead, 80 tonnes of cadmium and 0.3 tonnes of mercury are burned or dumped every year.

According to International Labour Organizations, in Nigeria, about 100,000 people work in the electronic waste sector to process 500,000 tonnes of discarded appliances annually

In 2019, the Nigerian Government, the Global Environment Facility and UN Environment, under the Circular Economy Approaches for the Electronics Sector in Nigeria project, joined forces to kick-off a $15-million e-waste initiative. The initiative will bring together players from the public sector, the private sector and civil society to jumpstart a financially viable approach for electronics in Nigeria, while protecting the environment and creating safe employment for thousands of Nigerians. Safe e-waste recycling is said to have an enormous economic potential, with “100 times more gold in a tonne of e-waste than in a tonne of gold ore”.

(UN Environment Programme, 2019) (The Conversation, 2020)

8.19.6 INTERNATIONAL BENCHMARK

Indices	Nigeria	Africa Benchmark			Global Benchmark		
		Ghana	South Africa	Egypt	US	UK	UAE
Population (million)	212	31	59	104	333	68	9

Tons of solid waste annually (million)	32		108		292	44	4.9
Plastics production (million)							

8.20 WATER

8.20.1 BACKGROUND

Nigeria has an abundance of water with an estimated 267.3 billion cubic meters of surface water and 52 billion cubic meters of groundwater. Unfortunately, these are not being effectively harnessed and utilized.

According to the Federal Ministry of Water Resources, the country's water infrastructure system is made of an estimated 2,041,389 water points, with about 65% located in rural areas and 35% in urban areas. However, only about 14% of the country's population has access to safely managed drinking water supply services. (Federal Ministry of Water Resources, Government of Nigeria, National Bureau of Statistics and UNICEF, 2019)

Despite Nigeria's poor achievement of the Millennium Development Goals (MDGs) for water in 2015, the country is determined to achieve the SDG 6 goals by 2030. In 2018, the Nigerian Government declared a State of Emergency on water supply services and launched National Action Plan (NAP) for the Revitalization of Nigeria's Water Supply, Sanitation, and Hygiene Sector which was aimed at ensuring universal access to sustainable and safely managed water services by 2030, commensurate with the SDGs 6. (WaterAid Nigeria, n.d.).

According to WHO, only about 0.42% of the GDP has been invested in the sector between 2006 and 2010 (WHO, 2014).

As of 2020, only NGN100 billion budget was allocated to the Federal Ministry of Water Resources. Meanwhile, to adequately provide access to sustainable and safely managed water services under the SDG 6, Nigeria must invest up to 2.7% of its current GDP or US$10 billion annually. To this effect, the Federal Ministry of Water Resources is putting in efforts to access more funding, one of which is proposing the water bill to attract private sector partners.

Table 1: Total Investments Needs for Achieving the SDGs by 2030

	Investment Needs for Existing Population (2016)			Investment Needs for Future Population to 2030			Total Investment Needs for Achieving the SDGs by 2030			As % of GDP per Year
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Total
Water	17,123	6,420	23,543	16,301	1,414	17,715	33,424	7,834	41,258	0.85%
Sanitation	30,221	15,271	45,492	28,088	3,455	31,543	58,309	18,726	77,035	1.59%
Hygiene	1,787	138	1,925	2,201	35	2,236	3,988	173	4,161	0.09%
Total	**49,131**	**21,829**	**70,960**	**46,590**	**4,904**	**51,494**	**95,721**	**26,733**	**122,454**	**2.52%**

Note: Urban-Rural Population Estimates between 2016 and 2030 calculated using growth estimates from United Nations Department of Economic and Social Affairs (2014). Population estimates for 2016, obtained from the World Bank Regional Indicators, serve as base year. WASH access estimates for existing population calculated using the National Water Supply and Sanitation Survey (2015). The estimates include the aggregate costs of providing basic and safely managed water and sanitation services to the population of Nigeria. Nigerian Unit costs for providing access to basic and safely managed services obtained from Guy Hutton and Mili Varughese (2016), with some additional changes made to the costs of rural tube well based on consultations with the Nigerian Government in 2016.

Table 2: Total Public Expenditure Needs (only CapEx) for Achieving the SDGs by 2030

	Investment Needs for Existing Population (2016)			Investment Needs for Future Population to 2030			Total Investment Needs for Achieving the SDGs by 2030			As % of GDP per Year
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Total
Water	13,698	5,136	18,834	13,041	1,131	14,172	26,739	6,267	33,006	0.68%
Sanitation	12,088	2,291	14,379	11,235	518	11,753	23,324	2,809	26,133	0.54%
Hygiene	1,787	138	1,925	2,201	35	2,236	3,988	173	4,161	0.09%
Total	**27,574**	**7,565**	**35,138**	**26,477**	**1,685**	**28,162**	**54,051**	**9,249**	**63,300**	**1.30%**

Note: Urban-Rural Population Estimates between 2016 and 2030 calculated using growth estimates from United Nations Department of Economic and Social Affairs (2014). Population estimates for 2016, obtained from the World Bank Regional Indicators, serve as base year. WASH access estimates for existing population calculated using the National Water Supply and Sanitation Survey (2015). The estimates include the aggregate costs of providing basic and safely managed water and sanitation services to the population of Nigeria. Nigerian Unit costs for providing access to basic and safely managed services obtained from Guy Hutton and Mili Varughese (2016), with some additional changes made to the costs of rural tube well based on consultations with the Nigerian Government in 2016.

In 1961, Nigeria established eleven (11) river basin development authorities to effectively manage the country's water resources and its utilization in terms of irrigation, construction of dams & reservoirs, fishing regulations, hydro-electric power generation etc. (Ezenweani, 2017)

There are over 200 dams owned by the Federal Government and located in various parts of Nigeria, that have the capacity to serve several purposes including supply of drinking water, hydroelectric power, irrigation, fishing etc.

8.20.2 INFRASTRUCTURE PROVIDERS/QUALITATIVE PERSPECTIVE AND RATING

The survey respondents rated the water infrastructure F2(1.39), indicating that it is unfit for purpose. The result is a slight improvement from F2(1.29) rating in 2017, although within the same grade. The 2021 and 2017 results declined significantly from E2(1.99) rating in 2015 which indicated that the infrastructure was in a poor state. The overall survey for water infrastructure included questions on the public water supply and the dams in the country.

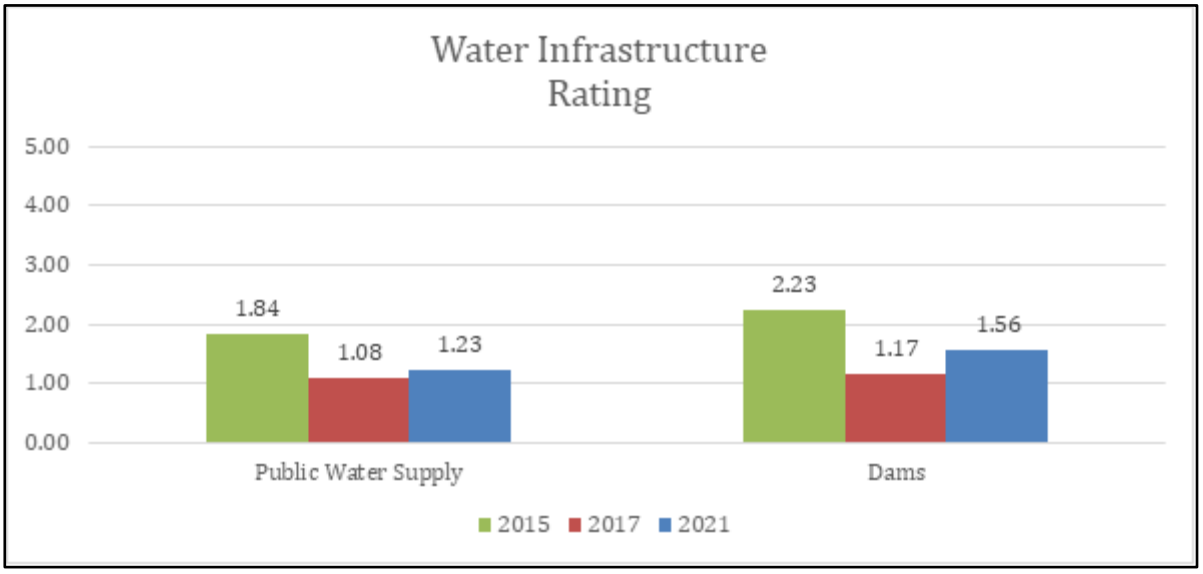


Figure 8-110: Water infrastructure rating

The ratings for both public water supply and dams both showed minimal improvements in 2021 from the ratings in 2017.

In 2021, the capacity of the infrastructure to meet current and future needs of the population was rated the highest at 1.48(F1), determining that it is unfit for purpose, while implementation of innovative techniques was rated the lowest at 1.29(F2), also unfit for purpose.

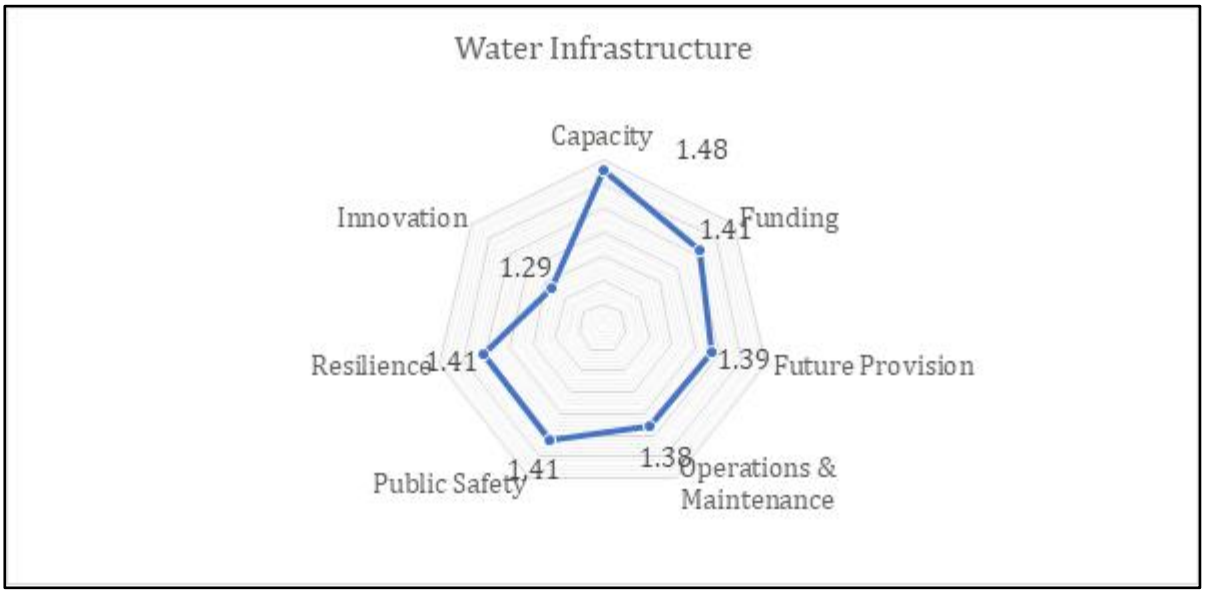


Figure 8-111: Water infrastructure

8.20.3 PUBLIC WATER SUPPLY

The public water supply in the country was rated 1.23(F3) indicating that the infrastructure is not fit for purpose. The rating though within the same grade, is a slight improvement from

1.08(F3) score recorded in 2017. The ratings for the public water supply in 2021 and 2017, declined significantly from 1.83(E2) recorded in 2015.

A look at the criteria rating chart, shows that in 2021, the highest rating 1.31, went to funding of the sub-sector and the lowest rating 1.12, went to innovation.

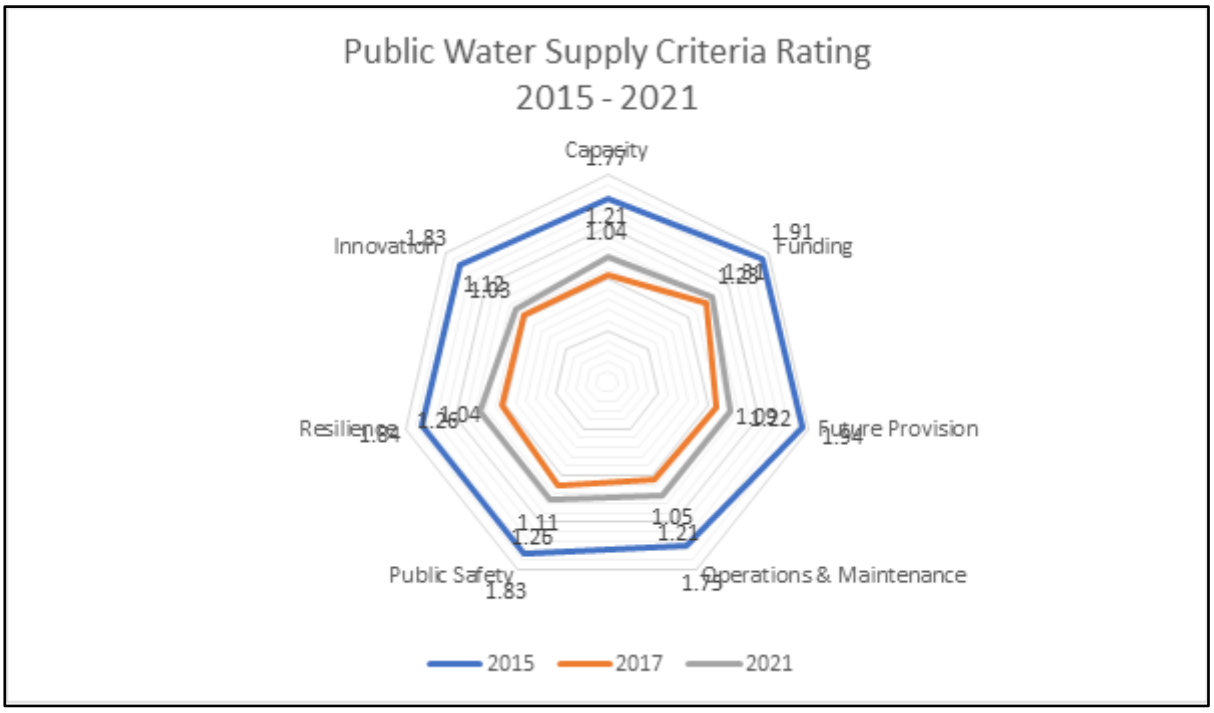


Figure 8-112: Public water supply criteria rating 2015-2021

In terms of public safety, the quality of water between 2016 and 2019 has shown some improvement. In 2016, 77% of the population accessed contaminated water from their household's drinking water source, while 9 out of 10 persons (91%) were found to consume drinking water contaminated by E. coli within their households. Results from the NORM II indicated that up to two-thirds of the population drink contaminated water at source (66%) and within their households (63%), equating to a general reduction in the proportion of people using contaminated water.

Despite these improvements, national water quality status is still critically poor. Even as 75% of the population are accessing improved water sources, about half of these improved sources (58%) are contaminated. This is compounded with the fact that up to a third of the population (36%) do not do anything to make their water safer to drink. The quality of water supplied by public utilities is also of major concern as well. About 41% of all taps fed by public water utilities' supply are contaminated with E. coli with an average thermotolerant coliform forming unit of 234 CFU/100ml.

8.20.4 DAMS

The rating for dams was 1.56(F1) indicating that the infrastructure is not fit for purpose. The rating though within the same grade, is a slight improvement from 1.08(F3) score recorded in

2017. Although, the ratings showed similar trends between 2015, 2017 and 2021, the results have seen a downward trend for the three consecutive reports. The highest rating for the three reports went to the capacity of dams in the country to meet current and future needs and the lowest ratings went to innovation.

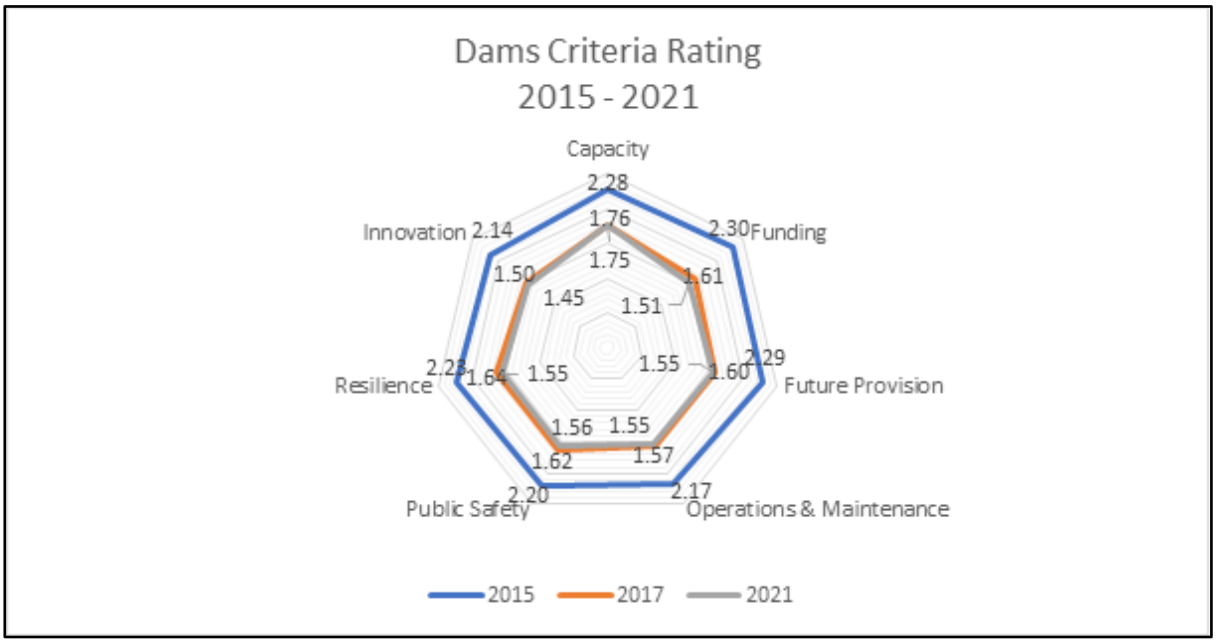


Figure 8-113: Dams criteria rating 2015-2021

The capacity of the sub-sector was rated 1.75(E2), indicating that it is in poor state. The over 200 dams in the country have the capacity to provide 11.2 billion cubic metres (BCM) of water for irrigation, 900 million cubic metres (MCM) for water supply and 18 billion cubic metres (BCM) for hydropower generation in the country. (Federal Ministry of Water Resouces, 2021). These dams, however, are not being harnessed to meet the needs of the country.

Under the Water Resources Sector Road Map in 2015, the Federal Ministry decided not to commence new projects but to complete inherited and abandoned projects. Of the 116 inherited on-going and abandoned projects, 37 were dams and 20 of the dam projects were prioritized for completion by the end of 2023. This may corroborate the views of the survey participants, as some of these inherited projects have been abandoned since as long as 1987, and as such, very little focus may have been given to new ideas in the sub-sector.

The Ministry, however, has had some major achievements since 2016. Some of these achievements include the (1) Concessioning of Gurara I 30MW Hydropower; (2) Signing EPC Contract of Gurara II Dam Project with 360MW Hydropower; (3) Initiate the construction of Itisi Multipurpose Dam (Water Supply, Irrigation & Hydropower) Project in Kaduna State; and (4) Initiate the Development of Hawal Interbasin Water Transfer Project.

Also, out of the 20 of the dam projects were prioritized for completion by the end of 2023, 12 of them have been completed so far.

Table 8-14: Inherited Dam Projects & Priority Status

S/N	PROJECT	LOCATION	PRIORITY STATUS
1	Kontagora Dam and Irrigation Project	Niger State	Prioritized
2	Jare Dam and Access Road	Katsina State	Prioritized
3	Adada River Dam	Enugu State	Prioritized
4	Ingawa Dallaje Dam	Katsina State	Prioritized
5	Galma Multipurpose Dam	Kaduna State	Prioritized
6	Gurara Dam and Water Transfer to FCT Project	Kaduna State	Prioritized
7	Mangu Dam	Plateau State	Prioritized
8	Ile-Ife Dam	Osun State	Prioritized
9	Otukpo Multipurpose Dam	Benue State	Prioritized
10	Nkari Dam	Akwa Ibom State	Prioritized
11	Gadau/Lafia/Zigau	Bauchi State	Prioritized
12	Kashimbila Multipurpose Dam	Taraba State	Prioritized
13	Galma Multipurpose Dam	Kaduna State	Prioritized

14	Amla Otukpo Small Earth Dam	Benue State	Prioritized
15	Irawo Earth Dam	Oyo State	Prioritized
16	Ivo Dam	Enugu State	Prioritized
17	Amauzari Earth Dam	Imo State	Prioritized
18	Monkin Earth Dam	Taraba State	Prioritized
19	Ogwashi-Uku Earth Dam	Delta State	Prioritized
20	Inyishi Dam Project	Imo State	Prioritized
21	Ekuku Dam	Kogi State	Not Prioritized
22	Kagara Earth Dam	Niger State	Not Prioritized
23	Ogbesse Multipurpose Dam	Ekiti State	Not Prioritized
24	27 Small Earth Dam (MDGs)	Nationwide	Not Prioritized
25	Jada Multipurpose Dam	Adamawa State	Not Prioritized
26	Barkin Ladi Dam	Plateau State	Not Prioritized
27	Upu-Itor Small Earth Dam	Benue State	Not Prioritized
28	Ibuso Small Earth Dam	Delta State	Not Prioritized
29	Iyamero Small Earth Dam	Ekiti State	Not Prioritized
30	Gimi Dam	Kaduna State	Not Prioritized
31	Rafin Soja Small Earth Dam	Taraba State	Not Prioritized
32	Sasa Small Earth Dam	Osun State	Not Prioritized
33	Alajue Small Earth Dam	Osun State	Not Prioritized
34	Ugene/Ihaji Small Earth Dam	Benue State	Not Prioritized
35	Besse Small Earth Dam	Kebbi State	Not Prioritized
36	Wannune Small Earth Dam	Benue State	Not Prioritized

37	Rehabilitation of Kargo Dam	Kaduna State	Not Prioritized

Table 8-15: Dam Projects Completed Between 2016 and 2021

S/N	Dam	Location
1	Kashimbilla Multipurpose Dam	Benue State
2	Ogwashi-Uku Dam	Delta State
3	Ibiono-Ibom Dam	Akwa Ibom State
4	Amauzari Earth Dam	Imo State
5	Amla Oturkpo Small Earth	Benue State
6	Gimi Dam	Kaduna State
7	Sulma Dam	Katsina State
8	Kampe Omi Dam (Rehabilitation)	Kogi State
9	Kargo Dam (Rehabilitation)	Kaduna State
10	Adada Dam	Enugu Sate
11	Gadau/Lafia Zigau	Bauchi State
12	Alajue Small Earth Dam	Osun State
S/N	**Dam**	**Location**
1	Kashimbilla Multipurpose Dam	Benue State
2	Ogwashi-Uku Dam	Delta State
3	Ibiono-Ibom Dam	Akwa Ibom State
4	Amauzari Earth Dam	Imo State

5	Amla Oturkpo Small Earth	Benue State
6	Gimi Dam	Kaduna State
7	Sulma Dam	Katsina State
8	Kampe Omi Dam (Rehabilitation)	Kogi State
9	Kargo Dam (Rehabilitation)	Kaduna State
10	Adada Dam	Enugu Sate
11	Gadau/Lafia Zigau	Bauchi State
12	Alajue Small Earth Dam	Osun State

8.20.5 EXECUTIVE INSIGHTS

In 1992, 30% of the country's population had access to pipe borne water and by 2015, it had dropped to 7%. This caused the federal government declaring a state of emergency on water sanitation and hygiene in November 2018, to emphasize the need for combined efforts between the federal and the state governments, if the country is to meet up with the SDG 6 goals by 2030.

The country's water infrastructure has been solely dependent on annual budget allocations which has not been enough to meet the current and future demands of the growing Nigerian population.

The Ministry has had to look for alternative sources of funding, however, without proper regulations, this has proven to be a herculean task. Engr Suleiman Hussein Adamu, Minister of Water Resources explaining why regulation of the sector is important, stated that "…the water resources bill is currently before the national assembly. One of the main reasons for this bill is to strengthen the regulation of the water sector, so that it can attract private sector funding and partnerships.".

The private practitioners upon forming a partnership with the Federal Government, will take over the commercial aspect of the infrastructure, to include the cost recovery. The private partners will also take over the service delivery, taking over the water boards, conducting quality tests, managing the laboratory and managing the water treatment plant while the government will be responsible for the billing, metering of houses and collecting the revenue.

The budget and funding constraints have also slowed down the construction and completion of inherited dam projects, as the Federal Ministry of Water Resources since 2015 has been committed to completing these inherited dam projects. "Out of those 116 projects we inherited, 37 were dam projects. One of them was started in 1987 and it is still not finished. Another

project, the Zobe Water Supply was started in 1992, but we have now completed it.'' - . Engr Suleiman Hussein Adamu, Minister of Water Resources.

As of 2021, the World Bank has approved a loan facility of $700 million, which will be split into $350 million for urban schemes and $350 million for rural schemes to tackle the lack of clean water and sanitation services within the country.

8.20.6 INTERNATIONAL BENCHMARK

Indices	Nigeria	Africa Benchmark			Global Benchmark		
		Ghana	South Africa	Egypt	US	UK	UAE
Population (million)	212	31	59	104	333	68	9
Use of water per capita per day (litres)	216	140	791	2,202	3,794	348	2,387
Number of dams	200		5,248		91,000	486	114

9 RWANDA

9.1 STATUS ON TRANSPORT INFRASTRUCTURE

9.1.1 RWANDA ROAD NETWORKS

The road networks in Rwanda are divided into Three Classes[1:]

- **National Road (NR**)- (1°-international roads that link Rwanda with neighbouring countries, 2^0 -roads that link Districts or that link a District and the City of Kigali, 3°-roads that link areas of tourist significance and facilities of national or international importance such as ports and airports).
- **District Class 1 and City of Kigali** (roads linking different sectors headquarters within the same District, or those roads that are used within the same Sector
- **District Class 2 and Special roads (**arterial roads that connect Districts roads to rural community centres that are inhabited as an agglomeration, and roads connecting national roads or District roads to Kigali City and other urban areas to the agricultural production, natural resources processing or to tourist sites).

Rwanda has a well-established road network encompassing about 37,879 Km of classified and unclassified roads. The Classified road networks is about 6,655km which consists of National Roads (2,749Km), District class-1 and City of Kigali roads (3,906Km)[2]. The remaining road network of about 31,224km is unclassified road network which includes District Class-2 roads network of about 9,763Km, and unclassified roads networks of about 21,461Km These road networks are based on available Geographical Information System shape files).

Figure 9-1 present Rwanda Road Networks vs. poverty rate per district

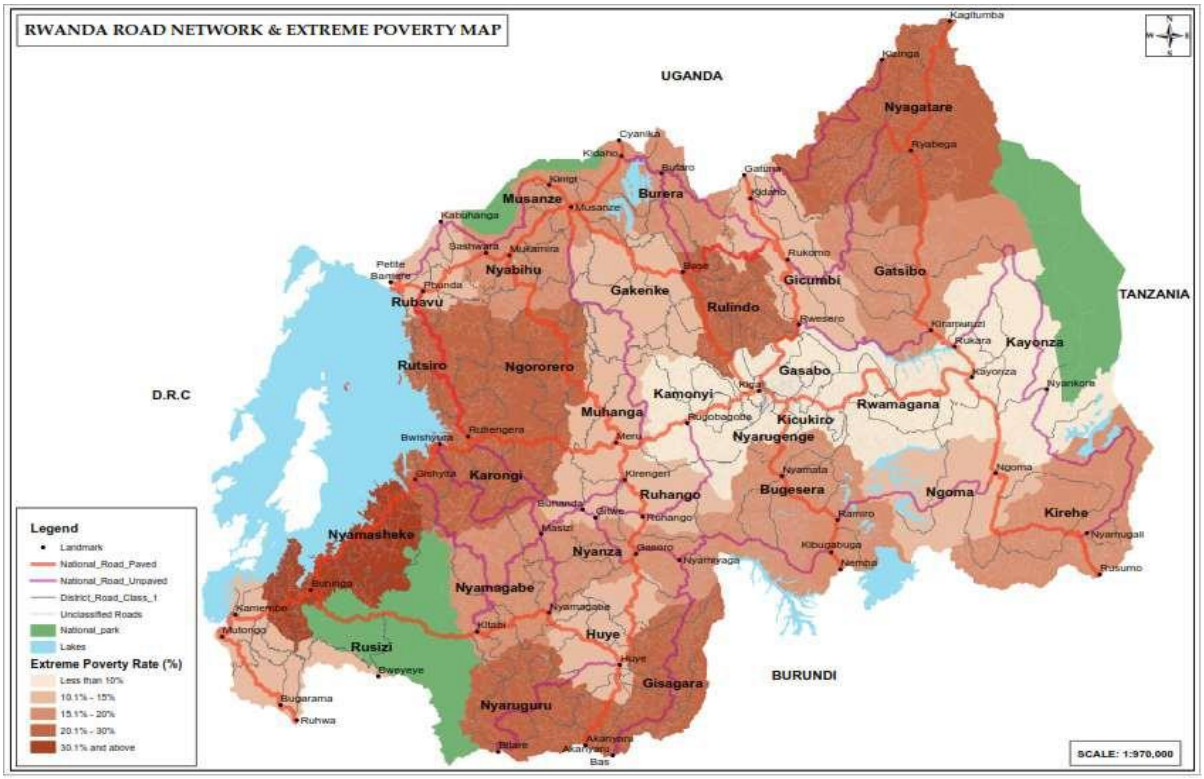


Figure 9-1: Rwanda road networks vs poverty rate per district

Characteristics of the road networks are presented as per the surface types and its classifications. It can be seen from the table below that 24% of the classified roads networks are paved surface and 76% are unpaved surface and the corresponding details are presented as follows;

Table 9-1: Rwandan road network by Surface type

Road class	Surface type 2020		
	Paved	Unpaved	Total Km
Classified road network			
National Roads (NR)	1,425	1,324	2,749
District Roads Class 1 (DR1)	151	3,755	3,906
Sub-Total 1	**1,577**	**5,078**	**6,655**
Percentage (%)	24%	76%	100%
Unclassified road network			
District Roads Class 2 (Draft)	132	9,631	9,763
Unclassified Road network	345	21,116	21,461

Sub-Total 2	**477**	**30,747**	**31,224**
Overall Km	**2,054**	**35,825**	**37,879**
Percentage (%)	**5%**	**95%**	**100%**

9.1.2 ROAD DENSITY

Road density is the ratio of the length of the country's total road network to the country's land area. This indicator is part of the WFO, Suite of Food Security Indicators. It measures the Km of roads per 100 square km of land area, where the total road network includes motorways, highways, national roads, secondary or regional roads, and all other roads in a country. This indicator provides information on the possible physical access to markets.

As presented in the road networks above, Rwanda has a total classified road network length of 6,655 km. This translates into a relatively high classified road density of 25.3 km per 100 km^2 [3] (or 62.3km per 100 km^2 if District Roads Class 2 are included) or (143.8 Km per 100 Km2 if all unclassified road network is included).

The comparison of road density with the EAC neighbouring countries is presented in the Table 9-2 below.

Table 9-2: Comparison of road densities with EAC neighbouring countries (source World Atlas (2019)

Country	Country Size (Km^2)	Classified road network (Km)	Road Density ($Km/100Km^2$)
Rwanda	6,655	26,338	25.3
Kenya	161,820.36	580,367	27.88
Tanzania	87,581	945,087	9.27

From the table above it can be seen that Rwanda has relatively high classified road density of 25.3km per $100km^2$ and is almost equal to that of Kenya of $27.88km/100km^2$ but munch higher than the classified road density of Tanzania which is $9.27km/100km^2$.

9.1.3 ROAD NETWORK CONDITION

The Government of Rwanda takes the transport sector as a key driving force to improve productivity, stimulate social and economic growth, and transform the country into a middle-income country by 2030.

The Government of Rwanda, in accordance with the national development objectives contained in Rwanda Vision 2020, Economic Development and Poverty Reduction Strategy 1-2 (EDPRS), and the recent Transport Sector strategic plan for the National Strategies for the Transformation (NST1, 2018) intensive road rehabilitation works over the last decade have been executed.

The condition assessment of the road networks are carried out annual are report to the transport sector group (TSG) which included review of all GoR, Funding Agencies and Private sector. The condition assessment shows that Rwanda has achieved notable success in maintaining the paved road network in good condition. However, the quality of unpaved national and district roads as well as unclassified roads remains a matter of concern and the road network condition is summarized in the Table 9-3 as follows.

Table 9-3Table 3 Rwanda Road Network Condition (Source: RTDA, 2020)

Road class	Road network condition by Surface type 2020								
	Paved				Unpaved				Total Km
	Good	Fair	Poor	Paved Total	Good	Fair	Poor	Unpaved Total	
Classified road network									

National Roads (NR)	1,391Km (97.6%)	14Km (0.98%)	20 Km (1.4%)	1,425Km	698Km (52.7%)	397Km (30%)	229Km (17.3%)	1,324Km	2,749Km
District Roads Class 1 (DR1)	148Km (98%)	4 Km (2.65%)	-	151Km	1,621Km (43.2%	1,126Km (30%)	1,007Km (26.8%)	3,755Km	3,906Km
Total classified road network	**1,539Km (97.6%)**	**18Km (1.14%)**	**20Km (1.27%)**	**1,577Km**	**2,319Km (45.7%)**	**1,523Km (30%)**	**1,236Km (24.3%)**	**5,078Km**	**6,655Km**
Unclassified road network									
District Roads Class 2	92Km (69.7%)	40Km (30.3%)	-	132Km	1,765Km (18.3%)	2,889Km (30%)	4,977Km (51.9%)	9,631Km	9,763Km
Unclassified Road network	242Km (70.1%)	104Km (30.1%)	-	345Km	2,112Km (10.0%)	4,223Km (20%)	14,781Km (70%)	21,116 Km	21,461Km
Total unclassified road network	**334Km (70%)**	**143Km (30%)**		**477Km**	**3,876Km (12.3%)**	**7,113Km (23.1%)**	**19,758Km (64.3%)**	**30,747Km**	**31,224Km**
Overall Total KM	**1,873Km (91.2%)**	**161Km (7.8%)**	**20Km (0.97%)**	**2,054Km**	**6,195Km (17.3%)**	**8,636Km (24.1%)**	**20,994Km (58.6%)**	**35,825Km**	**37,879Km**

9.1.4 ESTIMATED RURAL ACCESS INDEX (RAI)

The Rwanda's Rural Access Index (RAI) is estimated to be 55.3 percent. About 3.9 million out of 8.75 million people are estimated to be still unconnected to the road network. Based on measures per district, the RAI varies significantly from 25.7 percent in Rutsiro District in the Western Province to 79.2 percent in Nyarugenge District in City of Kigali. It is evident from the RAI that high connective/access are within the major cities, such as Kigali, Musanze/Ruhengeri, Rubavu, Muhanga and Huye as indicated in the Map presented in Figure 9-2

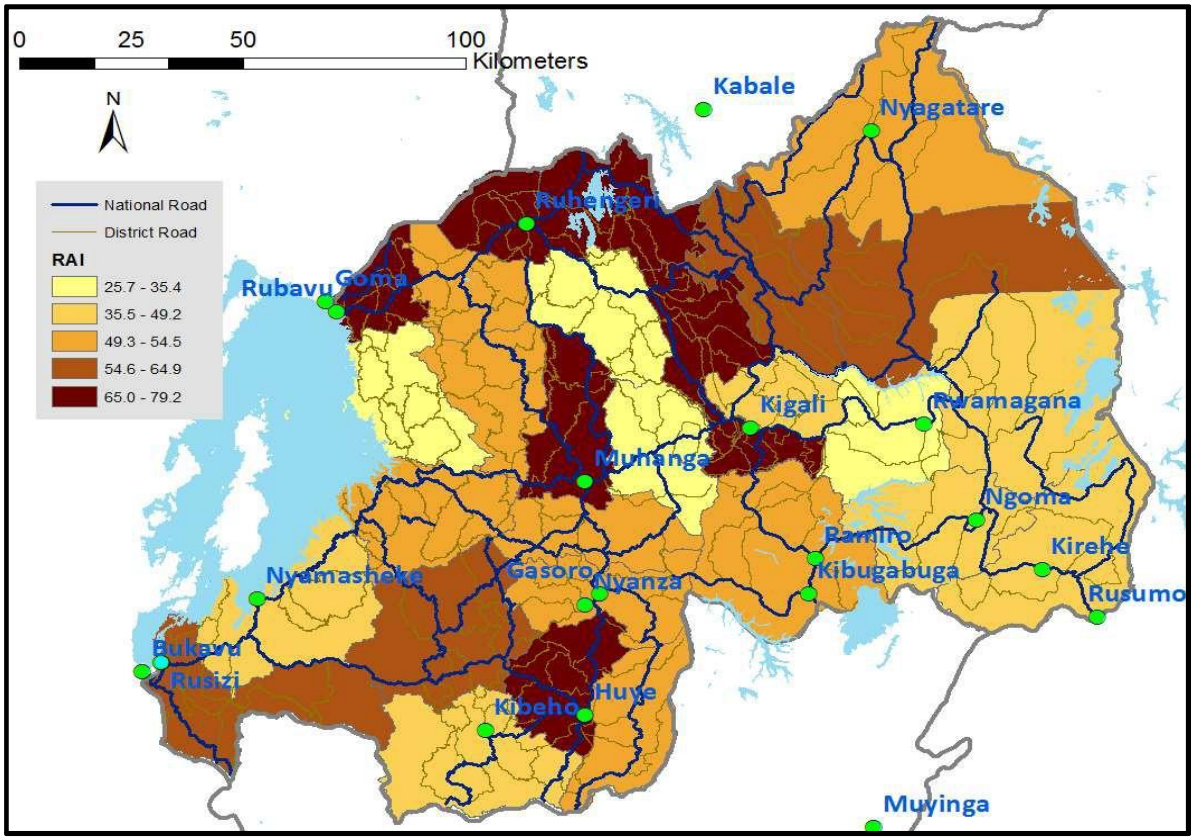


Figure 9-2: Rwanda rural accessibility index Map (Source: World Bank report (2019))

9.1.5 RAILWAY NETWORK

Rwanda does not have a railway infrastructure but the railway transport infrastructure is shaping up as the design review and updating of feasibility study for Isaka-Kigali Standard Gauge Railway (SGR) in the Central corridor from the port of Dar-es salaam was completed in 2014. The demarcation of the right of way (RoW) within Rwanda territory was completed in 2019 and currently the compensation for land acquisition is in progress.

The approved Master plan for the railway line networks is presented in Figure 9-3.

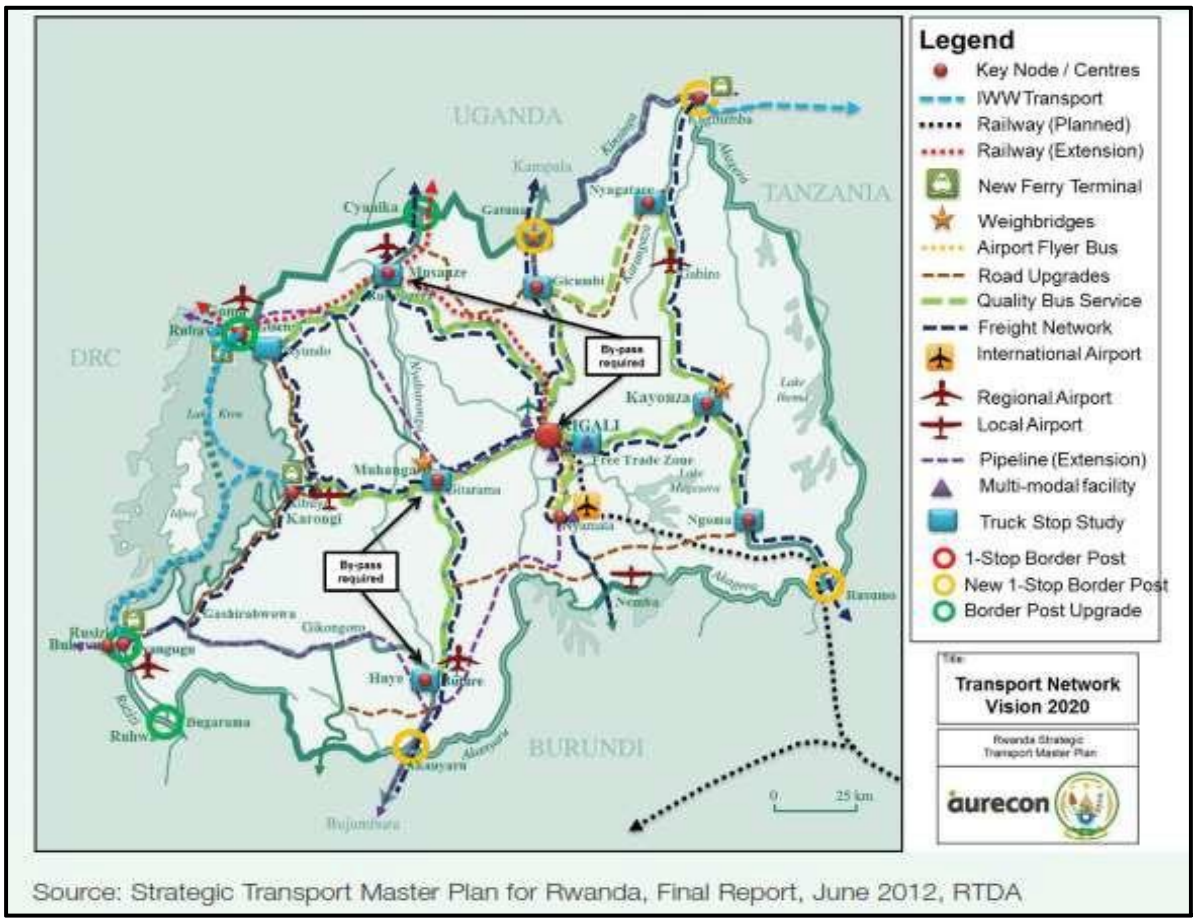


Figure 9-3: Rwanda proposed railway line network from port of Dar-es-Salaam, Tanzania (Source: Final Report, RTDA (2012))

9.1.6 PORT NETWORKS

Rwanda in the past did not have a port, but rather vessel landing sites. However, the Government of Rwanda, in accordance with the national development objectives contained in Rwanda Vision 2020, Economic Development and Poverty Reduction Strategy 1-2 (EDPRS), and the recent Transport Sector strategic plan for the National Strategies for the Transformation (NST1, 2018), maritime infrastructure development on Lake Kivu was one of the priority areas for the promotion of the inland water transport and reducing transportation costs for goods and people though road network. The study for development of 4 ports on Lake Kivu was completed at 100% in 2017, and the construction works of Port Facilities at Rubavu (Refer to the map, South of Lake Kivu) and Rusizi (Refer to the map, North of lake Kivu) are current under construction. The works are expected to be completed in 2021.

Figure 9-4 is the Map of the proposed Port along Lake Kivu in the Western Part of Rwanda and 2 ports which are under Construction

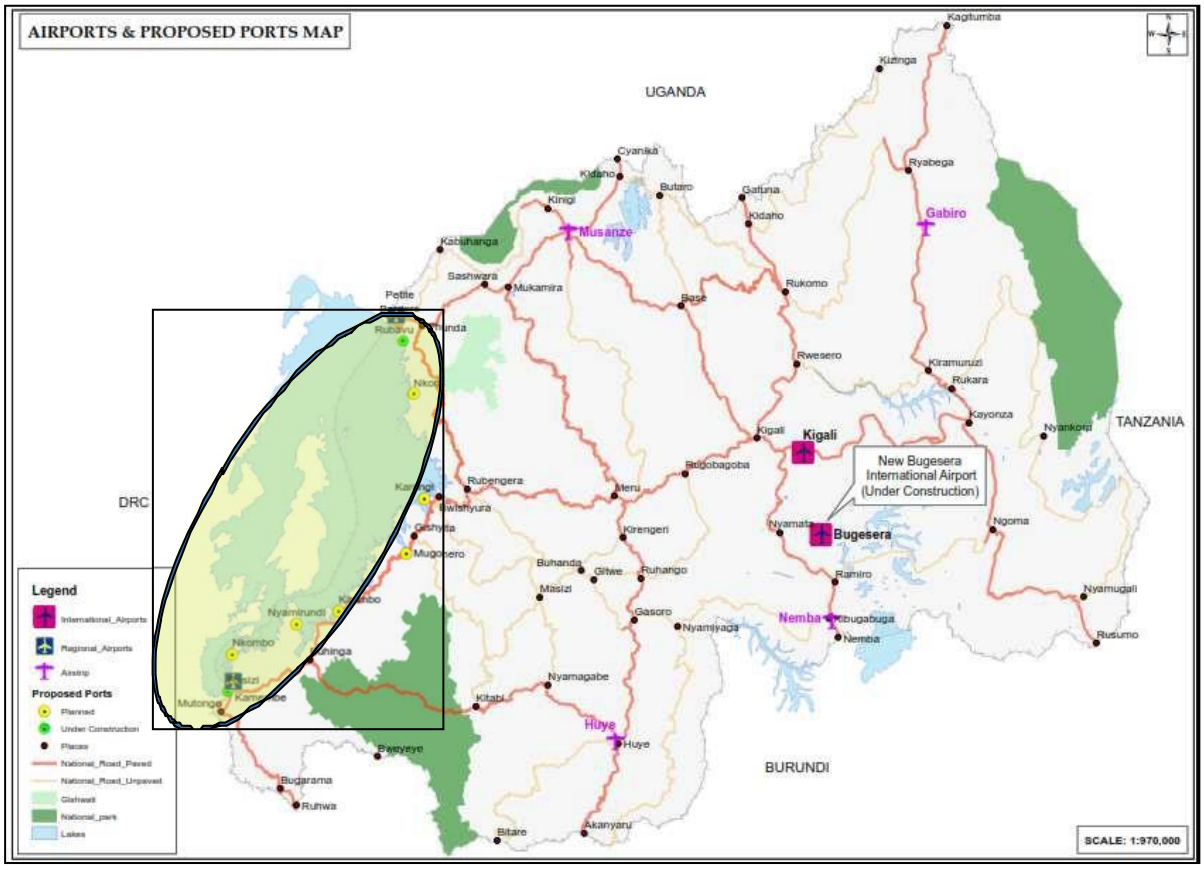


Figure 9-4: Ports Location along Lake Kivu and the one under Construction

9.1.7 AIRPORT AND AIRSTRIPS

The Government of Rwanda, in accordance with the national development objectives contained in Rwanda Vision 2020, Economic Development and Poverty Reduction Strategy 1-2 (EDPRS), and the recent Transport Sector strategic plan for the National Strategies for the Transformation (NST1, 2018), airport infrastructure development has been one of the priority areas for the promotion of the tourism and connective to Africa region, Asia and Pacific and America in order to increase on the import and expert of the Rwanda product globally

The airport and airstrip infrastructure in Rwanda are presented in Table 9-4 as follows;

Table 9-4: Air Infrastructure

SN	Name	Type	Capacity	Current Condition
1	The Bugesera International Airport (BIA)	International	Phase 1: 4.2Km runway, with other infrastructure Terminal capacity can handle over 3 million passengers a year	Under Construction, expected completion delayed it was to be completed in 2021

2	KIGALI international Airport (KIA)	International	The runway is 3.5Km with other infrastructure Terminal capacity can handle over 1.5mill passenger per year	Newly renovated from 2018 to 2021 both runway, terminal, apron, parking, VIP , fence, securities facilities etc
3	KAMEMBE AIRPORT	Regional	The runway is 1.5Km with other infrastructure	It was recently,2015 given a major facelift
			Terminal capacity can handle over 30,000 passenger per year	to reinforce the runway and apron, parking and terminal
4	Gisenyi Airstrip	Regional	The runway is 1.4Km with other infrastructure Terminal capacity can handle 3000 passenger per year	It is in bad condition, used by local touristic aircraft
5	Ruhengeri Airstrip	Local	The airstrip ceased to run commercial service operations in 2013. It remained to serve the tourist (private helicopter)	It is in very bad condition, not useable by jet aircraft only helicopters
6	Nemba Airstrip	Local	Not Operation	It is in very bad condition, used by helicopters
7	Huye Airstrip	Local	Not Operation	It is in very bad condition, used by helicopters
8	Gabiro Airstrip	Local	The runway is 1.4Km with other infrastructure It is for Military operations	Newly constructed it was completed 2019

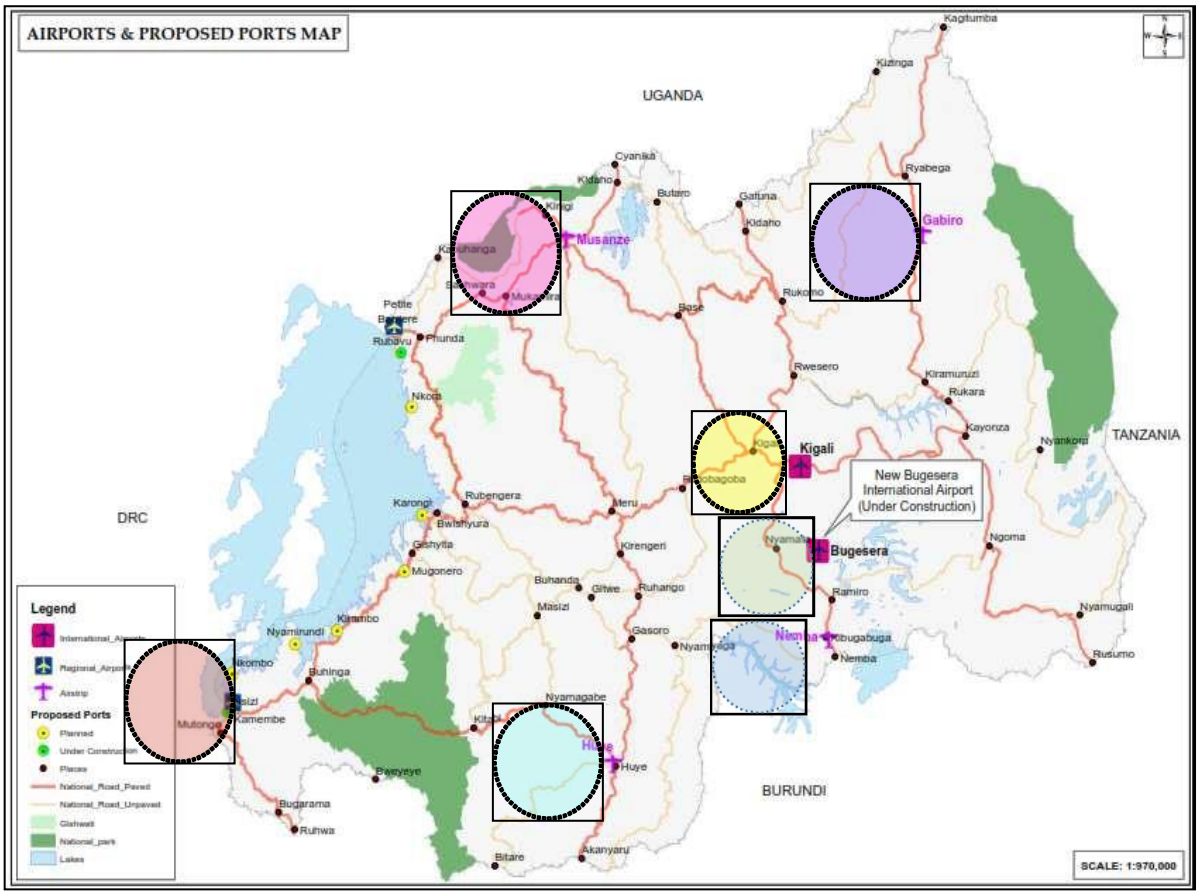


Figure 9-5: Map of Rwanda Air ports infrastructure (RTDA, 2020)

9.2 STATUS ON ENERGY/ELECTRICAL INFRASTRUCTURE

3.1 Energy is central to Rwanda's economy and development plans. It supports all other sectors, including housing and urbanization, manufacturing, agro-processing, mining, tourism and IT services. As such, a well-functioning, efficient energy sector is a prerequisite of achieving the country's national goals.

3.2 Rwanda's energy sector consists of different players with different roles as specified within the Rwanda grid code: State-owned Rwanda Energy Group (REG) was incorporated in 2014 to expand, maintain and operate the energy infrastructure in Rwanda through its two subsidiaries - the Energy Utility Corporation (EUCL) and the Energy Development Corporation (EDCL). Within this framework, planning of generation and transmission as well as electrification projects is the joint responsibility of the Ministry of Infrastructure (MININFRA) and the REG.

9.2.1 ENERGY CONSUMPTION BY SUB-SECTOR

The distribution of electricity in Rwanda have been increased which resulting into high consumption and also drive Rwanda's economic growth. However, it still accounts to only 2% of all energy consumed. In contrast, biomass consumption accounts for 85% of all energy consumed. Biomass energy is largely consumed in households where cooking using firewood

are manly used in rural households and charcoal in urban households. The biomass subsector is being streamlined by the development of the Biomass Energy Strategy (2018) which sets out a strategy to reduce reliance on wood and charcoal.

Petroleum consumption focuses on the purchase and storage. Petroleum and other related products, such as diesel, kerosene, LPG and natural gas accounts for 13% of the country's total energy consumption. Petroleum is used in transportation, electricity generation and, LPG for cooking. In the recent years , the use of LPG for cooking have increase significantly as urban households switch from using charcoal due to strict Government regulations on cutting of trees. For instance, the annual importation of LPG have impressively increased since 2014 up to December 2019 from 4,240,080Kg to 21,517,960 Kg.

In comparison, the Households are the largest category of energy consumer with 82%, transport with 8%, industries with 6% and others with 4%.

Table 9-5: present the comparison on the energy consumption in Rwanda by subsector

Table 9-5: Energy consumption

Energy consumption by subsector		Energy consumption by User category	
Electricity	2%	Households	82%
		Transport	8%
Biomass	85%	Industries	6%
Petroleum	13%	Other	4%

9.2.2 INSTALLED GENERATION CAPACITY BY SOURCE

Until the end June 2020, grid installed generation capacity in Rwanda comprising domestic, regional shared and imports electricity is totalling to MW228.102. The Electricity generation composed of hydropower which takes the largest share of 41.45% and fuel-oil is at 25.78% and the remaining distributed from solar, peat and import. The Solar power contribution is the least power generated in Rwanda.

Table 9-6 presents the overall power generation and sources in Rwanda

Table 9-6: Installed Capacity per source.

Sources	Installed capacity (MW)	Share
Hydropower	94.362	41.45%
Fuel-Oil	58.8	25.78%
Methane Gas	29.79	13.06%
Peat for power	15	6.58%
Solarpower	12.05	5.28 %
Regional shared	12	5.26%

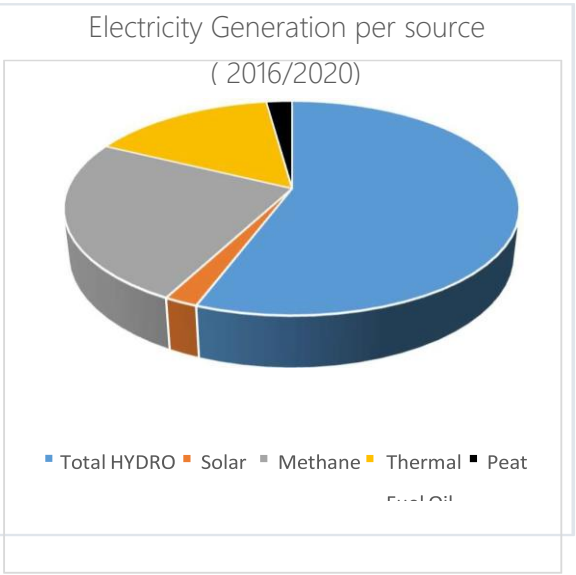
Imports	6.1	2.67%
TOTAL	**228.102**	**100%**

The during the FY 2019/2020 the annual grid electricity generated was 872.6 GWh. Of which the Domestic and regional shared power plants contributed 96.5% and Independent Power Producers had a share of 53.7%.[4]

The overall power generated in the FY 2019/2020 is present in the Table 9-7.

Table 9-7: Power generation capacity

Electricity (GWh) per Source		%
Renewabl eEnergy	504.1	58%
Hydropower (Domestic)	387	44%
Hydro Import	30.2	3%
Hydro (Shared)	69.2	8%
Total HYDRO	**486.4**	**56%**
Solar	17.7	2%
Methane	213.6	24%
Thermal Fuel Oil	135.9	16%
Peat	19	2%
Total	**872.6**	**44%**



It can be seen from the Table 9-7 that in FY 2019/2020 the electricity generated from renewable energy contributed the largest share of 58% against both Hydro, solar and shared regional plants which are at hydro 44%, solar 2% and regional shared 8%. Whereas fuel oil, methane gas and peat accounted for 16%, 24% and 2% respectively. The hydropower are shared from both domestic generation and regional shared hydropower plant (constructed at the Rwanda-DRC boarder in Rusizi I and II), and the share of imports hydropower includes electricity imported from Uganda through Gatuna.

The peak demand increased from 140.61 MW to 151.02 MW in the month of February 2020, corresponding to an increment of 7.4% compared to the same period in the last year (2019). This increment is mainly due to increase rate of connectivity and new customer's consumption of electricity.

9.2.3 ELECTRICITY TRANSMISSION AND DISTRIBUTION

The transmission and distribution of electricity networks as of End June 2020[5] is presented in Table 9-8.

Table 9-8: Electricity Transmission and Distribution in Rwanda

Description	Capacity Length (Km)	
Transmission network	High Voltage (HV)	1,285.62
Distribution network	Medium Voltage (MV)	9,205.8
	Low Voltage (LV)	16,108.9
Total distribution	**MV+LV**	**25,314.7**

The Map showing, Rwanda Transmission and Distribution network and District poverty rate is presented in Figure 6.

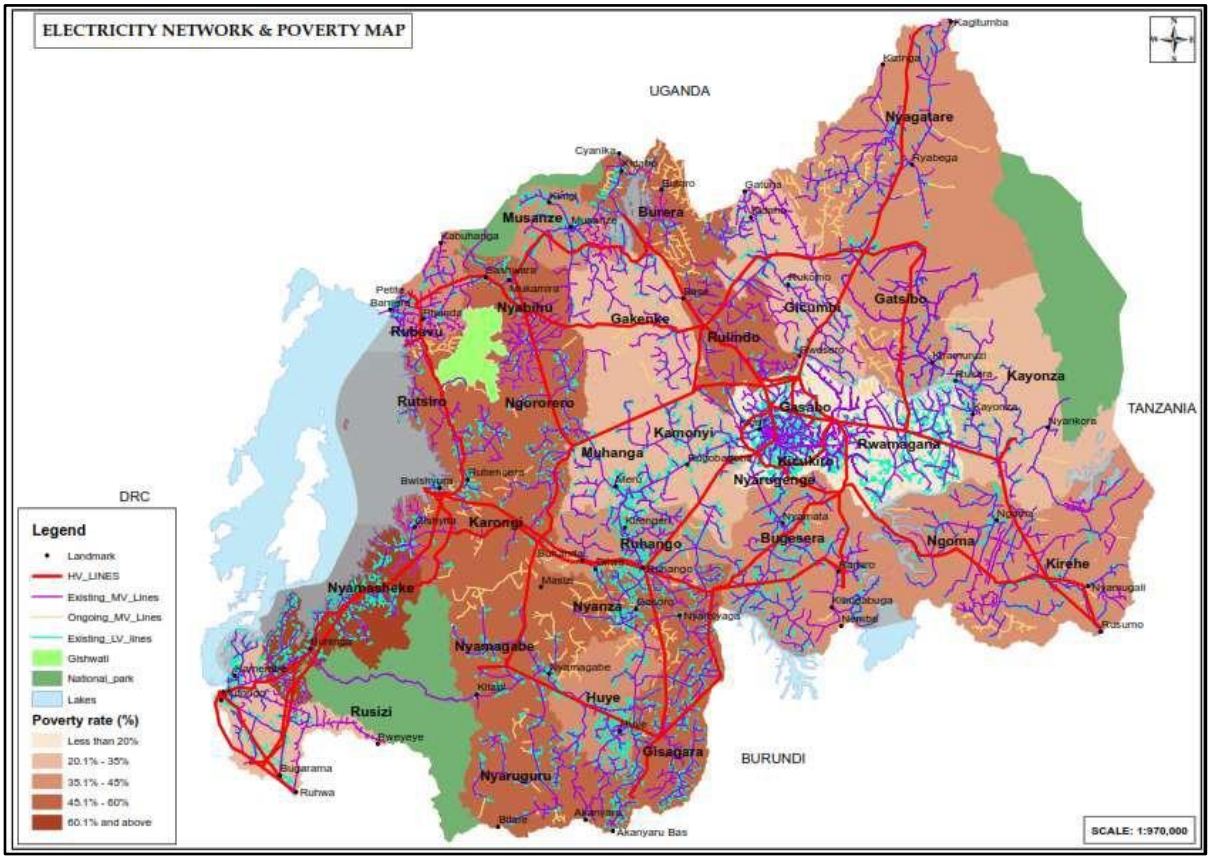


Figure 9-6: Present the HV line, MV and LV line networks in Rwanda

9.2.4 ACCESS TO ELECTRICITY

The overall access to Electricity in Rwanda FY 2019/2020 is presented in Table9-9.

Table 9-9: Access to Electricity in Rwanda

Description	Number of households	%
Total number of estimated households	2,773,285	100%
Cumulative number of householdconnections	1,560,699.00	56%
Total on grid connected households'connections	1,132,522.00	41%
Total off grid connections	418,502.00	15%

From Table 9-9 it can be seen that, the total number of households connected through both off grid and grid connection is 1,560,699 (56%) indicating an increase of 166,801 households from 1,363,957 (51 %) households registered the previous fiscal year.

In addition, Social and economic productive areas connected to electricity equivalent to 76% of 8855 total estimated facilities. These facilities includes; commercial canters, coffee washing stations, milk collection canters, water pumping stations, schools, health canters among others.

9.2.5 EFFICIENCY AND RELIABILITY

- The total network losses is at 19.10% above the standards of 8%. The number of outages reduced from 2,687 to 2,460, and their duration reduced as well from 1,632 to 1,488 hours[6]
- The system average Interruption Duration Index (SAIDI) is 17.2 hours by end June 2020. The average number of interruptions that a customer experienced (SAIFI) is 37 times.

9.2.6 OVERALL SUMMARY STATUS OF ENERGY INFRASTRUCTURE

Table 9-10: Status of Energy Infrastructure

SN	Component description with target by 2024	Indicator	Status by FY 19-20
1	Generation capacity increased to ensure that all demand is met and a 15% reserve margin is maintained	Reserve margin	15%
	Increased Generation capacity	Electricity generated	228.1MW
2	Reliability of electricity supply improved: average number of power interruptions per year reduced to 91.7 and average number of hours without power to 14.2	SAIFI (avg no of interruptions)	37
		SAIDI (avg hrs without power)	17.2
3	Losses in the transmission and distribution networks reduced to 15%	% losses on system	19.10%
4		% HHs connected to grid	1,132,522
			41.0%

	Household access to electricity (increased to 100%)	% HHs off-grid	418,502
			15%
		Overall	56.0%
5	Productive user access to electricity increased to 100%	% productive users connected	76.00%
6	Halving the number of HH using traditional cooking technologies to achieve a sustainable balance between supply and demand of Biomass	% of HHs depending on firewood	79.90%
7	Petroleum strategic reserves increased to cover three months' supply (198 Million)	Millions of litres of fuel storage	111

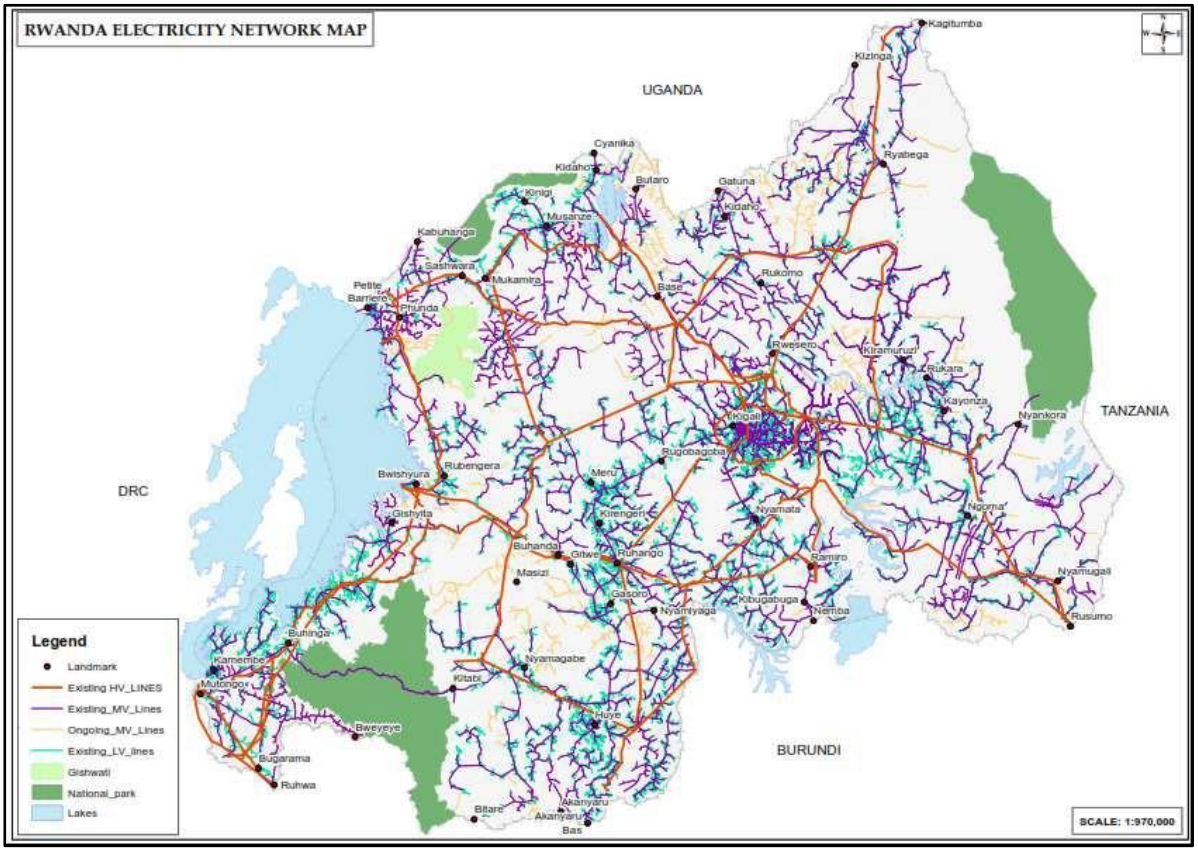


Figure 9-7: Current Map of Electricity network distribution in Rwanda

9.3 STATUS ON WATER AND SANITATION INFRASTRUCTURE

9.3.1 WATER SUPPLY

Over the last decade, Rwanda has made remarkable progress in extending water supply and sanitation services coverage. The importance of adequate water supply and sanitation

services as key drivers for social-economic development, poverty reduction and public health is fully acknowledged in the Country's flagship policy and strategy documents and political goals. Despite the efforts on provision of water and sanitation services, Rwanda still experiences enormous challenges due to the increasing water scarcity and risks associated with population growth and climate variability. Rwanda therefore, requires huge investments in water and sanitation infrastructure, major governance and policy reforms and an integrated approach towards water supply and sanitation services management

9.3.2 RWANDA WATER SUPPLY DEVELOPMENT AGENDA

Rwanda's Vision 2050 development plans for water supply and sanitation services, a universal access is expected in 2024 while household connections are planned to be at 95% for water supply, and 80% for sanitation services by 2035 and 100% by 2050 up from 9.4% and 1.9% in 2017 respectively.

The National Strategy for Transformation (NST1), a Medium-Term Strategy 2018-2024 aims at accelerating the attainment of Rwanda's Vision 2050 ambitions and global commitments. The NST1 targets, water and sanitation sector development targets aim to increase the proportion of the population/households accessing improved source of water from 87.4% (EICV5) to 100% and the proportion accessing improved sanitation services/ facilities from 86.2% (EICV5) to 100% by 2024. It is also envisaging to increase the proportion of the rural population living within 500m of an improved water source from 53.7% to 100%, and to raise the proportion of the urban population residing within 200m of an improved water source from 70% to 100% by 2024. Furthermore, regarding sanitation, the sector plans to increase the proportion of schools with latrines complying with health norms to reach a target of 100% and the proportion for rural households will increase to 100%.

In Rwanda, the SDGs have been domesticated and integrated in the long-term Rwanda's Vision 2050, the medium-term National Strategy for Transformation 2017-2024 (NST1) and related sectors strategies and districts' development plans to ensure "Leave No One Behind".

The implementation of SDG 6 in Rwanda, the most recent data are dated in 2017[3] and show that 79% of the population have access to drinking water services as a basic or limited service while 81% of the population have access to sanitation services as a basic or limited service. The same data show that 30% of water bodies have good water quality, the annual renewable water resources are about 1,089 m3 per capita while the annual water withdrawal is approximately 18 m3 per capita with agriculture representing 55% of the water withdrawal.

9.3.3 INSTITUTION FRAMEWORKS

The institutional framework is guided by both the National Water Supply Policy Implementation Strategy (MININFRA, 2016a) for the water supply subsector and the National Sanitation Policy Implementation Strategy (MININFRA, 2016b) for the sanitation subsector. The Ministry of Infrastructure leads coordination of stakeholders in the water supply subsector and sharing this role with the Ministry of Health for the sanitation subsector.

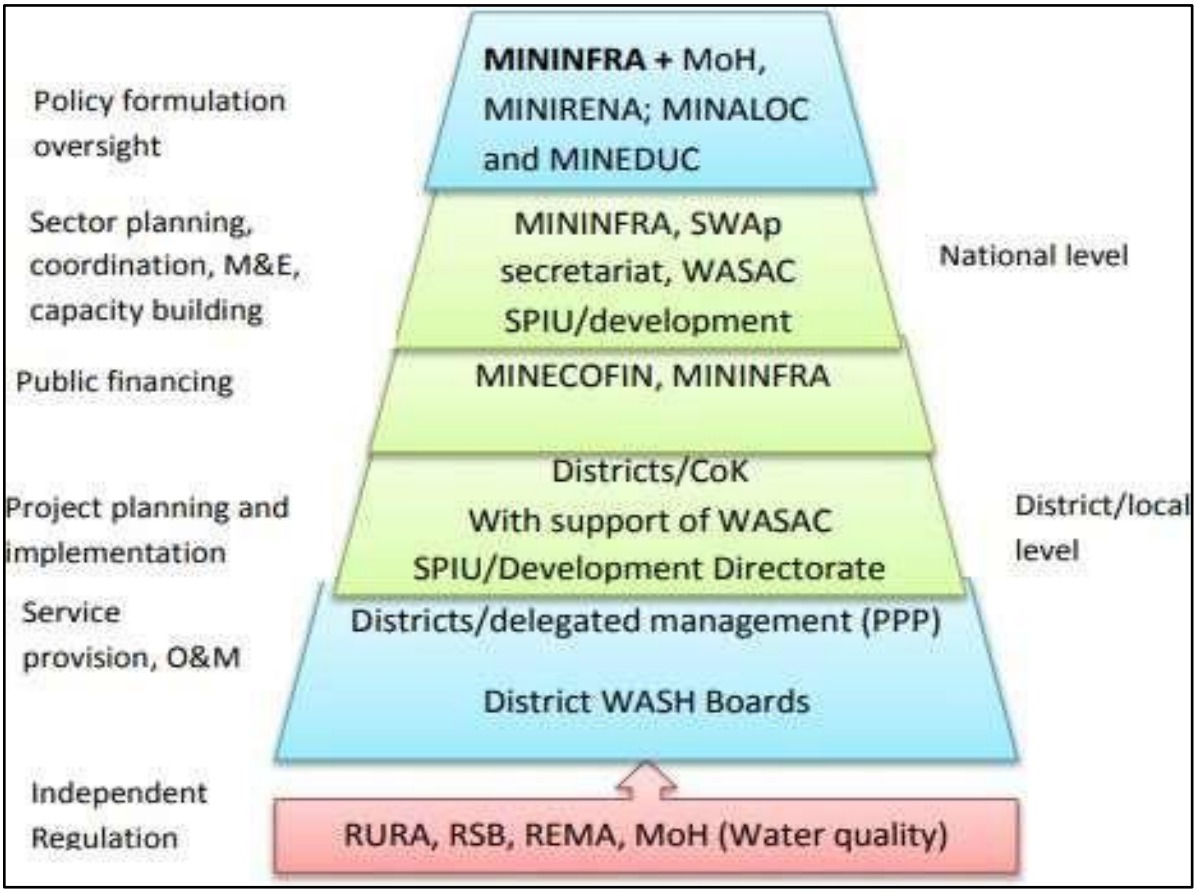


Figure 9-8: Water and Sanitation Institutional framework

9.3.4 FINANCING FRAMEWORKS

Financing framework for water and sanitation coverage in Rwanda is grouped into two: urban water supply and sanitation services and rural water supply and sanitation services.

Rural water supply and sanitation, the new infrastructure and major rehabilitation works that include treatment plants and networks of more than 60 km are funded by WASAC. The networks between 30 and 60 km are jointly funded by WASAC and the Districts, while the networks of 30 km and less are the responsibility of the Districts and their development partners. It is worth noting that the funds contributed by the Districts for the development of any water supply and sanitation project are fully provided by LODA (Local Administrative Entities Development Agency). LODA receives about 10% of the total domestic revenues collected in any fiscal year from the National Treasury to support development projects in various sectors at the District level. NGOs are very active in rural areas and continue to contribute to infrastructure development.

The operational costs of urban water supply are entirely covered by user fees under the management of WASAC, with the long-term objective of achieving full cost recovery. In the short and medium term, new infrastructure development and extensions of the production and distribution capacities are fully funded by WASAC with support from Development Partners.

Operation & Maintenance: the costs of rural and urban water supply infrastructure is covered by user fees. Tariffs are set to ensure the financial viability and sustainability of scheme

operations, at a level of cost recovery that includes major repairs and replacement of electro-mechanical equipment but not asset depreciation

9.3.5 WATER RESOURCE MANAGEMENT AND DEVELOPMENT

Rwanda's hydrology is divided into two major basins: the Congo basin (33%) draining towards the West into the Congo River and the Nile basin (67%) draining towards the North-East into the Nile River. The two basins are divided by a ridge commonly known as the Congo-Nile Divide formed by a mountain chain crossing the western part of Rwanda in a South-North direction.

The two major basins, Congo and Nile, are divided into nine water catchments forming the Level 1 catchment division of the country, These catchments are (i) Lake Kivu, ii) Rusizi, (iii) Upper Nyabarongo, (iv) Mukungwa, (v) Lower Nyabarongo, (vi) Akanyaru, (vii) Upper Akagera, (viii) Lower Akagera, and (ix) Muvumba (RNRA, 2015)[8].

Figure 9-9 present the Map of the major water catchment areas in Rwanda

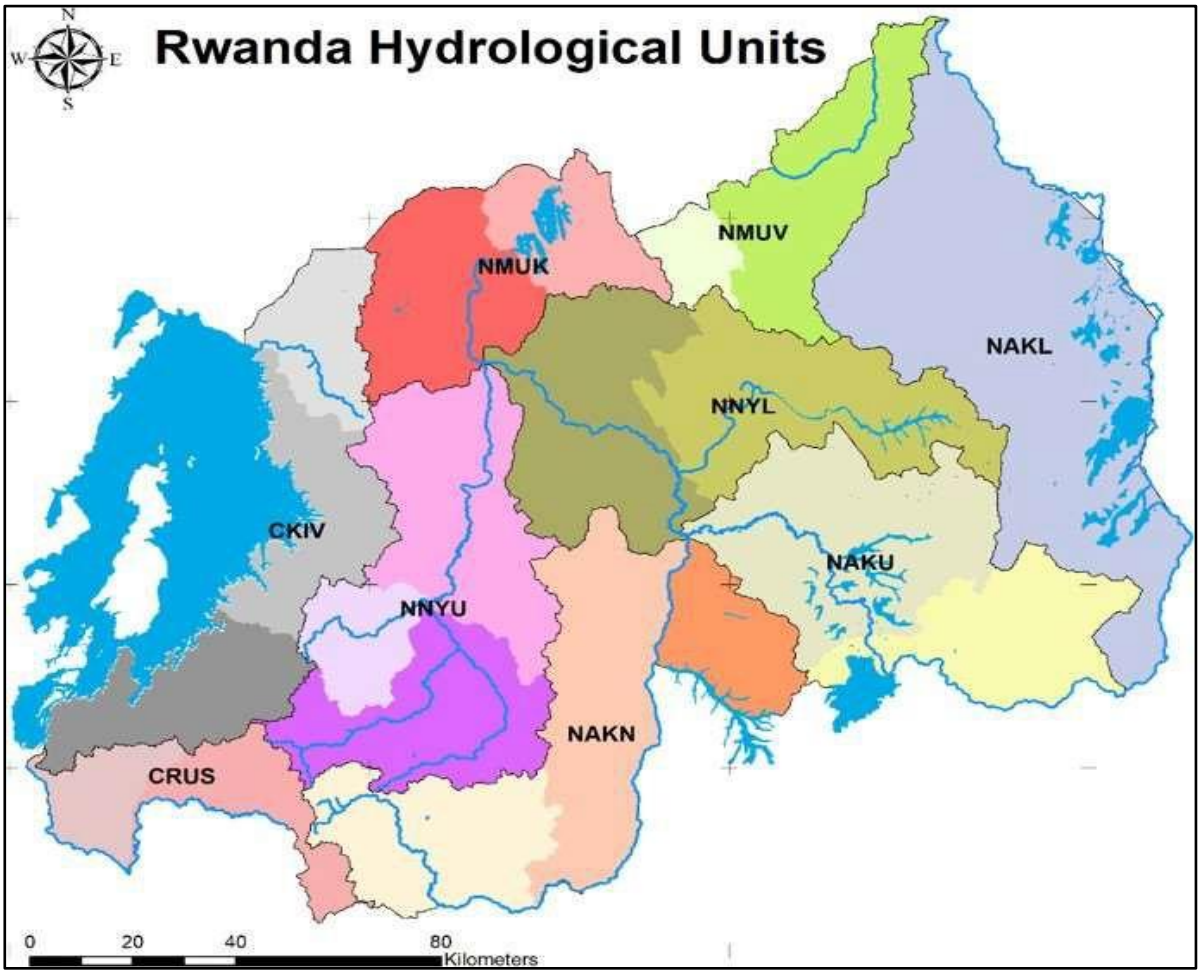


Figure 9-9: Level 1 catchments of Rwanda (RNRA, 2015)

Within its catchments, Rwanda counts 860 marshlands covering 10.6% of the country surface, 101 lakes covering 5.8% and 861 rivers totalling 6,462km in length (REMA, 2015)[9].

9.3.6 WATER ASSETS

Rwanda's water assets include surface water (stored in lakes, rivers, streams and artificial reservoirs), groundwater (wells, springs) and soil water from precipitation.

The quantity of water resources available per catchment is presented in Table 10 below, categorized under the base flows indicating actual quantities of available surface water, and ground water storage.

Table 9-11: Base flows and ground water storage within the catchments in Rwanda (RNRA, 2015)

Catchments	Lake Kivu	Rusizi	Upper Nyabarongo	Mukungwa	Lower Nyabarongo	Akanyaru	Upper Akagera	Lower Akagera	Muvumba
Surface area in Rwanda (km2}	2,425	1,005	3,348	1,887	3,305	3,402	3,053	4,288	1,565
Base flow (m3/s}	1.8	3.8	34.2	21.5	66.8	16.4	198	200	3.5
Ground water storage (MCM)	2,425	5,025	25,110	4,870	8,673	5,103	4,580	4,820	1,570
Precipitation (average annual rainfall in mm/year)	1,240	1,295	1,365	1,315	1,191	1,225	925	835	995

Most of Rwanda's water is stored in lakes (around 80%) followed by groundwater (19%). Rivers and streams, soil water and artificial reservoirs constitute a much smaller volume (1%), yet they play an extremely important economic role, for example in agriculture and forestry. Agriculture is a major water user, responsible for more than 96% of overall water use abstracted from the environment throughout the country

The data from the Natural Capital Account (NCA, 2019)[10] on physical water assets for the year 2012 indicate that the available quantities of surface water were estimated at 258 Billion of m^3 with only

0.61 Billion of m^3 abstracted for use by different sectors including Agriculture (about 200 Million m3), Electricity generation (350 Million m3), Water supply (50 Million m3) and Manufacturing (10 Million m3). For groundwater, the estimated quantities for the same period were 62 Billion of cubic meters, out of which only 63 Million m^3 are utilized with about 45% by households, 22% by agriculture, 19% by water utilities and 14% by manufacturing processes.

9.3.7 STATUS OF WATER SECTOR INFRASTRUCTURE

4.8 The status of urban and peri-urban areas, the water supply infrastructures which include the water intake infrastructure, treatment plants, pumping stations, treated water storage tanks and transmission or distribution pipelines are presented as follows:

Table 9-12: Status of this existing water treatment infrastructure in urban areas

WTP **Managed by WASAC Ltd**						
Q	Province	District	Name of Water treatment plant (WTP)	Installed Capacity m3/day	Production Capacity m3/day	Construction & Rehabilitation (Year Completed)
1	City of Kigali	Nyarugenge	Kimisagara	24,000	22,000	1988
			Rwamapara	1,100	900	1975
			Kizanye	750	550	1950
			Mburabuturo	950	1,100	2004
			Byimana	600	450	2010
			Gihogwe	300	750	
			Jali	150	190	1955
			Kinyinya	1,100	850	1985
			Nzove 1	25,000	10,000	2009
			Nzove 2	40,000	25,000	2016
			Nzove new 1	40,000	30,000	2018
2		Bugesera	Ngenda WTP	2,400	3,100	1988
			Compact Unit (CU)	2,000	1,400	2014
			Rwakibilizi	400	450	2012
			Kanyonyomba	5,000	3,300	2018
		Ngoma	Rwasaburo WTP	850	900	1986
			Bunono	720	850	2009
			Nyamuhinda	500	500	2016
			Cyondo	5,500	4,500	2015
			Gihengeri	3,500	3,500	2016

	Eastern Province	Nyagatare	LV WATSAN/ Mirama	2,400	2,000	2014
			TOVU	650	400	2015
			RWASAMA	400	150	2013
			KANWIRIRI	300	250	2013
			BYIMANA	400	400	2014
			CYAMPIRITA	450	400	2015
			RWABIGEYO	250	200	2014
		Rwamagana / Kayonza	Karenge	12,000	15,000	2008
			Muhazi	1,800	1,200	1986
			Muhazi WTP / LV WATSAN	2,800	2,800	2014
			Compact Unit (CU)	2,000	1,200	2014
			Cyatokwe	600	600	2013
3	Northern Province	Gicumbi	Nyamabuye	1,100	1,350	2013
			Miyove	150	170	2012
			Yaramba	500	600	2015
		Musanze	Mutobo	12,500	7,500	1994
4	Western Province	Karongi	Kanyabusage	850	900	1986
			Rubengera	400	400	2012
		Rubavu	Gihira	8,640	9,000	1987
		Rusizi	Cyunyu	1,200	1,200	1986
			Nkombo	720	300	2017
			Litiro	5,000	4,500	2017
5		Muhanga	Gihuma	1,930	1,600	1987
			CU	2,000	1,500	2015
			RWASAMIRA	100	100	2013
			MBARE	90	90	1988
			BYIMANA	120	150	1998
		Ruhango	Shyogwe-Mayaga	2,400	2,000	2005

	Southern Province	Nyanza	Mpanga WTP	1,840	1,200	1984
			CU	2,000	1,600	2014
			Mpanga WTP / LV WATSAN	5,300	4,500	2014
		Nyamagabe	Gisuma	1,200	1,500	2005
		Huye	Kadahokwa	8,000	5,500	2015
			Mbazi	450	250	2009
			Ngoma	720	150	1998
	WTP Managed by the Private operators					
Q	Province	District	Name of Water treatment plant (WTP)	Installed Capacity m3/day	Production Capacity m3/day	Construction & Rehabilitation (Year Completed)
1	Southern Province	Nyaruguru	Mata	600	400	2013
2	Southern Province	Nyaruguru	Nyabimata	1,800	600	2013
3	Western Province	Rubavu	Nyungwe - Bikore	5,600	1,900	1992
4	Western Province	Rubavu	Mizingo-Mutura	1,000	1,000	1992
5	Eastern Province	Kirehe	Mahama	1,800	1,400	2016

Table 9-13: Water network (Urban areas) in Km

No.	Province	District	Urban
1	COK	Nyarugenge	963.6737
		Gasabo	2,038.9880
		Kicukiro	1,937.4070
2	South	Nyanza	573.4152
		Gisagara	
		Nyaruguru	
		Huye	515.8755

		Nyamagabe	197.4186
		Ruhango	444.2479
		Muhanga	369.1257
		Kamonyi	510.4688
3	West	Karongi	369.2593
		Rutsiro	21.0118
		Rubavu	396.2720
		Nyabihu	
		Ngororero	
		Rusizi	714.2052
		Nyamasheke	42.5200
4	North	Rulindo	14.3249
		Gakenke	
		Musanze	831.6482
		Burera	224.0946
		Gicumbi	317.3115
5	East	Rwamagana	1,014.5299
		Gatsibo	483.2451
		Kayonza	371.2502
		Kirehe	
		Ngoma	239.8453
		Nyagatare	1,403.5730
		Bugesera	1,176.0350
	TOTAL Networks		15,169.75

Table 9-14: Water supply production projects

S/N	Project	Production capacity (m3/d)
1	Kanzenze WTP	40,000
2	Gihira WTP	15,000
3	Mwoya WTP	6,000

Table 9-15: Water supply network extension projects

No.	Project	Length of new water supply networks (km)
1	Rehabilitation, upgrading and extension of water supply network in Kigali city and the peri-urban areas	51 2
2	Rehabilitation and extension of water supply distribution networks in the 6 Satellite cities of Musanze, Rubavu, Muhanga, Nyagatare, Huye and Rusizi	71 1

In rural areas, the water supply infrastructures include treatment plants, improved springs, water storage tanks, distribution pipelines and public taps.

Table 9-16: Water supply infrastructures in rural areas (Source WASAC, 2020)

No.	Location	Length of water supply network (km)	Number of Water installed	actual Treatment capacity (m3/d)	production Plants capacity m3/d)	Total number of WSS	Total estimated discharge from springs (m3/d)
1	City of Kigali	157	-	-	-	31	2,500
2	Eastern Province	2,504	1	1,800	1,400	124	12,200
3	Northern Province	3,211	-	-	-	268	29,500
4	Western Province	4,420	2	6,600	2,900	243	19,600
5	Southern Province	4,223	2	2,400	1,000	252	11,100
Total		**14,515**	**5**	**10,800**	**5,300**	**918**	**74,900**

The actual total production capacity of the infrastructures in the rural water supply systems is about 80,000 m3/day with more than 90% of this volume supplied from improved springs. The population in the rural areas mainly accesses the water supply from about 14,000 constructed public taps spread throughout the country. In addition, the rural areas of the Eastern Province are served by 397 boreholes that have been constructed in areas where shallow springs are not found and are operated by using hand pumps. The infrastructures in the rural water supply systems are managed by private operators working under contractual arrangements with their respective Districts.

The available data from WASAC indicate that among 918 rural water supply systems, about 9% are non-functional while 83% are partially operating because most of the improved springs need rehabilitation and many pipelines are very old and need to be reconstructed. There is a need also to improve the operation & maintenance arrangements between the private operators and the Districts in order to improve the lifespan of the infrastructures and to avoid cyclic rehabilitation efforts.

9.3.8 WATER SUPPLY SERVICE LEVELS

The water supply service levels are evaluated considering the access to improved drinking water sources which are from: (i) protected spring, (ii) public standpipe, (iii) water pumped into dwelling/yard, (iv) borehole, (v) protected well, (vi) rainwater harvesting. Table 8 present the water supply service levels from EICV5[11]

Table 9-17: Population with access to improved drinking water services

EICV5	Use improved water sources (%)	Protected Public spring standpipe (%)		Water pumped into dwelling/yard (%)	Borehole (%)	Protected Rainwater well (%) harvesting (%)	
All Rwanda	87.4	38.3	35.4	9.4	3.0	1.2	0.1
Urban	95.8	10.5	41.5	39.2	2.5	2.0	0.0
Rural	85.4	45.0	33.9	2.3	3.1	1.1	0.1
Male	87.7	37.4	35.6	10.1	3.1	1.4	0.1
Female	86.6	41.1	34.6	7.3	2.6	0.9	0.1
Isolated rural housing	80.9	56.8	19.3	0.7	2.8	1.1	0.1

From Table 9-17 it can be seen that 87.4% of the population has access to improved drinking water services. However, there exists disparities of about 10% in accessing the drinking water

services between the urban and rural population, while the males and females almost equally access these services. The same table shows a deviation of about 7% less access to the drinking water services for the isolated rural housing, which has the least access compared to the national average.

EICV5 showed also that 70% of the population are located within 200 m of an improved drinking water source in the urban areas while only 53.7% of the population in the rural areas are located within 500 m of an improved drinking water source. NST1 and the Water and Sanitation Sector Strategic Plan 2018-2024 (MININFRA, 2018) set the target to achieve 100% for both urban and rural areas by 2024; this indicating that the level of investments needed to attain the set targets are still high. Furthermore, investments are also necessary in reducing the levels of non-revenue water that are still high with some areas recording non-revenue water levels as high as 60% like Nyagatare District11. Figure 8 shows the trends for non-revenue water in Rwanda (RURA, 2020).

Table 9-18: Trend of non-revenue water in percentage for 2019-2020

9.3.9 SANITATION SERVICE LEVELS

The sanitation service levels are evaluated considering the use of improved sanitation services, taking into account: (i) use of sanitation facilities without sharing with other households, (ii) use of flush toilet, and (iii) use of pit latrine with a solid slab. Table 9-19 present the sanitation service levels from EICV5.

Table 9-19: Population with access to improved sanitation services

EICV5	Use improved sanitation (%)	Use improved sanitation not shared with other HH (%)	Flash toilet (%)	Pit latrine with solid slab (%)

All Rwanda	86.2	66.2	1.9	84.3
Urban	93.6	45.0	9.2	84.4
Rural	84.4	71.3	0.1	84.3
Male	88.0	68.6	2.0	86.0
Female	80.6	59.1	1.5	79.1
Isolated rural housing	74.7	64.8	0.0	74.6

In addition, the Ministry of Health indicate that many health facilities still need essential sanitation infrastructure as shown in Table 9-20.

Table 9-20: Health facilities without essential sanitation infrastructure (Source: Rwanda MoH)

No.	Description	Number
1	Hospitals without modern incinerator	9
2	Hospitals without modern wastewater treatment plant	24
3	Health centres without water supply connection	560
4	Health centres without hand-washing facilities	139

The Government of Rwanda, through WASAC, has started implementing a number of projects to address the challenging sanitation issues in the City of Kigali. These projects include the following:

- Construction of Kigali Centralized Sewerage System with a capacity of 12,000 m3 per day and 89 km sewer network;
- Rehabilitation and upgrading of semi-centralized sewerage systems in fifteen (15) Estates in Kigali;
- Construction of faecal sludge treatment plants and sanitary landfills in Kigali and secondary cities.

WASAC indicates that water supply in the rural areas a total of 106 out of 2,148 Cells in the country do not have water supply infrastructures as per Table 19 below.

Table 9-21: Cells without water supply

No.	Provinces	Number of Cells without water supply infrastructures
1	Eastern Province	14
2	Northern Province	9
3	Western Province	28
4	Southern Province	55
Total		**106**

The data from WASAC also indicate that out of the existing water supply systems in rural areas, only 42% are fully functional while 46% are partially functional and around 12% are not operational at all. The key challenges affecting the effective water supply systems in rural areas remain a high number of aged and non-functioning systems with a poor management of the private operators contracted by the Districts.

Priority infrastructure interventions have been proposed from the adopted policy documents, strategic plans and masterplans under development in water and sanitation sector as presented in Table 9-22.

Table 9-22: Proposed infrastructure interventions in water and sanitation sector

No.	Proposed infrastructure intervention	Implementing Agency
1	Construction, extension, rehabilitation of 1,851 Km in rural areas	WASAC/Districts/LODA
2	Construction, extension, rehabilitation of 1,937 Km in city of Kigali and other towns	WASAC
3	Increase daily water production capacity from 182,120 m3 to 303,120 m3 per day	WASAC
4	Rehabilitation of 430 Non-functional rural water supply systems country wide	WASAC/Districts/LODA
5	Development of National Integrated Water Supply and Sanitation Master Plan	WASAC
6	Construction of Kigali Centralized Sewerage System	WASAC
7	Rehabilitation and upgrading of semi-centralized sewerage systems in 15 Estates in the City of Kigali	WASAC
8	Construction of faecal sludge treatment plants and sanitary landfills in Kigali and secondary cities	WASAC
9	Increasing the artificial water storage for multipurpose economic use	RWB
10	Catchment restoration for erosion and landslides control	RWB
11	Flood control measures to protect high zones and disaster management	RWB
12	Innovative capacity development programs to support the infrastructure interventions: Construction of WASAC capacity building premises, Establish MIS for the sector, Implementation of District Wide Approach, WATSAN coordination, M&E	MININFRA

9.3.10 SWERAGE SYSTEM INFRASTRUCTURE

The City of Kigali, with 1.3 million inhabitants, has neither a centralized treatment facility for sewage nor a system of central sewer networks. Apart from a few standalone semi centralized sewage treatment systems, septic tanks with soak away pits are predominantly used, together with pit- latrines, despite their impact on ground water resources especially in an urban environment

The Rwanda Wastewater Design Stage 2 report (2012) advised a wastewater project to serve the central business district of Kigali which consists of gravity sewers and a wastewater treatment works located outside of the city. Kigali centralized sewerage system project will be implemented in four phases and currently the detailed studies for phase one of this project which covers the Central Business District (CBD) of Kigali, Nyarugenge and Muhima zones. The system is also designed to accommodate extension of the network to other areas of Kigali City in the future.

- Sewerage collection from the central part of Kigali, comprising 89 km sewer network,
- A 3.1 km trunk main sewer to transport the collected wastewater to the wastewater treatment plant.
- A wastewater treatment plant to treat this wastewater with the capacity of 12,000m3/day and maturation ponds, located in Nyabugogo (10 ha site).

Semi-centralized sewerage systems in Kigali Estates" exist , however most of them need rehabilitation or upgrading. Table 9-23 present the existing semi-centralised sewerages system at estates.

Table 9-23: semi-centralised sewerages system at estates

2. GEOLOCATION OF THE PROJECT

№	NAME OF ESTATE	LOCATION District Sector Cell Village	PHOTOS
1.	Kacyiru (RSSB)	Gasabo Kacyiru Kibaza Ubumwe	  
2.	Umucyo	Gasabo Kinyinya Gacuriro Urugarama	  

3.	Lagoon Nyarutarama	Gasabo Remera Nyarutarama Juru	  
4.	Urumuri Village	Gasabo Kimironko Kibagabaga Urumuri	  
5.	Sunset	Gasabo Kimironko Kibagabaga Nyirabwana	  

6.	Kabuga Hillside	Gasabo Rusororo Nyagahinga Kigarama	  
7.	Gate Hills II (Sekimondo Est.)	Kicukiro Nyarugunga Kamashashi Mukoni	  
8.	Vision 2020	Gasabo Kinyinya Gacuriro 2020	  

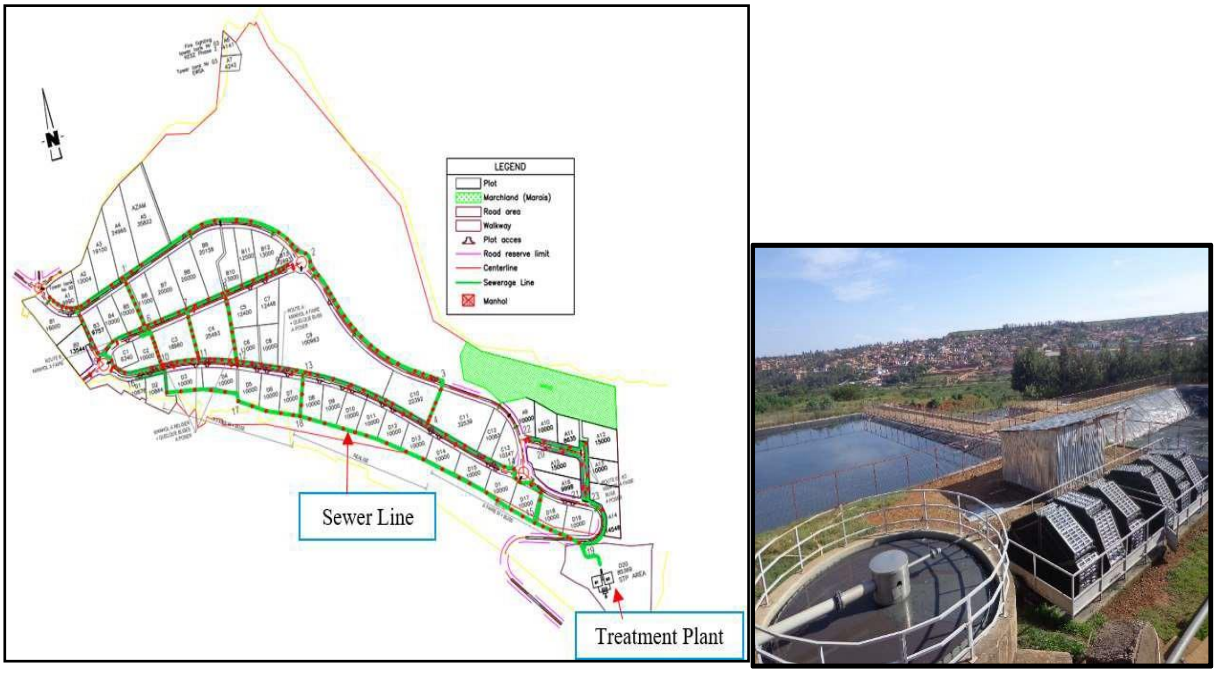


Figure 9-10: Semi-centralized sewerage systems in Kigali special ecomonic zone (KSEZ)

9.4 SOLID WASTE AND LANDFILL INFRASTRUCTURE

Kigali and other secondary city are under rapidly urbanizing city that is experiencing increasing volumes of Municipal Solid Waste. Various estimates on the amount of waste generated exist; the Rwanda Environment Management Agency (REMA) estimates that between 1,800 and 2,000 tons of solid municipal waste is generated in the city per daywhile other studies put it at a more realistic400- 800 tons per day.3Regardless,evidence suggests that only between 300-400tons of waste per day isactually collected and transported to a single dumping site.4Overall, official government policies and reports including the REMA State of Environment and Outlook Report, 2017, highlight the inevitability of waste production increases, as the city population continues to expand, as citizens continue to increase their incomes.

9.4.1 WASTE COMPOSITION IN KIGALI CITY

Table 9-24; Waste composition

	%	UNEP waste characterization (lower income) (2015)[28]	Rapid Planning (2018)[29]	Kabera et. al (2017)	Sylvie Mucyo (2013)	REMA (2013)	SWM Strategic Plan[30] (2012)
Organic	Food, garden wood	53	75.3	70	74	77	70
Non-Organic	Paper and Cardboard	6	6.6	5	26	16.1	6
	Plastic	7	3.7	5		1.5	5
	Metal	2	1.6	1-3		1.9	3
	Glass	2	1.1			1.4	1
	Other (incl. textiles, rubber/ leather	30	11.7			2.4	15
	Total	**100**	**100**	**100**	**100**	**100**	**100**

9.4.2 WASTE COLLECTION

Presently waste collection in Kigali is largely outsourced with the collection being carryout by private companies and cooperatives that collect waste and fees directly from households under 1-5 year contracts.

Rema report, 2013 indicates that the number of firms operating in waste collection are 13 as presented in Table 9-25.

Table 9-25: Waste collection

Waste collection Company	Operating in 2013	Operating in 2019	Household/ Commercial Waste
AGRUNI	Yes	Yes	Household
COPED	Yes	Yes	Household
Ubumwe Cleaning Company	Yes	Yes	Household
Inzira Nziza	Yes	Yes	Household
CESCO	Yes	No	Commercial
COCEN	Yes	Yes	Household
Coyagaying	Yes	No	N/A
Isuku Kinyinya	Yes	Yes	Household
Umurimo Mwiza	Yes	No	Commercial
Indatwa	Yes	Yes	Household
Baheza	Yes	Yes	Household
Real Protectors	No	Yes	Household
Road Environment Protection	Yes	No	N/A

Table 9-26: Estimated number of households served, by company

Company	Estimated Households (2012)	Estimated Households – Urban (2012)	Estimated households served from interviews (2019)	% of households served
AGRUNI	92,600	69,710	36,087	51
Baheza General Services	22,560	22,560	10,240	45
Ubumwe Cleaning Company	33,919	29,100	14,440	49
Cooperative Indatwa	27,819	21,830		
COOCEN	18,020	18,020	11,160	61
Isuku Kinyinya	26,120	16,560		
COPED	14,650	14,650	4,000	27
Inzira Nziza	7,340	7,340		
Real Protectors	3,260	3,260		

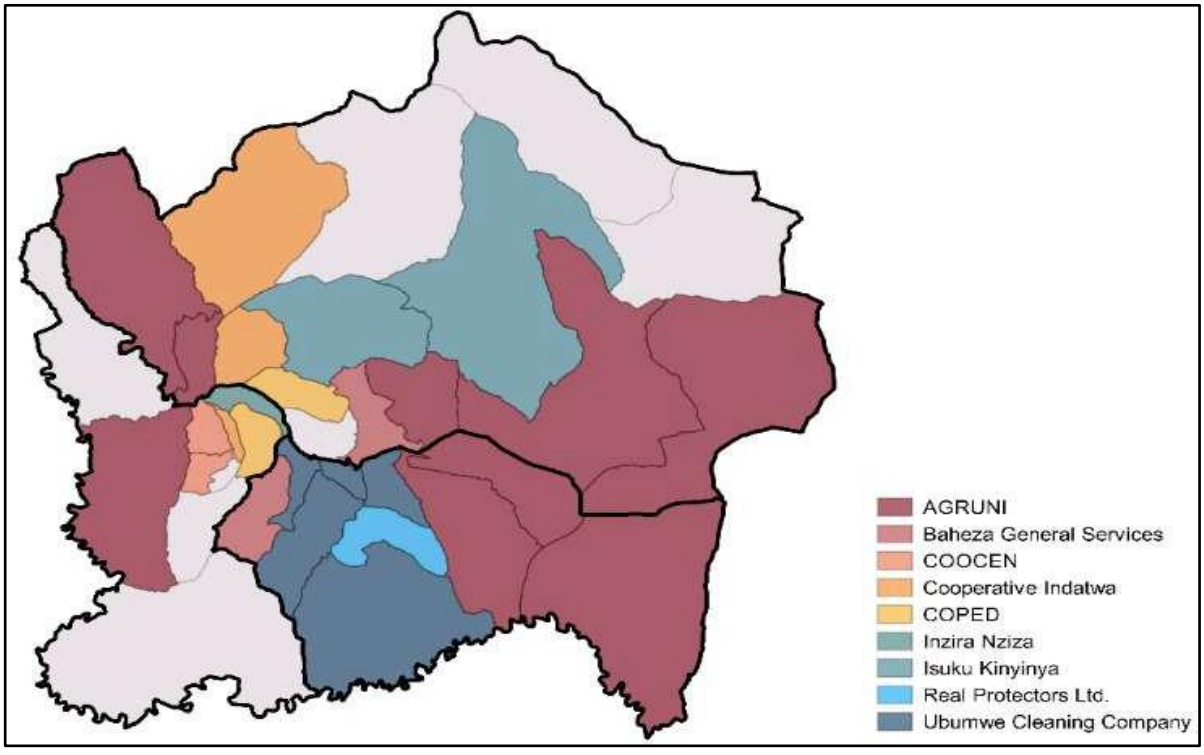


Figure 9-11: Spatial distribution of the waste collection companies in Kigali city

9.4.3 ACCESS TO WASTE COLLECTION SERVICES BY HOUSEHOLD QUINTILE ACROSS KIGALI (EICV 5)

The increase in the likelihood of accessing waste collection services is coupled with a decrease in the proportion of households relying on the disposal of waste in bushes or fields: approximately 85% of households in the bottom 20 percent in Kigali city report disposing of

waste informally compared to only 20% in the highest consumption quintile (see Figure 9-12). The trends are similar across districts (IGG-2019)

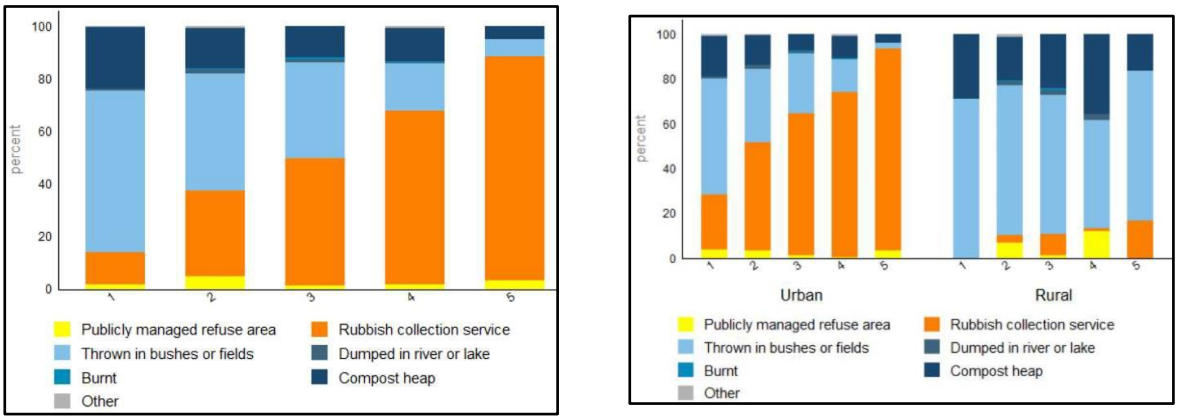


Figure 9-12: Disposal of Waste

9.4.4 WASTE DISPOSAL (IGC REPORT -2019)

Waste in Kigali province was initially dumped on a waste site in Nyanza, located in Kicukiro district. The site was originally a quarry but started receiving waste from transition centres located across the city after it was first opened up in 1983.The landfill, which was closed in May 2012 after being in operation for 29 years was replaced by the Nduba landfill in Gasabo district. The Nduba landfill is still currently in operationand remains Kigali's only landfill

The Nduba landfill can be characterized as an open-air dumping site. As per the State of Environment Outlook, 2018, the Nduba landfill receives approximately 35.8% of the overall waste generated in the city, a 10% difference compared to what is collected (see above)either suggesting that this waste is diverted to recyclers or illegally dumped to avoid landfill charges.

In addition to solid waste, liquid waste generated from human excrement is deposited at the Nduba landfill, although this is currently deposited in a separate area.51Landfill operators currently estimate that approximately 100 trucks -80% of which are small trucks with an approximate size of 5 tons, and 20% of which are large trucks with an approximate size of 10 tons -make their way to the landfill each day, dumping an estimated 600 tons.

A number of environmental issues currently plague the Nduba landfills-similar to what was experienced in Nyanza. The Nyanza site, which was never designed to be a landfill, started encountering issues beginning in 2003 after closure of waste transit centers, the privatization of waste collection systems and the increasing volume of waste collection.53.These included spontaneous methane gas explosions as well as leachate flowing to nearby communities, unpleasant smells and the existence of vermin.54Despite its official closure, the Nyanza landfill still suffers from land-slides on the eastern part of the site, and apparent tension cracks in the landfill, which makes it susceptible to water penetration and instability, and a lack of access control in certain areas, which allow for scavengers to recover metals and other scrap materials.55The Nduba landfill, which replaced the Nyanza landfill, has also faced a number of growing management deficiencies as highlighted in the Auditor General's assessment of waste management in Kigali. These include12

- Leachate with high polluting potential is not prevented from seeping into the ground and surface water
- Issues with vermin and flies, in addition to the loss of a wasted opportunity to recover valuable products as a result of solid waste is not being separated into separate biodegradable and non-biodegradable waste
- Spontaneous combustions due to build-up of landfill gas (comprising flammable methane) due to the solid waste only being covered by soil once every two months rather than every working day
- Three of the four cells which were constructed are nearing full capacity

The Nduba landfill has been through a number of management changes over the past year

While mismanagement at the Nduba landfill has been a major issue, environmental degradation at the dumpsite has largely been caused by the fact that the site was never designed as a sanitary landfill.

Currently, the management of the landfill faces major financial shortfalls, both in terms of revenue recovery and the cost of managing the site. Costs of running the landfill are covered by the City of Kigali and WASAC.60On the revenue side, private collectors are required to pay approximately RWF 1,000 per ton of waste deposited at the site; however, the lack of a weighbridge, or suitably inventive alternative means that trucks are charged per trip with smaller trucks being charged RWF 3,000 and larger trucks -regardless of tonnage-being charged RWF 5,000.61This likely creates a perverse incentive for collectors to aggregate waste into bigger trucks to reduce disposal fees. Landfill managers ensure that any truck passing by the landfill pay before they receive access to the premises.

9.4.5 WASTE MINIMIZATION AND RECOVERY

Overall, waste recycling rates are low in Kigali city. REMA's report13 indicates that only about 2% of waste is recycled.63More recent studies suggest that the recycling rate is closer to 10-12%.64Regardless, these are significantly below government targets which have sought to achieve a recycling rate amongst non-organic solid waste of 30% by 2019/2020 and 40% by 2029/30

A few companies exist to handle recycling, the majority of which center around paper and plastics. One paper treatment and recycling plant, Trust Industries, transforms paper waste into toilet paper. Several plastic recycling organizations exist, the majority of whom turn a combination of high density and low density plastics into furniture, household objects and industrial agriculture materials. At present, there is no domestic recycling facility for PET bottles, meaning that the majority of these bottles -estimated to be 100,000 bottles on a daily basis -are crushed and sold onto recyclers in Uganda, Kenya, Tanzania and, until recently, China (IGG,2019).

Almost all material that is recycled is collected separately from households; almost no recyclable material is obtained from the landfill. Recyclers of plastics tend to receive materials from small industries which are then separated, cleaned and combined with virgin materials to create new products for the market. Similar trends are likely to exist for recyclers of paper materials. At the moment, only one company, Agruni, actively sorts waste at the landfill.

Informal waste collectors or scavengers are actively discouraged as per various policy documents including REMA's Practical guides on Solid Waste Management of Imidugudu Towns and Cities, 2010,

The government of Rwanda has, over the past two years, prioritized two special forms of waste remediation-e-waste recycling and hazardous waste treatment-and has enacted regulations regarding these initiatives. E-waste has generated the most attention recently, given Rwanda's ambitions to become an ICT and technology hub. Given current -annual growth in the generation of e-Waste in Rwanda is at about 5.95% -and anticipated growth in this sector, the government instituted an e-Waste policy in 2015 targeted at "resource recovery involving the collection and dismantling of electronics to recover valuable metals." In 2017, Rwanda opened a USD 1.45 million electronics recycling facility in Bugesera.72With regards to hazardous waste, the government has constructed an incinerator with installed capacity of 100 kg per hour at the landfill site.73While reports note that a small portion of hazardous and infectious waste is burnt by the incinerator, interviews suggest that the incinerator is not currently in operation and that the majority of hazardous waste is disposed of in a pond and covered on a monthly basis. (IGC study -2019)

9.5 STATUS ON EDUCATION INFRASTRUCTURE

Rwanda has made great strides in education over the past couple of decades. The government has shown considerable commitment to the sector through various initiatives, including through providing free and compulsory education for nine years of basic education. Since 2012, free education is now being expanded to 12 years of education.

Table 9-27: Education system

No.	Education	School/Level	Grades	Age	Years
1	Pre-Nursery	Pre-Nursery Education		1-3	2
2	Nursery	Nursery Education		4-6	3
3	Primary	Primary Education	1	7-12	6
4	Lower Secondary	Lower Secondary Education	7-9	13-15	3
5	Upper Secondary	Upper Secondary Education	10-12	16-18	3
6	Technical and Vocational Education and Training	Certificate of Higher Education: 1yrs Diploma in Higher Education: 2yrs Advanced Diploma in Higher Education: 2.5yrs		-18	1-3

7	Tertiary Education	Bachelor 3-5yrs Master 1-2yrs Doctorate 3-4yrs		18-23	3-5
8	Adult Literacy Education	Certificate of Education		>24	variable

The government has also undertaken the major reform of changing the curriculum, switching from knowledge to competence-based, and thus make it responsive to the needs of learners, society and the labour market.

Despite these successes, Rwanda is still facing challenges in ensuring better learning outcomes, building teacher capacities, improving gender equality, and reducing dropouts and repetition rates.

Table 9-28: Number enrolled students from 2017 to 2019

SN	Category	Number of students enrolled		
		2017	2018	2019
1	Pre-nursery	5,234	6,491	6,690
2	Nursery	220,435	226,706	282,428
3	Primary	2,540,374	2,503,705	2,512,465
4	Lower secondary	382,661	422,093	481,138
5	General upper secondary	139,319	147,618	158,489
6	TVET level1 to 5	79,595	79,388	83,157
7	TTC	9,397	9,186	9,320
8	TVET level 6 to 7	10,420	13,447	14,078
9	Higher Education	80,773	75,713	72, 128
10	TVET NEP	17,486	9,650	9,932
11	Adult literacy	152,015	132,365	123,607
Total		**3,637,709**	**3,626,362**	**3,753,432**

5+6+7	Upper secondary	228,311	236,192	250,966
4+5+6+7	Secondary	610,972	658,285	732,104
4+5+6	General Secondary	531,377	578,897	648,947
6+8+10	TVET	107,501	102,485	107,167
8+9	**Tertiary**	**91,193**	**89,160**	**86,206**

Table 9-29: Number of Students in 2019 compare to total population

Category	Official age range	Population	Enrollment
Pre-nursery	1-3 years	1,350,751	6,690
Nursery	4-6 years	947,252	282,428
Primary	7-12 years	1,810,665	2,512,465
Lower secondary	13-15 years	908,132	481,138
Upper secondary	16-18 years	812,637	250,966
Tertiary	19-23 years	1,168,850	86, 206
TVET NEP			9,932
Adult literacy			123,607
Total		**6,998,287**	**3,753,366**

9.5.1 EARLY CHILD EDUCATION (PRE-NURSERY SCHOOL)

Table 9-30: Number of ECE Schools /Centres, learners and Staff from 2017 to 2019

Level	2017	2018	2019
Schools/Centres	**3,276**	**3,306**	**3,488**
Pre-Nursery	90	96	87
Nursery	3,186	3,210	3,401
Learners	**225,669**	**233,197**	**289,118**
Pre-Nursery	5,234	6,491	6,690
Nursery	220,435	226,706	282,428
Staff	**7,055**	**7,440**	**8,097**
Pre-Nursery	243	262	232
Nursery	6,812	7,178	7,865

Table 9-31: Number of Pre-Nursery centers from 2017 to 2019

Description/Year	2017	2018	2019
Total number of Pre-nurseries	**90**	**96**	**87**
Number of public centres	22	23	61
Number of private centres	68	73	26

Percentage of public centres	24.4%	24.0%	70.1%
Percentage of private centres	75.6%	76.0%	29.9%

Table 9-32: Number of Pre-nursery by owner from 2017 to 2019

Centre by Owner/year	2017	2018	2019
Total Number	**90**	**96**	**87**
Government	22	23	35
Catholic	5	5	11
Protestant	1	1	3
Adventist	0	1	0
Islamic	0	2	4
Parents' associations	36	38	25
Individuals/NGOs	26	26	9
Percentage	**100%**	**100%**	**100%**
Government	24.4%	24.0%	40.2%
Catholic	5.6%	5.2%	12.6%
Protestant	1.1%	1.0%	3.4%
Adventist	0.0%	1.0%	0.0%
Islamic	0.0%	2.1%	4.6%
Parents' associations	40.0%	39.6%	28.7%
Individuals/NGOs	28.9%	27.1%	10.3%

Table 9-33: Number of Pre-Nursery learners from 2017 to 2019

Indicator/Year	2017	2018	2019
Total Pre-Nursery learners	**5,234**	**6,491**	**6,690**
Male	2,516	3,199	3,290
Female	2,718	3,292	3,400
% of Male	48.1%	49.3%	49.2%
% of Female	51.9%	50.7%	50.8%
Pre-Nursery learners in Private centres	**3,302**	**3,598**	**983**
Male	1,553	1,750	446
Female	1,749	1,848	537
% of Male	47.0%	48.6%	45.4%
% of Female	53.0%	51.4%	54.6%
Pre-Nursery learners in Public centres	**1,932**	**2,893**	**3,861**
Male	963	1,449	1,925
Female	969	1,444	1,936
% of Male	49.8%	50.1%	49.9%
% of Female	50.2%	49.9%	50.1%
Pre-Nursery learners in Government aided Centers	**0**	**1,756**	**1,846**
Male	0	835	919
Female	0	921	927
% of Male	0	47.6%	49.8%
% of Female	0	52.4%	50.2%

9.5.2 EARLY CHILD EDUCATION (NURSERY SCHOOL)

Table 27: Number of Nursery schools, by schools status from 2016 to 2019

Schools status	2016	2017	2018	2019
Total schools	2,757	3,186	3,210	3,401
Public schools	527	455	455	508
Government aided schools	947	1,484	1,632	1,555
Private schools	1,283	1,247	1,123	1338

Average pupils per school	70	69	71	83
Public schools	65	71	70	81
Government aided schools	66	66	67	80
Private schools	70	73	77	86

Table 9-34: Number of Nursery schools, by ownership from 2016 to 2019

School by Owner/Year	2016	2017	2018	2019
Total number of schools	2,757	3,186	3,210	3,401
Government	527	468	459	506
Catholic	639	781	812	840
Protestant	629	685	732	799
Adventist	55	50	76	59
Islamic	13	19	28	28
Parents associations	683	929	838	854
Individuals/NGOs	211	254	265	315
Percentage of schools by owner	100%	100%	100%	100%
Government	19.1%	14.7%	14.3%	14.9%
Catholic	23.2%	24.5%	25.3%	24.7%
Protestant	22.8%	21.5%	22.8%	23.5%
Adventist	2.0%	1.6%	2.4%	1.7%
Islamic	0.5%	0.6%	0.9%	0.8%
Parents associations	24.8%	29.2%	26.1%	25.1%
Individuals/NGOs	7.7%	8.0%	8.3%	9.3%

Table 9-35: Number of Nursery classrooms, by schools status from 2016 to 2019

Schools status	2016	2017	2018	2019
Total classrooms	4,427	5,207	5,509	5,879
In Public schools	701	615	608	674
In Government aided schools	1,243	1,896	2,234	2,050
In Private schools	2,483	2,696	2,667	3,155
Average pupils per classroom	42	42	41	48

In Public schools	49	52	53	62
In Government aided schools	50	51	49	61
In Private schools	36	34	32	36

Table 9-36: Number of Nursery desks, by schools status from 2016 to 2019

Schools status	2016	2017	2018	2019
Total desks	**74,515**	**86,607**	**103,993**	**119,279**
In Public schools	12360	11763	13,780	15,565
In Government aided schools	21,084	31,513	37,802	39,551
In Private schools	41,071	43,331	52,411	64,163
Average pupils per desk	2	3	2	2
In Public schools	3	3	2	3
In Government aided schools	3	3	3	3
In Private schools	2	2	2	2

Table 9-37: Nursery pupils enrolled from 2016 to 2019

Indicator/Year	2016	2017	2018	2019
Total (pupils)	185,666	220,435	226,706	282,428
Male	91,356	108,462	112,044	138,911
Female	94,310	111,973	114,662	143,517
% of Male	49.20%	49.20%	49.40%	49.20%
% of Female	50.80%	50.80%	50.60%	50.80%
Pupils in public schools	34,335	32,281	31,940	41,646
Male	16,836	15,765	15,978	20,531
Female	17,499	16,516	15,962	21,115
Pupils in Government aided schools	62,106	97,226	108,750	125,658
Male	30,242	47,431	53,386	61,610
Female	31,864	49,795	55,364	64,048
Pupils in Private schools	89,225	90,928	86,016	115,124
Male	44,278	45,266	42,680	56,770
Female	44,947	45,662	43,336	58,354

Table 9-38: Nursery school staff from 2016 to 2019

INDICATOR/YEAR	2016	2017	2018	2019
School staff	5,859	6,812	7,178	7,865
Male	1,297	1,367	1,457	1,553
Female	4,562	5,445	5,721	6312
% of Male	22.1%	20.1%	20.3%	19.7%
% of Female	77.9%	79.9%	79.7%	80.3%
Teaching staff	5,024	6,039	6,280	6,931
Male	846	956	994	1059
Female	4,178	5,083	5,286	5872
% of Male	16.8%	15.8%	15.8%	15.3%
% of Female	83.2%	84.2%	84.2%	84.7%
Administrative staff	835	773	898	934
Male	451	411	463	494
Female	384	362	435	440
% of Male	54.0%	53.2%	51.6%	52.9%
% of Female	46.0%	46.8%	48.4%	47.1%
Qualified teachers	4,114	5,116	5,414	6,183
Qualified Male Teachers	660	778	813	943
Qualified Female Teachers	3,454	4,338	4,601	5,240
% of Qualified Teachers	81.9%	84.7%	86.2%	89.2%
% of Qualified Male teachers	78.0%	81.4%	81.8%	89.0%
% Qualified Female teachers	82.7%	85.3%	87.0%	89.2%
Trained Teacher	2,060	2,512	3,392	3,432
Trained Male Teachers	332	395	733	551
Trained Female Teachers	1,728	2,117	2,659	2881
% of Trained Teachers	52.7%	41.6%	47.3%	49.5%
% of Trained Male teachers	55.7%	41.3%	50.3%	52.0%
% Trained Female teachers	49.2%	41.6%	46.5%	49.1%

Pupils: Teacher Ratio	32	37	32	36
Pupils: Qualified Teacher Ratio	45	43	36	40
Pupils: Trained Teacher Ratio	90	88	67	71

9.5.3 PRIMARY EDUCATION

Table 9-39: Number of primary schools from 2016 to 2019 by schools' status

School status	2016	2017	2018	2019
Total schools	2,842	2,877	2,909	2,961
Public	725	725	736	759
Government aided	1,769	1,774	1,781	1,787
Private	348	378	392	415
Average Pupil per School	896	883	861	848
Public	1,063	1,099	1,075	1,069
Government aided	935	929	904	891
Private	350	254	264	261

Table 9-40: Number of primary schools by owner from 2016 to 2019

School by Owner	2016	2017	2018	2019
Total schools	2,842	2,877	2,909	2,961
Government	725	726	736	759
Catholic	1,137	1,152	1,153	1,168
Protestant	640	647	648	653
Adventist	57	57	57	55
Islamic	20	19	21	20
Parents associations	122	137	137	137
Individuals/NGOs	141	139	157	169
Percentage	100%	100%	100%	100%
Government	25.5%	25.2%	25.3%	25.6%
Catholic	40.0%	40.0%	39.6%	39.4%
Protestant	22.5%	22.5%	22.3%	22.1%
Adventist	2.0%	2.0%	2.0%	1.9%

Islamic	0.7%	0.7%	0.7%	0.7%
Parents associations	4.3%	4.8%	4.7%	4.6%
Individuals/NGOs	5.0%	4.8%	5.4%	5.7%

Table 9-41: Number of primary classrooms from 2016 to 2019 by schools' status

School status	2016	2017	2018	2019
Total classrooms	31,437	31,927	32,548	34,468
Public	8,781	9,073	9,287	9,884
Government aided	19,636	19,849	20,072	21,205
Private	3,020	3,005	3,189	3,379
Average Pupil per Classroom	81	80	77	73
Public	88	88	85	82
Government aided	84	83	80	75
Private	40	32	32	32

Table 9-42: Number of primary classrooms from 2016 to 2019 per grade

Grade	2016	2017	2018	2019
Number of classrooms				
P1	6,537	5,975	5,825	5,537
P2	6,186	6,033	5,488	5,399
P3	5,453	5,646	5,373	5,051
P4	4,848	5,119	5,212	5,077
P5	4,424	4,662	4,884	7,112
P6	3,989	4,492	5,766	6,292
Average number of Pupils per classroom				
P1	93	83	89	89
P2	88	88	84	86
P3	85	85	84	85
P4	81	82	82	83
P5	77	79	78	56
P6	50	54	45	48

Table 9-43: Number of primary schools' classes from 2016 to 2019 by schools' status

School status	2016	2017	2018	2019
Total classes	58,560	59,572	56,683	53,364
Public	17,021	17,680	16,891	15,901
Government aided	37,986	38,602	36,370	33,929
Private	3,553	3,290	3,422	3,534
Average Pupil per Class	43	43	44	47
Public	45	45	47	51
Government aided	44	43	44	47
Private	34	29	30	31

9.5.4 SECONDARY EDUCATION

Table 9-44: Number of secondary schools from 2016 to 2019 by schools' status

School year	2016	2017	2018	2019
Total	1,575	1,567	1,728	1,783
Public	460	461	522	547
Government aided	862	871	892	912
Private	253	235	314	324
Average students per school	352	378	378	409
Public	376	405	403	432
Government aided	350	381	408	448
Private	313	314	250	257

Table 9-45: Number of secondary schools by owner from 2016 to 2019

School by Owner	**2016**	**2017**	**2018**	**2019**
Total schools	**1,575**	**1,567**	**1,728**	**1,783**
Government	460	461	524	547
Catholic	620	632	661	677
Protestant	279	288	314	316
7th Day Adventist	22	21	19	23
Islamic	16	15	17	17
Parents associations	106	102	104	106
Individuals/NGOs	72	48	89	97
Percentages	**100%**	**100%**	**100%**	**100%**
Government	29.2%	29.4%	30.3%	30.7%
Catholic	39.4%	40.3%	38.3%	38.0%
Protestant	17.7%	18.4%	18.2%	17.7%
7th Day Adventist	1.4%	1.3%	1.1%	1.3%
Islamic	1.0%	1.0%	1.0%	1.0%
Parents associations	6.7%	6.5%	6.0%	6.0%
Individuals/NGOs	4.6%	3.1%	5.2%	5.4%

Table 9-46: Number of secondary school classrooms from 2016 to 2019 by schools status

School status	2016	2017	2018	2019
Total Classrooms	16,797	17,081	17,972	18,685
Public	5,110	5,269	5,718	5,957
Government aided	9,086	9,312	9,566	9,842
Private	2,601	2,500	2,688	2,886
Average students per Classroom	33	35	36	39
Public	34	35	37	40
Government aided	33	36	38	42
Private	30	30	29	29

Table 9-47: Number of students in secondary schools from 2016 to 2019

Description/Year	2016	2017	2018	2019
Total Students	553,739	592,501	658,285	732,104
Male	260,679	276,437	308,367	341,691
Female	293,060	316,064	349,918	390,413
% of Male	47.10%	46.70%	46.80%	46.70%
% of Female	52.90%	53.30%	53.20%	53.30%
Students in Public schools	173,109	186,914	212,250	240,588
Male	83,457	89,354	102,414	116,902
Female	89,652	97,560	109,836	123,686
Students in Government aided schools	301,554	331,712	364,096	408,534
Male	136,108	148,362	162,963	181,495
Female	165,446	183,350	201,133	227,039
Students in Private schools	79,076	73,875	81,939	82,982
Male	41,114	38,721	42,990	43,294
Female	37,962	35,154	38,949	39,688

9.5.5 TECHNICAL AND VOCATIONAL EDUCATION TRAINING

Table 9-48: Number of TVET schools by level in 2017 to 2019

Descriptions	2017	2018	2019
Total schools	402	360	341
Level 1 to 5	385	350	331
Level 6 to 7	17	10	10
TVET special program	-	-	-

Table 9-49: Number of TVET schools by status from 2016 to 2019

Status	2016	2017	2018	2019
Total schools	394	402	360	341
Public	104	102	96	92
Government aided	42	40	45	45
Private	248	260	219	204

Table 9-50: Number of TVET classrooms for level I to 5 in 2017 to 2019

Status	2017	2018	2019
Total classrooms	3,014	2,846	2,860
Public	759	756	752
Government aided	410	439	468
Private	1,845	1,651	1640
Trainees per Classroom	26	28	28
Public	27	29	27
Government aided	30	28	27
Private	25	28	28

Table 9-51: Percentage of students enrolled in TVET Level 3 after passing S3 National Exam

Indicator	T=2016	T=2017	T=2018	T=2019
Number of students passed S3 exam in year (T-1)	73,897	79,198	86,837	81,998
Male	38,212	37,886	41,639	39,443
Female	35,685	41,312	45,198	42,555
Number of students registered in TVET level 3 in year T	20,825	24,603	28,732	25,885
Male	11,526	13,590	16,218	14,459
Female	9,299	11,013	12,514	11,426
Percentage of students enrolled in TVET level 3	28.2%	31.1%	33.1%	31.6%
Male	30.2%	35.9%	38.9%	36.7%
Female	26.1%	26.7%	27.7%	26.8%

9.5.6 TERTIARY EDUCATION

Table 9-52: Number of tertiary institutions from 2016 to 2019

DESCRIPTION/YEAR	2015/16	2016/17	2017/18	2018/19
Total Tertiary institutions	45	54	40	40
Public	10	10	3	3
Private	35	44	37	37
TVET Higher Learning Institutions	16	17	10	10
Public	8	8	1	1
Private	8	9	9	9
Higher Education Institutions	29	37	30	30
Public	2	2	2	2
Private	27	35	28	28

Table 9-53Table 47: Tertiary Institution students from 2016 to 2019

Indicator/Year	2015/16	2016/17	2017/18	2018/19
Total number of students	90,803	91,193	89,160	86,206
Male	52,297	49,908	51,119	49,090
Female	38,506	41,285	38,041	37,116
% of Male	57.6%	54.7%	57.3%	56.9%
% of Female	42.4%	45.3%	42.7%	43.1%
Students in Public Tertiary institutions	39,208	38,595	38,338	35,719
Male	27,451	25,518	26,247	24,364
Female	11,757	13,077	12,091	11,355
% of Male	70.0%	66.1%	68.5%	68.2%
% of Female	30.0%	33.9%	31.5%	31.8%
Students in Private Tertiary institutions	51,595	52,598	50,822	50,487
Male	24,846	24,390	24,872	24,726
Female	26,749	28,208	25,950	25,761
% of Male	48.2%	46.4%	48.9%	49.0%
% of Female	51.8%	53.6%	51.1%	51.0%

Table 9-54: Tertiary institution students enrolled from 2016 to 2019 by field of education

Field of Education/Year	2015/16	2016/17	2017/18	2018/19
Education	12,768	10,906	8,938	10,875
Male	7,709	6,892	5,513	6,402
Female	5,059	4,014	3,425	4,473
Arts and Humanities	2,787	2,741	1,533	973
Male	2,014	737	924	590
Female	773	2,004	609	383
Social Sciences, Journalism and Information	5,284	4,309	5,001	6,258
Male	2,608	2,065	2,861	3,151
Female	2,676	2,244	2,140	3,107
Business, Administration and Law	30,330	30,360	29,408	25,708
Male	13,786	12,999	13,361	11,481
Female	16,544	17,361	16,047	14,227
Natural Sciences, Mathematics and Statistics	3,877	3,977	2,984	3,775
Male	2,538	2,614	2,020	2,461
Female	1,339	1,363	964	1,314
Information and Communication Technologies	9,368	9,309	7,540	9,427
Male	5,936	5,984	4,930	5,888
Female	3,432	3,325	2,610	3,539
Engineering, Manufacturing and Construction	5,337	11,228	14,241	14,220
Male	4,087	9,292	11,391	11,423
Female	1,250	1,936	2,850	2,797
Agriculture, Forestry, Fisheries and Veterinary	4,100	4,302	2,576	2,907
Male	2,720	2,597	1,725	1,909
Female	1,380	1,705	851	998
Health and Welfare	7,962	7,230	8,251	6,726
Male	3,977	3,545	4,442	3,477

Female	3,985	3,685	3,809	3,249
Services	8,990	6,831	8,688	5,337
Male	6,922	3,183	3,952	2,308
Female	2,068	3,648	4,736	3,029

Table 9-55: Tertiary graduates by fields of education from 2015 to 2018

Field of education	2014/15			2015/16		
	Male	Female	Total	Male	Female	Total
Education	2,043	1,097	3,140	2,565	2,001	4,566
Arts and humanities	380	123	503	148	64	212
Social Sciences, journalism and information	833	726	1,559	630	508	1,138
Business, Administration and Law	3,339	4,284	7,623	3,807	4,881	8,688
Natural Sciences, Mathematics and Statistics	324	187	511	886	481	1,367
Information and Communication Technologies (ICTs)	956	550	1,506	1,908	636	2,544
Engineering, Manufacturing and construction	2,784	602	3,386	673	230	903
Agriculture, Forestry, fisheries and veterinary	856	303	1,159	667	281	948
Health and Welfare	1,511	1,779	3,290	960	1,193	2,153
Service	-	29	29	530	586	1,116
TOTAL	**13,026**	**9,680**	**22,706**	**12,774**	**10,861**	**23,635**

Adult Literacy Education

Table 9-56: Adult literacy centers from 2016 to 2019

Indicators / Year	2016	2017	2018	2019
Centres	4,654	5,160	4,991	5,194
Public	1,363	1,447	1,418	1,389
Private	2,047	1,214	815	1046
Government aided	1,244	2,499	2,758	2,759
Percentage	100%	100%	100%	100%
Public	29.3%	28.0%	28.4%	26.7%
Private	44.0%	23.5%	16.3%	20.1%
Government aided	26.7%	48.4%	55.3%	53.1%

Table 9-57: Number of adult literacy Centres, by owner in 2016 and 2019

Number of centers by Owner/Year	2016	2017	2018	2019
Total Centers	4,654	5,160	4,991	5,194
Churches	2,741	2,745	2,899	2,949
Government	1,676	2,129	1,947	1,959
NGOs	169	202	145	286
Projects	68	84	0	0
Percentage	100%	100%	100%	100%
Churches	58.9%	53.2%	58.1%	56.8%
Government	36.0%	41.3%	39.0%	37.7%
NGOs	3.6%	3.9%	2.9%	5.5%
Projects	1.5%	1.6%	0.0%	0.0%

Table 9-58: Adult Literacy learners in 2016 and 2019

Indicator/Year	2016	2017	2018	2019
Total learners	126,165	152,015	132,365	127,117
Male	49,293	61,556	51,220	49,096
Female	76,872	90,459	81,145	78,021
% of Male	39.1%	40.5%	38.7%	38.6%
% of Female	60.9%	59.5%	61.3%	61.4%
Learners in public centres	38,495	43,791	37,020	41,738
Male	14,649	17,431	14,169	16,312
Female	23,846	26,360	22,851	25,426
% of Male	38.1%	39.8%	38.3%	39.1%
% of Female	61.9%	60.2%	61.7%	60.9%
Learners in private centres	57,275	35,043	18,086	22,561
Male	22,745	14,899	7,031	8,716
Female	34,530	20,144	11,055	13,845
% of Male	39.7%	42.5%	38.9%	38.6%
% of Female	60.3%	57.5%	61.1%	61.4%
Learners in Government aided centres	30,395	73,181	77,259	62,818
Male	11,899	29,226	30,020	24,068

Female	18,496	43,955	47,239	38,750
% of Male	39.1%	39.9%	38.9%	38.3%
% of Female	60.9%	60.1%	61.1%	61.7%

Figure 9-13: A rural school in Rwanda

9.6 STATUS ON HEALTH CARE INFRASTRUCTURE

The Rwandan health sector is a pyramidal structure and consists of three levels: the central level, the intermediary level, and the peripheral level.

- The central level comprises (i) Ministry of Health (MOH), (ii) Rwanda Biomedical Center (RBC) and the (iii) national referral and teaching hospitals.
- The Intermediary Level consist of district hospital and provincial hospital, established to decrease the pressure of demand for services in the national referral hospitals
- The peripheral level is represented by the health district and consists of an administrative office of district health Unit (DHU), a district hospital (DH), and a network of health centers and health posts (HCs / HPs)
- At the village level, Community Health Workers (CHWs) provide prevention, promotion and some curative health services. Community health services are integrated into the community development services and administrative structures

As part of the decentralized structure of the GOR, the District Health Unit (DHU) is an administrative unit in charge of coordination of the provision of health services(including the private sector)and responsible for planning, monitoring and supervision of the decentralized implementing agencies

9.6.1 GEOGRAPHICAL ACCESSIBILITY TO HEALTHCARE SERVICES

The Ministry of Health has a plan to have a healthcare facility structure for each administrative entity in Rwanda; down from a comprehensive primary healthcare in community up to the referral health services at provincial, regional and national levels. By June 2020, there were 8 referral hospitals and each Province had a Provincial Hospital. Each Administrative District had at least one District Hospital, and there 510 Health Centers for 416 Administrative Sectors. For Administrative Cells, 209 Additional Health Posts were constructed from 2019 to June 2020. To improve access to modern hospitals, five new Hospitals are being constructed and are at an advanced level of completion. These include:

- Gatunda Hospital : construction works were completed at 98 % by June 2020
- Gatonde Hospital : construction works were completed at 95% by July 2020
- Nyabikenke Hospital construction works were completed at 77.1 % by June 2020
- Nyarugenge Hospital: construction works were completed at 99% by June 2020
- Munini Hospital: construction works were completed at 65.32% by June 2020
- Construction works for the establishment of the “Institut de Recherche contre le Cancer de l’Appareil Digestif (IRCAD)” in Rwanda have also started and were at 11,5% % by June 2020

9.6.2 PUBLIC HEALTH FACILITIES IN RWANDA IN 2016-2020 (MOH 2019-2020)

Table 9-59: Health facilities

Heath Facility type	2016	2017	2018	2019	(June 2020)
National Referral Hospital	8	8	8	8	8
Provincial Hospital	4	4	4	4	4
District Hospital	36	36	36	36	37
Health Center	499	503	504	509	510
Prison Clinic	14	13	13	13	13
Health Post	471	505	703	885	1094
Private Dispensary	125	130	130	123	122
Private Clinics and polyclinic	123	128	128	149	158
Private Hospital	5	5	8	8	8
Total	1285	1332	1534	1735	1954

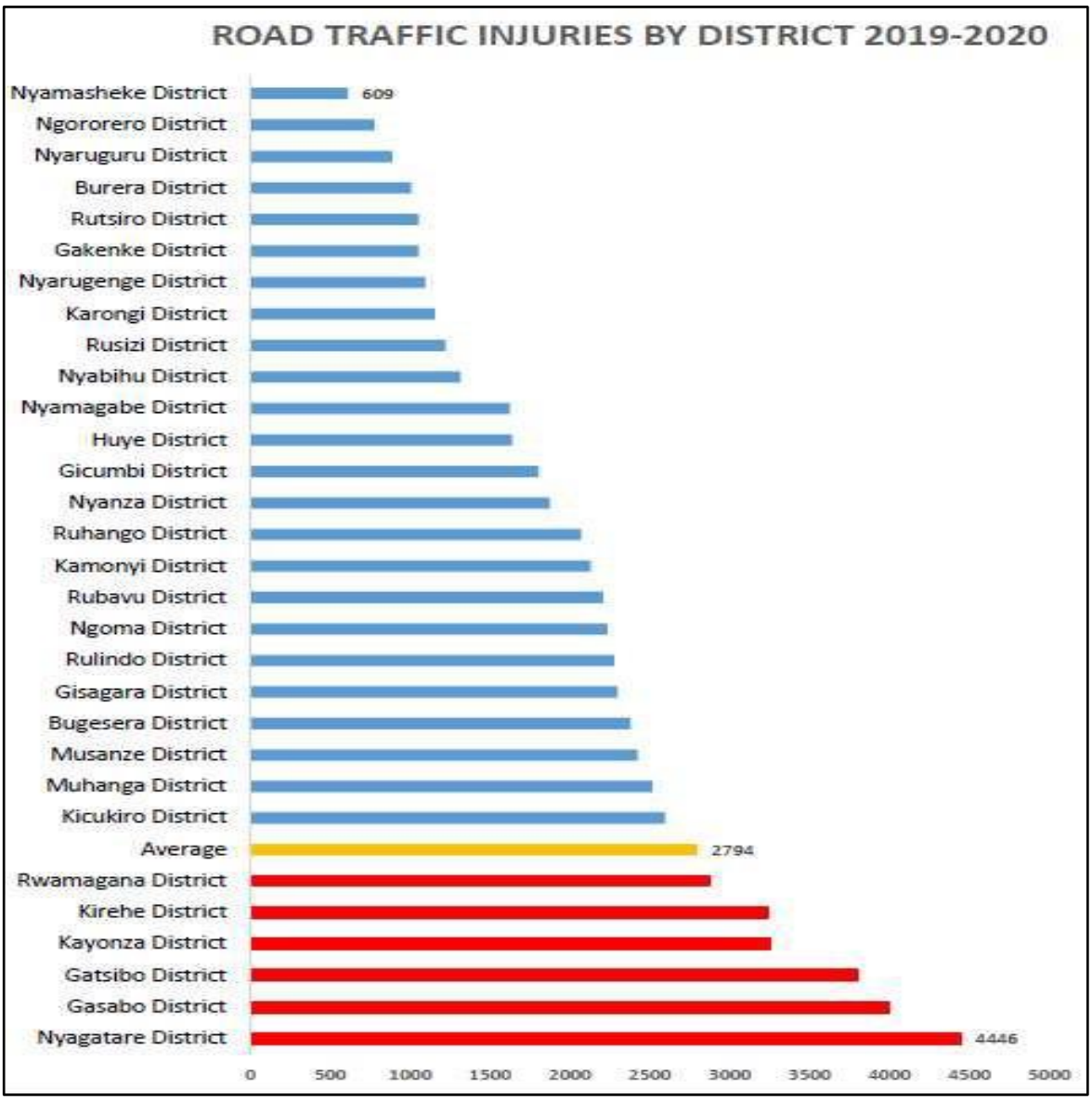


Figure 9-14: Road traffic accidents

9.7 HEALTHCARE SERVICE DELIVERY

Table 9-60: Annual trends of OPD visit in health facilities from the FY 2016-2017 to FY 2019- 2020 (MOH-RHMIS 2019-2020)

Facility Type	OPD new cases			
	FY 2016-2017	FY 2017-2018	FY 2018-2019	FY 2019-2020
Health Posts	71,212	86,634	1,445,119	3,824,343
Private Health Facilities	593,850	615,013	847,643	1,072,167
Health Center	13,327,004	14,755,758	13,268,067	11,302,357
Prison Clinic	131,520	141,545	147,662	175,223
CHW Home-Based Care	2,475,802	2,446,200	2,398,468	1,558,153
District and Provincial Hospitals	551,772	638,849	712,355	725,365
Referral Hospitals	177,829	194,022	207,200	203,011
Grand total	17,328,989	18,878,021	19,026,514	18,860,619
Total Population	11,671,371	11,949,508	12,232,059	12,518,758
Per Capita utilization rate	1.48	1.58	1.56	1.51

9.7.1 CONTRIBUTION OF THE PRIVATE SECTOR TO THE HEALTH SECTOR

Health Facility (HF) Type	OPD new cases			
	FY 2016-2017	FY 2017-2018	FY 2018-2019	FY 2019-2020
Public Health Facilities	16,735,139	18,263,008	18,178,871	17,788,452
Private Health Facilities	593,850	615,013	847,643	1,072,167
Total	17,328,989	18,878,021	19,026,514	18,860,619
Coverage rate Public vs Private HFs				
Public HFs (Percentage)	97	97	96	94
Private HFs (Percentage)	3	3	4	6

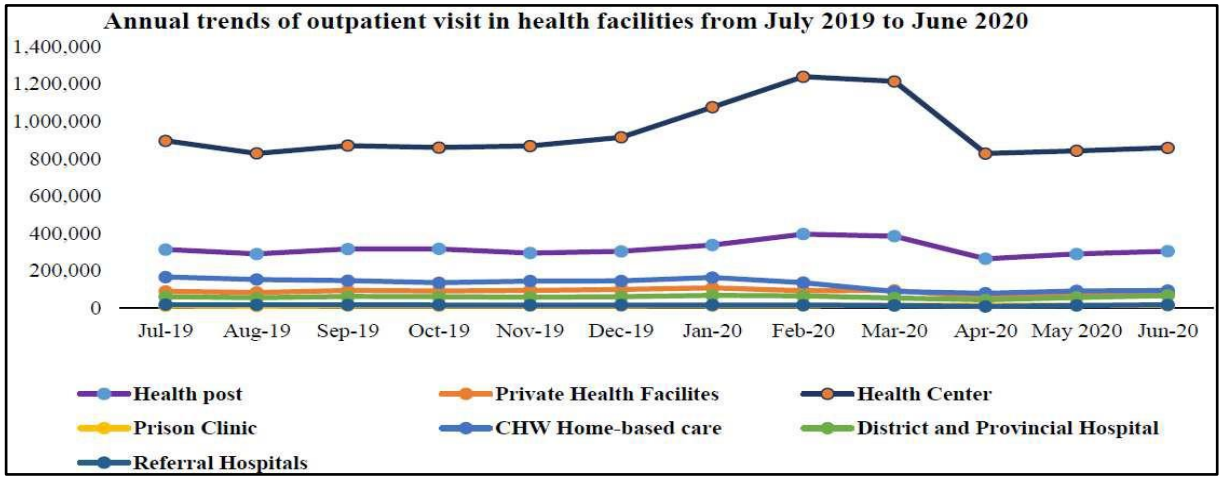


Figure 9-15: Trends in outpatient visits

Table 9-61: Hospitalization by facility type

Year	Facility Type						
	Private Facilities		Health center		Hospital		Total
	Number	%	Number	%	Number	%	Number
FY 2016-2017	17,590	2.5	251,261	35.9	431278	61.6	700,129
FY 2017-2018	17,706	2.5	246,821	35.4	433263	62.1	697,790
FY 2018- 2019	24,905	3.4	248,573	34.0	457117	62.6	730,595
FY 2019- 2020	27,515	3.7	271,729	36.3	448925	60.0	748,169
FY 2016-2017	17,590	2.5	251,261	35.9	431278	61.6	700,129

Table 9-62: Health facilities bed occupancy rate and average length of stay

Health Facility (HF) Type	Bed occupancy rate (%)				Average length of stay (days)			
	FY 2016-2017	FY 2017-2018	FY 2018-2019	FY 2019-2020	FY 2016-2017	FY 2017-2018	FY 2018-2019	FY 2019-2020
Private HFs	9	9,9	9	12	2	1	1	1
HCs	18	21	30	29	2	2	2	2
DH and PH	65	66	66	62	4	4	4	4
RH	68	79	78	72	6	6	6	6
National average	**40**	**44**	**46**	**44**	**6**	**6**	**5**	**4**

The current health worker density in Rwanda is 1.08 skilled health workers (physicians, nurses, and midwives) per 1,000 population, while WHO health workforce density used to recommend a minimum of 4.45/1, 000 to achieve the SDGs.

Table 9-63: Health Professionals per population in Rwanda in 2020 (MoH 2019-2020)

Staff per population ratio	Number	Ratio Per Population	Ratio/1,000 Population
Population	12,518,757		
Medical Doctor	1,518	8,247	
Nurse	10,447	1,198	
Midwife per Women in reproductive age	1,562	2,340	
Total	13,527		1,08

10 SOUTH AFRICA

10.1 WATER RESOURCES

South Africa's water is a precious resource. Rainfall is on average low and its distribution is uneven. The concept of a "water mix", i.e. assuring supply from a variety of sources including groundwater, re-use and desalination, is accepted. Surface and groundwater quality is slowly deteriorating because of factors including direct pollution, pollution from surface run-off, salination and acid mine drainage. Although the recent drought has once again emphasised the need for better conservation measures and changes in consumption behaviour, the public appears to take little heed of these warnings for example targets for water demand management are very seldom met by municipalities. Funding is a major problem – funding for operations and maintenance, and for new capital works.

Growth in population has seen increased demand for fresh water resources, which has put a strain on avail- able bulk supplies. This has been exacerbated by the recent drought in different parts of the country. Current water usage already exceeds the reliable yield of existing water infrastructure, and the marginal cost of future expansions is rising rapidly. As a consequence, although South Africa uses less than 40% of the country's total renewable water resource, much of this is not available at the required assurance level, and thus economic and physical water scarcity is a reality. Growing water shortages mean that alternative sources will have to be considered. Chief amongst these are water re-use, aquifer water resource exploration and desalination, some of which are energy-intensive and expensive. There is little clarity on who will bear the costs, and whether the charging structures will adequately serve both resource conservation and equity goals.

Water infrastructure consists of bulk abstraction and conveyancing, as well as local treatment and distribution. The Department of Water and Sanitation (DWS) is responsible for the major water resources infrastructure, principally comprising the major dams, pipelines and canals. It

controls 257 water schemes, of which 25% (65) are considered national schemes where raw water is collected and transferred from one catchment to another. The remainder are schemes where raw water is collected and delivered within a particular catchment

Given the recent drought conditions, these systems have been under severe stress. A number of new schemes, to address future water problems, are in various stages of preparation. The largest of these, the second phase of the Lesotho Highlands Water Project (LHWP), is some five to seven years behind the planned timing, which will place the urban and industrial heartland of South Africa at risk in the event of drought. The augmentation of supplies to Cape Town has also been considerably delayed. Similar challenges are reported from the Umgeni system where the proposed bulk supply from a new uMkhomazi dam is likely to be late, not least because of the substantial bulk transmission requirements. In addition, supplies to Nelson Mandela Bay Metro have been limited due to the multi-year delay in completing the Nooitgedacht pipeline which would provide additional supplies from the Orange River Scheme.

In these and other cases, responsibility is usually shared between the DWS and other authorities, such as the beneficiary municipalities. Funding, as noted above, is a major reason for delays. Implementation of new water resources infrastructure development is typically between 40% and 60% of targets, due largely to the difficulties which one or other party is having in securing funding – augmentation of supply to Nelson Mandela Bay Metro is a case in point.

The Department's asset register indicates a total pipe network of 1 070 km and canal systems of 8 100 km. Of the 5 248 registered dams in South Africa, the DWS only owns 6% (320), but they account for 86.4% of the retained water. The majority of the dams ear- marked for rehabilitation were inherited from former homelands and do not meet the required acceptable safety standards. A number of these dams suffer from inadequate spillway capacities and some from structural instability.

In general, the major water resources infrastructure is not only ageing, but there has been further deterioration as a result of insufficient maintenance and inadequate ongoing capital renewal. Management failures have also been signalled in budgeting, operations and maintenance, as witnessed in the transmission and transfer systems in the Western Cape, the Vaal River Eastern Subsystem Augmentation Project (VRESAP), and the Thukela–Sterkfontein transfers. In other in- stances contracts have been awarded in excess of budgets or against the evidence of better cost-effective technical options. Many of the major water re-source systems include a significant component of pumped transmission. The condition of the mechanical and electrical equipment, which has a shorter life and is more maintenance-intensive, is a matter of concern, since equipment failures have resulted in service re- strictions in some cases.

There has been significant improvement in the alignment of the DWS maintenance programme with its Asset Management Plan of 2010. However, there are some anomalies. For example, the DWS in its 2014/2015 annual report identified a vacancy rate of 17% in critical, technical and professional skills, whereas the 2015/2016 annual report states that it had been eliminated. This seems to contrast strongly with the views of personnel within the DWS, and indeed is not reflected in some divisional organograms, which still indicate more than 50% vacant engineering posts. In the past, the presence of experienced professional engineers in

senior and top management was a key element in enabling strategic and day-to-day decision-making, and facilitating efficient operations. The rapid turnover of Directors General (DG) (eight, including Acting DGs, since 2009) and other senior staff further contributes to poor performance.

The water resources sector now faces a similar crisis to that of the electricity generation sector a decade ago – and as the IRC forewarned in 2006. It is important to recognise that it is also a crisis caused essentially by poor management at both national and local level, poor planning, unnecessary delays in implementation and a concerning decline in institutional competence. Other contributory issues include financial constraints at both national and local level, irresponsible consumption patterns, and wastage directly due to the poor condition of some infrastructure. The current wide- spread drought has exacerbated and exposed these weaknesses.

New investment sometimes diverts attention from the sustainable management of the existing infrastructure. Paradoxically, infrastructure failures might now be removing supply from more people than are served by new investment.

10.2 WATER SUPPLY SERVICES

Water supply services, in the form of water treatment works, pump stations, reservoirs and reticulation, are the responsibility of the local government sphere, within the definition of which it is convenient for IRC purposes to include water boards and catchment management agencies. They are supported, and regulated, by national government departments, in particular the DWS.

South Africa met the 2015 Millennium Development Goal targets. However, the new challenge is to achieve the Sustainable Development Goals which focus on the reliability and safety of water supplies, and the safe and effective management of human waste.

A wide range of legislation and frameworks governing water supply and sanitation, including the policy of free basic water and sanitation services, is in place.

A recurring theme that hampers achievement of service delivery goals is inadequate capability of service providers to fulfil their responsibilities. Delivering new infrastructure, operating and maintaining it, and eventually renewing or replacing it, are complex activities. Appropriately competent and skilled persons, how- ever, are in short supply in the public sector, especially in rural areas. This is exacerbated in that infrastructure has been provided in settings where there is no financial capacity to hire the qualified staff needed, nor to provide the requisite levels of operation and maintenance spending. Many municipalities, including some district municipalities, require assistance, de- spite which there appears to be general reluctance to outsource any significant operation and maintenance tasks to the private sector. Nonetheless, in all of the metros, and in many other towns as well, the water supplied to households is of top quality – not many countries are able to boast that water can be drunk from the tap without treatment.

A consequence of inadequate capability is often in- appropriate operational practices, together with neglect of maintenance. This without question reduces the functionality of infrastructure. To quote the DWS:

“Initially water provision progress was measured by the supply of water infrastructure. In recent years, however, due mainly to poor maintenance practices, an increas- ing amount of infrastructure has become non-functional. By 2016, 86.51% of households had been provided with basic (RDP) level of water supply infrastructure. However, not all of the infrastructure was able to meet the level of assurance (reliability) of supply requirements, defined for a basic water supply as interruptions of <48 hrs at any one time, and a cumulative interruption time of <15 days over three months. If this reliability requirement is taken into consideration, then the 86.51% value is reduced to about 69% of the total number of households.” 13

The stark reality is that repairing dysfunctional infra- structure without addressing the factors that impact negatively on operations and maintenance is simply not a sustainable option in the medium to long term. Without basic maintenance, much of the more sophisticated and/or less robust infrastructure, such as treatment plants or pump stations, cannot be expected to deliver service indefinitely.

Some years ago, the DWS instituted the Blue Drop performance rating system for water services. This has clearly indicated where the challenges are greatest – which is particularly in the smaller towns and rural areas. It has also indicated which are the weakest aspects. Prominent among these are skills and budget issues, and also the lack of maintenance plans.

Figure 4 illustrates that the latest available (2014) Blue Drop scores are without exception higher around the major urban areas, and/or where water boards treat water in bulk and supply it to municipalities (to a great extent, the same areas).

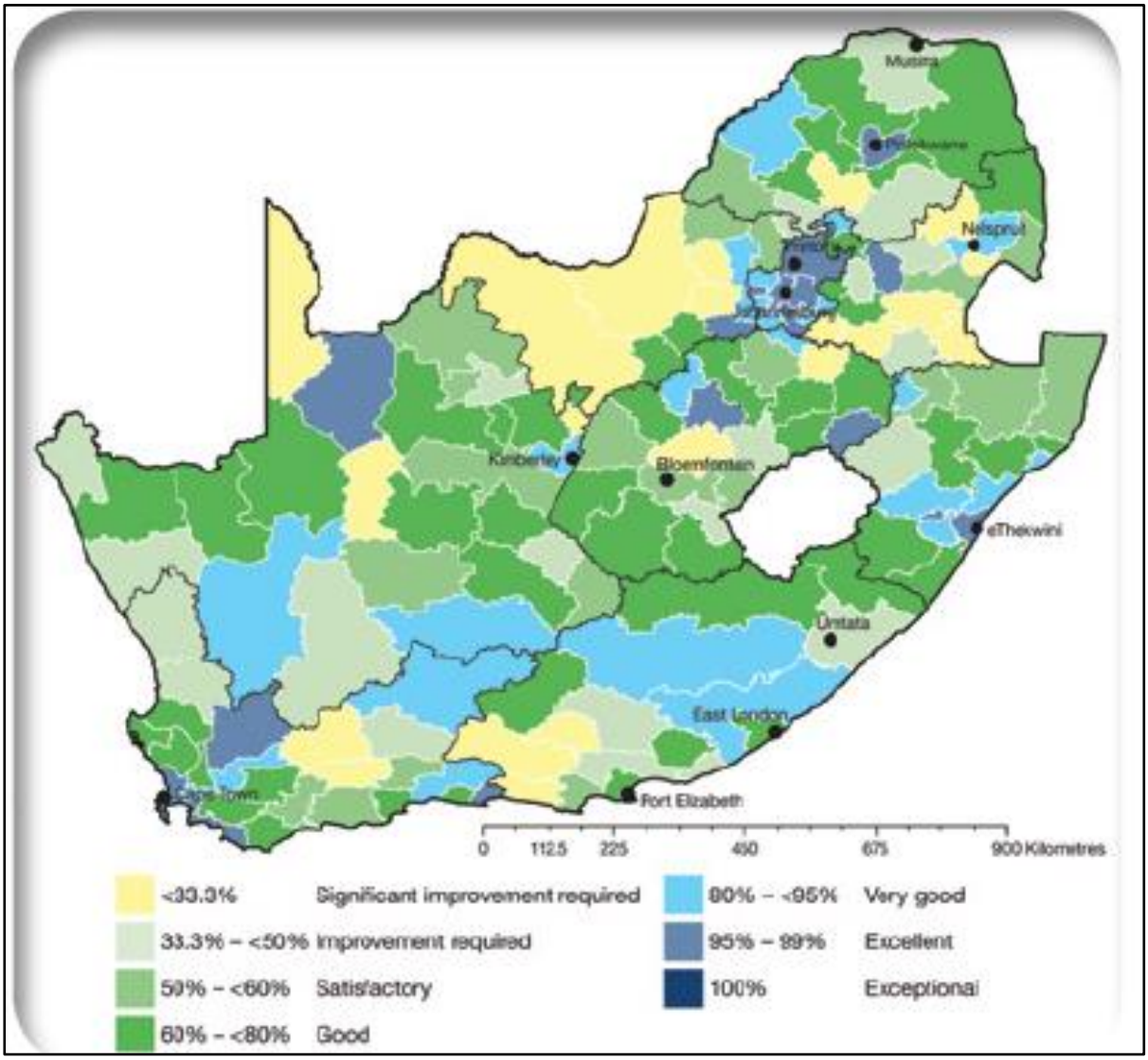


Figure 10-1: Blue Drop score 2014 (data supplied by the DWS in 2016)

One of South Africa's main water management challenges is non-revenue water (NRW), which represents the water lost through physical leakage or commercial losses. About 31% of piped water does not reach consumers because of leaks in the network system. Although the relevant national data is incomplete, if commercial losses are included, then total loss is closer to 40%, much of it due to failed systems and political unwillingness to enforce cost recovery and debt col- lection. NRW represents a lost "resource" that cannot be afforded. In recognition of this, the DWS instituted the No Drop performance rating system of water supply institutions.

It is estimated that 35% to 45% of the water used by the agricultural sector is lost during irrigation, mostly because schemes are in a state of disrepair or have exceeded their economic lifespan.

Addressing the capability limitations of much of local government is the greatest challenge facing local ser- vice delivery – not just in respect of water supply ser- vices. Key functions such as planning, budgeting, project management and the daily operation and maintenance functions are severely hampered. Widespread non-compliance with infrastructure asset

management recommended practice results in funds that are allocated to new infrastructure investment being used for unplanned repairs and replacements. Repair and maintenance budgets are inadequate, which can sometimes be attributed to the ease with which these allocations may be deferred by municipalities in the expectation that the consequently deteriorated infrastructure will in due course be refurbished or replaced at the cost of national government. The DWS has on occasion rehabilitated selected infrastructure owned by municipalities, but has had no choice thereafter other than to hand it back to the same municipalities which had already proved themselves unable to adequately care for it.

The primary benefits of changing the current culture will be a drastic reduction in infrastructure life cycle costs, and a greatly improved ability to deliver a reliable, resilient and sustainable service.

10.3 SANITATION

Sanitation services comprise the provision of on-site or reticulated sanitation, and the conveyance and treatment of wastewater. The government's commitment to providing sustainable sanitation to its people is reflected in the country's constitution and in its policies. It also features in the widely accepted vision for the nation – the National Development Plan Vision 2030, which states that "… all South Africans will have access to sufficient … hygienic sanitation to live healthy and dignified lives …" Responsibility for this falls within the mandate of the DWS, and local government and/or water boards.

In 2014 the DWS took back responsibility for house- hold sanitation provision from the Department of Human Settlements (DOHS). Currently an updated delivery status verification process is underway, but provisional figures for 2016 (see Table 114) indicate that, although the percentage unserved is declining, due to population growth the absolute number of the unserved has remained relatively constant since 1994, at about 4 million households.

If the sanitation backlog is to be eradicated, then additional finances, combined with appropriate project management skills and effort, will be required. Political pressure to provide full waterborne sanitation as a basic level of sanitation is severely impacting the cost of service provision in parts of the country, as well as slowing down service delivery. Waterborne sanitation services cannot be provided effectively unless there is adequate and reliable water supply, so further investment in that dimension will often be wasted and the untreated wastewater crisis will simply get worse.

The DWS instituted the Green Drop performance rating system for wastewater systems. According to the latest available Green Drop findings, 30% of large WWTWs (Wastewater Treatment Works) are in a critical condition, implying that millions of litres of un- treated or inadequately treated sewage are illegally dis- charged into rivers and streams each day. Water treatment and wastewater treatment works are generally in poor condition, thus increasing the environmental health risk, with 66% of all WWTWs requiring short to medium-term intervention, 35% requiring capacity upgrades and 56% requiring additional skilled operating and maintenance staff (DWS 2015. 2014 Green Drop Progress Report–Executive Summary.)

Figure 5 illustrates that the Green Drop scores are without exception higher around the major urban areas, and also that two provinces have higher average scores than the others.

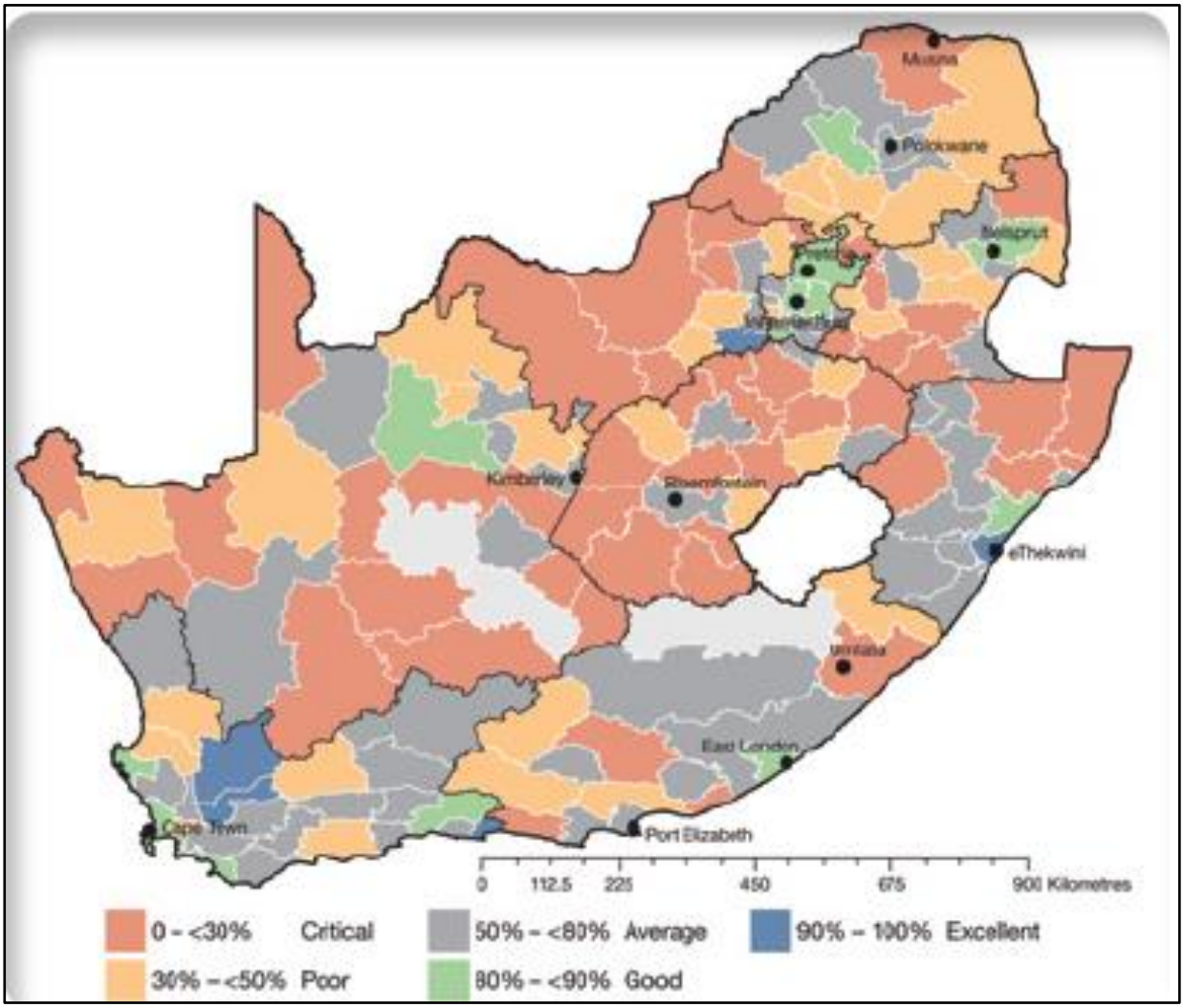


Figure 10-2: Green Drop scores

The most common problems experienced at WWTWs are poor design of treatment plant or individual processes, processes not operated according to design criteria, breakdown of equipment, inadequate technical back-up, change in raw water quality, poor planning of operations, and insufficient resources.

The skills required to operate and manage sophisticated technologies are often scarce outside of major urban centres. Downstream users and ecosystems subsequently bear the consequences in the form of high pathogen loads, eutrophication, and higher treatment costs to achieve potable water standards. Trickling systems and, where space permits, pond systems, may be a better option as they are more tolerant of power failures, have far lower energy costs, have more modest skills requirements and cost users less.

Municipal treatment facilities handle of the order of 6 000 Megalitres per day. Taking into account the demographic changes and the subsequent sanitation requirements, 22% available capacity remains for future demand – but this is an average figure nation- ally, whereas locally many WWTWs have no surplus capacity and are running at full demand. During the rainy season, because of infiltration into the sewers upstream, many receive more inflow than they

can cope with, with the result that treatment processes are speeded up or simply bypassed. Electricity outages disrupt treatment processes and, if pumping is part of the process, can quickly cause temporary storage facilities at the WWTWs to be overwhelmed and/or require that the inflow bypass the works.

The status of sanitation infrastructure in the country is of grave concern. This is mainly related to communities served with waterborne sewerage systems where maintenance, refurbishment and upgrading of collection and treatment infrastructure have been neglected over the years. An increasing number of sewer failures are occurring within municipalities, which cause blockages in pipelines, overloading of manholes, flooding of community areas and leading to degradation of neighbouring services. Typical challenges include poor enforcement of policies (e.g. industrial effluent bylaws) and poor governance problems, lack of capacity to manage, corruption, inadequate sustainable financial models, vandalism, theft and illegal connections.

The dominant challenges are related to insufficient technical capacity to manage, operate and maintain existing facilities and to plan for new facilities. However, many on-site sanitation systems are no better off. For example, Ventilated Improved Pit (VIP) latrines work well, but, like any other form of infrastructure, need to be maintained from time to time. In particular, they need to be emptied, but this is generally not being done. Schools and clinics and other government institutions in rural areas also make general use of on-site sanitation systems, and these, too, are often neglected to the point of being unusable.

The stark reality is that repairing dysfunctional infrastructure without addressing the factors that impact negatively on operations and maintenance is simply not a sustainable option in the medium to long term. Without basic maintenance, much of the more sophisticated and/or less

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And yet there are examples worthy of celebration. In May 2014 it was announced that eThekwini's Water and Sanitation Department won the Stockholm Industry Water Award "for its transformative and inclusive approach," calling it "one of the most progressive utilities in the world." The city has connected 1.3 million additional people to piped water and provided 700 000 people with access to toilets in 14 years. It also was South Africa's first municipality to put free basic water for the poor into practice. Further- more, it has promoted rainwater harvesting and urine- diverting dry toilets.

10.4 SOLID WASTE MANAGEMENT

Solid waste management includes collection of waste from the population and appropriate quality of disposal mechanisms. The 2011 IRC highlighted important progress made since 2006 in waste management, and since then there have been further developments, with long-term implications in terms of legislation, policies and strategies. The National Waste Management Strategy (NWMS) was published in 2011 and is currently being updated by the Department of Environmental Affairs (DEA), in line with the requirement from the Waste Act for the NWMS to be updated every five years.

South Africa generated approximately 108 million tonnes of waste in 2011, of which 98 million tonnes were disposed of at landfills. In the order of 54.6% (59 million tonnes) is general waste, 44.4% (48 million tonnes) is currently unclassified waste and the remaining 1% (1 million tonnes) is hazardous waste.

The internationally accepted waste management hierarchy consists of options for waste management during the life cycle of waste, arranged in descending order of preference:

- Waste avoidance and reduction
- Re-use
- Recycling
- Recovery, and

1. Treatment and disposal as the last resort.

If implemented correctly, this strategy has far-reaching cost-saving and sustainability implications. In the order of 10% of all waste generated in South Africa was re- cycled in 2011. Currently 54% of mainstream recyclables are recycled, with scrap metal at 80% doing the best and eWaste at 14% doing the worst.

Although recycling is legislated within South Africa, the actual recycling activities are largely driven by industry through the establishment of industry bodies, also known as Producer Responsibility Organisations (PROs). The first Industry Waste Management Plan (IndWMP) for tyres is a good example. Approximately 11 million tyres are currently sold per year locally and will eventually become waste. The estimated mass of the tyres sold is 275 000 tonnes. At the commencement of the plan in November 2012 only 4% of waste tyres were diverted from landfills, while by August 2016 over 60% were being diverted from landfills. However, in 2017 the contractor was placed under liquidation. It is nevertheless encouraging that such initiatives are on the increase, with impressive results also in the paper and packaging industry, where draft plans are undergoing a public consultation process.

Since 2011, households receiving an adequate refuse removal service have increased to approximately 67%. In major urban areas, the figure is between 86% and 91%, while in the rural areas it is around 52%.The rural figure must be taken in the context of low settlement densities, where on-site disposal or backyard burning of waste is sometimes appropriate.

Recent data on the number of waste disposal sites and the number that are licensed is not readily avail- able. It is estimated that 64% of general waste landfill sites are not licensed. The situation with the licensing of hazardous waste landfill sites, health care risk waste storage

facilities, recycling facilities and transfer stations has improved, with unverified data showing100% of these facilities as licensed.

Municipalities generally charge users for waste disposal at less than cost. This practice encourages waste disposal rather than minimisation or recycling, and tends to subsidise the present generation at the expense of future generations – this must be corrected. The National Pricing Strategy for Waste Management (published in August 2016) aims to address the imbalance of under-pricing of waste services and cost-reflective tariffs, together with full cost accounting through ap- propriate financial systems.

10.5 ROADS

The South African road network is managed at three levels: (a) primary intercity, with economic roads mainly managed by SANRAL on behalf of the Department of Transport (DOT); (b) the secondary and tertiary intercity network, primary access and mobility roads largely managed by the nine provincial departments; and (c) the urban and rural municipal roads managed by local authorities.

The condition of South Africa's circa 750 000 km road network, which includes approximately 17.6% (132 000 km) of unproclaimed roads, remains very variable in nature, both between spheres of government and geographical areas. At one end of the spectrum, the condition of the primary (national) 21 403 km intercity road network is, and has for several decades been, very good. The sub-sector "national roads", however, does not achieve an "A" grading because of the additional 5 233 km of provincial roads incorporated into its network during the past few years. A large proportion of the national road network (76%) is older than the 20-year theoretical design life, which is a reflection of the quality of the roads built in the past, as well

as the road maintenance operations carried out by SANRAL. Currently 11% (2 354 km) are in poor to very poor surface condition.

SANRAL has, since its inception in 1998, managed to retain its high level of professional engineering expertise. On the other hand the nine provinces have suffered for two decades from a loss of experienced road professional expertise. Whilst some provinces have suffered more than others, the results of this have been reflected in the overall deterioration of provincial road networks. Metropolitan and municipal road authorities vary in performance, with the larger metropolitan authorities to a great extent retaining their levels of professional expertise, and consequently the condition of their road networks, whilst the municipal authorities in the main reflect the same pattern as some provincial authorities, namely a dearth of expertise.

The visual condition and riding quality of national and provincial roads were depicted in the 2013 State of Logistics Survey (CSIR 201315). From Figure 6 it is ap- parent that, based on the proportions of “very poor” and “poor” roads, the condition of the SANRAL net- work and the networks of several other provinces is satisfactory, but could nonetheless do with some improvement, while the networks of Mpumalanga, KwaZulu-Natal and the Free State are the most un- satisfactory, with the Free State network substantially deteriorating between 2009 and 2013.

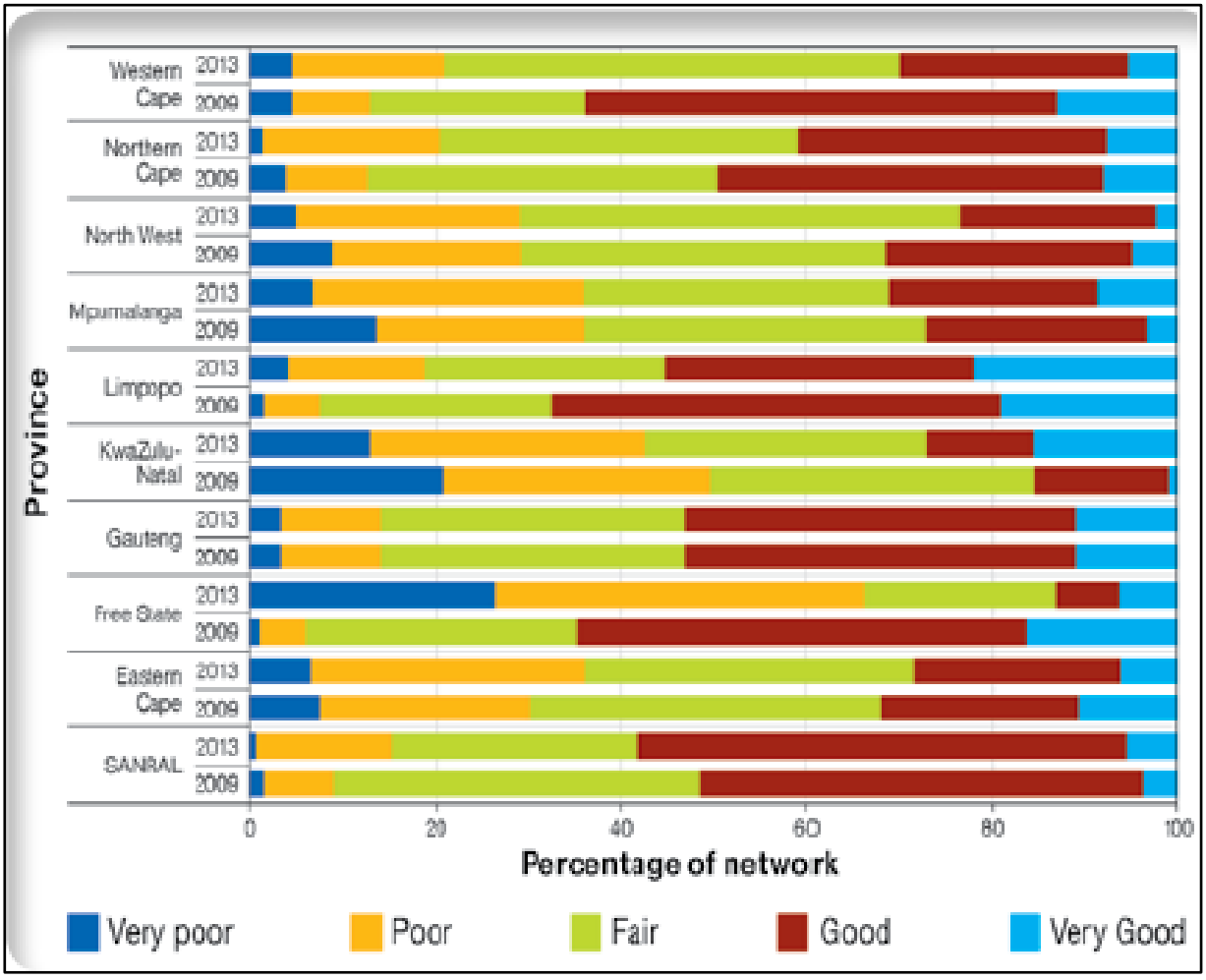

Figure 10-3: Condition of Road Network

The secondary and tertiary intercity road network, some 273 078 km in extent, is undergoing accelerated deterioration, so much so that both the efficiency and cost of moving freight on the network face severe challenges. In addition, road safety is compromised by the condition of the secondary road network.

The 83% (226 273 km) of this network which com- prises gravel roads is in a very unhealthy condition, ranging between 40% and 90% being in a “poor” and “very poor” condition, depending on the province concerned. The percentage of these gravel roads which fall in the “good” and “very good” condition is between 2% and 12%, once again depending on the province concerned.

The 17.1% (46 805 km) secondary surfaced roads fall into the different condition categories, depending on the province in which they are situated. The figures vary from a high of 58% to a low of 32% in a “good” and “very good” condition. For the classification of “poor” and “very poor” the range was from 13% to 33%, well above the accepted international norm of 10%.

The primary contributing factors leading to pavement deterioration in South Africa are capacity constraints, lack of maintenance, high traffic volumes, overloading and poor stormwater management. For example, poor drainage can be caused by poor (or no) storm- water system maintenance, or increases in surface runoff due to under-design because of gradual urban development.

For municipal and metropolitan paved and gravel roads, totalling 322 057 km, insufficient data has been provided by the authorities to be able to make an assessment on their condition. Hence this IRC has kept the rating as provided in 2011.

10.6 AIRPORTS

The SOC Airports Company of South Africa (ACSA) resides under the DOT. South Africa's nine major airports which are owned and operated by ACSA include: (i) the three major international airports, namely, Oliver Tambo International, Cape Town International and King Shaka International, and (ii) the other six commercial airports in Kimberley, George, Upington, East London, Port Elizabeth and Bloemfontein.

The IRC grading does not take into account the secondary commercial airports, which include Rand Airport, Wonderboom Air- port, Kruger Mpumalanga Airport, Pietermaritzburg Airport, Richards Bay Airport and Lanseria Airport. These secondary commercial airports are either owned and operated by the private sector (e.g. Lanseria, Rand Air- port, Kruger Mpumalanga) or by provincial governments (e.g. Mthatha) or municipal governments (e.g Richards Bay, Pietermaritzburg).

There are also many smaller airports.

The three major international airports account for nearly 90% of the 39 million annual ACSA passenger movements. OR Tambo International had the highest number of passengers with 52.9% (20 million peo- ple), followed by Cape Town International at 26.5% (10 million) and Durban at 10.6% (4 million people). From years 2014 to 2016, the number of departing passengers increased by 11.5%, and aircraft landings increased by 8.8% (261 000 to 284 000).

ACSA is responsible for the property as a whole at all nine airports, in particular the runways, terminals and some of the hangars and technical areas. ACSA is not responsible for the navigational aids and air traffic control, which are the responsibility of the Air Traffic and Navigation Services (ATNS). ACSA invested more than R17 billion in capital infrastructure in the years preceding the 2010 FIFA World Cup. The total asset value16 of all ACSA infrastructure exceeds R54 billion.

ACSA's success in operating and maintaining its air- ports is attributed to its strong financial state and its management, as well as the incentives of mandatory requirements for safety and reliability, coupled with regular and stringent inspections by regulatory authorities. ACSA budgets for infrastructure management are close to optimum. In addition it has secured ad- equate technical staff resources at all levels who are competent to manage and safeguard the sustainability of its infrastructure. This has resulted in award-winning airport infrastructure.

The quality of airport infrastructure is driven more by local and international regulations than any other infrastructure sector. The most economical way to retain the value and extend the design lifespan of the infra- structure is by carrying out regular maintenance and by the optimisation of replacement periods. ACSA pays close attention to the condition of its runways and aprons. The sophisticated pavement management system is kept up to date with weekly visual inspections, record-keeping on all works undertaken and annual assessments on the remaining useful life of the infrastructure. Instrument landing systems, runway approach lights and runway ground lights are the highest priority and are maintained in such a way as to ensure statutory safety and reliability compliance with the International Civil Aviation Organisation (ICAO) requirements. All ACSA airports have standby generators with enough capacity to meet the power needs of these high-priority elements. The next priority level includes runways, baggage handling systems, fuel hydrant lines, security, emergency lighting within terminals and all "people movers" such as lifts, escalators, loading bridges, shuttles, etc.

Regular inspections from regulating authorities, such as the Civil Aviation Authority of South Africa (CAASA), have assisted in keeping the quality of the infrastructure on par with international standards. The CAASA inspects all infrastructure, including runway markings, lighting, electricity supply, fire engines, runway structures and surfaces. They also scrutinise airport officials' qualifications and training standards.

One size does not fit all in respect of the different components of infrastructure. For example, runways: ACSA uses the number of movements as a base for calculating when maintenance is required. Once the appropriate number of movements for the runway design has been determined, the number of years between runway rehabilitation cycles can be established. The rehabilitation is undertaken at short-term (5-year) cycles and long-term (10-year) cycles. The data system captures all visual condition reports, and all maintenance and repair works; it further captures information on use and is able to analyse this, comparing wear and tear (from the visual condition reports) with use, and employing past records of maintenance and repair to make predictions of useful life, there- by enabling recommendations on interventions to be made.

10.7 COMMERCIAL PORTS

The commercial ports are owned by Transnet (since 1989 a SOC, wholly owned by the South African government as represented by the Ministry of Public Enterprises) through its business units (divisions) – the Transnet National Ports Authority (TNPA), Transnet Port Terminals (TPT) and South African Port Operations (SAPO). The TNPA is responsible for the ports and their infrastructure, including berths, port buildings, tug and pilot services, navigable areas (therefore including services such as dredging) and aids to navigation. TPT is responsible for

equipment such as straddle carriers, cranes and conveyor belts, and terminals (such as grain elevators) and their equipment. SAPO is responsible for vessel traffic and nautical services.

There are nine ports in the TNPA stable: seven major commercial ports – Saldanha Bay, Cape Town (Table Bay), Port Elizabeth, Ngqura (Coega), East London, Durban, Richards Bay – and two minor ports – Port Nolloth and Mossel Bay. The various ports cover a range of activities, some focusing on bulk commodities (iron ore export and petroleum import), servicing off- shore oil industry, and single-cargo handling with col- lection facilities of different commodities, while others specialise in handling petroleum, dry bulk and mixed- use cargoes.

The financial state of Transnet has been highly material to the state of its infrastructure and that of its business units. Since Transnet's return to profitability a dozen years ago, there has been significantly greater emphasis in the TNPA and SAPO (and indeed in all other Transnet business units) on infrastructure, both on capital investment to grow the business, and on repair and replacement of existing infrastructure. Even though much of the infrastructure, including port infra- structure, has been ageing, it is generally maintained in an operationally serviceable condition.

Regular condition monitoring of all infrastructure in- forms the work of the maintenance staff. This information is used to identify faults which need to be repaired, and to schedule planned maintenance interventions (the information is also utilised for audit and long-term planning). The seven port engineers are obliged to inspect their infrastructure annually, and report to the TNPA, which has laid down a maintenance policy. Each port puts together its own maintenance programme, unique to its environment, within the guidelines set out in the policy. SAPO has similar measures in place for its infrastructure.

The condition of the commercial ports infrastructure (defined, for present purposes, to comprise breakwaters, quay walls, terminal areas, lighting and navigation systems) can be said to be in an acceptable condition for port operations in all the ports. A wide variety of structural systems have been used for the working structures, the quays and jetties and the dry docks. Except for some steel sheet piling and, in the earliest portions of Cape Town harbour, some dressed stone- work, all these structures are of concrete construction,

mostly reinforced concrete. In general, the awareness of and good practice in the challenges of corrosion of reinforced concrete construction, despite, in the case of the older structures, the limitations of the under- standing of the problem, has resulted in very durable structures. Doubtless, in the case of the older structures, incipient degradation is accumulating, but in general they still have significant operational life span left.

As much as the demand has increased in most of these ports, both the fixed and movable infrastructure still perform well in meeting the safety and operational standards.

The breakwaters at the entrances to all these ports are exposed to wave attack from storms. The design of these "rubble mound" breakwaters allows for a small percentage accumulating damage to the armour layer to the breakwaters. Repair and refurbishment intervention will usually be needed at intervals that vary from five to twenty years. It would appear from the breakwater inspections carried out periodically that such maintenance interventions are again becoming necessary at most of the breakwaters

Roads and services within the port jurisdictions ap- pear to be of reasonable condition.

In general Cape Town and Saldanha Bay, the ports on the west coast, are relatively free of littoral drift of sediment, and dredging is limited to routine maintenance. On the east coast there is a strong littoral drift, and hence the harbour entrances to the ports of Ngquru (Coega), East London, Durban and Richards Bay are designed with large sediment traps on the updrift side. Extensive dredging is needed to bypass this sediment flow that would otherwise block these entrances. The dredging programme keeps the harbour entrances clear and usable.

The ports, particularly Cape Town, Port Elizabeth and Durban, have facilities for drydocking of large ships. With this capacity, ship repair, properly supported and husbanded, could be a major industry and economic sector. However, on the TNPA books, the dry docks run at a loss. This has led to the facilities being run- down in both maintenance and manning.

In the older ports – Cape Town, Port Elizabeth, East London and Durban – there is very little vacant land or water left for development. In the newer ports – Saldanha Bay, Ngqura and Richards Bay – there is still plenty of land or water available for development. This availability will lend itself to meet the 30-year demand forecasts as envisaged by Transnet for some of the ports; others may become congested and hinder logistical flows. Generally the terminals are operating close to their optimal capacity. To meet the anticipated forecast demands, further investments in capital and maintenance will be required.

Apart from its duties with respect to shipping – e.g. inspecting ships for seaworthiness – the South African Maritime Safety Authority (SAMSA) exercises certain regulatory functions over infrastructure at the harbours. These infrastructure responsibilities relate to navigation aids such as beacons and telecommunications – these and others are governed by international agreements.

10.8 FISHING HARBOURS

Fishing harbours featured as a sub-sector in the 2011 IRC. Due to lack of data, it was not possible to update this report in 2017, and hence the sub-sector is not graded. The following brief note must suffice:

Deterioration of the proclaimed fishing harbours began with the winding up of the competently-staffed Technical Department of the Fisheries Development Corporation around 1991. Management of these harbours was then transferred to the Fisheries Branch of the Department of Agriculture, Water and Forestry, which proved to be not up to the task. For the last 15 years responsibility for the infrastructure component has been with the Department of Public Works (DPW).

In recent years at least one provincial government and a municipality or two have proposed that they take over the administration of those small harbours that fall within their jurisdiction, but it is doubtful that any of them has more capacity than the DPW. The issue

comes back to the shortfall in overall coastal engineering capacity to manage the coastline and its infrastructure.

10.9 RAIL

South Africa's rail environment can be divided into two components – the freight rail network and the passenger rail networks.

Four main railway transportation bodies, namely Transnet, the Passenger Rail Agency of South Africa (PRASA), Gautrain Rapid Rail Link (Gautrain) and the Railway Safety Regulator (RSR), safeguard the rail sec- tor in South Africa. The Gautrain, a new sub-sector to the IRC, is a mass rapid transit rail passenger line, which commenced operations in 2010 under a public-private partnership (PPP) framework.

There are three types of rail gauges (distance between the rails) in South Africa, with the majority being Cape gauge (92.7% of the total track owned by Transnet, i.e. 30 400 km of track, as opposed to the length of route) and PRASA (2 228 km); followed by narrow gauge (7.0% of isolated lines on the branch network); and international standard gauge (0.3% of the total track for the Gautrain passenger line).

Transnet, a SOC reporting to the Department of Public Enterprises (DPE), operating through its Transnet Freight Rail (TFR) division, is responsible for the management, maintenance and operations of the nation- al freight rail network. TFR has the responsibility for an estimated 21 000 km route (12 800 km of core network, including 1 500 km of heavy-haul line, and 7 278 km of branch lines).

Transnet has allocated R201 billion over the period 2012/2013 to 2018/19 to increase rail carrying capacity and cargo volumes by refurbishment of existing infrastructure, namely rail, signalling, depots, locomotives and rolling stock, acquisition of new locomotives and rolling stock, and upgrading of other rail infrastructure

This large spend is an indication of a backlog in rail renewal and upgrading, and is needed to align with the anticipated 30-year demand forecasts for ports.

The increase in funding allocation for maintenance over the past five years (2011–2015) has seen in- creased volumes in freight rail – export coal up by 23% (from 62.2 million tonnes to 76.3 million tonnes), export iron ore up by 29% (from 46.2 million tonnes to 59.7 million tonnes) and general freight business (GFB) up 23%.

The condition of the coal, iron ore and manganese systems is acceptable, and the infrastructure appears to be functionally adequate, with the exception of poor electrical, signalling, perway or telecoms conditions on specific sections of route. Two areas of concern are the track-over-bridge structures on the Sishen–Saldanha line, and the inability to accommodate future traffic growth or increased axle loading resulting in high con- gestion and low performance on the Hotazel–Kimber- ley and Kimberley–De Aar lines. A further challenge is on the operational bottleneck between Kimberley and De Aar due to the single line.

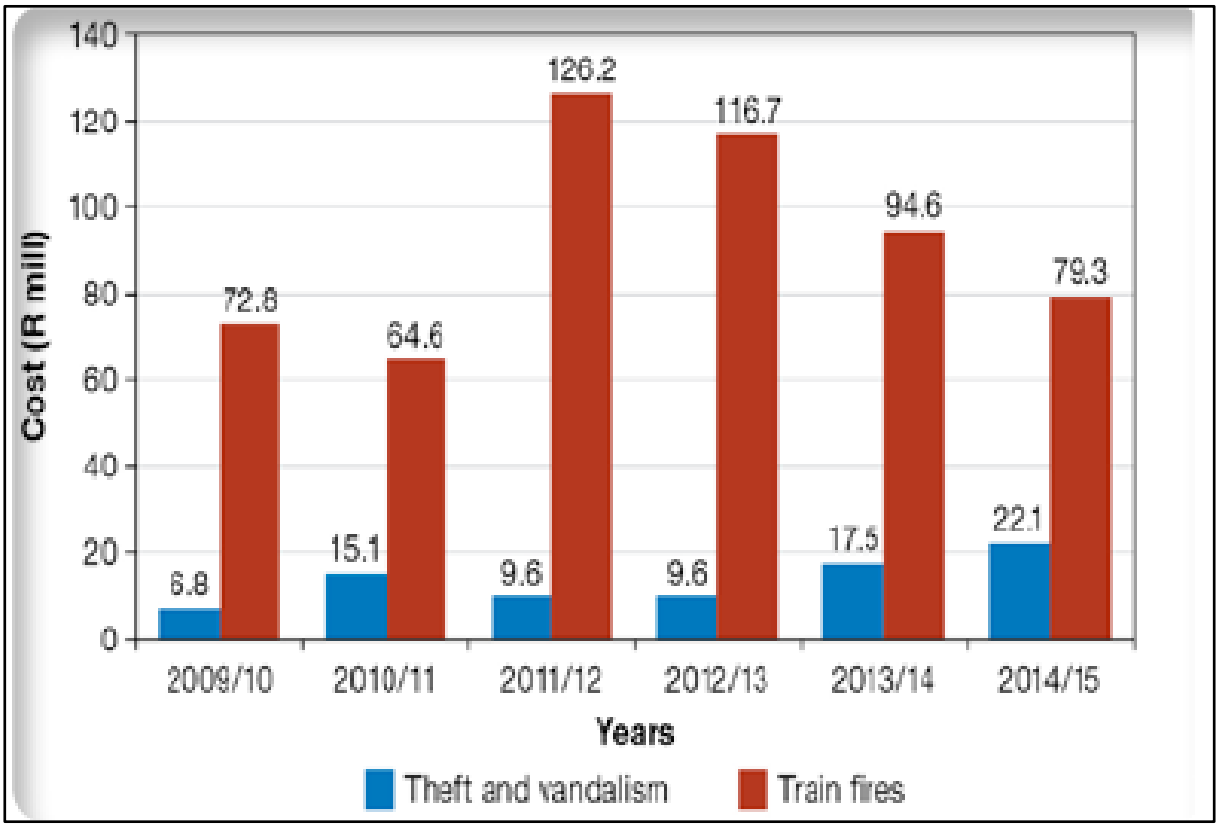

Figure 10-4: Damage to rail infrastructure

Branch lines (comprising 7 278 km with only 3 928 km operational) have been prone to theft, vandalism and insufficient or no maintenance, resulting in a poor to very poor condition, with several lines not being operational. The rest of the TFR network ap- pears to be in an adequate to poor condition.

PRASA provides commuter rail services in metropolitan areas, and long-distance (inter-city) rail and bus services within and to and from the borders of South Africa. PRASA rail operations are through Metrorail (400 million passengers per annum), Main Line Passenger Services, Shosholoza Meyl and Premier Class, with PRASA Corporate Real Estate Solutions (PRASA CRES) and PRASA Tech providing maintenance and upgrading of buildings, stations, depots, staging yards and reliable overhauled rolling stock. Due to a reduction in subsidies, the

condition of existing locomotives, and late arrivals caused by line shutdowns and derailments, patronage of the Mainline Passenger Services has declined by 57% (from 1 538 000 passengers in2010/11 to 660 000 in 2015/16).

PRASA has embarked upon a R123 billion rolling stock acquisition programme over the next 20 years. This includes the establishment of a local manufacturing facility, and a spares and maintenance agreement has been entered into for the next 18 years, indicating the seriousness of ensuring continuous and proper maintenance. Of the first R5 billion to be spent, R0.9 billion (2016/17) will be used for the upgrading of rail infrastructure, such as signalling. Outdated and inadequate equipment is causing operational problems, with the signalling and building structures now in a critical condition.

With this planned expenditure staged over a period of years, it will still take some time to eradicate the serious backlog and observe significant improvements in service delivery based on the new and upgraded infrastructure. Temporary speed restrictions have been imposed in an attempt to prevent derailments and damage to the rail infrastructure. These speed restrictions have negatively affected service delivery levels, particularly the 'on-time' performance of trains. Operational performance was 80.5%, but this was negatively affected by challenges with train set availability, signal failure and security-related incidents, particularly in the Western Cape and KwaZulu-Natal. 'Mean time between failures' has increased, with an increase in derailment incidences by 68% (between 2012/13 and 2013/14).

Derailments and train fires peaked in 2010/11 and 2012/13 respectively, with a steady increase in collisions from 2011 to 2015, which is an indication of the condition of infrastructure and its poor operability. Increases in theft and vandalism have cost PRASA many millions over the years (see Figure 7). Train fires, particularly, lead to less availability of train sets at peak hours, causing more delays to trains and inconvenience to commuters.

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The 80 km Gautrain rapid rail network, not reported on in earlier IRCs, was constructed and is operated and maintained by the Bombela Concession Company (BCC) under a public-private partnership. The Gautrain Management Agency (GMA), a Gauteng provincial entity, is tasked with the management, coordination and oversight of the Gautrain. At the end of the 19½-year concession period the rail asset will reside fully with the Gauteng Provincial Government.

The Gautrain started operation in 2010 and to date has completed about 80 million passenger trips. With a 99.6% availability rate (the norm is 94%) and 98.7% punctuality of its trains (the norm is 98.5%), the GMA has seen a growing ridership and demand for extension of the system. The BCC has strong incentives to keep the Gautrain at optimal service levels through adequate operating and maintenance procedures.

10.10 ELECTRICITY

10.10.1 ELECTRICITY GENERATION AND BULK TRANSMISSION

The Department of Energy (DOE) has the legislative mandate, together with the Department of Public Enterprises (DPE), of ensuring energy security, oversight into the operations and running of the Electricity Sup- ply Commission (Eskom – a SOC), and safeguarding access and regulation to the energy sector.

A sustainable sector comprises three elements: (i) economic growth, (ii) environmental sustainability and (iii) energy security.

Eskom's electricity supply activities include generation, transmission and distribution. Eskom generates ap- proximately 95% of the electricity used in South Africa and 45% of the electricity used in Africa. Eskom is also the system operator of the interconnected power system, and it manages the supply and demand of electricity. This includes selling electricity abroad, buying electricity from independent power producers (IPPs), managing customer programmes to reduce consumption, as well as demand-response programmes, such as the energy efficiency initiatives and the 5PM–9PM demand-reduction campaigns.

The electricity generation mix continues to be dominated by coal technology (86%), with nuclear technology at 6% and gas and hydro technology providing 4%.The DOE hopes to reduce the reliance on coal to 46%, and increase the role of renewable energy to 21% and nuclear energy to 13%, with both gas and hydro generation increasing to 11%.To realise the targets set out in this vision, government would need to interact more with IPPs to increase South Africa's clean energy and veer off the "dirty energy pathway". It is estimated that Kusile will contribute 36.8 million tonnes of equivalent greenhouse gas emissions, increasing South

Africa's energy sector emissions by 12.8%, and the country's total contribution to climate change by 9.7%.

Eskom dominates the production of electricity, with generation comprising 14 coal-fired power stations (including Kusile and Medupi, which are the largest), nine hydroelectric and pump storage power stations, four gas turbine stations, one wind farm power station and one nuclear power station. Ingula, Medupi and Kusile will provide an additional 10 896 MW with original budget cost of R9 billion, R69 billion and R80 billion respectively. The capital expenditure for Medupi and Kusile is now R193 billion and R213 billion respectively, with Ingula allegedly coming in at R36 billion.

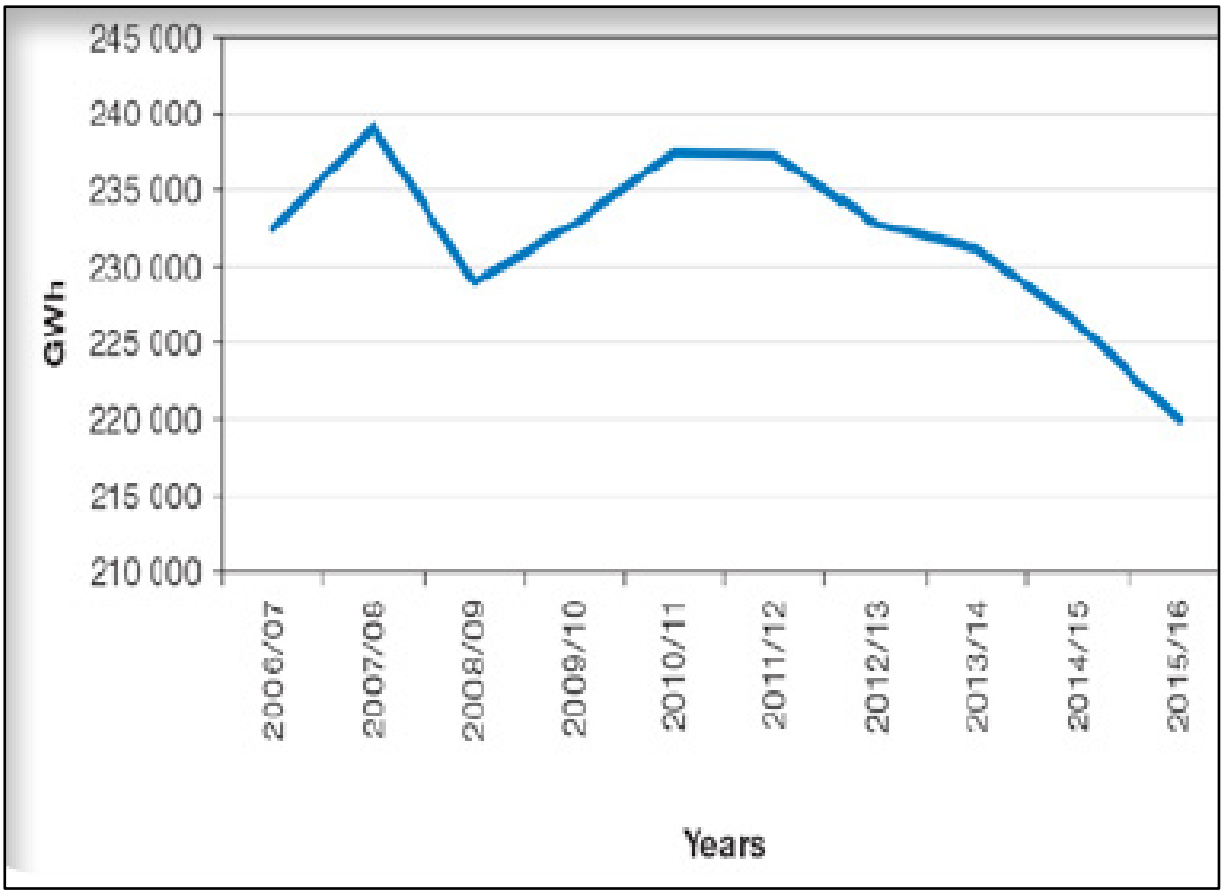


Figure 10-5: Electricity demand on Eskom

The 2006 IRC predicted that under-investment and poor forward planning with regard to electricity generation and distribution infrastructure would result in load-shedding. This became evident from 2007 onwards. Demand for electricity from Eskom started to decline in the same year, attributed to the appeal by Eskom that industry and the mining sector make use of less electricity, the steep increases in electricity tariffs which encouraged users to become more energy-conscious, and the general slowing down of the economy. The recent growth in IPPs has also contributed to the decrease in dependence on Eskom (see Figure 10-5).

Declining demand, together with the additional Eskom capacity coming online, will enable generation units to be taken out of service temporarily so that they can receive planned maintenance and midlife refurbishments. With the recapitalisation in generation capacity and

Eskom's ability to leverage cross-border sales, Eskom can, governance permitting, once again achieve its competitive advantage as an SADC energy supplier. However, this will require diverting further in- vestment in energy generation towards upgrading its transmission network.

Evidence is mounting that renewable energy will be- come the cheapest form of additional generation capacity (displacing fossil fuels), placing a greater focus on the IPPs, which already provide about 5% of the electricity. The role played by the IPPs is an important one and has helped South Africa towards a cleaner energy path. Research by the CSIR suggests that by 2020 a combination of solar, wind and gas energy would be as effective in meeting local baseload demand as a nuclear/coal energy mix.

The average age of Eskom's coal-fired power stations is 36 years, with Komati Power Station being the oldest at 52 years. Due to the costs involved in bringing older power stations to a level of compliance with minimum emission standards (in terms of the NEMA: Air Quality Act (Act 39 of 2004)) by the required 2020 cut-off, some may be decommissioned, the prime candidates being the Hendrina, Camden, Grootvlei and Komati power stations.

Breakdowns of Eskom generation capacity were increasingly reported on in the press from about the end of 2010. Eskom was slow to advance plausible reasons for this, but it became increasingly apparent that Eskom had departed from its programme of planned maintenance. The problem was compounded by the outages – because of the consequent loss of generation capacity, infrastructure was often kept in service, even though its time for scheduled maintenance had arrived, further exacerbating the backlog in maintenance, and leading directly to breakdowns.

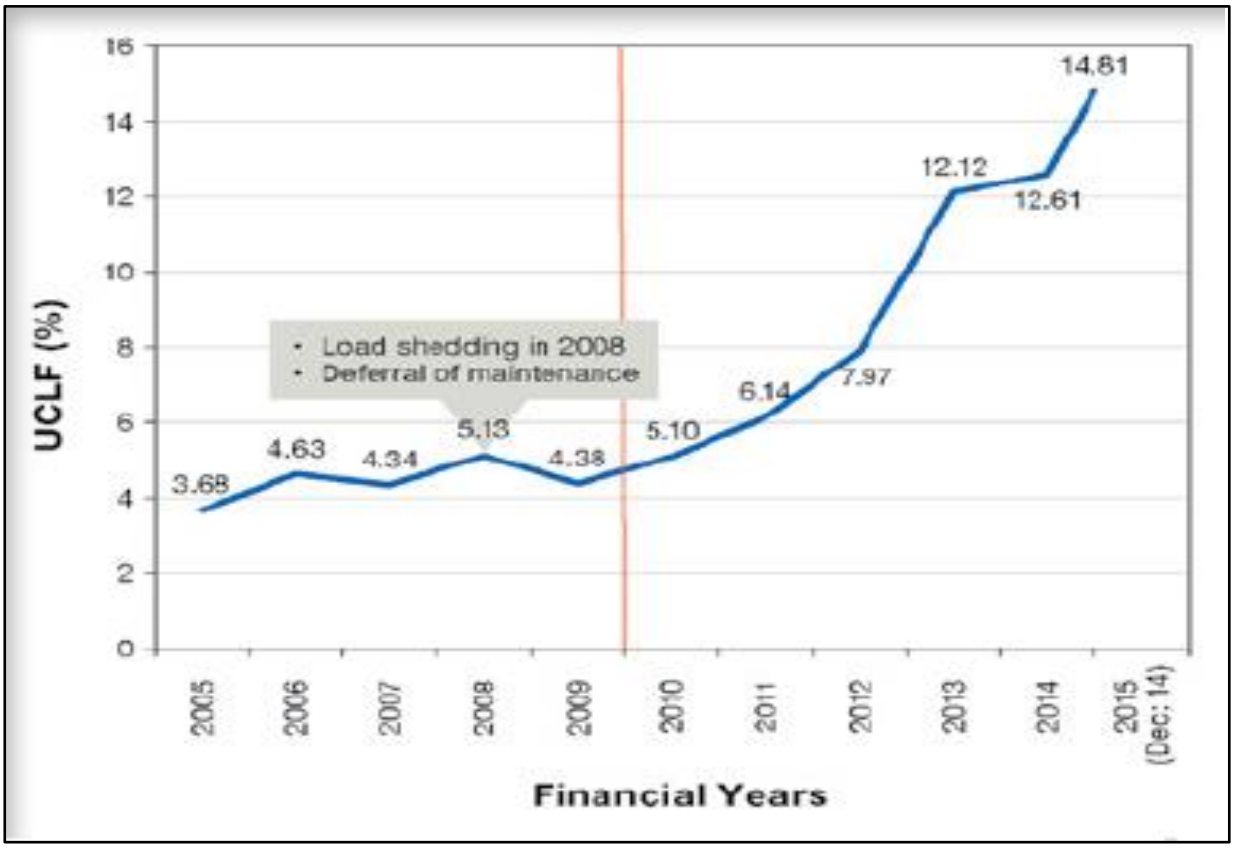


Figure 10-6: Unplanned capacity loss factor

However, the extent of this neglect of maintenance was only revealed by Eskom from 2014. Early in 2015, the then Eskom CEO for the first time revealed the full scope – and consequences for generation capacity of this neglect. The following extracts from his media presentation on 15 January 2015 refer:

“Eskom has an elaborate maintenance regime that should maintain the health of our generation fleet Our philosophy of keeping the lights on at all costs superseded the maintenance philosophy and has put us into a very difficult position – Keeping the lights on program has avoided load shedding in the last seven years against all the odds, managing an extremely low operating margin – There is a severe maintenance backlog – Increasingly leading to unplanned outages (load losses). Some of our running plants have partial load losses, because parts are worn out, and we do not have a time window to replace/fix. Keep the lights on philosophy has created a culture where proactive maintenance is less important.

10.10.2 ELECTRICITY LOCAL DISTRIBUTION

Electricity consumption in South Africa sees the bulk of the energy (60%) consumed by industries (manufacturing, mining, etc). Residential consumption is at 20%, commerce is at 15%, transport is at 2% and agriculture is at 3%.The lowest proportions of residential household connections are in KwaZulu-Natal and the Eastern Cape, due to their rural nature.

The electricity distribution network experiences significant challenges, as a result of factors such as under- investment in asset maintenance, an under-performing industry and a shortage of skills. As noted above, local distribution is by Eskom in certain areas, and by some of the municipalities within their jurisdiction. These municipalities buy the electricity from Eskom and sell it to consumers at a premium. Generally the maintenance by Eskom of its distribution network is good, but the maintenance – and hence the condition – of the municipal network varies greatly from municipality to municipality. Unfortunately there is no consolidated up-to-date municipal information – for example no statistics of the maintenance backlogs. However, it is understood that networks in many municipalities are in a poor condition

Household electrification, especially rural electrification, remains a problem. In 2014 only 86% of houses had access to electricity for lighting purposes. Many of these houses were unmetered, or were the homes of those eligible for free basic electricity. With the DOE’s electrification targets sitting at 97% by 2025, the development and formalisation of informal settlements is a priority. The idea of increasing the number of IPPs, especially for peri-urban and rural areas, and introducing distributed power generation and microgrids, needs revisiting.

10.11 HEALTH CARE

hospitals and clinics The public sector “health estate” is the responsibility of the Department of Health (DOH), together with the Department of Public Works (DPW), provincial health departments and, in some instances, municipalities.

There are over 6 000 healthcare facilities in South Africa, the vast majority (estimated at 3 885) being publicly owned and operated. There are 347 hospitals and 3 538 clinics, community health centres and com- munity day centres. The CSIR estimates that the 2017 replacement value of public sector health buildings is in excess of R180 billion. Nearly seven in every ten households make use of public health facilities. The infrastructure is geographically dispersed, with 65% categorised as non-urban – for example, the two provinces with the largest number of hospitals are Eastern Cape and KwaZulu-Natal. The public facilities differ in age by 150

years – the oldest being the Somerset Hospital (established in 1864) and the latest the Nelson Mandela Children's Hospital (opened in 2016).

Arrangements for budgeting and implementation of maintenance vary across provinces. In assessing life cycle costing for health facilities, it is important to differentiate between the movable and immovable assets. For example, medical equipment tends to have a short life cycle, with replacement on a five to ten-year cycle, with this lifespan growing shorter due to technology obsolescence and growing software sophistication. Chronic underspending is evident, resulting in a reactionary spend on maintenance, rather than prevention. A large backlog of maintenance has developed, contributing to increased service delivery failure. The Health Facility Revitalisation Grant – which funds a wide range of health infrastructure projects – was reduced by R200 million in 2016/17 and R365 million over the 2016 MTEF period, due to underspending. National Treasury has committed to invest R19.8 billion in health infrastructure over the 2017/18 to 2019/20 MTEF period.

Apartheid policies resulted in a legacy of inadequate and inequitable access, but despite the 23 years of democracy since then, there is still poor health infrastructure in the rural areas, with pockets of improvement under the Ideal Clinics Realisation and Maintenance Programme (primarily in the National Health Insurance (NHI) priority districts). Many urban hospitals – especially central or tertiary facilities – are entering into further decay and dilapidation. A baseline audit conducted by the DOH (2011/12) indicated that 80% of clinics were not fit for purpose, with weakness- es in infrastructure, staffing, availability of medicine,

cleanliness, security and waiting times. After an intervention in 2014 to get clinics to "ideal" status by March 2019, the DOH reported in June 2016 that a turn- around was evident, based upon eight work-streams through a systems approach. However, this appears only to be at the clinics and community health centres, whereas maintenance has been neglected at district, regional, tertiary and central hospitals.

The 2016 Auditor General's report observed a sustained and significant building deterioration at some health facilities in all provinces over a five-year period. AGSA (Auditor General South Africa) identified the following as the root causes: lack of skilled staff, poor financial management, inadequate supply chain management processes, lack of sufficient and capable project managers and poor coordination amongst different stakeholders. Coupled with this was

the lack of con- sequences for contractors, implementing agents and provincial departments that performed poorly. Due to this, AGSA has stated that in the next audit it will be giving special attention to planning for maintenance and the quality of implementation.

Whilst international research suggests a link between health facility design and management, and health ser- vice delivery, there is very little South African evidence of the impact of facility condition on health outcomes. This is mostly attributable to a scarcity of comparable information, and a lack of proper ongoing monitoring and evaluation, healthcare infrastructure information systems and/or coordinated data collection and sharing. Nonetheless, it is widely understood that poorly maintained facilities do not only impede health service delivery, but also increase the level of risk to patients, staff and service costs, besides reducing the service life of equipment and facilities. The inadequate facilities make it challenging for health care professionals to carry out their work, and incentivise them to relocate from rural areas, despite this being where their services are most needed.

Public health sector infrastructure is highly variable. The best maintained examples are comparable with private sector and international facilities, whilst the worst maintained are condemnable, uninhabitable and not fit for service. There is a dire need to shift from a pure maintenance regime to life cycle approaches with a view to delivering better value for money.

In South Africa, where there is a high burden of dis- ease and immune-suppressed patients and staff, there is a direct link between design, operation and maintenance, and infection control. For example, the risk of transmission of airborne diseases, such as tuberculosis, is high, especially due to poorly maintained heating, ventilation and air conditioning systems. A shortage of skilled and experienced staff, and lack of supervision present risks and bring the public health service into disrepute. For example, insufficient bulk water supply

led to the closure of a Mpumalanga hospital, failure to purchase fuel for back-up generators led to the death of a number of ICU patients at Letaba hospitals, and failure to clean plumbing equipment led to nosocomial infection at the Chris Hani Baragwanath Hospital, resulting in a number of deaths.

10.12 EDUCATION

10.12.1 PUBLIC ORDINARY SCHOOLS

Basic education, including primary and secondary schooling, is the responsibility of the Department of Basic Education (DBE). There is a great deal of variation across and within provinces in terms of access to education and the condition of schools. The focus for schooling infrastructure has been on addressing backlogs, particularly those preventing learners from accessing schools and those endangering their health and safety, e.g. replacing schools built from inappropriate materials such as asbestos.

In 2016 there were 23 577 public ordinary schools, compared to approximately 24 460 schools reported in the 2011 IRC. The decrease is due to programmes such as the Rationalisation Programme, which closes schools with enrolments of under 135 learners (considered the minimum number of learners for effective utilisation of physical and human resources). Most of these schools were in the Eastern Cape, Mpumalanga and the Free State. Gauteng and the Western Cape were the only provinces to have increased the number of public schools.

Damage, theft and vandalism to public schooling infra- structure have evolved as key themes to the infrastructure assessment of public schools. A recent example is the damage to 28 schools in Vuwani, Limpopo, in 2016, with a repair cost of around R720 million. The protests kept learners away from school for several weeks, and the loss of critical infrastructure resulted in the quality of education being compromised. Criminal- ity, such as destruction during service delivery protests or theft of electricity equipment (which the North- ern Cape provincial education department cited as a reason for slow electrification of schools), threatens schooling infrastructure. Yet, even well-intentioned efforts may have adverse infrastructure consequences if paired with misinformation, e.g. civil activism around schools that may demand flush toilets rather than VIPs – where the latter are realistic to provide and maintain, given water resources, and are adequately safe for learner health. In this case there is perhaps need for greater communication across stakeholders in the education environment.

The DBE has made a lot of progress in building new schools since the 2011 IRC. Programmes such as the Accelerated School Infrastructure Development Initiative (ASIDI) have reduced the numbers of schools built out of inappropriate materials, and increased provision of water, electricity and sanitation. However, this focus on new schools has deprioritised maintenance. As a result, the reliability of infrastructure has decreased sharply due to a lack of maintenance programmes, skilled staff managing the public school infrastructure, and a diversion of maintenance funds. The maintenance of water and sanitation facilities, particularly, at many schools, leaves much to be desired. Although the DBE claims that less than 1% of schools are without water and toilets, in some provinces these facilities at the majority of rural schools are out of order for much of the time. More than 10% of schools have unreliable electricity infrastructure, 20% of schools were found to have unreliable water supply, and 30% of schools have neglected the maintenance of toilets and toilet systems. In provinces such as the Eastern Cape, North West, Limpopo and KwaZulu-Natal, the increase in schools provided with water and electricity is exceed- ed by the decrease in reliability of these services since 2013.

Bad sanitation facilities impact especially on female learners – no more so than at the time of menstruation, when privacy, frustrated by inadequate toilets, is denied. The 2011 IRC highlighted that female learners miss school during menstruation because of in- adequate sanitation. A closely related issue, namely the unavailability and unaffordability of sanitary pads, has since received considerable media and public attention, resulting in multiple efforts to donate sanitary pads, and a notable commitment by KwaZulu- Natal authorities to provide sanitary pads for learners. Unfortunately, the issue of inadequate sanitation facilities (including handwashing) remains a problem, speaking to the urgent need for further improvements in schooling infrastructure, one of the measures need- ed to help address South Africa's crisis in basic education outcomes.

These problems require urgent attention. If existing infrastructure is allowed to become completely non-functional, it will require replacement at much higher cost than allocated for maintenance. Planning seems to have improved across most provinces, but technical and planning capacity is still insufficient in places like Mpumalanga. Maintenance budgets are of- ten too low and should be ring-fenced. An additional problem is that valuation of school infrastructure is not based on consistent practices across provinces, which complicates estimation of maintenance budgets.

School infrastructure also includes the provision of se- cure fencing, libraries, classrooms, laboratories, sports facilities, computer facilities and internet access. There has been little progress in addressing these lower- priority backlogs – in fact, access to sports facilities has worsened, 86.2% of schools are without laboratories, 77% have no libraries, 42% have no sports facilities and 67.5% have no computer facilities. Only 19.7% of schools have access to the internet.

10.12.2 PUBLIC HIGHER EDUCATION

The public higher education sector and all its infra- structure is the responsibility of the Department of Higher Education and Training (DHET) and the DPW. The sector, not featured in previous IRCs, consists of 4 048 educational institutions, which include public and private universities, TVET colleges, adult education centres, SETAs (Sector Education and Training Authorities) and formal post-school institutions such as prison schools.

As with schools, the quality and quantity of higher education infrastructure vary significantly around the country, particularly on a rural/urban divide. And, as with schools, the quality and quantity of higher edu- cation infrastructure will affect learning outcomes and graduation rates.

There are 26 public universities and 50 public TVET colleges, with more than 1.6 million students utilis- ing the infrastructure at the various campuses and/ or learning online. The sector has experienced rapid growth in a short space of time, as universities in particular have been instructed to accept and graduate as many students as possible. This has put great strain on infrastructure, staff and other resources. The biggest challenge at the moment is developing new and larger infrastructure that is capable of handling the student influx, whilst ensuring the existing infrastructure (some of which is decades old) is maintained and upgraded. A further challenge is providing residential facilities for students, as the demand far exceeds the current sup- ply, even when private residential accommodation is taken into account.

Two additional universities have been constructed in Mpumalanga (University of Mpumalanga) and the Northern Cape (Sol Plaatje University) to provide additional capacity. Sixteen new or renovated TVET college campuses are also currently in advanced stag- es of development or construction. The location of these new campuses is evidence of increased efforts by government to improve access to education, as the geographical locations are not all concentrated in city centres, but spread across remote areas of South Africa, including the Waterberg Campus in Thabazimbi, Limpopo, the Nkandla Campus in KwaZulu-Natal, and the Ingwe Campus in Nqgunqgushe Lusikisiki, Eastern Cape.

The most recent (2014) reliable collation of infrastructure condition information for public universities stated that, of the 5 206 buildings, 13% were in a poor condition and 54% were in a good condition. Compared to the previous collation in 2011, this indicated an overall improvement in condition. However, most of this improvement was a result of new buildings rather than better maintenance practices. Most universities have insufficient institutional capacity for planning and maintaining infrastructure, which forces them to rely on external consultants. This can, and sometimes does, lead to ad hoc interventions, weak systems and limited institutional memory, to the detriment of long-term planning.

The latest reliable collation of infrastructure condition information for TVETs was in 2005.18 However, the limited assessment which the CSIR engaged in for the purposes of the current IRC showed that the condition of their infrastructure has deteriorated over the past ten years. Budget allocations for maintenance have been well below the levels required for acceptable levels of maintenance. Limited maintenance seems to have occurred across the 50 campuses. The problems are exacerbated at rural TVETs, where it is very difficult to find and retain skilled capacity for maintenance of infrastructure.

Significant attention was brought to the higher education sector during the Fees Must Fall campaign, which saw damage to higher education infrastructure costing more than R600 million in 2016. The damage was worst at the North-West University Mafikeng Cam- pus, where numerous buildings were burnt, as well as at the University of Johannesburg and the University of the Witwatersrand, but there was also widespread damage at several TVET campuses. Without doubt, this damage has impacted on the quality of higher education and training, and the funding needed to repair the damage will undoubtedly impact on maintenance budgets.

11 ZIMBABWE

The country urgently requires a national infrastructure development plan and score card system for infrastructure in the country. The current status for sanitation and solid waste in the country is below standard for acceptable containment, collection, conveyance and treatment when comparing to regional and international standards.

As the engineering fraternity, the tripartite comprising the ECZ, and its two constituent bodies: the Zimbabwe Institution of Engineers (ZIE) and the Zimbabwe Association of Consulting Engineers (ZACE), have a duty of care and responsibility to the nation to ensure that the national infrastructure score card becomes a reality.

The issue of the national infrastructure score card (ISC) was discussed at the Joint ECZ/ZACE/ZIE Executive Committees tripartite meeting on 26 November 2018 and again on 01 March 2019. The ISC is a system that critiques and rates the infrastructure development plans for adequacy and suitability for the purpose.

Most developed countries employ an infrastructure score card or rating system, to advise and assist government MDA's (Ministries, Departments and Agencies) in the prioritisation of investments in infrastructure. The American Society of Civil Engineers (ASCE) and the South African Institution of Civil Engineers (SAICE) use a similar Infrastructure Rating Card (IRC) system covering all sectors.

It is proposed to adopt a similar system in Zimbabwe, but this can only be achieved after the preparation of the base infrastructure development plans in conjunction with the relevant MDA's and local authorities in charge of the respective infrastructure: roads and bridges, railways; water and sewerage, reservoirs and dams; the utility service providers for electricity; and telecommunications; etc.

11.1 SANITATION

In Zimbabwe, the coverage with acceptable sanitation (flush toilets) in the urban areas varies from 85 to 98%. A total of 42,996 households do not have access to adequate sanitation in urban areas on the basis of census figures. Most sanitation infrastructure built pre-independence and in the 80s and 90s, has since been left to deteriorate and collapse to such an extent that sewage in some areas flows directly into open watercourses. The general trend is that operation and maintenance is underfinanced resulting in a gradual decay of sanitation systems to the point where a very large investment is required for rehabilitation.

The condition of the wastewater treatment plants when last visited by the Pollution Control Branch of the Department of Water Resources shows that only 20% could be regarded as good with almost 45% in the poor category. There is no fixed schedule of examination of sites by any institution. From 1971 to 1991, there were a total of 107 original exemption permits that were granted to allow temporary discharge of inadequately treated waste (sewage) and in many cases the exemption was renewed, even for periods of over 10 years, without the pollution being controlled.

There is generally a lack of information at municipal level on the system capacity and actual flows for sewerage systems. A large number of the smaller systems throughout Zimbabwe, mainly ponds, have no flow measuring devices. The majority of sewerage reticulation systems are facing problems due to overloading in the high-density areas Where additional treatment works have been built or extensions made to existing ones, often the reticulation system has not been upgraded as the increased flows are coming from infilling or densification, subletting and increased occupancy rates.

The majority of sewerage reticulation systems are facing problems due to overloading in the high-density areas. Where additional treatment works have been built or extensions made to existing ones, often the reticulation system has not been upgraded as the increased flows are coming from infilling or densification, subletting and increased occupancy rates. Common problems, and in cases such as Marondera they are serious, are leakage and sewer blockages.

Commonly, sand is used for the cleaning of utensils and accumulates in the reticulation system and thereby damaging the sewer pipe infrastructure. Additional problems are caused by solid objects which enter the system via squat pans or opened, vandalised manhole covers. Such objects block, or restrict the flow through pipes. These problems are exacerbated by the fact that levels of sewage now being conveyed in the sewer networks are far higher than that for which the sewer was designed. This was found in virtually all systems examined and is unfortunately the current status of sanitation in the country.

It is clear from the data available that a large proportion of sewerage systems in urban centres are not being well maintained, effluent being released is not of an acceptable standard and significant pollution of surface and groundwater is occurring

11.1.1 CURRENT RATING FOR SANITATION

Based on the desk top study and background of the current sanitation status in the country, the scoring rating for sanitation has been categorised as D-, according to the sanitation cluster group committee members. This grading is classified as poor and at risk. See below table for grading matrix;

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition, committed investment, regulatory regime and planning processes.	Minor rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Major rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Critical rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Infrastructure is totally inadequate for present and future use

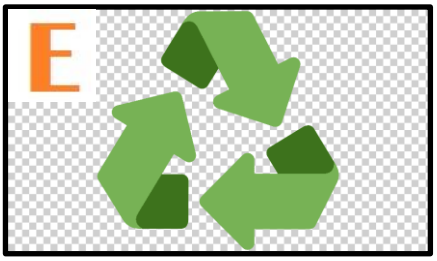
Data on quality of sewage treatment indicate that the majority of local authorities' sewage quality tests are failing. This is an indication that local authorities are not treating their sewage to the expected standards. On average, 27% of the sewage tests undertaken have passed leaving a gap of 73% of sewage not being subjected to quality tests. There is very little investment in sewage treatment infrastructure and laboratories.

There is very little investment into sewage infrastructure. Whatever amounts are being collected are far inadequate and cannot be reinvested. The low standards of quality of sewage treatment can be directly linked to failing sewage infrastructure.

11.2 SOLID WASTE

Based on the desk top study and background of the current solid waste status in the country, the scoring rating for solid waste has been categorised as E, according to the sanitation cluster group committee members. This grading is classified as inadequate. See below table for grading matrix;

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition, committed investment, regulatory regime and planning processes.	Minor rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Major rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Critical rehabilitation required in one or more of the infrastructure condition, committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	Infrastructure is totally inadequate for present and future use



This classification is based on the analysis of reports and research conducted in the solid waste sector in Zimbabwe. The 2019 SLB report compiled by the Urban Councils Association

of Zimbabwe gives a benchmark of the current status of solid waste within the country. The SLB report has scored the provision of solid waste very low.

Recycling or recovery of solid waste remains very low in all local authorities averaging 8.1%. The majority of local authorities have reported no recycling activities at all. With respect to scientific disposal of waste, statistics show that this is still a huge challenge across all local authorities with only Bulawayo and Kadoma have reported as compliant to this indicator. The other 31 local authorities are still dumping their waste in dumpsites. On average, only 3.5% of the waste generated is being disposed of in the recommended manner. The major hindrance is the cost of constructing the landfill and associated equipment which is beyond the reach of most local authorities. There is need for external investment in this area to improve on solid waste disposal, management and reuse.

In Zimbabwe, refuse is largely uncollected and piles of decaying waste are allowed to rot in streets and open vacant areas. Solid waste disposal is a major concern in the country and this requires to be addressed. Solid waste infrastructure is generally poor and there remain very few engineered landfill sites in the country.

With this in mind, the Government of Zimbabwe embarked on a new exercise a few years ago, to assess and grade the status of infrastructure in the country at urban council level. This exercise is termed the Service Level Benchmarking (SLB) program. The SLB process has continued gaining momentum and interest from stakeholders. There has been a huge demand for the SLB data from government, development partners, civil society and many other external stakeholders. The usage of the SLB data has increasingly been adopted for budgeting processes in councils, for informing decision making in government, for investment decision making by investors and opportunities for partnerships from development partners. The government commitment to the usage of SLB data has been expanded from policy decision making on local governance and service delivery to the requirement that SLB data inform the budgeting process of councils. As a result, Performance Improvement Plans (PIPs) which are a product of the peer review process now form the basis of council budgets.

The process of coming up with PIPs has helped councils to plan realistically and in the medium to long term. Similarly, local authorities now have readily available well costed PIPs which can be used to source development funds and partnerships in service delivery interventions. Availability of accurate data raises investor confidence. Although SLB is an expensive exercise to undertake, especially so under the harsh economic conditions prevailing in the country, local

authorities have remained resolute and committed to the process because the benefits outweigh the costs.

The government of Zimbabwe has also thrown its weight behind implementation of SLB through its unwavering support to the process throughout the various stages of implementation. SLB presents opportunities for partnerships, collaborations and investment for sustainable development.

It is with this in mind, that the Zimbabwe Institution of Engineers aim to use the data produced in the SLB exercise to gain an insight into the condition of existing sanitation and solid waste infrastructure in the country through the urban council's exercise. Such data provides a head start and an advantage that the ZIE can take in the assessment and scoring of infrastructure within the country.

Table 11-1: Wastewater management

Summary of SLB indicators - Wastewater Management (2018)

	Coverage of Functional Toilets		Coverage of sewerage network		Efficiency in collection of sewage		Adequacy of capacity for treatment of Sewage		Quality of Sewage treatment		Extent of recycling or re-use of sewage		Efficiency in satisfactory response/ reaction to customer complaints		Efficiency in cost recovery of in sewage management		Efficiency in Collection of sewage charges		Maintenance Coverage Ratio	
Benchmarks	100%		66%		95%		100%		100%		10%		80%		150%		75%		15%	
Town/City	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS
Beitbridge	86	1	76	1	69	1	71	4	0	4	3	4	92	2	89	1	58	4	0	4
Bindura	77	2	76	1	215	4	204	4	100	1	0	4	29	3	127	1	36	1	12	4
Bulawayo	93	1	90	3	38	1	155	1	0	1	17	1	21	1	178	2	73	2	3	4
Chegutu	99	4	90	3	89	4	298	4	78	1	74	1	92	2	319	2	28	2	30	2
Chinhoyi	100	1	70	1	167	4	129	3	8	4	0	4	91	2	433	1	25	1	5	1
Chipinge	76	4	76	1	92	3	194	2	63	4	0	4	83	2	146	2	33	0	32	4
Chiredzi	92	1	92	1	167	4	205	3	0	4	0	4	23	3	531	4	25	2	3	4
Chirundu	94	1	1	1	86	2	107	2	0	4	0	4	100	1	122	3	30	4	0	4
Chitungwiza	100	4	70	3	81	2	191	2	13	4	99	1	62	2	225	2	20	1	14	4
Epworth	15	4	1	3	125	4	0	4	100	4	0	4	100	3	0	4	0	4	0	4
Gokwe	11	1	8	1	36	3	872	3	0	4	0	4	100	3	55	2	0	0	0	0
Gwanda	94	1	83	3	32	3	86	2	0	2	1	4	82	2	99	2	81	4	1	4
Gweru	99	1	91	1	159	1	109	1	0	1	0	4	87	1	138	2	24	1	1	4
Harare	70	1	60	1	171	2	183	2	2	1	41	4	60	2	133	1	32	4	0	4
Hwange LB	94	1	88	3	5	4	0	4	0	4	0	4	100	3	296	2	50	2	21	4
Kadoma	91	1	84	1	251	2	272	3	0	4	0	4	90	2	541	4	28	1	6	4
Kariba	100	1	86	1	62	2	89	2	0	2	0	4	100	2	81	1	40	1	6	4
Karoi	100	4	37	3	24	3	259	3	50	4	0	4	10	2	201	4	32	4	4	4
Kwekwe	100	1	94	1	77	3	89	2	88	1	0	4	98	2	117	1	33	2	3	4
Lupane	82	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marondera	89	4	87	3	0	4	0	4	0	1	0	1	54	2	426	2	78	2	0	2
Masvingo	97	1	88	1	103	2	191	2	93	1	37	1	90	3	142	2	28	2	11	4
Mutare	89	4	94	3	59	3	107	3	0	2	0	4	96	1	470	2	62	1	3	1
Mvurwi	100	1	84	1	83	4	0	4	0	0	0	4	100	1	340	0	14	0	3	4
Norton	85	4	56	3	100	4	435	3	0	4	0	4	100	2	100	2	31	2	4	4
Plumtree	97	2	69	3	104	4	143	4	75	4	60	2	100	4	105	2	38	4	20	1
Redcliff	100	1	99	1	0	4	410	4	0	4	0	4	79	3	130	4	46	4	11	4
Rusape	47	1	52	1	143	1	172	1	33	1	0	4	100	1	129	1	25	1	1	1
Ruwa	100	1	43	1	261	1	207	1	0	4	0	4	4	1	228	2	33	2	13	1
Shurugwi	84	1	54	1	42	4	210	1	0	4	0	4	100	1	115	2	20	1	2	1
Victoria Falls	96	1	88	1	66	1	66	1	0	1	0	4	89	2	309	1	74	1	16	1
Zvishavane	100	1	97	1	47	4	69	3	100	4	0	4	86	2	191	2	9	2	8	4
Average	86,1	1,8	68,3	1,7	92,4	2,8	172,6	2,6	25,1	2,6	10,4	3,3	75,5	2,0	203,6	2,0	34,6	1,9	7,3	3,0
Std Deviation	22,3	1,3	29,8	1,0	69,7	1,3	167,7	1,2	38,4	1,5	24,6	1,3	32,4	0,9	146,8	1,1	21,6	1,4	8,6	1,5

Table 11-2: Solid waste management

Summary of SLB indicators - Solid Waste Management (2018)

	Coverage of SWM services through door to door collection of waste		Efficiency of collection of municipal solid waste		Extent of recovery of municipal solid waste collected		Extent of scientific disposal of waste at landfill sites		Efficiency in satisfactory response/ reaction to customer complaints		Efficiency of cost recovery in SWM services		Efficiency in collection of SWM charges		Maintenance Coverage ratio		Coverage of receptacles	
Benchmarks	100%		100%		20%		100%		80%		100%		75%		20%		100%	
Town/City	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS	Value in %	RS
Beitbridge	96	3	90	4	8	3	0	2	0	2	298	1	74	4	3	4	59	3
Bindura	82	1	49	2	2	3	0	4	25	2	150	1	18	1	9	1	51	1
Bulawayo	97	1	93	3	9	2	100	2	75	1	133	1	57	1	1	1	63	4
Chegutu	99	3	95	2	2	4	0	4	100	2	208	2	35	2	37	4	59	4
Chinhoyi	92	3	69	3	2	1	0	4	86	2	318	2	20	1	2	1	92	1
Chipinge	28	2	92	3	0	3	0	3	50	2	89	4	43	1	14	4	4	4
Chiredzi	91	3	95	2	2	3	0	4	75	2	556	2	26	2	3	4	39	3
Chirundu	100	3	55	2	0	4	0	4	100	2	129	2	36	4	2	4	9	4
Chitungwiza	91	3	51	3	14	4	0	4	56	2	512	2	20	2	6	4	9	4
Epworth	35	3	30	4	0	4	0	4	100	4	1	4	0	4	11	4	34	4
Gokwe	25	3	83	3	7	1	0	4	100	2	184	2	62	1	6	1	13	1
Gwanda	80	3	72	4	0	4	0	0	20	1	151	2	56	0	0	4	80	3
Gweru	91	1	57	3	7	3	0	3	56	1	549	2	23	1	6	4	38	1
Harare	71	1	70	3	12	2	11,5	2	82	2	214	1	183	4	10	4	68	4
Hwange LB	85	3	25	4	0	4	0	4	100	3	220	2	22	2	10	4	54	1
Kadoma	91	1	26	2	27	4	0	2	56	2	253	2	15	1	2	4	65	1
Kariba	100	1	26	3	88	4	0	4	100	2	171	1	43	1	10	4	72	1
Karoi	94	3	51	4	8	4	0	4	100	2	235	4	20	2	4	4	94	1
Kwekwe	93	2	92	3	14	3	0	2	28	2	152	1	33	2	38	4	62	1
Lupane	10	3	53	4	0	4	0	4	100	0	12	4	1	4	14	4	45	0
Marondera	57	3	64	2	1	4	0	4	17	2	112	2	33	2	8	4	61	4
Masvingo	98	1	38	4	13	2	0	2	0	3	263	2	51	2	12	4	85	1
Mutare	78	3	84	4	1	2	0	4	25	2	594	2	65	1	1	4	78	4
Mvurwi	100	1	85	2	2	4	0	4	100	1	198	1	16	1	12	4	7	4
Norton	100	4	60	3	12	4	0	3	25	2	595	2	31	2	2	4	39	4
Plumtree	100	3	62	4	9	4	0	4	100	4	163	2	33	4	12	4	70	1
Redcliff	92	4	33	2	1	4	0	4	60	3	295	4	13	4	2	4	17	3
Rusape	100	3	43	4	26	4	0	2	50	1	678	1	44	1	11	1	31	1
Ruwa	76	1	36	2	0	4	0	4	100	1	344	1	15	1	8	1	48	1
Shurugwi	100	1	79	2	0	2	0	4	86	4	518	2	33	1	2	1	100	1
Victoria Falls	100	1	82	3	3	4	0	2	20	3	209	1	56	1	0	1	87	3
Zvishavane	99	3	72	4	0	4	0	4	78	3	188	2	20	2	6	4	91	4
Average	82,8	2,3	62,8	3,0	8,4	3,3	3,5	3,3	64,7	2,1	271,6	2,0	37,4	1,9	8,2	3,3	54,0	2,4
Std Deviation	24,7	1,0	22,9	0,8	16,3	1,0	17,7	1,1	34,4	0,9	179,6	1,0	32,3	1,2	8,9	1,3	28,1	1,5

11.3 ROADS

The Ministry of Transport and Infrastructural Development (MoTID), through the Department of Roads (DoR) is responsible for all the gazetted public roads and bridges countrywide. The Ministry of Transport is the ultimate authority with overall responsibility over all gazetted public roads in the country. The responsibility to provide, manage and maintain the various roads networks is delegated to: the DoR for the State roads; city and town councils as well as local boards for the urban roads; the District Development Fund (DDF) and Rural District Councils (RDC's) for the rural roads.

In Zimbabwe, the World Bank-supported Roads Maintenance Initiative (RMI) initiated in 1994 an institutional study that led to the creation in 1996 of the Road Sector Reform and Development Programme (RSRDP). The reform programme was a stakeholder-driven consultative process that led to the publishing of a Policy Green Paper for the roads sub-sector and the drafting of the Roads Act (chap. 13). The RSRDP resulted in the establishment of the Zimbabwe National Road Administration (ZINARA) in 2000 to administer the Road Fund, as well as the designation as Road Authorities of: the Department of Roads (DoR) for State roads; Urban Councils for urban roads; the Rural District Councils (RDC's) for tertiary rural roads; and subsequently, the District Development Fund (DDF), for the primary and secondary rural roads.

ZINARA manages the Road Fund to which the road user charges (fuel levy, vehicle licence fees, toll gate fees and transit fees, etc.) earmarked for the routine and periodic maintenance

of the roads accrue. ZINARA allocates the funds to the designated road authorities based on requests for funding made by the road authorities.

ZINARA has a technical unit that is designed to conduct technical and financial audits to ensure that the funds allocated and disbursed from the Road Fund are used for the roadworks as stated.

As such, ZINARA plays a *de facto* centralised role of coordinating and superintending in consolidating the rolling 5-year development plans for the State, urban and rural roads networks that are supposed to be submitted by the respective designated road authorities annually, with requests for funding of the year-one priority plans by the Road Fund.

So it is fortuitous that the Zimbabwe National Roads Administration (ZINARA) approached the Zimbabwe Institution of Engineers (ZIE) to assist with the supervision of the roadworks being undertaken under the Emergency Road Rehabilitation Programme. The ERRP was borne out of the realisation by Government that most of the national roads network had deteriorated to beyond maintainable state by routine and periodic maintenance procedures, and the situation now required more drastic interventions like rehabilitation or reconstruction in the first instance.

An assessment of the ERRP in the City of Harare (CoH) identified numerous shortcomings with the programme regarding the procurement process for the construction services, delays in payment of contractors resulting in delays in project implementation and payments for standing time, and a lack of adherence to standard specifications on geometry and provision of requisite drainage systems. The shortcomings and recommendations in the ERRP report for the CoH may be largely extrapolated and applied to the rest of the country.

However, for this to be achieved in a systematic manner, there is need to prepare a report card for the entire national roads network, which report card will enable and facilitate the prioritisation of the roadworks that need to be implemented, taking into account issues like:

- Economic importance, including prioritising of regional trade routes
- Hierarchical Classification of the Road Network
- Policy position on which road condition can still be maintained and which condition is only suited to Reconstruction/Rehabilitation
- Traffic and population densities, prioritising return on investment
- Social responsibility for marginalised populations to access essential amenities like health facilities, schools, markets.
- The prioritisation will need to be done fairly and equitably at a national level.

11.3.1 NATIONAL ROAD CONDITION SURVEY

A National Roads Condition Survey (NRCS) was conducted in 2016-17, entailing a GIS (geographical information system)-based survey of the national roads network under each of the 92 MDA's (Ministries, departments and agencies) that are the designated road authorities, for use in the production of a baseline inventory.

According to the findings of the **National Road Condition Survey (NRCS)**, generally, over the years (particularly over the past 10 years from since around 2009 when ZINARA took over vehicle licencing from local authorities, which fees were previously collected and retained by the local authorities for use in urban road maintenance), road maintenance budgets have been

less than the funds required to adequately maintain the roads, and this led to an accumulation of unsustainable maintenance backlog.

It is now estimated that, of the surfaced network, 50% is in an un-maintainable status and requires rehabilitation or reconstruction before maintenance operations can be undertaken economically. Gravel roads are in a worse situation. More statistics on the state of the roads are presented in the tables below copied from the NRCS report.

The NRCS report states that the majority (87%) of the bituminous surfaced roads are rated to be in fair to poor condition, as analysed in the table below.

Table 11-3: Condition of surfaced roads

VCI (%)						
	Poor	Fair	Good	Very Good		
Province	0 - 30	30 - 55	55 - 80	81-100	No Info	Grand Total
Harare Metro	1,505	1,843	203	7	152	3,711
Manicaland	257	1,230	388		37	1,912
Mash Central	709	394	55		2	1,160
Mash East	180	782	318		90	1,370
Mash West	354	1,194	184	5	91	1,828
Masvingo	264	1,035	236		4	1,539
Mat North	98	1,909	124	0	121	2,252
Mat South	62	843	258		10	1,173
Midlands	1,392	330	41	6	53	1,822
Bulawayo	602	939	54	0	7	1,601
Grand Total	**5,423**	**10,500**	**1,861**	**19**	**567**	**18,369**
Percentage	30%	57%	10%	0%	3%	

Table 11-4: Condition of unsurfaced roads

VCI (%)						
	Poor	Fair	Good	Very Good		
Province	0 - 30	30 - 55	55 - 80	81-100	No Info	Grand Total
Manicaland	6,481	2,518	86		451	9,535
Mash Central	3,364	2,096	25		91	5,575
Mash East	6,154	2,479	75		818	9,525
Mash West	7,530	2,274	33	8.32	427	10,272
Masvingo	7,854	1,638	9		549	10,050
Mat North	3,634	2,296	62		575	6,567
Mat South	8,844	900			216	9,960
Midlands	7,425	978	32		590	9,025
Harare Metropolitan	473	174	14	0.25	145	806
BULAWAYO	425	236	2	0.00	1	664
Grand Total	**52,182**	**15,588**	**337**	**9**	**3,863**	71,979
Percentage	72%	22%	0%	0%	5%	

The GIS-based survey does provide real-time mapping of the roads infrastructure that may incorporate topographic surveys, spatial imagery, satellite imagery and aerial and/or drone

photography, together with GPS (geographical positioning system) coordinates, to produce an inventory of each length of public road by location, extent, size, type, and current condition.

This information now needs to be updated, then analysed and synthesised in to a schedule or bill of quantities, specifying the state and condition of the infrastructure, and the scope of remedial, rehabilitation and upgrading works required, together with the costs thereof.

This will then enable the preparation of the roadworks implementation programmes, presented in development plans of ideally not more than 5 years duration, prioritising the urgent works in year 1 of the plans.

The 5-year development plans will need to be updated annually, involving field inspections to update the inventory, but focusing on the condition to take into account wear and tear as well as damage to the infrastructure.

The 5-year development plans will need to be coordinated and consolidated at national level, to facilitate equitable prioritisation, allocation and disbursements of funds from the Road Fund, to enhance a fair return on investment in supporting economic activities, whilst also ensuring social responsibility by providing access to social amenities like health, education, and market facilities by marginalised societies in rural remote areas with limited road networks.

It is emphasised that the NRCS was completed in 2017, and there have been 4 rain seasons since then, and given the above normal rains received in the 2020-21 rain season, the condition of all the roads would have deteriorated significantly. Also the cross-drainage structures would have been affected, with some bridges having been damaged by the rains, such that the inspection of the structures is also now urgent. Various reports put the estimated budget at USD 30 billion over the next 10 years. The concern will be the ability to generate the requisite funding, and the capacity required to implement the works.

There is need for the updating of the NRCS covering both the roads and the cross-drainage structures (bridges, box and pipe culverts, shelverts, masonry arch culverts, drifts and fiords), and the preparation of 5-year development plans, complete with investment budgets and implementation timelines, for the IRC transportation roads sector panel to review and analyse, so as to be able to critique and make appropriate recommendations.

Based on the 2017 NRCS, and the subsequent four rain seasons, including the above normal rains in the 2020-21 season, it is safely concluded that the IRC rating of the national roads infrastructure is in the worst category of "F", especially for the backstreets in urban areas, and the gravel roads in rural areas, with most of the roads requiring reconstruction.

11.3.2 BRIDGE INSPECTION PROGRAMME

The Ministry of Transport and Infrastructural Development (MoTID), through the Chief Engineer Bridges in the Department of Roads (DoR) is responsible for all structures on all the gazetted public roads, including all the bridges countrywide. The Ministry of Transport is the ultimate authority with overall responsibility over all gazetted public roads in the country. The responsibility to provide, manage and maintain the various roads networks is delegated to: the DoR for the State roads; city and town councils as well as local boards for the urban roads; the District Development Fund (DDF) and Rural District Councils (RDC's) for the rural roads.

The fact of the matter is that all structures on the national roads networks, ranging from bridges, shelverts, box and pipe culverts, causeways, to drifts, all require and should be subjected to at least annual inspections, ideally just before the rains when they are most accessible.

Unfortunately, the inspections have not been done for a long time, due to a lack of appreciation of the importance of the inspections, coupled with the lack of skilled and experienced personnel, and a lack of funding.

Yet there is a well-designed and comprehensive bridge inspection manual in the Department of Roads, which used to guide the conduct of the annual inspections.

There have been numerous reports made to the Ministry of bridges manifesting damage and repairs that require urgent attention for several years, and yet nothing has been done: these bridges include the Jack Quinton Bridge, the two bridges just outside Gwanda on the Bulawayo to Beitbridge Road, amongst others.

Another sad example is the case where the City of Harare commissioned and received a report on the poor state of the flyovers at the Rotten Row interchanges in 2006, and yet no action has been taken 14 years later.

The Director of Roads was reminded about the need for annual bridge inspections at a recent Engineering Council of Zimbabwe (ECZ) Board meeting, and about the urgency of conducting the overdue inspections of all the bridges and structures on the national roads network, as advised in a letter written by the ECZ to the Ministry earlier in the year 2018, and to which the MOTID had responded positively.

It was pointed out that no action has been taken to date, to which the Director said there was no money, but that the DoR would be calling for tenders for a few of the bridges that have been reported to require urgent attention.

The DoR was implored to consider to stop the construction of new roads (like the dualisation of the Bulawayo and Mutare Roads beyond the toll gates at Norton and Melfort respectively) and to use the money for the overdue inspection of all the bridges and structures countrywide before there is a major disaster.

The Director of Roads suggested that perhaps the politicians may not appreciate the importance of the bridge inspections as much as they want to see new roads.

One of the ECZ Board members then lamented the fact that it may need the collapse of a bridge to jolt the government to accept the importance of the inspection of all bridges and the other drainage structures countrywide.

In the letter to the Ministry, the ECZ offered a training programme by experienced consulting engineers for road authorities' personnel to be trained in conducting the inspections, and identifying and effecting of the routine and periodic maintenance works and *ad hoc* repairs.

The consultancy services being offered by the ZIE will include a bridge inspection programme that will incorporate theoretical lectures on the fundamentals of bridge designs, concrete design specifications and deterioration modalities, followed by hands-on inspections of all the structures on every public road.

This information will need to be analysed and synthesised into a schedule or bill of quantities, specifying the state and condition of each structure, and the scope of remedial, rehabilitation and upgrading works required, together with the costs thereof.

This will then enable the preparation of the implementation programmes, presented in development plans of ideally not more than 5 years duration, prioritising the urgent works in year 1 of the plans.

The plans will need to be updated annually, involving field inspections to update the inventory, but focusing on the condition to take into account wear and tear, as well as any damage to the structures.

11.3.3 ZIE INFRASTRUCTURE REPORT CARD TRANSPORTATION SECTOR PANEL

According to the 2017 Zimbabwe National Transportation Master Plan ZNTMP, transportation is a multi-mode sector, covering:

- Roads (with bridges forming a specialist sub-division)
- Rail (lines, rolling stock and stations)
- Air (airports and airfields: runways, taxiways, and the terminal buildings and equipment)
- Water (waterways and docking facilities)
- Pipelines: lines, pumps, terminal facilities.

Each of these modes may require a separate sub-sector panel, in order to do justice to the IRC project.

The ZIE IRC sector panels should be independent of employees of the facility and utility services providers, although the MDA's will be required to prepare the inventories and condition surveys and development plans. So, it will be imperative to get the utmost cooperation from the responsible authority to obtain the sector infrastructure inventory and current conditions.

11.4 WATER

The water sector in Zimbabwe includes the following:

- Urban water supply
- Rural water supply
- Water resources management

The main operating agencies which operate in the cluster are:

- Zimbabwe National Water Authority (ZINWA)
- Urban local authorities
- Rural district councils
- Urban Councils Association Of Zimbabwe(UCAZ)- for coordination of the urban councils and dissemination of information
- Association Of Rural District Councils Of Zimbabwe (ARDCZ)- for coordination of the rural councils and information dissemination
- Ministry Of Local Government And Public Works
- Ministry Of Environment, Water And Climate

The Government of Zimbabwe in partnership with the World Bank took an initiative from 2012 to assess service levels in urban local authorities including water supply. The importance of

improved water supply, sanitation and hygiene has been recognised by their inclusion as specific targets in the framework of SDGs (Loewe and Rippin, 2015). As such Goal Number 6 and its specific targets emphasize the need for universal and equitable access to water, adequate and equitable sanitation, water use efficiency, integrated water resources management and protection and restoration of water resources systems (Loewe and Rippin, 2015). Therefore the infrastructure report card on mapping and assessing the water supply infrastructure underpins sustainability of water resources in light of achieving SDGs. The data and information used on water supply is mainly from the Service level benchmarking exercise of 2018 and the Rural Wash Information Management System (RWIMS) . The review of 2018 was done in 2019 courtesy of the UCAZ (Urban Council Association of Zimbabwe). Measurable and verified data could be obtained from UCAZ, and the lack of physical visits and key informant interviews, and no responses with head of institutions presents limited results of the water cluster.

Also Government of Zimbabwe introduced the Rural Wash Information Management System which tracks the status of water supply for rural communities. It is a mobile to a web base monitoring system under the Rural WASH subsector. Communities provide feedback in real-time on an online portal on the status of WASH infrastructure thereby reducing downtime and causing improvements in provision of services in remote rural areas. The online portal is available for all stakeholders. According to L Dhoba et al, 2017 the system is across all 36 rural districts councils giving opportunities to improve WASH service delivery.

According to UCAZ, (2019) the acute shortage of foreign currency in the country and high inflation has made it difficult for local authorities to plan and budget. At the social front, unemployment reigns supreme, high poverty levels and drought which is attributed to climate change have adversely affected the ability of rate payers to honour their obligations to councils. The high unemployment levels have adversely affected the much-needed revenues for local authorities thus further exacerbating the poor service delivery especially in areas such as water supply and sanitation as water supply. There are 32 urban local authorities.

11.4.1 CURRENT RATING FOR WATER SUPPLY

Based on the desk top study and background of the current evident water supply status in the country, the scoring rating for water supply has been categorised as D^-. This grading is classified as poor and at risk. See below table for grading matrix;

Letter Grade	A	B	C	D	E
Designation	Very good	Good	Adequate	Poor	Inadequate
Weighting Factor	90-100%	80-89%	70-79%	41-69%	40% and below
Interpretation	Infrastructure is fit for present and future use in terms of infrastructure condition,	Minor rehabilitation required in one or more of the infrastructure condition,	Major rehabilitation required in one or more of the infrastructure condition,	Critical rehabilitation required in one or more of the infrastructure condition,	Infrastructure is totally inadequate for present and future use

	committed investment, regulatory regime and planning processes.	committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	committed investment, regulatory regime and planning processes to enable infrastructure to be fit for its present and future use	

11.4.2 WATER SUPPLY INDICATORS FOR URBAN AREAS

Coverage of water supply

The coverage of urban properties with direct water supply declined from 82% to 77.8% for the years 2017 and 2018 respectively. This was due to cleaning up of data and use of reliable methods in data measurement during the service level benchmarking process by UCAZ in 2019. Per capita water supply indicator shows that the majority of local authorities are supplying water above the benchmark of 150lpcd. These figures are a result of the methodical calculation of per capita which is a percentage derived from water produced divided by population served in the council area. The population served figure is derived from the 2012 census report which is extrapolated by the growth rate of the city to give us an estimate of the population of the city in a particular year. However, in the majority of cases this population figure is an underestimation of the total population that consumes water in a city especially when we consider transit populations, high water losses, which is excluded from the calculation. If this population is to be included in the population figures, the per capita will definitely drop to more realistic figures. Average per capita figure for the year 2018 was 197.3lpcd.

Non-revenue water remains a challenge across local authorities. Non-revenue water affects the water available for use by users. According to UCAZ report of 2018 the majority of local authorities reported significantly high figures of non-revenue water above 40% while Chirundu reported 7%, Epworth 17% and Karoi 23%. The highest non-revenue water figures were reported for Chinhoyi (63%), Kadoma (63%), Marondera (65%) and Ruwa (68%). 2018 data on continuity of water supply show that the average water supply is 12hrs as compared to 12.1hrs in 2017. Kwekwe reported 24hrs per day water supply while Bulawayo reported 23hrs. The situation of water supply is dire in Epworth with 1hr, Chitungwiza 3hrs, Karoi 5hrs, Redcliff 4hrs, Ruwa 3hrs, Norton 4hrs and Chegutu 4hrs. Redcliff, Chitungwiza, Ruwa, Epworth and Norton do not have their own water supply. Continuity of water supply is also affected by the fact that some areas are not connected. On water quality monitoring It is encouraging that all urban local authorities are testing their water in all parameters. Where necessary, corrective measures are taken to ensure that water meets the expected standards.

11.4.3 INDICATORS PER URBAN LOCAL AUTHORITY

Property level coverage of direct water supply

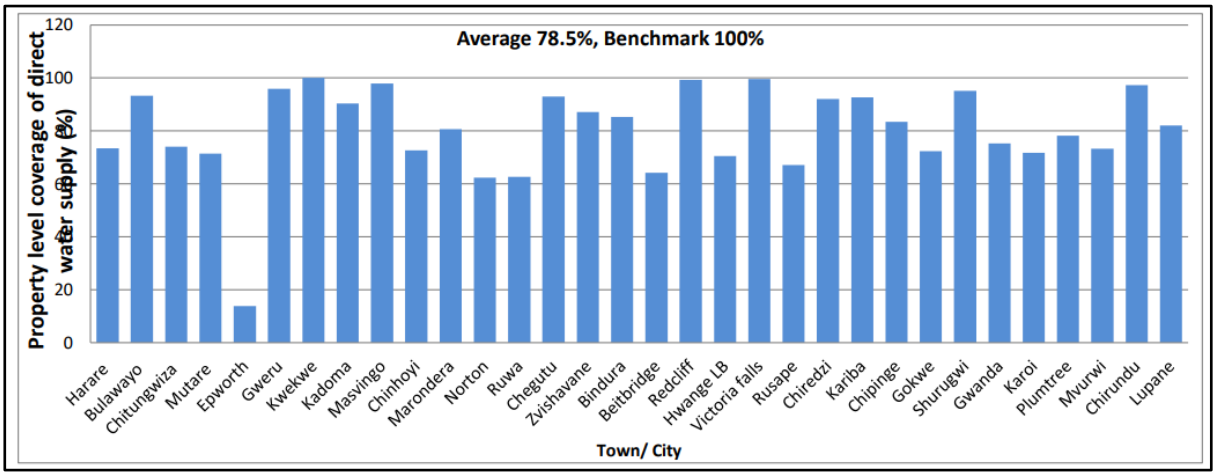


Figure 11-1: Water supply coverage

Results show that Kwekwe and Victoria Falls reported 100% of water supply connections to its properties while 16 others reported above 80% coverage. On the average, property coverage of direct water supply connections increased from 77% in 2017 to 77.8% in 2018. Epworth has the lowest coverage. Furthermore, data on this indicator show that 30 local authorities have above 50% of their properties with direct water supply which is a pleasing development.

Per capita Water Supply

Data on this indicator show that 16 local authorities have a high per capita water supply above the benchmark of 150lpcd while 7 local authorities reported per capita figures below the 150lpcd benchmark. Among the local authorities that reported very high per capita water supply are; Mutare, Kwekwe, Hwange, Victoria Falls, Chiredzi and Kariba. Local authorities that reported very low per capita include Epworth, Chitungwiza, Ruwa, Norton and Lupane. The average per capita for this indicator is reported to be 197.3lpcd which is comparatively very high when juxtaposed to the benchmark of 150lpcd. These figures portray a picture that citizens in most local authorities are receiving adequate water supply and yet in reality the opposite is true. These distortions arise from use of unscientific methods of calculating per capita , overestimation of water production figures and underestimation of population figures

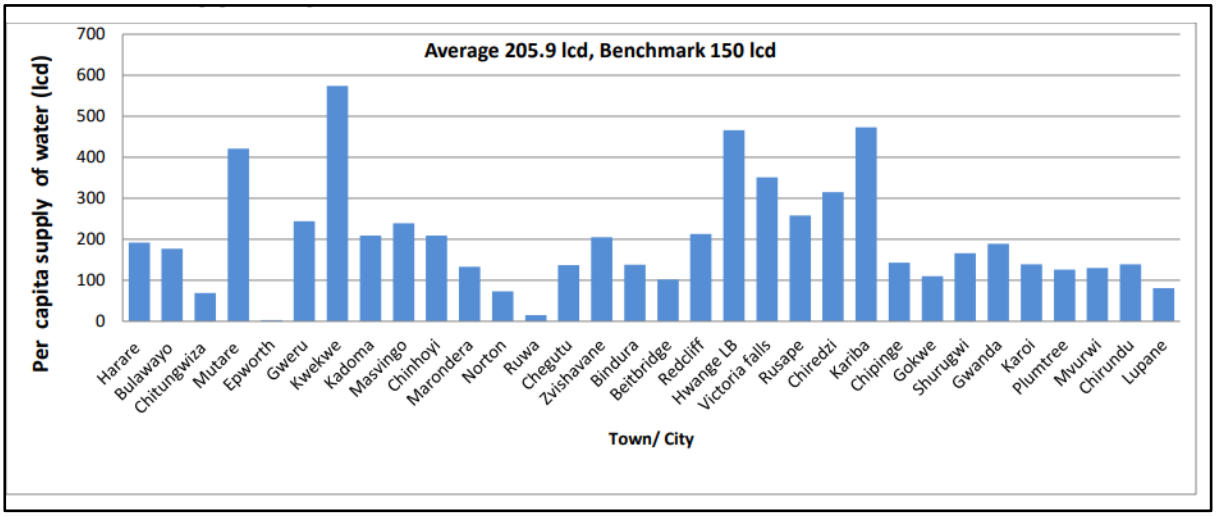


Figure 11-2: Per capita water supply

Continuity of Water Supply

The graph on continuity of water supply show that urban Local water authorities are struggling to supply water 24hrs per day with the exception of Kwekwe. This performance is a clear indication that citizens are not receiving adequate water within the prescribed period of time thus posing possible health hazards including the spread of diarrheal diseases and cholera. As indicated in the graph, 50% of the local authorities are hardly supplying water 8hrs per day. Councils such as Epworth, Chitungwiza, Norton, Ruwa, Chegutu and Redcliff have the lowest hours of water supply averaging 4hrs per day.

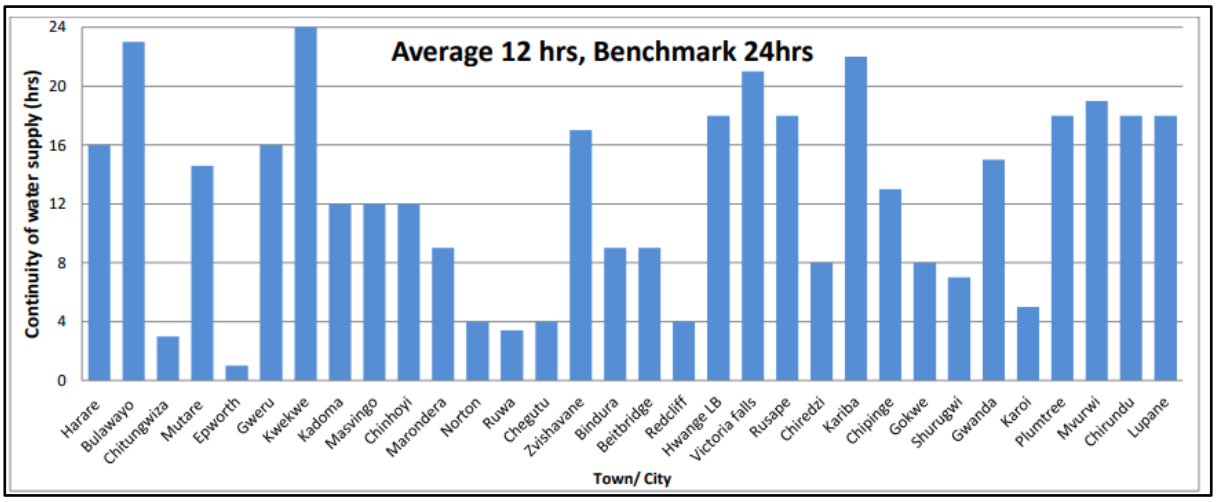


Figure 11-3: Continuity of water supply

Quality of Water Supplied

The graph below shows that the majority of local authorities are treating their water to acceptable standards. On average, 90.6% of the water produced passed its water quality tests which are very encouraging particularly in the light of the sporadic outbreak of diarrhoea and cholera. These quality test results give confidence to stakeholders on the safety of the water being supplied by local authorities.

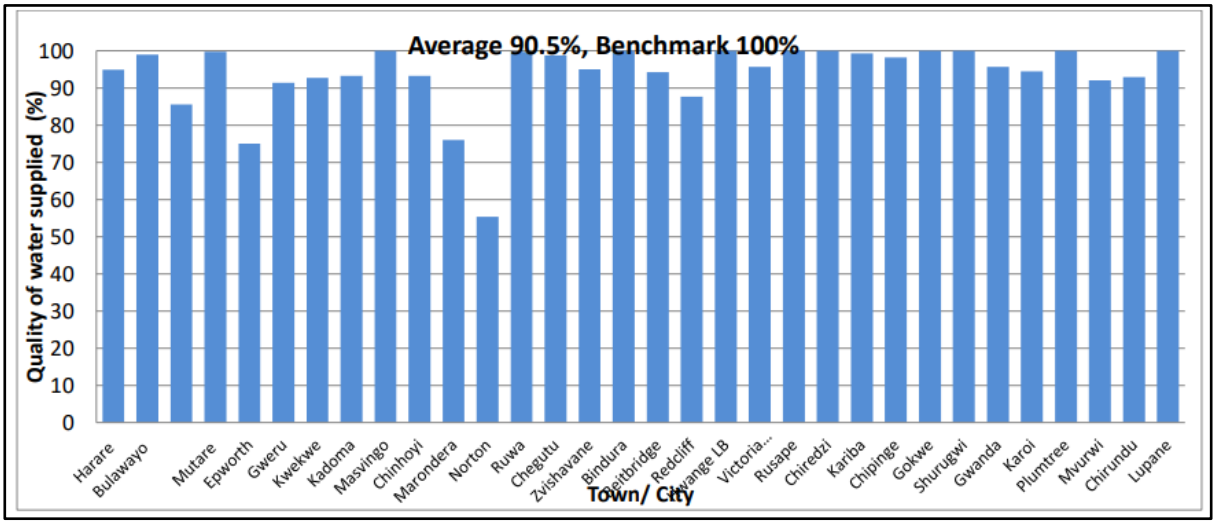


Figure 11-4: Quality o water supplied

Raw water supply

There is inadequate Raw water supply in Harare, Bulawayo, Gweru, Masvingo and Bindura. There is urgent need for finding alternative or new sources of raw water for these towns.

Treatment capacity

Most of the treatment works have never been upgraded and therefore there is need to investment in this area.

11.4.4 LOCAL AUTHORITIES DEPENDENT ON WATER FROM OTHER TOWNS

Redcliff get water from Kwekwe and Ruwa, Epworth, Norton and Chitungwiza get their water from Harare. This creates service delivery problems. It is recommended that new water sources for these local authorities be identified or alternative water supply models be identified and implemented.

Shared Water Management

Gwanda, Beitbridge, Mvurwi, Gokwe, Karoi, Chirundu, Victoria Falls and Lupane share water management with (ZINWA) Zimbabwe National Water Authority .

11.4.5 RURAL WATER SUPPLY

Through the use the Rural Wash Information Management System which tracks the status of water supply for rural communities the current status of rural water supplies as at 31 March 2021 the dashboard for key indicators for water supply showed the following

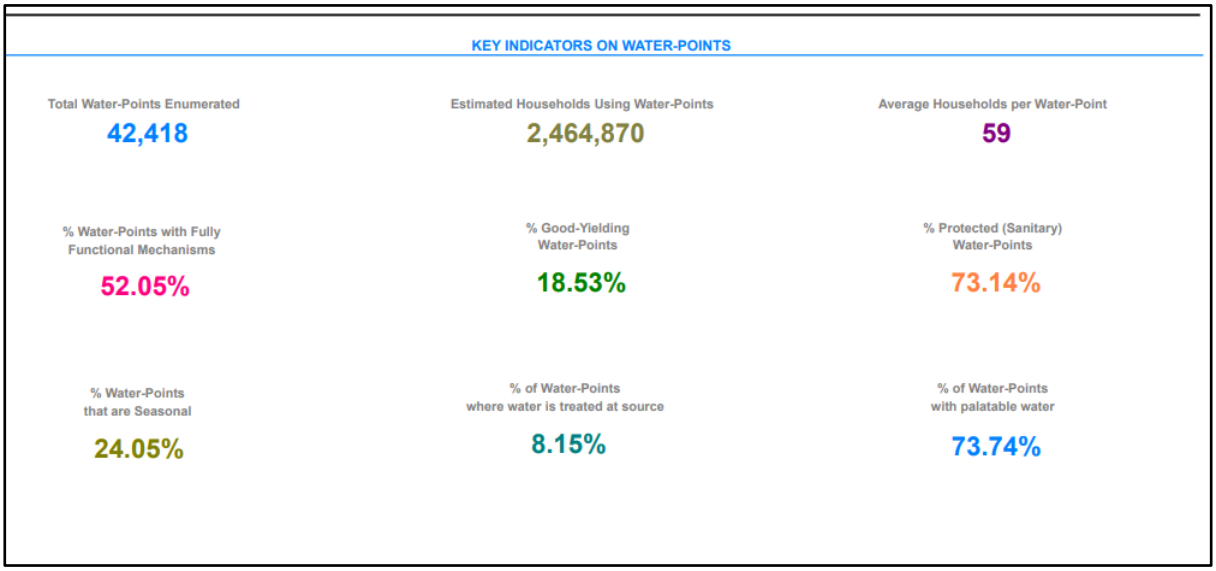


Figure 11-5: Key indicators for water points

Distribution of water points

Water points are classified as artisan wells, borehole, deep well, sand abstraction and spring. Distribution by location is as follows:

SUMMARY OF ENUMERATED WATER-POINTS

	Artisan well	Borehole	Deep Well	Sand Abstraction	Spring	Total
Manicaland	24	5,460	1,508	71	2,128	9,191
Mash. West	7	3,964	371	130	194	4,666
Mashonaland Central	8	3,027	473	91	290	3,889
Masvingo	9	5,309	851	470	923	7,562
Mat. North	13	4,059	835	227	171	5,305
Mat. South	8	3,646	1,878	364	44	5,940
Midlands	31	4,425	697	487	225	5,865
Total	100	29,890	6,613	1,840	3,975	42,418

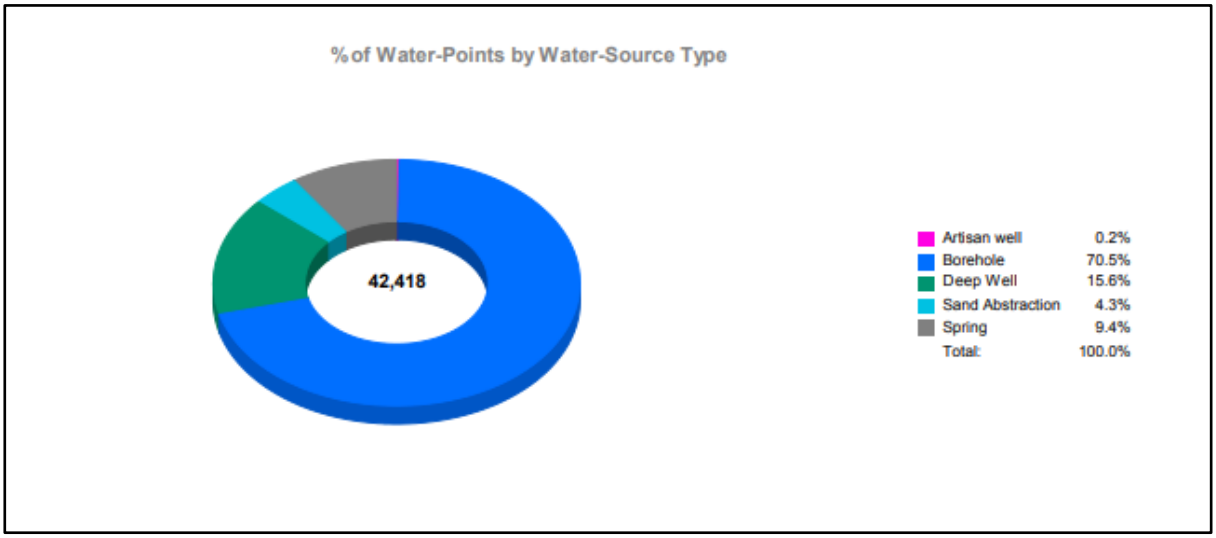


Figure 11-6: Water points by source

Summary of estimated households using water points

The total number of households using the various water points is 2,464,870:

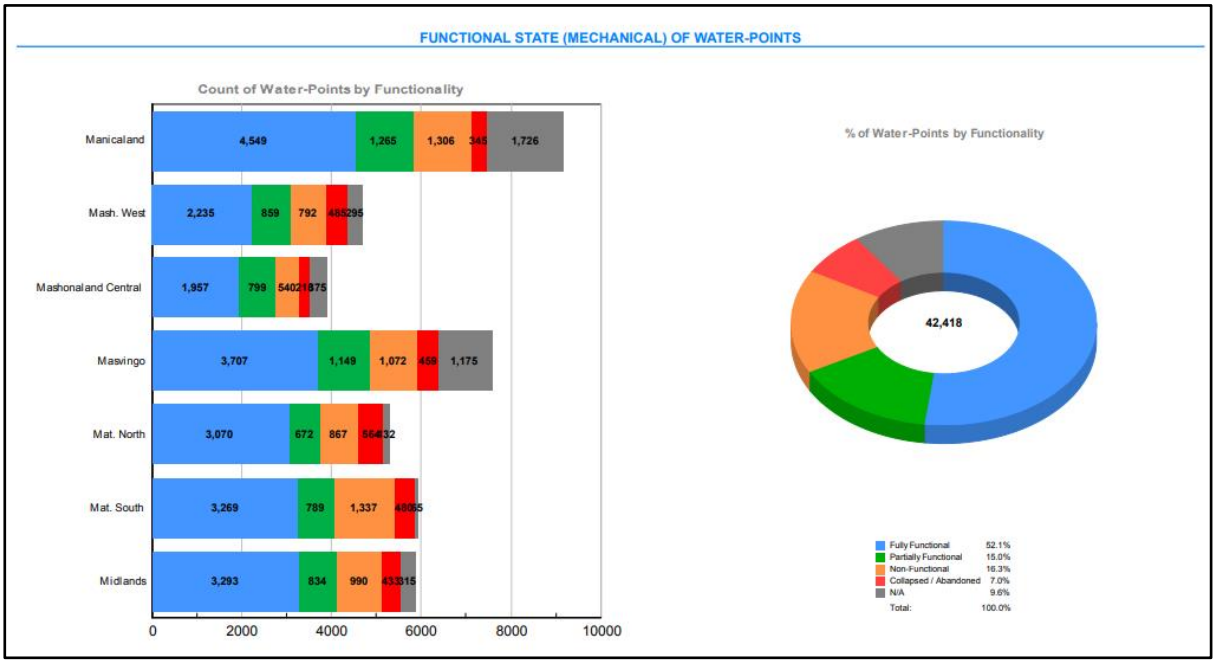
SUMMARY OF ESTIMATED HOUSEHOLDS USING WATER-POINTS

	Artisan well	Borehole	Deep Well	Sand Abstraction	Spring	Total
Manicaland	974	447,722	41,092	2,257	66,297	558,342
Mash. West	138	269,533	14,438	4,641	9,091	297,841
Mashonaland Cen	462	254,438	23,495	7,030	12,802	298,227
Masvingo	212	406,648	44,123	21,923	36,253	509,159
Mat. North	941	175,015	36,125	11,908	9,412	233,401
Mat. South	124	116,889	49,837	8,716	1,358	176,924
Midlands	12,118	298,739	28,089	36,396	15,634	390,976
Total	14,969	1,968,984	237,199	92,871	150,847	2,464,870

%of Households by Water-Source Type

Functional state of water points

52.1% of the water points are functional whilst 24.3% are non-functional:



11.5 ELECTRICITY INFRASTRUCTURE SEGMENT

The energy sector in Zimbabwe is comprised of mainly the electricity sector and the petroleum sectors. This industry is entirely regulated by ZERA to ensure performance and the main subjects of regulation being ZETDC, ZPC, IPPs and Oil Companies. ZERA regulates the industry on behalf of the Ministry of Energy and Power Development (MoEPD) (Government) to ensure the following:

- Sustainable and competitive growth of the sector to ensure energy security and affordability
- Effective market operations and sustained sector investment confidence
- competitive operation of market operatives
- Protect the market from adverse political influence and that the industry has an equitable participation for all parties government owned companies and private entities.

The electricity Infrastructure in Zimbabwe is mainly grid connected to the ZESA system and therefore very much centralised around the grid that operates at a frequency of 50Hz. Power producers are mainly comprised of ZPC and small IPPs. The market has been opened to allow for private investors participation into the sector and to date, successful progression and implementation of major projects has been limited outside the state owned ZPC utility. IPPs have been slowly implementing small projects that are not effective in covering the demand and supply gap with a current total installed capacity of 38MW. Local electricity generation that mainly comes from ZPC and IPPs is not adequate to meet national pick demand pre and post Covid-19 pandemic. The electricity supply gap is there covered by power imports from the SAPP and in some instances load-shedding. The transmission and Distribution Network as well as the electricity retail infrastructure is currently dominated by ZETDC, although it has been opened up to competition with the exception of Grid power system operation services. This report therefore analysis and evaluates the state of national infrastructure in the

generation sector as represented by the dominant ZPC and Transmission and Distribution Network infrastructure as represented by currently the only operational Licensee ZETDC. The current level of market participation of private players will however, be adequately reported. The image below summarises the industry layout.

11.5.1 CRITICAL INDUSTRY STATISTICS

Table 11-5: Key parameters in electricity industry of Zimbabwe and peer countries

Parameters	Zimbabwe	South Africa	Kenya	Zambia	Namibia	India
Access to electricity 2020	40.46%	85.4%	23%	22.1%	47.3%	78.7%
Energy Consumption 2020	0.54 MWh/ capita	4.24 MWh/ capita	0.17 MWh/ capita	0.7 MWh/ capita	1.56 MWh/ capita	0.8 MWh/ capita
National Electricity consumption (GWh)2020	7,292	214,487	7,912	12,303	3,831	1,042,332
Transmission & Distribution Loss (2020)	17.4%(2015) 18.43% (2016)	8.49%	19.4%	15%*	13%**	19.3%
Installed capacity (GW)	2.05	50.46	2.30	2.41	0.51	310

Source: World Bank, IEA, Company Annual Reports

11.5.2 ELECTRICITY SECTOR INDUSTRY VALUE CHAIN

The electricity market in Zimbabwe is completely open throughout the entire value chain to participation of private developers and operators. In such cases the state owned entities, ZETDC and ZPC are treated equally with all their competitors in every way for security of market confidence. There is therefore no discriminative market treatment in favour of the state owned market participants. The value chain is unpacked below:

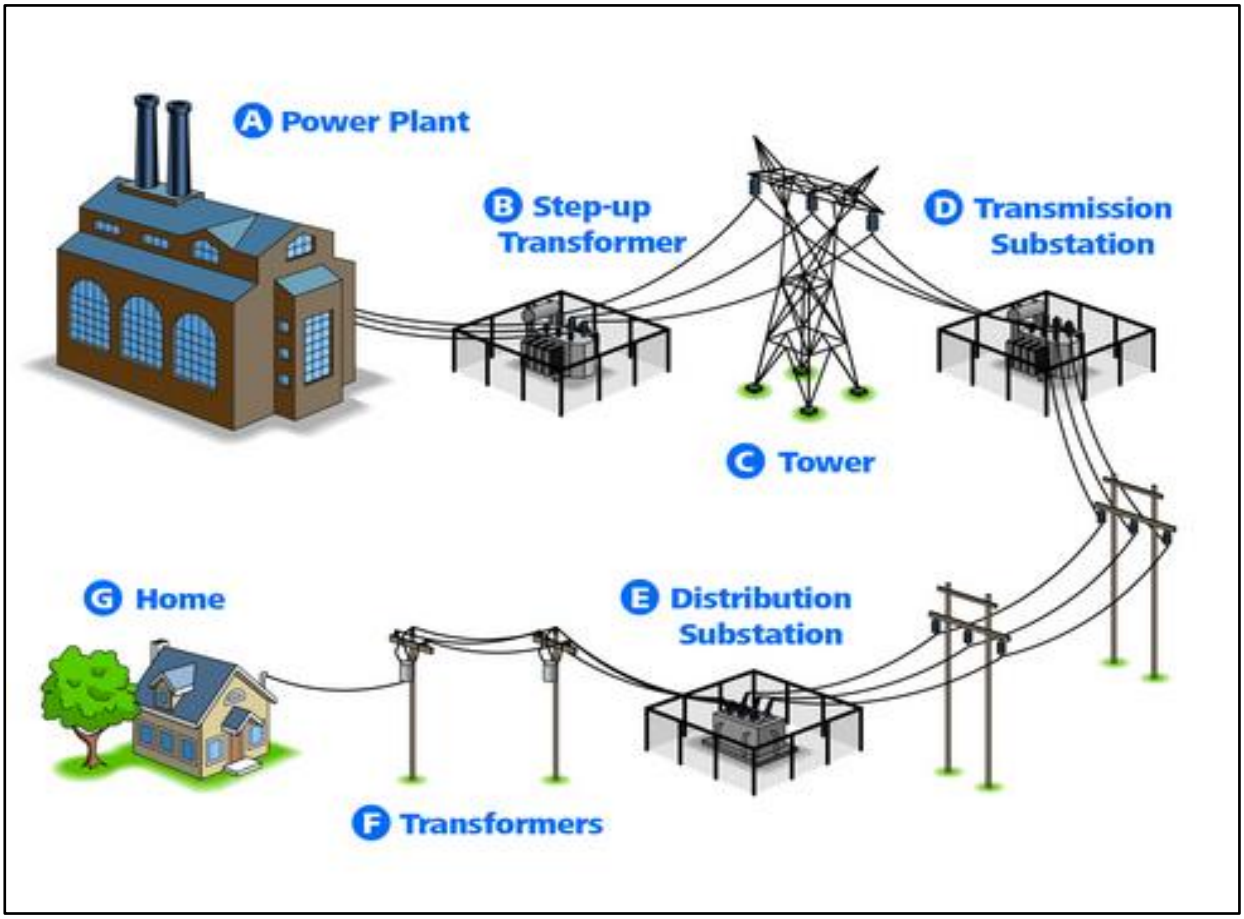


Table 11-6: Electricity Production Investment Chain

A – represents all power stations or power producers that are connected to the Zimbabwe National Grid.

(B – D - E) – Represents the Zimbabwe Transmission System or National Grid

(E – F) – Represents Distribution System

Substations **(B, D, E & F)** – clients of various categories are connected depending on size.

The entire grid is currently operated by ZETDC a subsidiary of ZESA and is entirely synchronised at 50Hz.

11.5.3 ZPC POWER STATIONS

The power stations are the bulky producers of electricity for the country. Zimbabwe has all its major power stations and electricity generation capacity owned and operated by the state owned electricity utility company Zimbabwe Power Company (ZPC) a subsidiary of ZESA Holdings. No new major power plants have been installed onto the market that are owned or operated by Independent Power Producers (IPPs) regardless of the opening up of the sector to participation of private developers, owners and operators throughout all stages of the electricity sector value chain. These existing major power stations are Kariba, Hwange, Bulawayo, Munyati and Harare.

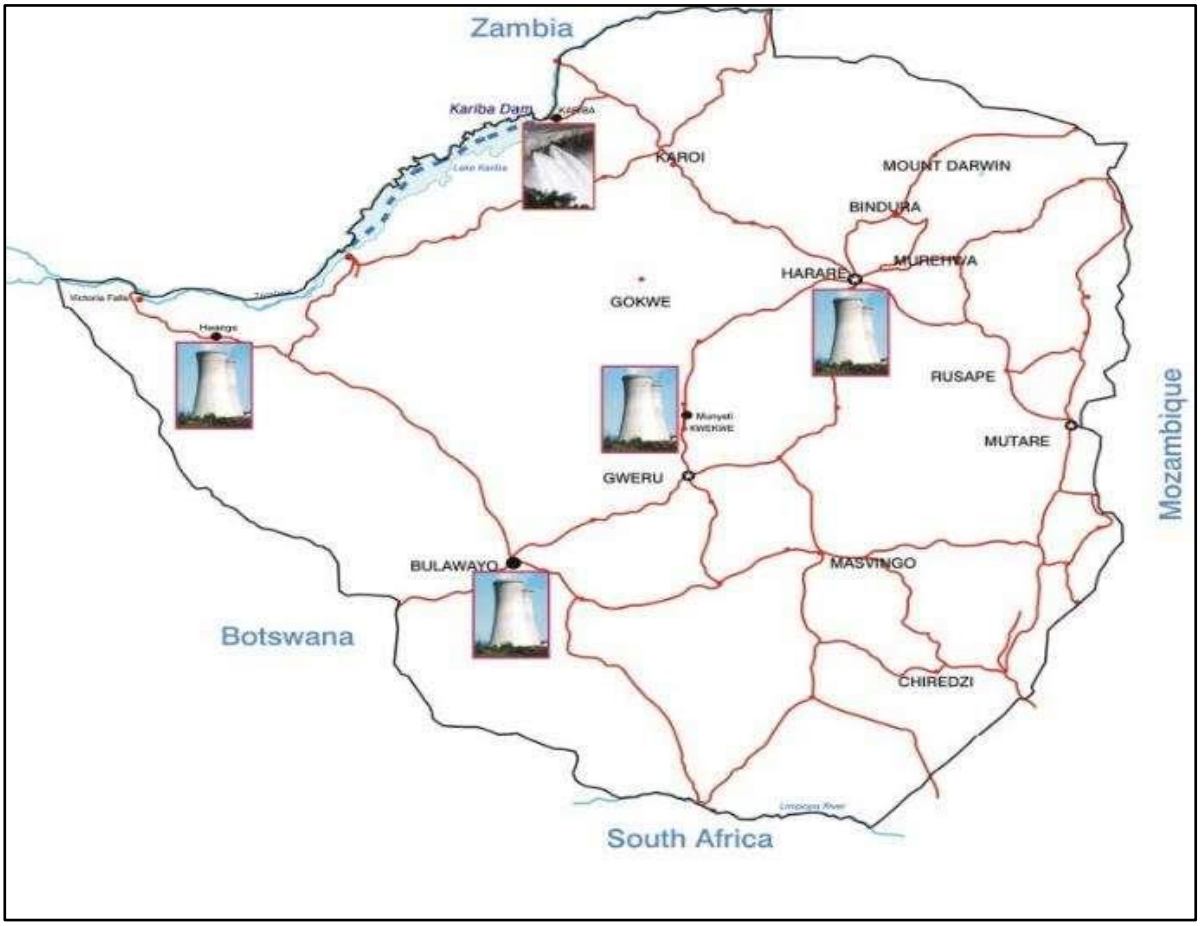


Figure 11-7: Existing Major Power Plants and geographic distribution

11.5.4 EXISTING MAJOR POWER PLANTS

The major current local electricity generation power plants are mature and aged. The thermal fleet has outlived its economic life. As such, the power plants have been derated and their operational dependable capacities are way below their installed capacities. The existing local dependable generation capacity is below the system peak demand and regional power imports are currently being used to bridge the supply – demand gap.

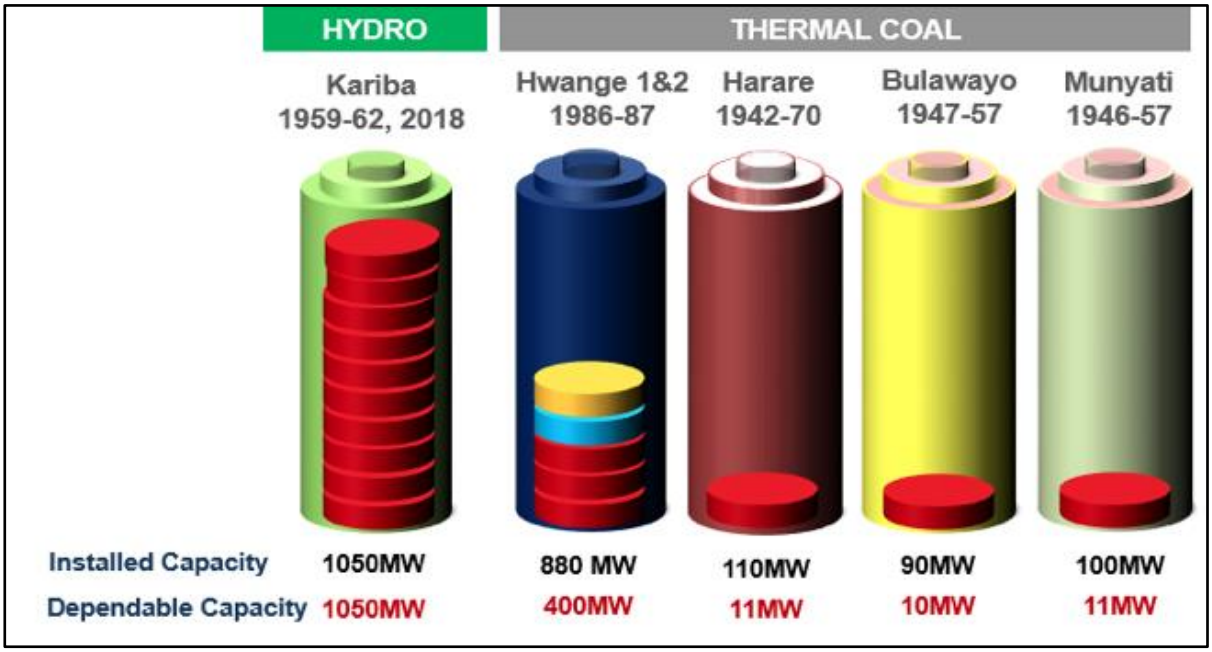


Figure 11-8*: Existing Major Power Plants*

The total installed capacity ZPC generations is 2230MW.

The battery illustration on the fig 3 above shows the erosion of installed capacity as a factor of age. Dependable capacities are used in this case as power plants are unable to achieve their installed capacity due to age constraints. That generation profile has not improved in any significant way between 2017 and 2021. See details below:

Table 11-7: Power generation capacity

	Kariba 1- 4	***Kariba 5 - 6***	***Hwange Stage 1&2***	***Bulawayo***	***Munyati***	***Harare***
Fuel	*Hydro*	*Hydro*	*Coal*	*Coal*	*Coal*	*Coal*
Technology Adoption	*1950s*	*2010s*	*1960s*			
Staff	*243*		*736*	*220*	*205*	*188*
Year of Commission	*1962*	*2018*	*1987*	*1957*	*1957*	*1970*
Age	*59*	*3*	*34*	*64*	*64*	*51*
Installed Capacity	*750*	*300*	*880*	*90*	*100*	*110*
Average Dependable Capacity as at 2020	*294*		*350*	*15*	*15*	*15*

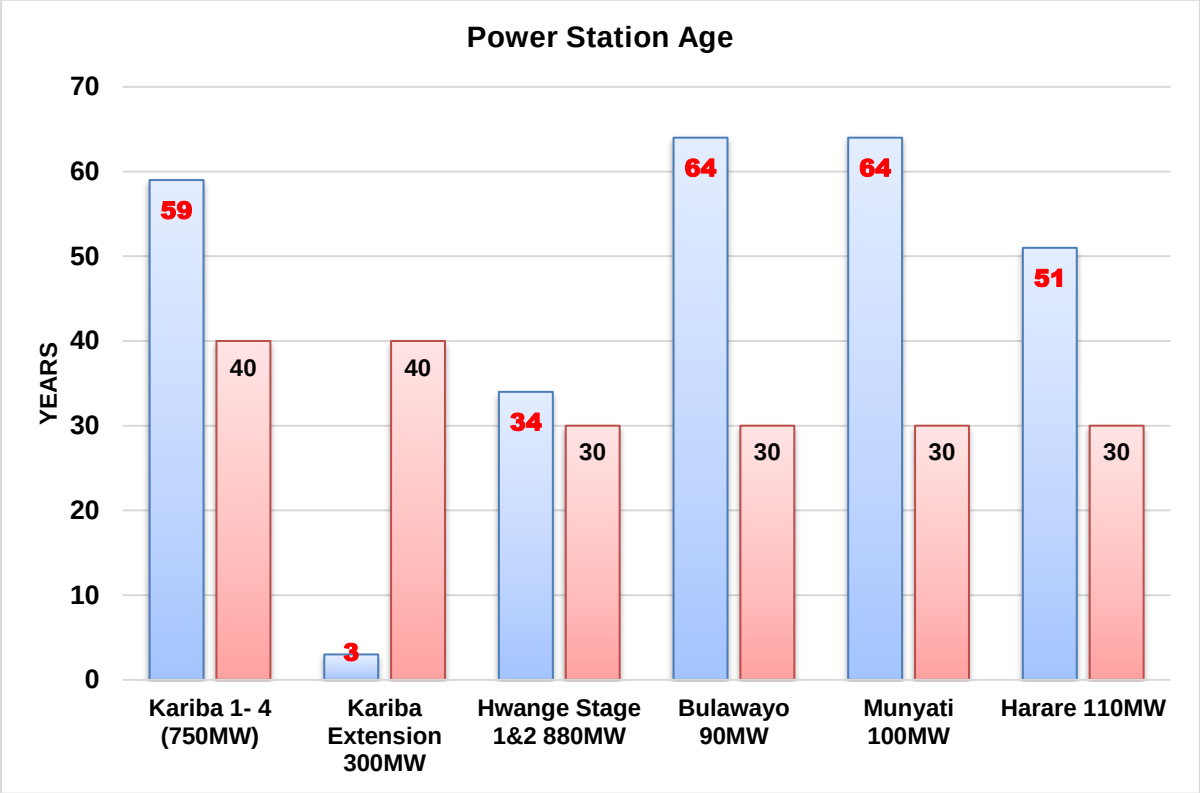


Figure 11-9: Power station age

All of ZPC power stations with the exception of Kariba extension are aged as reflected in the graph above. The Kariba units 1-4, although 59 years old is still very reliable plant and fits into some hydro power plants that achieve a useful life of 100 years with necessary interventions.

Hwange Power station is strategically located next to coal supplies (Hwange Colliery and Makomo resources). Bulawayo, Harare and Munyati small thermal power stations are located far away from call supplies and rail transport is used to transport coal to these power stations.

11.5.5 ZIMBABWE POWER COMPANY (ZPC) PLANTS

Table 11-8: ZPC Power plants

Plant Name		Fuel	Number of Units	Installed Capacity (MW)	Dependable Capacity (MW)
Hwange		Coal	6 (4x120+2x220)	920	350
Kariba	South	Hydro	6	750	340
	Extension	Hydro	2	300	
Harare	2	Coal	3	110	15
	3	Coal	2		
Bulawayo		Coal	6	90	15
Munyati		Coal	5	100	15
Total				2,270	735

11.5.6 GRID CONNECTED OPERATIONAL IPP PLANTS

Table 11-9: IPP plants

Plant Name	Technology	Installed Capacity (MW)	Dependable Capacity (MW)
Pungwe A	Hydro	2.75	2.75
Pungwe B	Hydro	15	15
Pungwe C	Hydro	2.7	2.7
Duru	Hydro	2.2	2.2
Nyamingura	Hydro	1.1	1.1
Hauna	Hydro	2.3	2.3
Kupinga	Hydro	1.6	1.6
Riverside Solar	Solar	2.5	2.5
Claremont	Hydro	0.3	0.3
Tsanga B	Hydro	2.06	2.06
Green Fuel (Chisumbanje)	Bagasse	18.3	3

Centragrid	Solar	2.5	2.5
Total Operational IPP Capacity		**53.31**	**38.01**

Fig 7

11.5.7 POWER PLANT ASSET MANAGEMENT AND MAINTENACE

ZPC Has the following Divisions and functions:

DEPARTS	**FUNCTIONS**
Operations	Operates and maintains power generation assets
Projects and Technical	Development of new capital projects and implementation of ICT and SHERQ policies
Finance	Cost control, financial management and fundraising
Human Resources	Recruitment, retention and development of employees
Legal	Corporate governance, compliance and legal advisory
Supply Chain	Procurement of goods and services for the organization
Public Relations	Stakeholder management and event

ZPC Operations and Maintenance Approach

ZPC maintenance philosophy aims to maximise plant availability and ensure safety. The maintenance philosophy employed is aggregated as follows by plant technology.

Thermal Power Station Maintenance Philosophy

All ZPC maintenance is based on the following philosophy:

1. **Statutory inspection and routine maintenance:**

The Boilers of thermal power plants are pressure vessel and covered under Factories and Works Act of Zimbabwe and require inspection by the Factories Inspectorate every 2 years. The inspection generally lasts for 28 days. During this period, opportunity is taken to carry out the following tasks:

- Clean the gas pass and carryout tube thickness tests.
- Replacement of tubes below the minimum thickness
- High pressure components such as safety valves are also attended to and
- Hydraulic pressure test is carried out to ascertain the integrity of the boiler after completing all repairs.

2. **Major Overhaul:**

Major Overhauls are carried out every 5 years or 50,000 hours of operation of the turbine, whichever comes first. Major overhaul ordinarily takes 14 weeks but can last longer depending

on extent of repairs required on the unit. During this period, extensive work is carried out on both the boiler and the turbine/generator. The plant is stripped to component level and thorough inspections and measurements are taken including sandblasting to remove scaling on turbine internal components and rotor balancing.

3. **Mini Outage**:

These are opportune outages carried out so as to address teething and persistent problems on a particular plant. These are condition based maintenance. The duration is proportionate severity of defects and availability of parts.

4. **Breakdown Maintenance**

This is carried out in reaction to equipment failure and to bring back machine to service

ZPC Hydro Power Plant Maintenance Philosophy

ZPC hydro power station maintenance philosophy is based on the following maintenance approaches:

5. Annual routine maintenance
6. Breakdown maintenance
7. Mini Outage

11.5.8 ZPC LEVEL OF PLANT MAINTENANCE

Table 11-10: Overall expense summary of ZPC (USD million)

	2012	2013	2014	2015	2016
Units sent out (GWh)	**8,963**	**9,315**	**9,783**	**9,215**	**6,779**
Fuel Cost	**125**	**145**	**144**	**140**	**107**
R&M	31	33	42	53	32
Payroll Cost	62	69	77	78	72
Depreciation	**95**	**98**	**104**	**102**	**101**
A&G	62	76	74	73	76
Management Fees	33	36	28	16	13
Finance Charges	20	18	17	14	17
Total	**429**	**474**	**485**	**475**	**418**

Hwange Power Station generation units are 1960s technology and were installed and commissioned as second hand units between 1983 and 1987. Units have therefore an estimated age of over 40 years and have exceeded their design and economic life which is estimated at 30 and 40 years respectively. The units have been subjected to repeated inadequate maintenance for a period in excess of 20 years due to foreign currency shortages, working capital constraints, spare parts shortage and limited outage period due to operational pressure. The impact of the repeated deferred maintenance and component replacement would inevitably reduce the economic life of the power plant, steeply reduce the reliability performance, operating efficiency, maximum operating capacity of the power plant, increase plant down time and increase plant operating costs. The main factors that's have resulted in differed plant maintenance and capital investments are:

1.**System constraints:** The general power deficit prevailing in the country makes it difficult for ZPC to find suitable outage slots that would result in minimum impact on the national power supply situation. This often results in the deferment of the critical maintenance.

2.**Working Capital challenges:** Critical spare parts for maintenance and plant repairs are not delivered on time due to financial constraints. Critical maintenance and repairs are therefore repaired. Delays in payments of previous works performed also affect contractor continuous service delivery.

Inadequate maintenance of the old Units of Hwange Power plant has led to numerous forced or unplanned outages of the plant. Hwange Power Station, just like the rest of the Power Stations, does not have a documented Life of plant plan (LOPP)/ technical plan which is considered a good tool used to address issues of aging plant equipment. Refurbishment and replacement projects should form part of this plan. In the absence of a documented LOPP, the effectiveness of asset management is compromised thereby affecting business performance. It is recommended that LOPP should be developed and used across the Group.

The persistent limited maintenance and recapitalisation budgets has affected the utility and created a situation of insufficient maintenance planning, plant condition analysis, and reduced activities. The Insufficient maintenance and asset recapitalisation has led to sustained year on year assets underperformance that is associated with increased risks, high service disruptions, Increased plant down time, reduced plant technical and economic efficiency and premature asset failure. The net result is a struggling generating company that is overwhelmed with pressure to produce from down-rated and unreliable assets that are operating with higher plant lifecycle costs.

The following shows the resultant ZPC Assets performance as influence by the following critical persistent constraining factors:

- Aged Assets
- Reduced asset management and maintenance planning
- Under maintained Assets
- Undercapitalised business

11.5.9 ZPC OPERATIONAL PERFORMANCE

Hwange Power Station Performance 2012 - 2020,

Operational performance of Hwange Thermal Power Station post appointment of Wapcos Ltd.

	2012	2013	2014	2015	2016	2020
Units sent out (GWh)	3133.28	3826.85	3819.25	3721.72	3474.8	2356

Parameter	Base Line (Dec 2010)	2011	2012	2013	2014	2015	(May 2016-Feb 2017)	2020
Availability Factor (%)	48	68.83	61.43	73.41	72	68.1	60	37.88
PLF (%)	36	46.6	45.12	57.23	52	50.55	43.6	32.21
Forced Outage (%)	35.5	23.43	28.14	14.96	15	23	25	48.12
Planned Outage (%)	16.5	7.74	10.43	11.63	13	8.95	15	11.61
Specific coal cons. (kg/kWh)	0.64	0.53	0.525	0.527	0.52	0.5	0.51	0.54
Plant Efficiency (%)	24	28.35	29.26	28.23	26.15	28.5	28.4	27.18

Hwange power station energy production increased significantly between 2013 and 2014 following the Wapcos intervention project. The overall trend shows significant loss of production over time between 2012 and 2020 inclusive. This is of major significance as this power station constitute 44% of National installed capacity. The plant factor and availability factor has proportionately decreased over the seven year period. The trend above also shows that the interventions implemented around 2010 resulted in improved performance for a limited period of two years before the onset of a progressive sustained performance reduction. It can be deduced that all interventions implemented to restore Hwange performance between 2010 and 2020 by Wapcos and ZPC were not effective in achieving plant sustainable operational performance improvements or maintaining its 2010 baseline. Asset management approach to Hwange power station therefore need to be reviewed to identify effective approaches and

interventions that would transform the performance of the station to secure long tern performance and viability.

Hwange 2020 Performance

Hwange Power Station sent out a total of 2356.38GWh in 2020 versus a target of 3952.83GWh. The annual energy production was significantly lower than 2019 performance. Power Station operated with an average dependable capacity below 300MW.

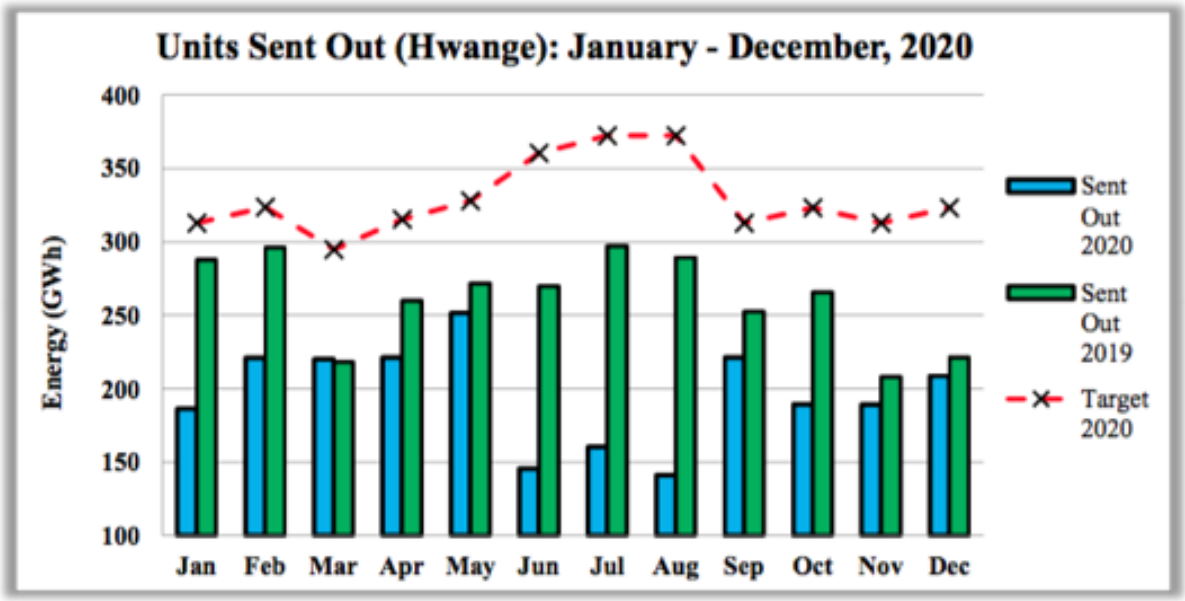


Figure 11-10: Hwangwe performance

Hwange power station production performance reduced significantly between 2019 and 2020 as shown on the graph above.

The chart below illustrates the major forced outages that were recorded at Hwange in 2020 as well as their respective contribution to the potential generation loss.

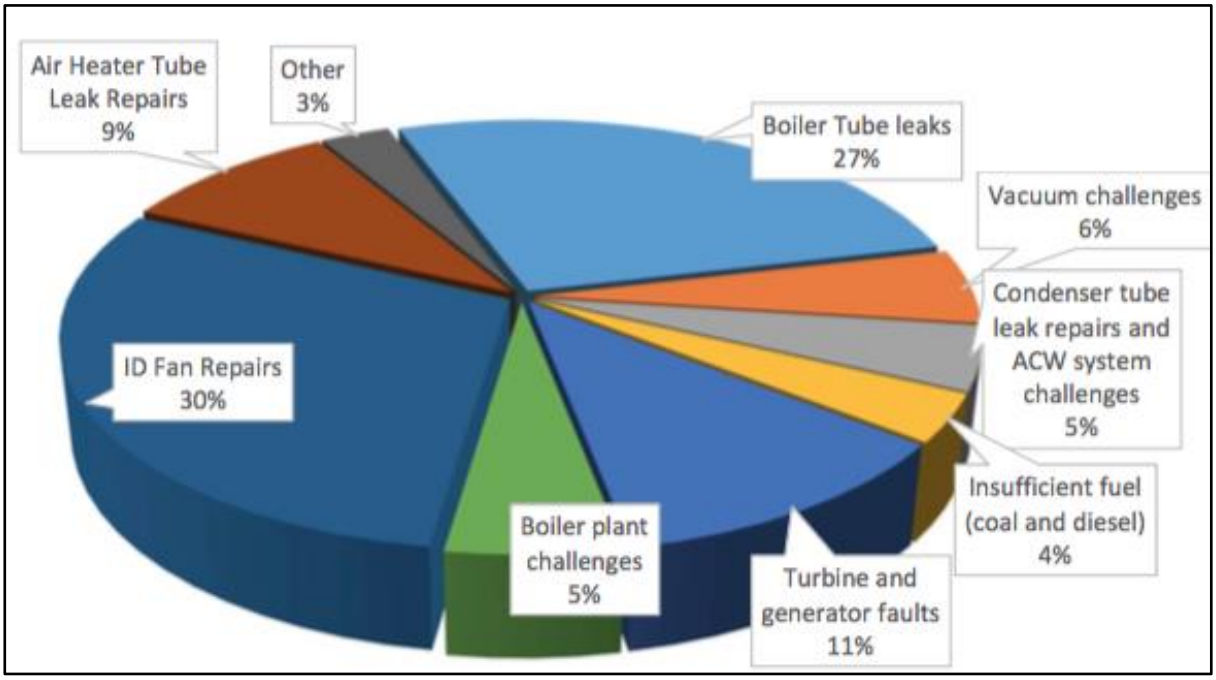


Figure 11-11: Reasons for breakdown

2020 Hwange Planned Outages

Hwange Unit 3 major overhaul which kick started towards the end of 2019 was delayed due to lack of funding, Unit 6 Rotor Earth Fault repairs were delayed due to the COVID-19 pandemic lockdown that saw the contractors suspending works. Unit 4 and 5 statutory maintenance were delayed and postponed as below.

Table 11-11: Hwange 2020 Planned Outages,

Unit	Reason	Date Out	Date In	Status
1	Major Overhaul			Postponed to 2021
3	Major Overhaul	28/Oct/20	22/Jan/21	On-going
5	Statutory Maintenance			Postponed to 2021

ZPC continue to experience major challenges in maintaining its power plants. Deferral of maintenance is routine with major impact to overall plant performance and effective useful life.

Hwange power station performance is poor, maintenance delivery is continuously challenged, plant has exceeded its useful life and without strong aggressive, timely and effective maintenance interventions, the power station going concern is challenged.

Performance of Hwange power station has remained the major cause of major unplanned power deficits to the country. The national power supply stability is subject to Hwange reliability. Power plant is aged and its maintenance is challenged, its average reliability rating is poor. It is not possible to achieve security of power supplies in the country while retaining

strong dependency on Hwange Power Station and without major changes to the consistency of delivery of effective maintenance to services to the plant.

11.5.10 ZPC THERMAL POWER STATIONS

The historic performance of small thermals from 2012 to 2020 for the purpose of establishing a critical context platform is as follows:

Table 11-12: Energy sent out by power station by year,

Units in (GWh)	Hwange	Harare	Munyati	Bulawayo	Kariba	ZPC (Total)
2012	3133	60	204	178	5387	8963
2013	3827	145	189	172	4982	9315
2014	3821	216	176	167	5403	9783
2015	3721	209	173	174	4938	9215
2016	3473	162	117	111	2917	6779
2020	2356	54	43	24	3707	6184

The energy sent out production analysis above, shows that small thermals and Hwange Power Station performance sustained at appreciable levels from 2012 to 2015 post Wapcos interventions.

Table 11-13: Forced Outage Rates by power station by year,

Forced Outage (%)	Hwange	Harare	Munyati	Bulawayo	Kariba
2012	27.78	16.23	26.8	24	1.08
2013	17.59	5.22	42.2	45	2.57
2014	14.82	27.81	48.9	37	0.25
2015	24.78	41.71	39.8	23	0.72
2016	28.91	2.51	29.9	39	1.3
2020	48.12	68.77			2.31

The table above shows that the forced outage rate for small thermals and Hwange power station increased from 2012 to 2020. This pattern is consistent with the trend of energy production above.

Table 11-14: Plant Efficiency analysis by station and by year,

Efficiency (%)	Hwange	Harare	Munyati	Bulawayo	Kariba
2012	27.74	14.4	15.94	17	94.96
2013	27.09	18.89	16.64	19	95.32
2014	26.1	22.97	14.57	17	95.13
2015	29.08	23.21	14.39	16	95.01
2016	28.17	20.54	17.43	18	94.65
2020	27.18	20			93.08

Hwange plant efficiency only increased by 1% in 2015 and has otherwise remained relatively constant around 27%. Impact of Wapcos interventions and those that might have been implemented by ZPC were not effective in achieving notable gains on plant operational efficiency from 2012 to 2020.

11.5.11 COST STRUCTURE ANALYSIS BY POWER STATION FOR 2016,

Particulars (2016)	Hwange	Harare	Munyati	Bulawayo	Kariba	Total
Fuel Cost	2	6.7	9.5	7.8	0.2	1.6
R&M	0.6	0.7	0.9	0.6	0.3	0.5
Payroll Cost	0.9	4.6	5.9	6.5	0.3	1.1
Depreciation	1.4	4.4	6	6.4	1.1	1.5
A&G	0.9	2.4	2.8	2	0.7	1.1
Management Fees	0.5	1	1.1	0.9	-0.4	0.2
Finance Charges	0.2	-0.3	-0.5	-2.7	-0.1	0.3
Total Costs (per kwh)	**6.5**	**19.5**	**25.8**	**21.5**	**2.1**	**6.17**
% Fuel / Total Cost	**31%**	**34.3%**	**36.8%**	**36.3%**	**10%**	**25%.9**

Fig 16

ZPC Station combined Tariff 2020,

STATION	Hwange	Harare	Munyati	Bulawayo	Kariba	Total
USD/Kwh	3.8	14.4	15.4	12.4	2.0	2.38

The cost structure analysis by power station for 2020, shows that cost of fuel is the main single dominant cost contributor to the generation cost of all thermal power stations. Small thermals cost is above that of Hwange power station mainly due to the plant size and coal transportation cost from mines to power stations by rail though there are other factors that will contribute to the same effect that are less dominant.

The other compelling deduction is that the effective ZPC generation tariff across its entire fleet reduced from 6.17USDc/kw to 2.38USDc/kwh between 2016 and 2020

This is of major concern as ZPC still remains with legacy financial commitments that need to be serviced in USDs (or foreign currency) from the various services and products it has acquired for its operations. ZPC is in the progress of implementing new major project projects that include Hwange extension amongst other and projects are advanced. A reduction in price per unit of energy to ZPC shall substantially affects its ability to maintain its assets, service its financial commitments and will certainly constrain its operations including securing financial closures for new projects**.**

Table 11-15: Overall income to ZPC over the years (USD million),

	2012	**2013**	**2014**	**2015**	**2016**	**2020**
Revenue from Sale of Power	*408.56*	*457.55*	*504.94*	*491.59*	*412.01*	*113.68*
ZETDC	*378.38*	*402.75*	*452.5*	*450.52*	*363.33*	*79.41*
NamPower	*30.18*	*54.8*	*52.44*	*41.07*	*48.68*	*34.27*
Other Income	*33.5*	*33.1*	*-14.34*	*2.64*	*15.18*	*0.87*
Total Income	**442.07**	**490.65**	**490.6**	**494.23**	**427.19**	**114.55**

The 2020 ZPC income has been eroded to 27% of its 2016 levels. This development is a major cause of concern and can be catastrophic if not quickly mitigated. Operations sustainability with acceptable Asset management are not possible. Sustainability of service delivery and realisation of the reasonable competitive returns from asset investments is at risk. Even maintenance of recently acquired assets may be compromised and if unmitigated for longer periods will certainly results in negative asset life cycle impact on recent acquisitions.

Small thermal power stations sent out a combined 121.00GWh of energy in 2020. The annual production target which was set at 395.32GWh was missed by 69.39%. The figure below shows the energy sent out trend at the small thermals in 2020. it can be seen that the energy sent out for the Small Thermals was consistently below the target throughout the year. The installed capacity of small thermals to the country is about 13% of the national installed capacity. The actual 2020 energy contribution from small thermals is however only 2% of the total national local production. The total loss of production potential from the unusable small thermals capacity is major.

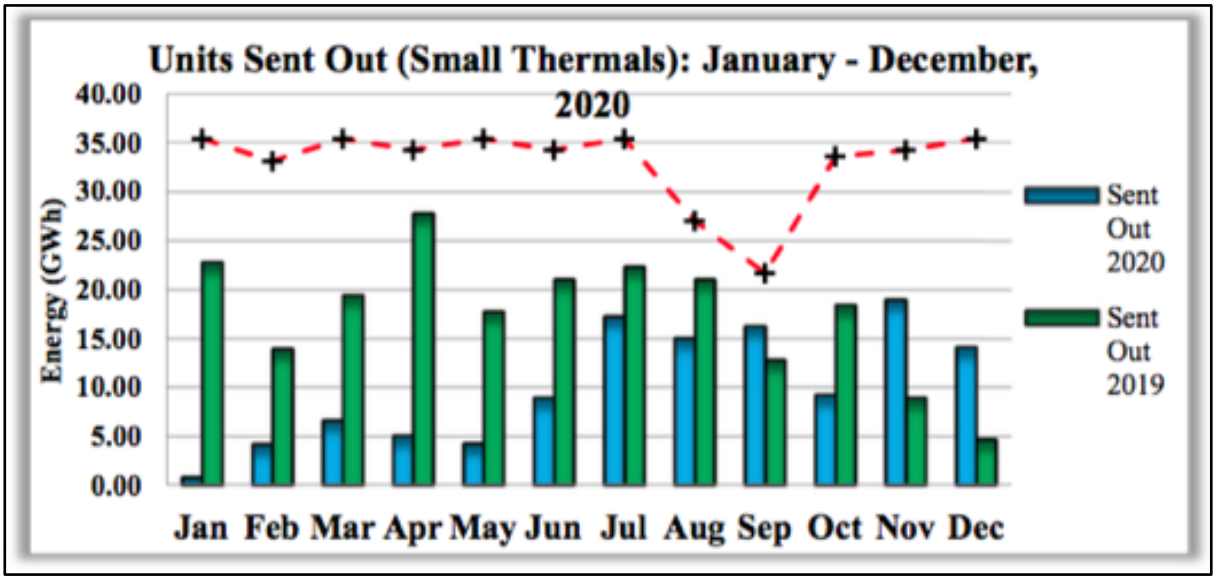


Figure 11-12: Small thermals power production

As depicted in Figure 18, insufficient coal stocks and poor performance of the boiler plant remained the major challenges at the small thermals. The unavailability of unit at Harare, due to rotor earth fault contributed to the missed target. Unavailability of ash plant as well as insufficient boiler feed water posed a threat to loss of generation at Harare Power Station. The repowering project which is going to involve replacement of the old boilers with new CFBC ones will address the issue of poor boiler performance.

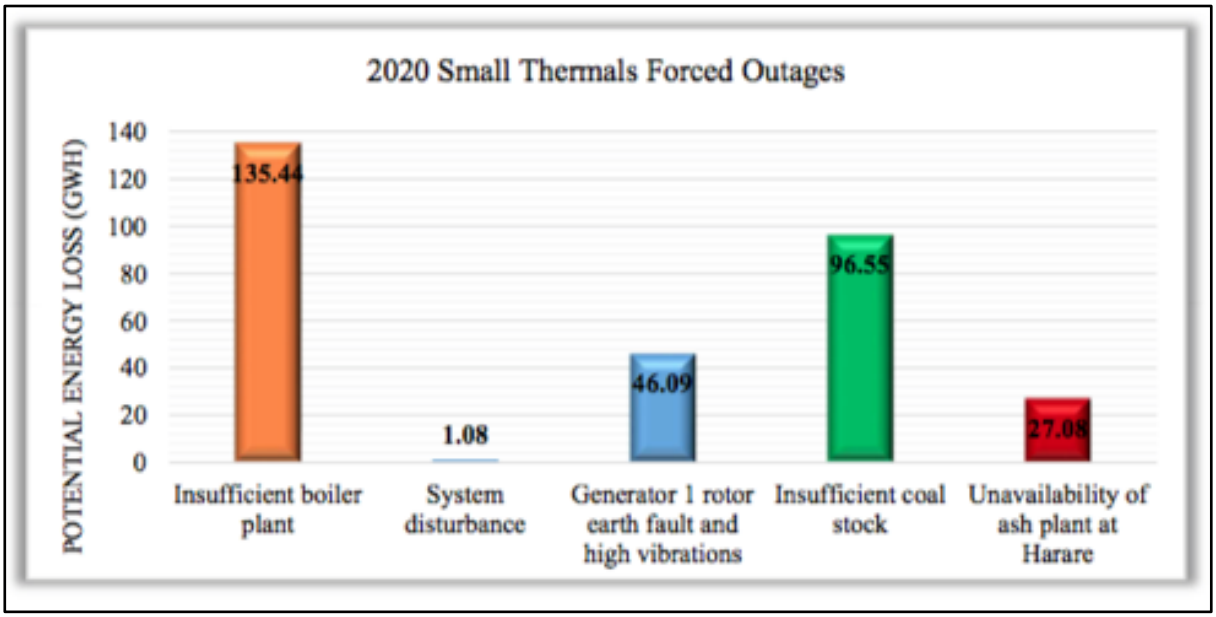


Figure 11-13: Small thermals forced outages

Bulawayo

Bulawayo Power Station sent out a total of 24.34GWh of energy in 2020. The production target for Bulawayo was set at 130.92GWh. Therefore, the station missed its production target by 81.41%. Figure 20 shows the energy sent out trend for Bulawayo in 2020.

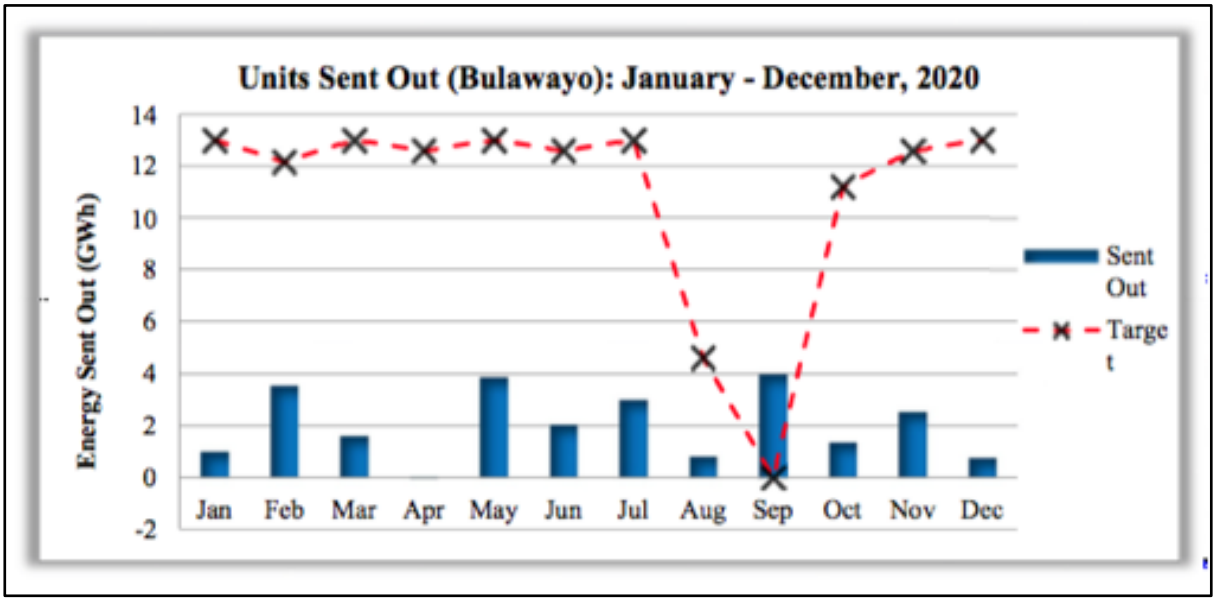


Figure 11-14: Bulawayo

Harare

Harare Power Station sent out a total of 53.73GWh of energy in 2020, thereby missing the production target set at 132.20GWh by 59.36%. Figure 21 shows the energy sent out trend for Harare in 2020.

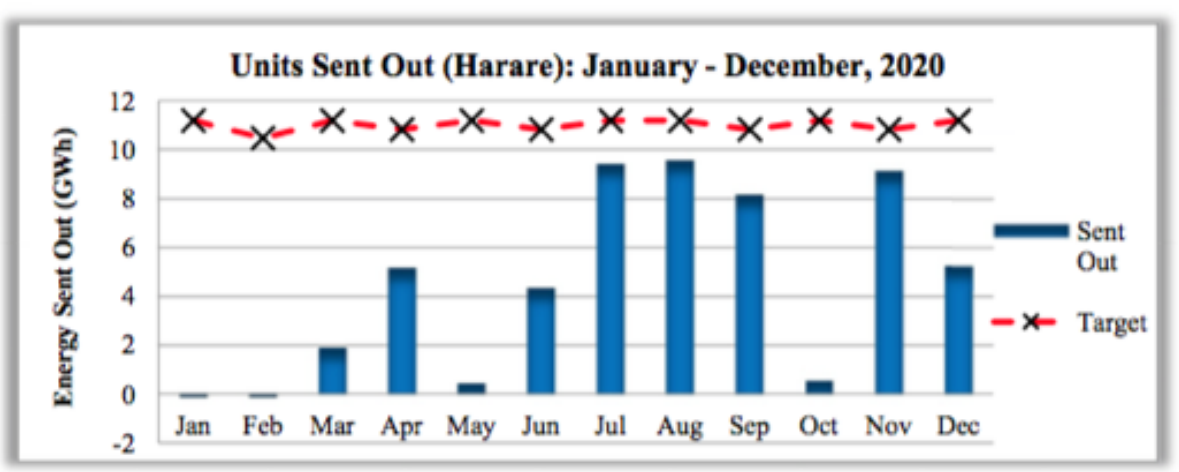


Figure 11-15: Harare

From Figure 11-15 it can be seen that Harare was consistently below the target throughout the year. This is because of the unavailability of Boiler 2 which was on extended statutory maintenance for the greater part of the year. Boiler 1 and Boiler3 were in service, but were constantly unavailable due to boiler tube leaks. Unavailability of ash plant and insufficient feed water also contributed to the missed target.

Munyati

A total of 42.93GWh of energy was sent out in 2020 at Munyati Power Station. This was 67.53% below the target for the year which was set at 132.20GWh. The greatest limitation to generation for Munyati Power station was insufficient coal. The station was shut down in the months of January, April and May due to insufficient coal stocks. Figure 11-17 shows the energy sent out trend for Munyati Power Station in 2020.

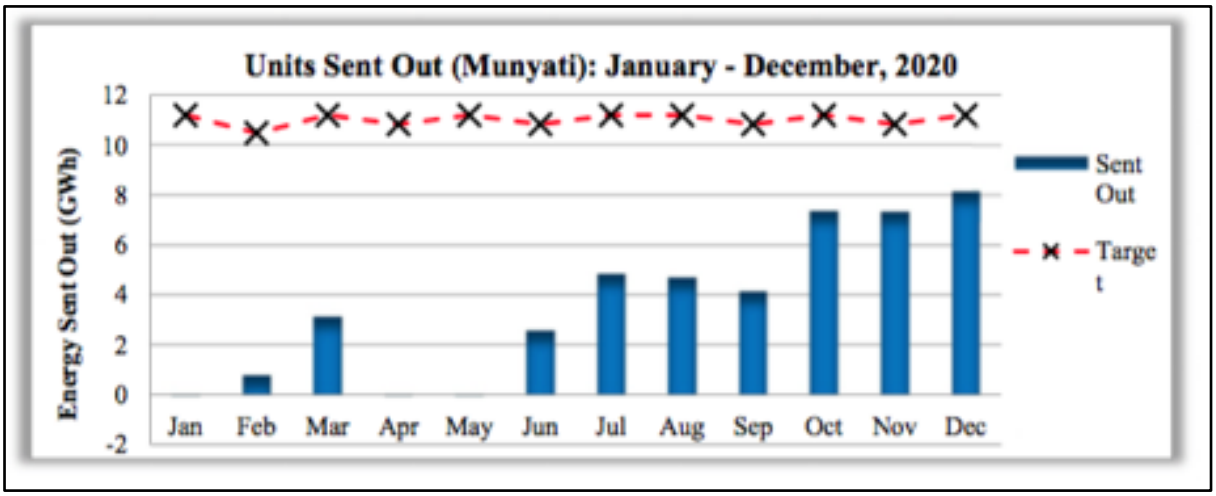


Figure 11-16: Munyati

Kariba

Kariba South Power Station sent out a total of 3,706.97GWh in 2020. The power plant technical performance is excellent and stands out as the most technically efficient and reliable plant. Performance is Kariba is however subject to previous rain seasons performance and the resulted hydrology and dam water levels. 2017 through to 2019 rain seasons were poor resulting a three year conservative drought period. Water available for electricity generation therefore decreased year on year to critical levels limit the generation output from the power station. Thus the 2020 production target which was pegged at 2,415.60GWh was surpassed by 53.46%. Kariba had to ramp up power generation to compensate for the low generation at the thermal power stations. As a result Kariba exceeded its water allocation of 13.5Bm3 by 16.34% which attracts a penalty under the Water Purchase Agreement with ZRA. Figure 11-17 has the energy sent out trend for the station.

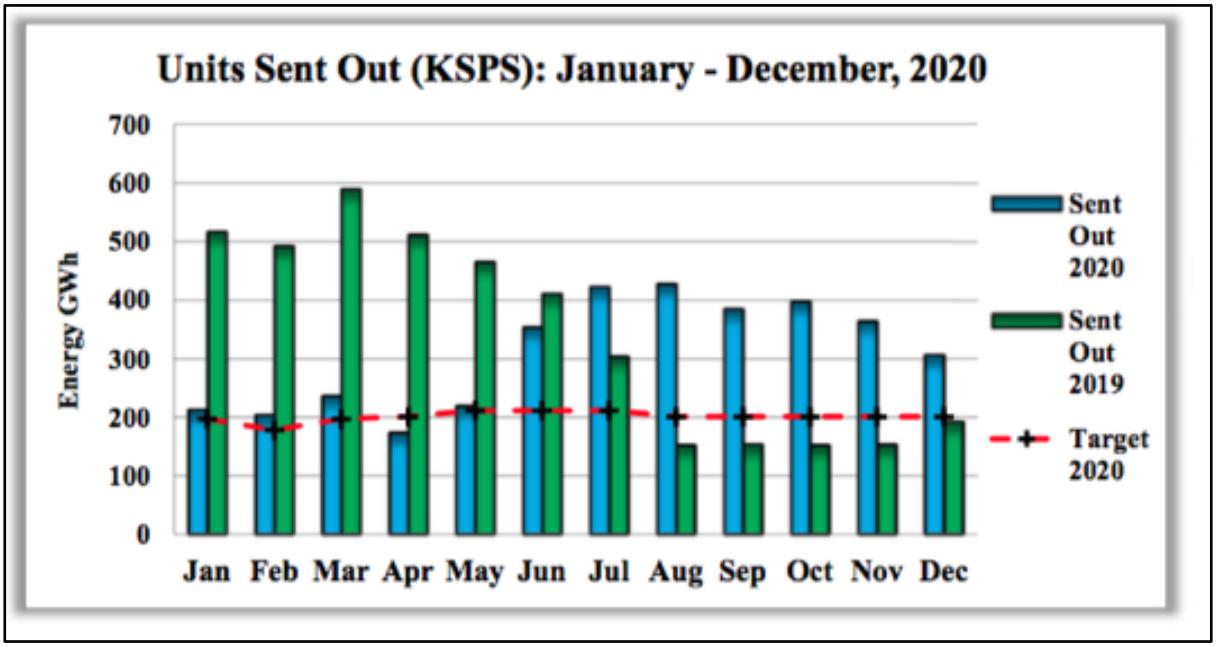


Figure 11-17: Kariba

Kariba performance is therefore dependent on available water reserves in Kariba Dam and is climate change sensitive. The plant although Aged is in an excellent reliability and efficiency technical state.

11.5.12 AVAILABILITY AND OUTAGE RATES

The actual availability and outage rates for 2020 against the targets are depicted in Figure 24 below. Availability at Hwange Power Station was mainly affected by the unavailability of Unit 6 since March 2019 due to a rotor earth fault, extended major overhaul on Unit 3, numerous boiler tube leaks on units and milling plant challenges which resulted in the frequent shutting down of units, reducing plant availability. Frequent failure of the boiler plant across all the Small Thermals resulted in low plant availability and potential generation loss. Rotor earth fault at Harare Power Station from mid-November 2019 up to the mid-March 2020 as well as unavailability of the ash handling plant at Harare Power Station also contributed to the missed target.

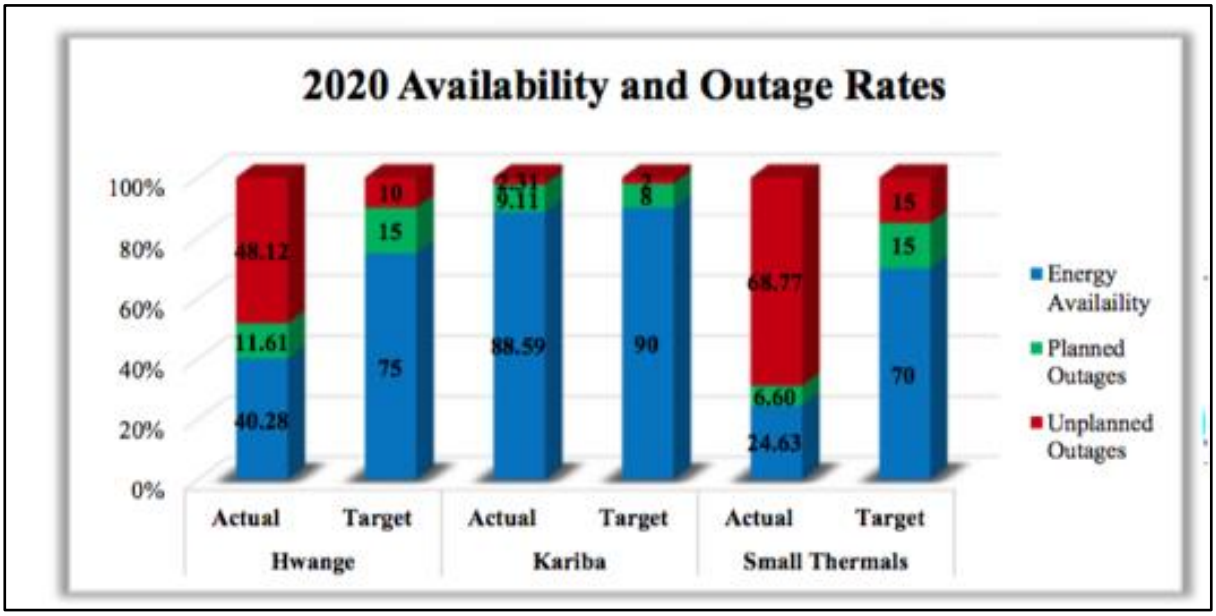


Figure 11-18: Availability and outage Rates

The unavailability of Hwange Power Station Unit 6 due to rotor earth fault and the extended major overhaul of Unit 3 as well as the numerous forced outages at the small thermals, contributed to the missed annual energy sent out target by 8.57%. Hwange Power Station operated with an average of three units against a plan of five units. Kariba ramped up production after the increase in water allocation hence resulting in the station surpassing its energy sent out target. In 2020, ZPC managed to send out 6184.35GWh of energy thereby missing the yearly target by 8.57%%. The Kariba lake level increased from 476.69m at the beginning of the year to 478.38m at the end of December 2020. This represented a 1.69m increase in lake level over the year. As at the end of the year, the station had utilised 15.71Bm3 of water. The annual water allocation of 13.5Bm3 was thus surpassed by 1.58%. The coal supply situation was dire due to funding challenges and erratic diesel supplies for transportation.

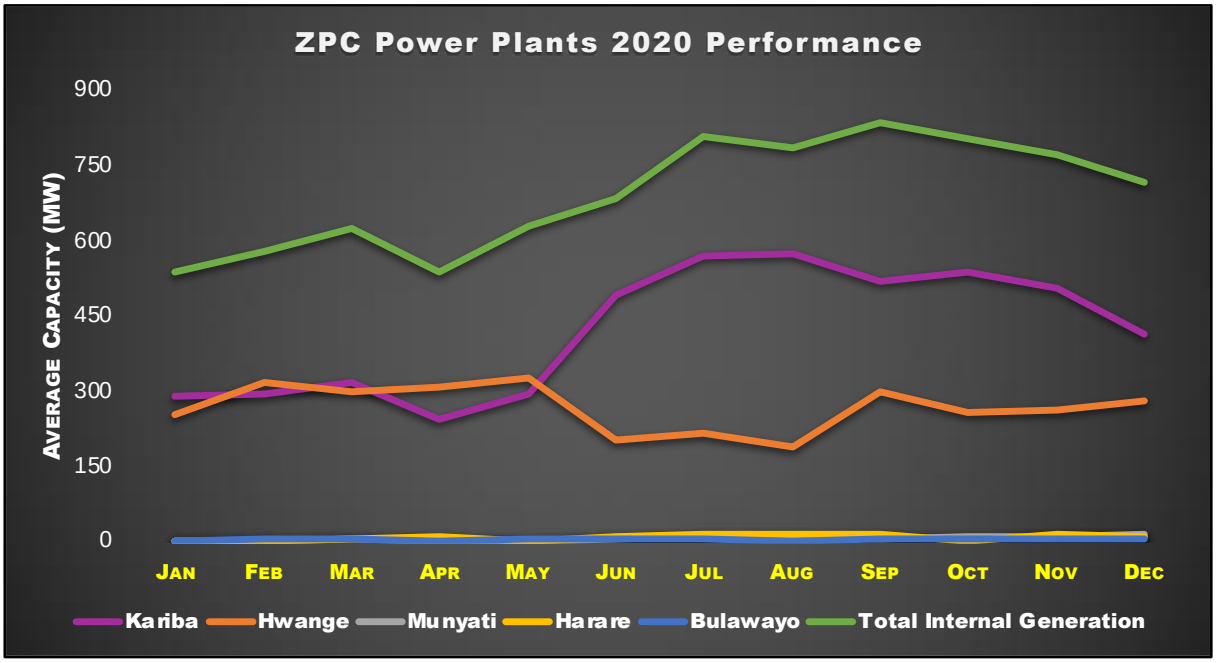


Figure 11-19: Power plant performance

The national peak demand for 2020 was 1531MW against a local generation capacity between 538MW and 837MW for the entire year. The power gap had to be covered by power imports, load shedding or a combination of both. 2020 system peak demand was supressed due to Covid induced economic compression. Without Covid the country power deficit in the country would have been challenging, with an estimated peak demand of 2102MW and deficit of 1265MW still under the then projected suppressed economic conditions.

11.5.13 ZPC POWER STATIONS CONDITION RANKING

Based on the above detailed asset analysis, ZPC Power stations are condition ranked or graded based on the following Criteria:

A World-class	B Fit for The Future	C Satisfactory For Now	D At Risk of Failure	E Unfit For Purpose
Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure pressure from unusual events.	Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents.	Infrastructure condition is acceptable, although stressed at peak periods. It will need investment in the current Medium-Term Expenditure Framework period to avoid serious deficiencies.	Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience, and even danger, without prompt action.	Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate action is required.

Parameter	ASSET RANK/GRADE
Hwange Stage 1 & 2	E
Kariba 1 & 2	A
Bulawayo	E
Munyati	E
Harare	E

All ZPC Thermal power stations fully satisfy grade D as they cannot cope with demand anymore and are poorly maintained. Plants have been downrated for a period exceeding 10 years with sustained loss of installed capacity ranging from 85% for small thermals to 66% on Hwange stage 1 and 2. Plants are frequently failing and that exceeds category D. Interventions implemented since 2010 have failed to achieve meaningful capacity recovery and reliability

performance. Infrastructure has therefore failed from sustained loss of installed capacity and has an unacceptably high outage or failure rate as reflected form number of condition related outages and low availability.

11.5.14 ZETDC ASSETS ANALYSIS

The Zimbabwe power system network is split into the Transmission and Distribution segments. This section of the report assesses the network (Transmission and Distribution) status as far the performance requirements to deliver power to demand centres across the country.

TRANSMISSION NETWORK

The Transmission network is the power system highway of electricity or electric energy. This system is designed to transmit bulk power or energy form remote power stations, with low power losses at the highest level of power quality to load centres. Power stations are normally located closer to fuel geographic locations for cost efficient and reliable fuel supplies and logistics. All Zimbabwe largest power stations are located appropriately as influenced by the fuel geographic location and these are Kariba and Hwange power stations. Kariba power station is located by the Kariba Dam wall the fuel source and Hwange power station in proximity to large coal reserves that are currently mined by Hwange Colliery and Makomo resources. These two power stations supplies most of the national electricity requirements from local sources before power imports. These power stations are located near country borders by coincidence location of fuel and further away from the main Zimbabwean load centres. The Transmission System takes this power from these production centres to all national load centres that are located nationally and delivers power at the highest level of power quality for forward distribution.

The table below shows the Grid map and the extend of national coverage.

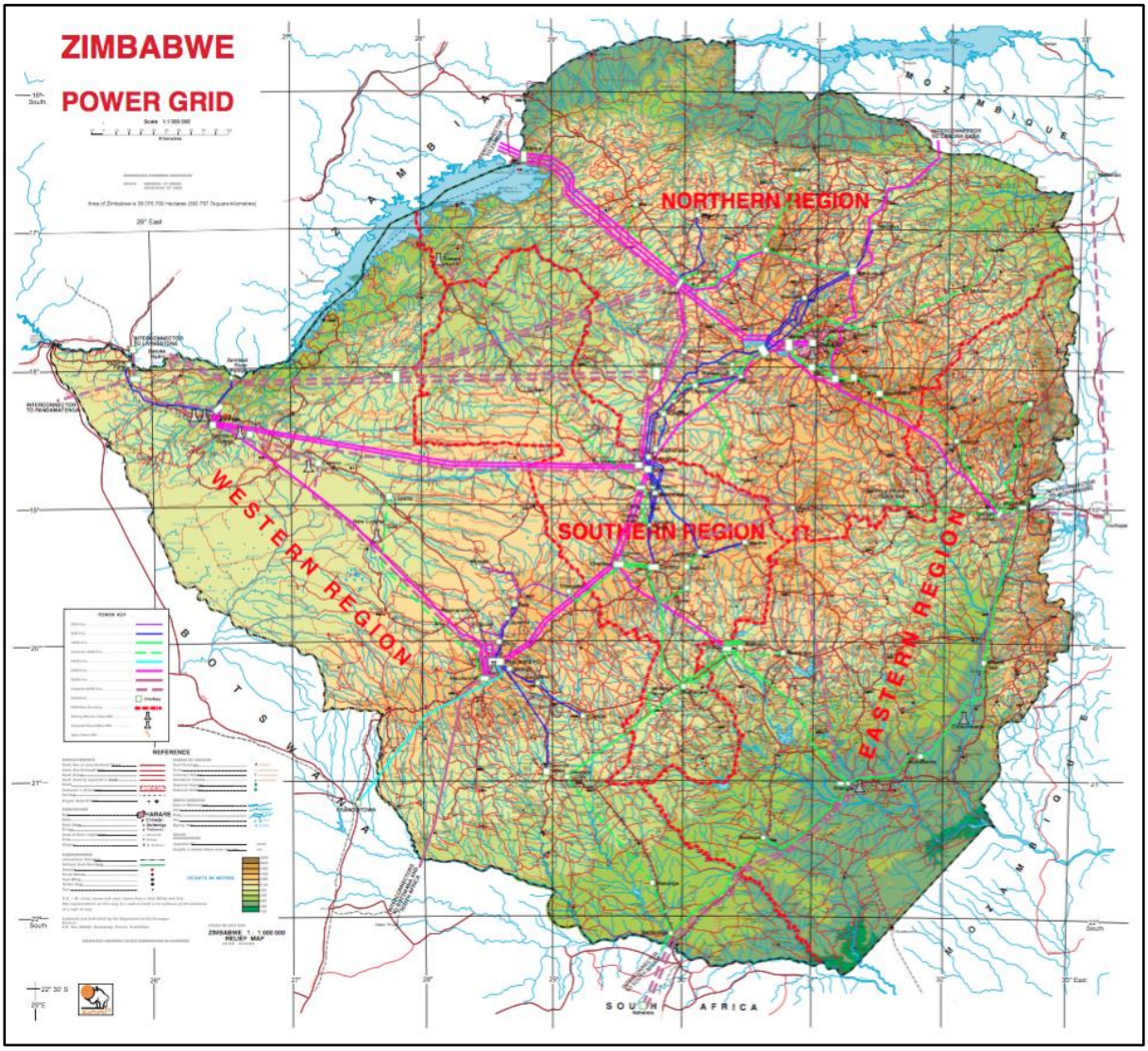


Figure 11-20: Zimbabwe grid map

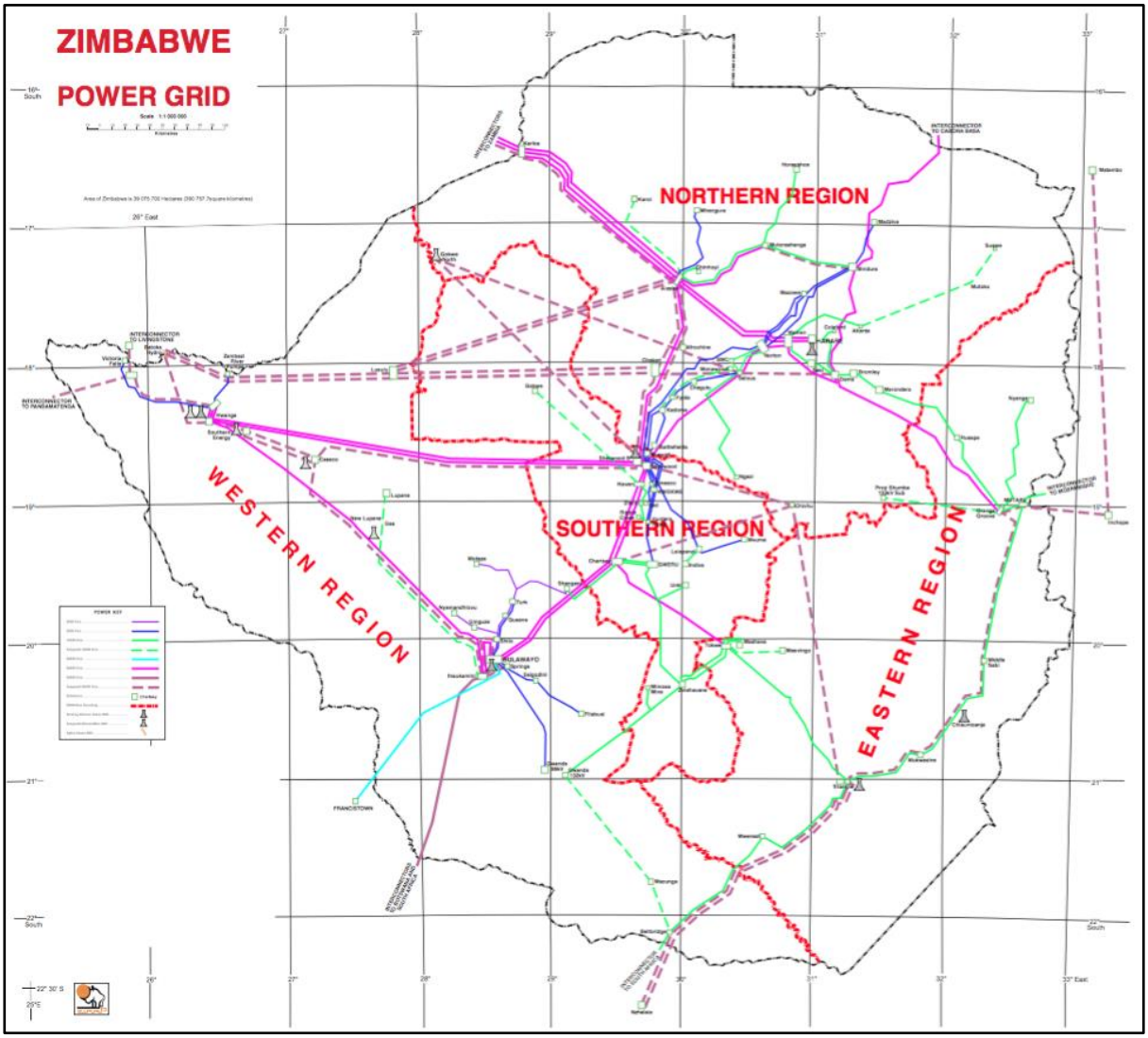


Figure 11-21: Zimbabwe Power Grid

11.5.15 ZETDC CRITICAL NETWORK INFRASTRUCTURE

Table 11-16: Transmission Line Lengths

Voltage (kV)	Total Length (km)
400	161.1
330	3230.4
220	126
132	2129.49
110	4.8
88	1643.9
66	52.5

TOTAL	**7348.19**

Table 11-17: Distribution Line Lengths

Voltage (kV)	Total Length (km)
33	18244
11	47710
0.4	53819
TOTAL	**119773**

Table 11-18Substations

ITEM	TYPE OF S/STATION	QUANTITY
1	400/330	1
2	330/220/11kV	1
3	330/132/11kV	9
4	330/88/11kV	4
5	330/33/11kV	3
6	132/33kV	24
7	132/11kV	13
8	88/33kV	14
9	88/11kV	15
10	33/11kV	471
11	33/0.4kV	2156
12	11/0.4kV	32437

Table 11-19: Transmission and Sub-transmission Transformers

Transformer Voltage Rating (kV)	Quantity
400/330//11	1
330/220/11	2
330/132/11	20

330/33/11	5
345/33/11	3
345/96/12	2
330/88(132)/11	2
330/88/11	7
330/88	2
132/110	1
132/88	2
132/33	51
132/11	7
132(88)/11	5
88/66	2
88/36	1
88/33	20
88(132)/11	1
88(132)/33	2
88/11	26
88/36(12)	1
Total	**163**

11.5.16 TRANSMISSION SYSTEM AGES ANALYSIS

Table 11-20: Summary of 330kV Line Numbers and Lengths

Age Category (Years)	>=60	50 - 59	40 - 49	30 - 39	20 - 29	Total
No. of 330kV Lines	8	2	9	2	4	25
Combined Line Length in Age Category (km)	708.2	29.2	1644.5	485	365.3	3232.2

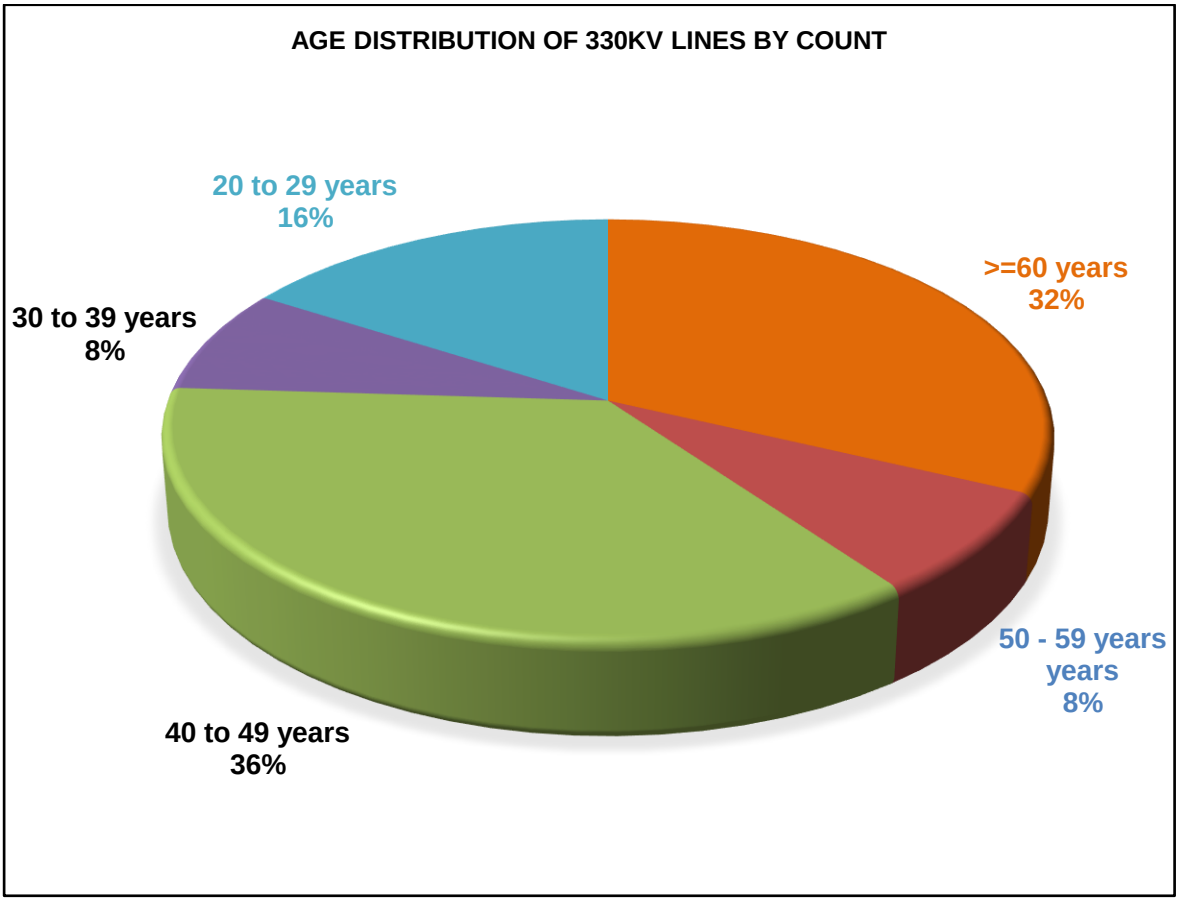


Figure 11-22: Distribution of 330kV line age

Over 76% of 330kV lines are over 40 years old.

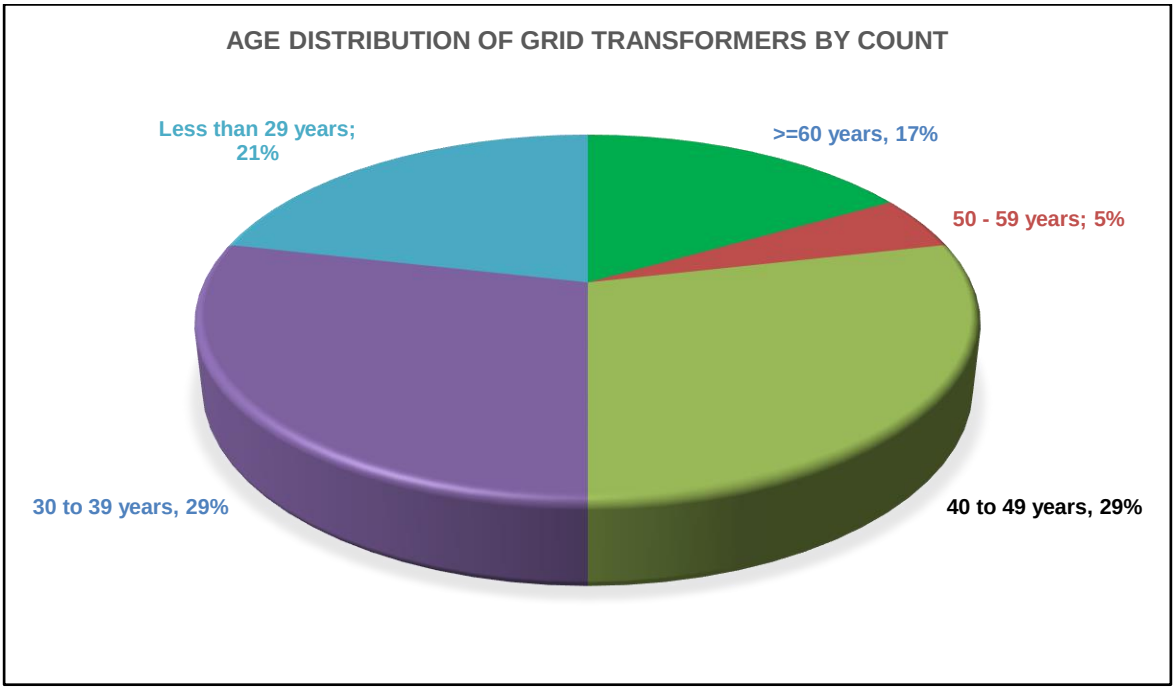


Figure 11-23: Grid Transformer age

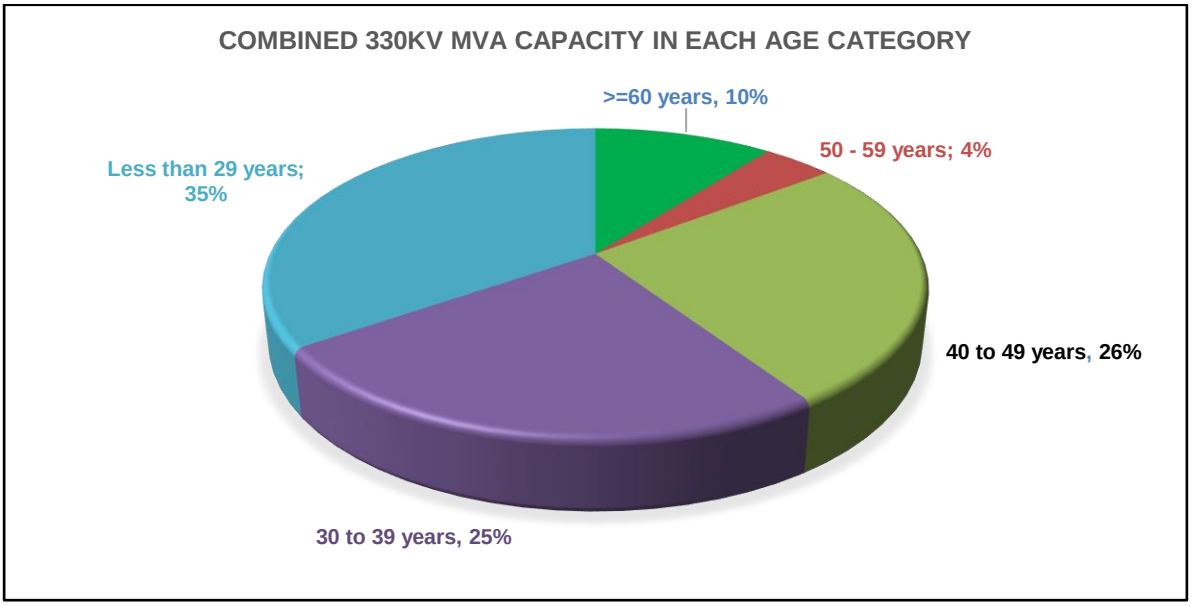


Figure 11-24: 330 kV Capacity per age category

Grid transformers are critical components at bulk supply points of the network and 40% of these transformers are over 40 years.

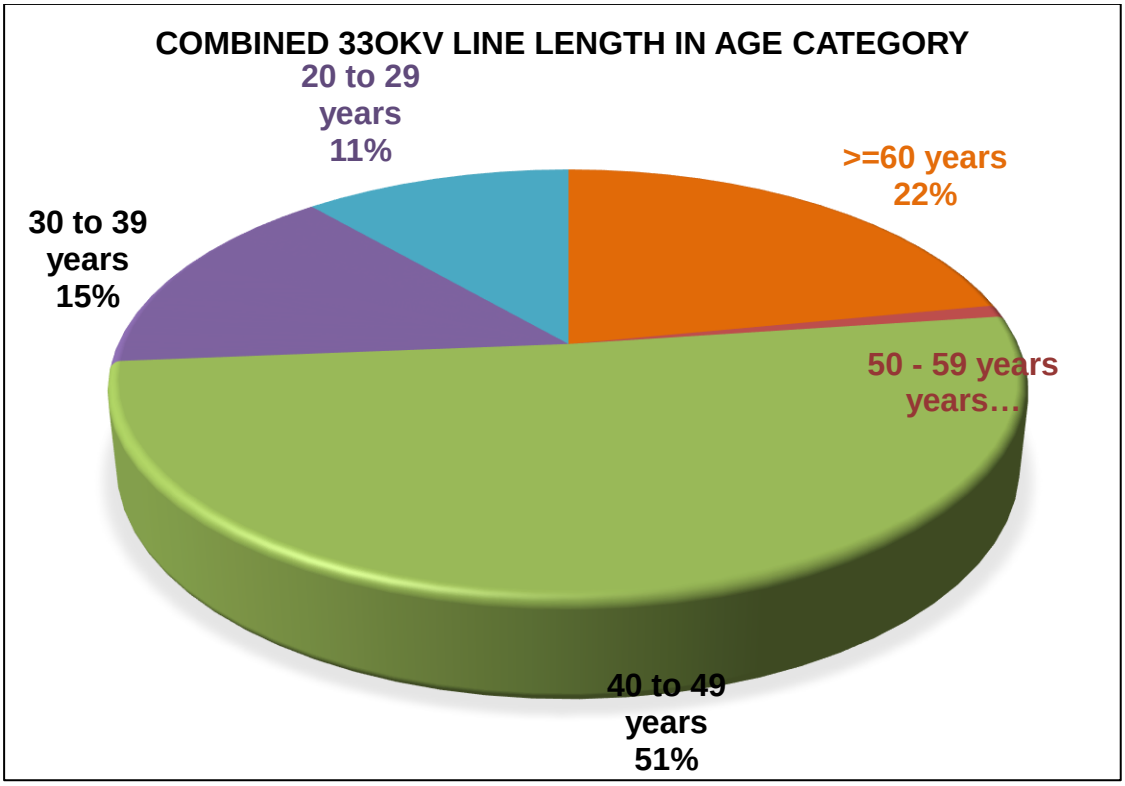


Figure 11-25:330kV Line length age

The last pie-chart depicts the combined line lengths in each age category as percentages of the total 330kV transmission line length.

Table 11-21: Summary of 132kV Line Numbers and Lengths

Age Category (Years)	>=60	50 - 59	40 - 49	30 - 39	20 - 29	0 - 19	Total
No. of 132kV Lines	1	10	16	4	18	5	54
Combined Line Length in Age Category (km)	108.1	157.4	732.9	273	725.2	103.2	2099.8

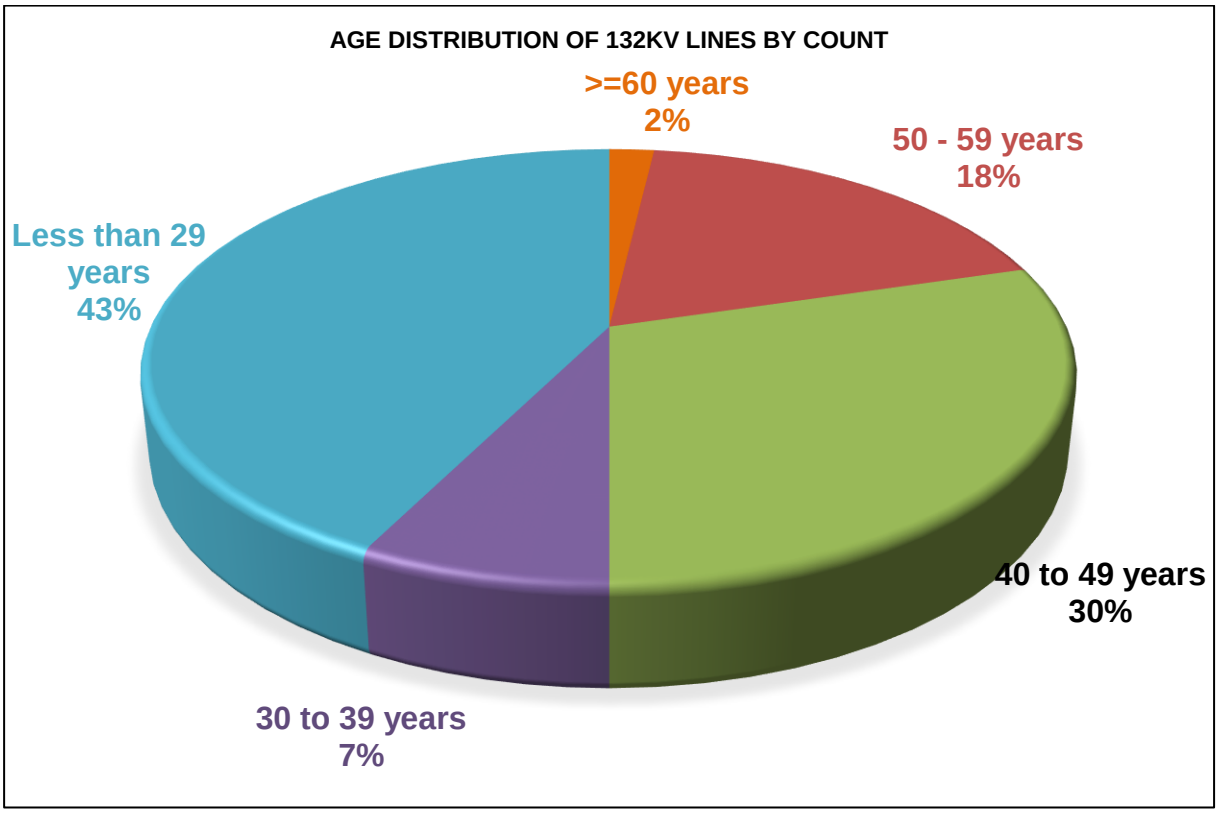


Figure 11-26: 132 kV Age distribution by count

50% of the 132kV Transmission Lines are over 40 years.

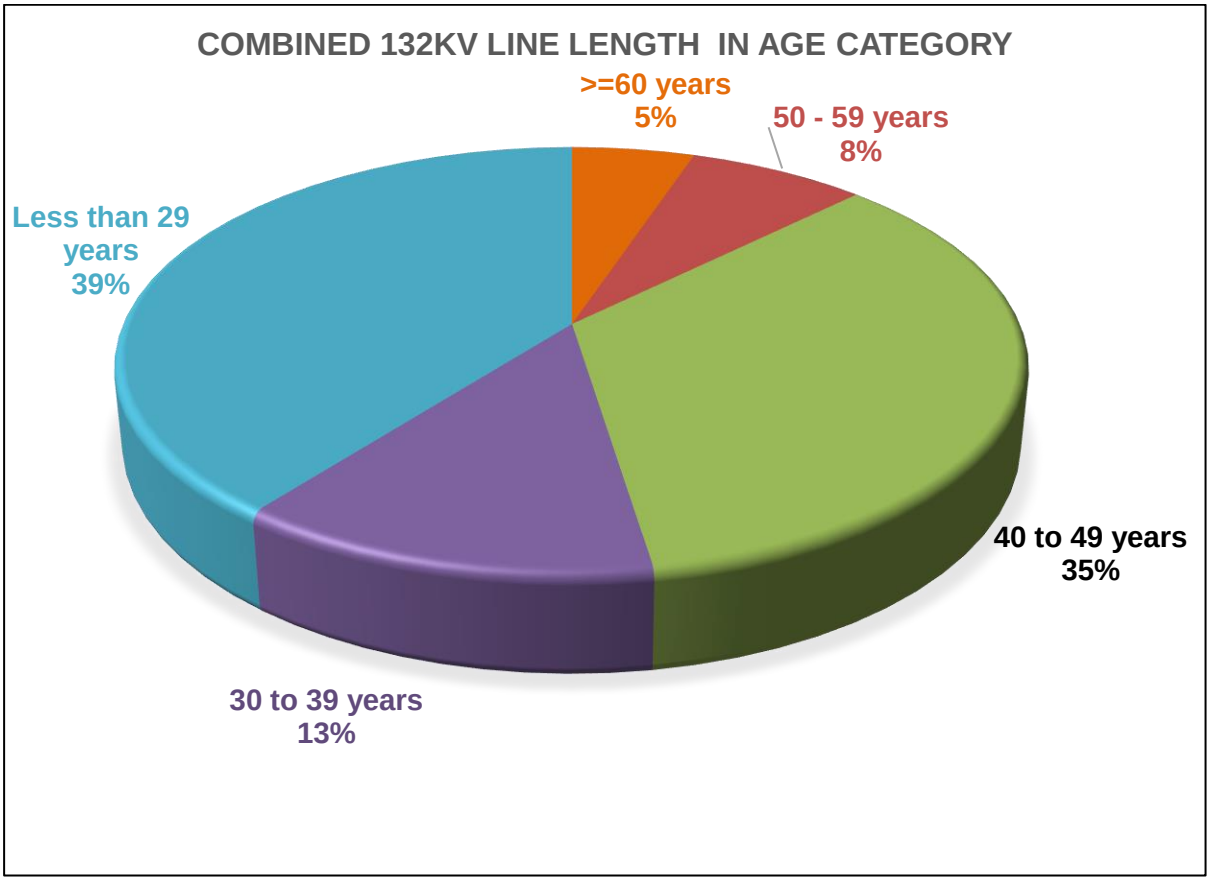


Figure 11-27: 132kV line length age

The last pie-chart depicts the combined line lengths in each age category as percentages of the total 132kV transmission line length.

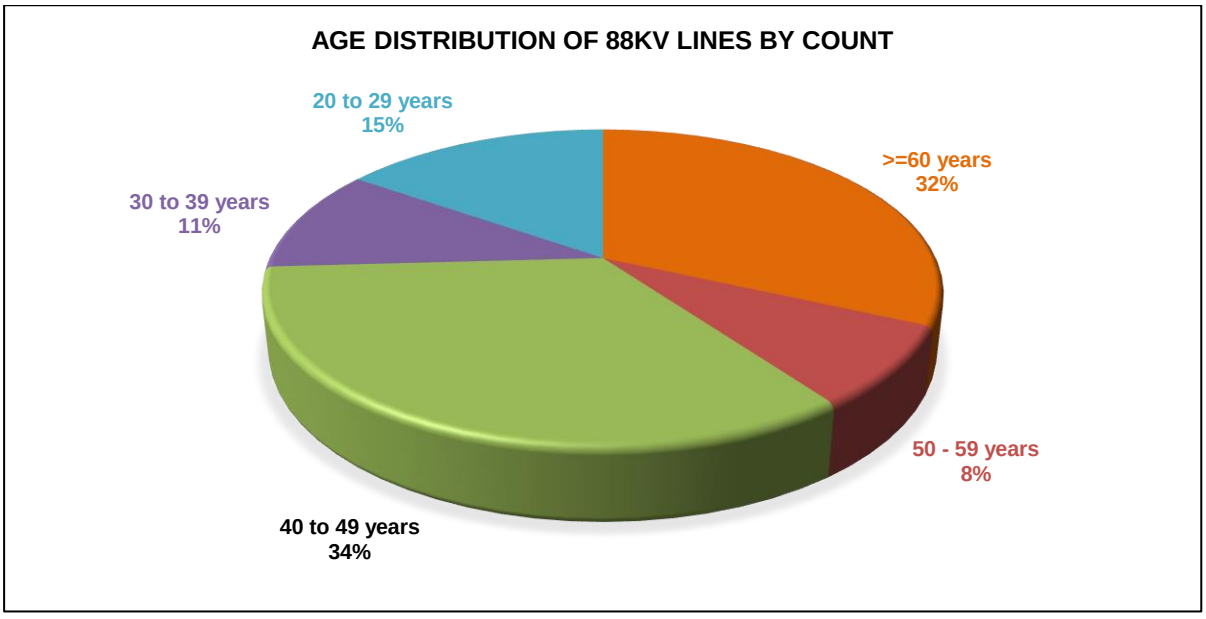


Figure 11-28: 88kV lines age distribution

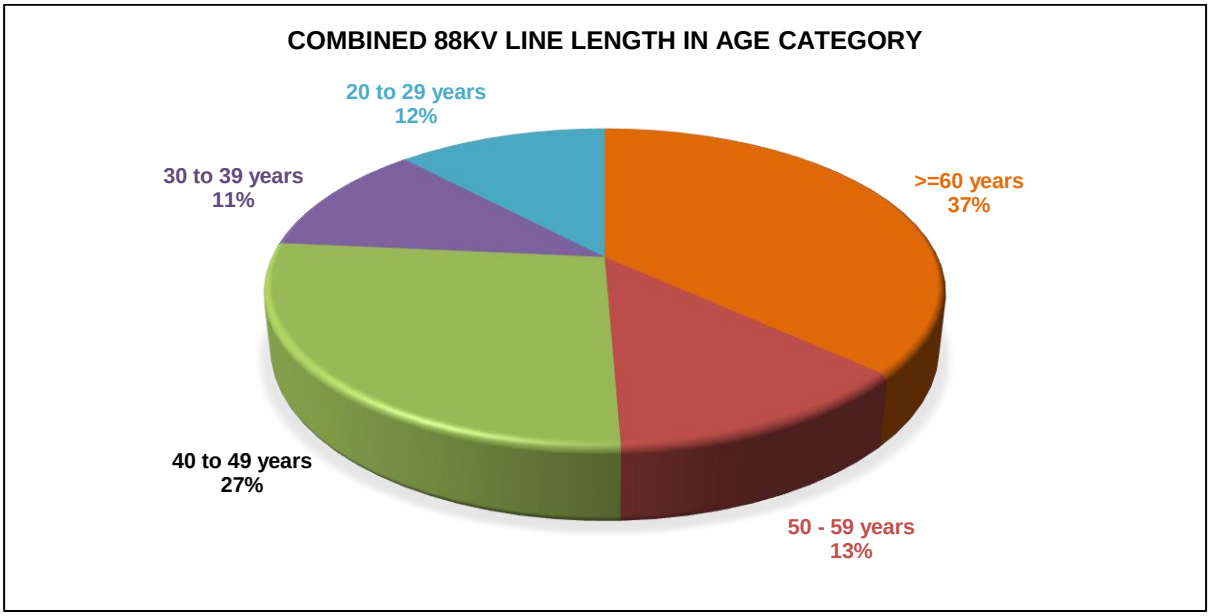


Figure 11-29: 88kV Line age

The last pie-chart depicts the combined line lengths in each age category as percentages of the total 88kV transmission line length. 74% Of the 88KV lines is over 40 years old.

11.5.17 DISTRIBUTION NETWORK AGE ANALYSIS

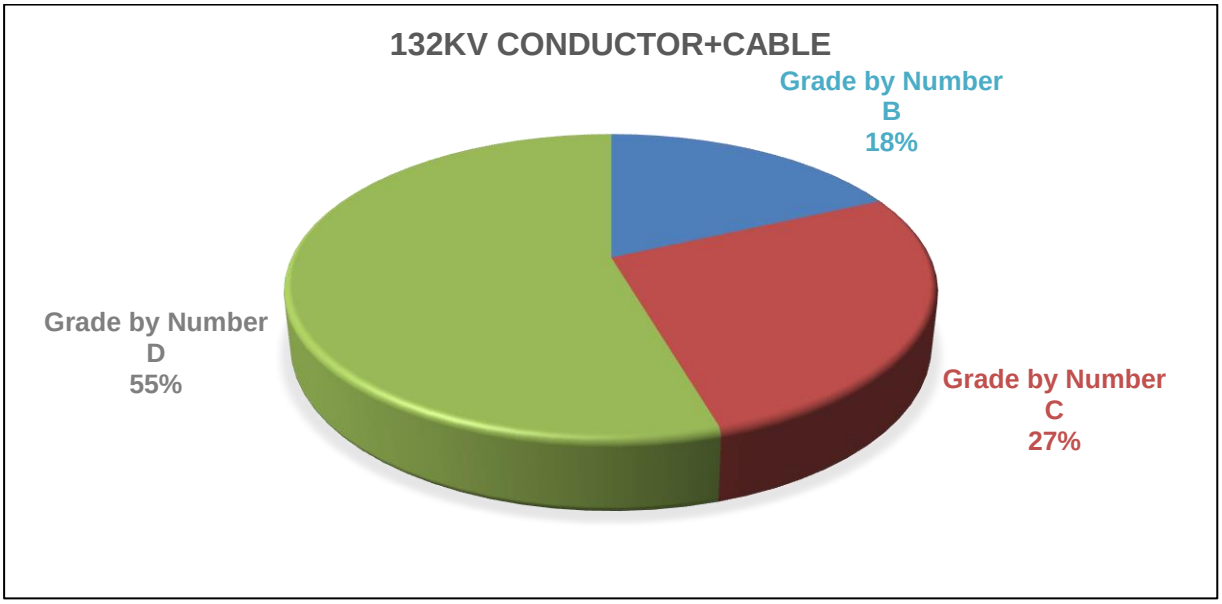


Figure 11-30: 133kV conductor cable age

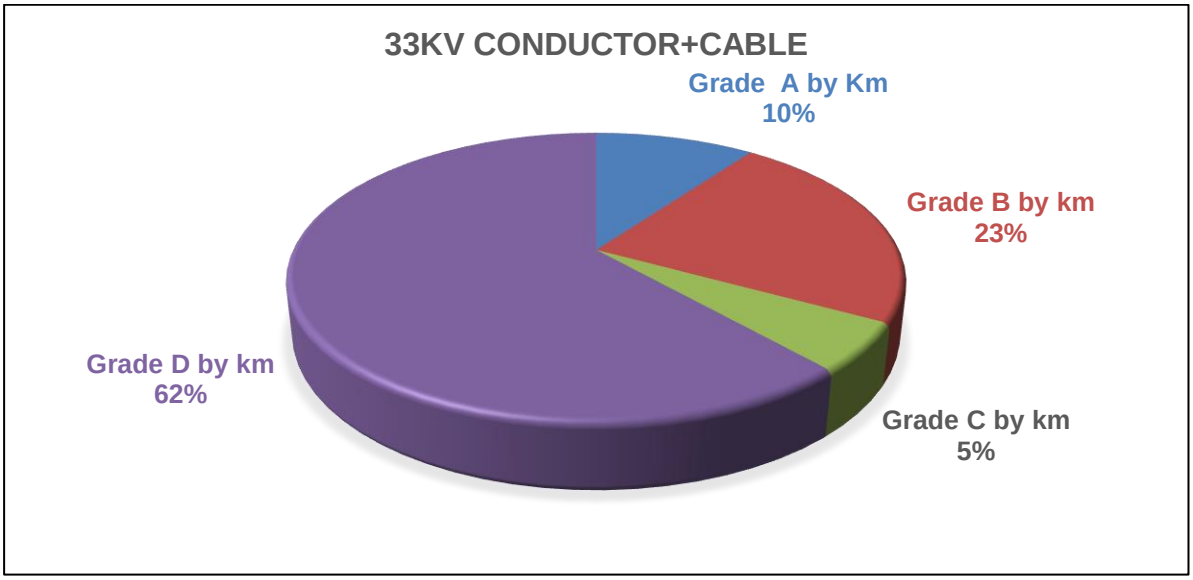


Figure 11-31: 33kV Conductor cable Grade

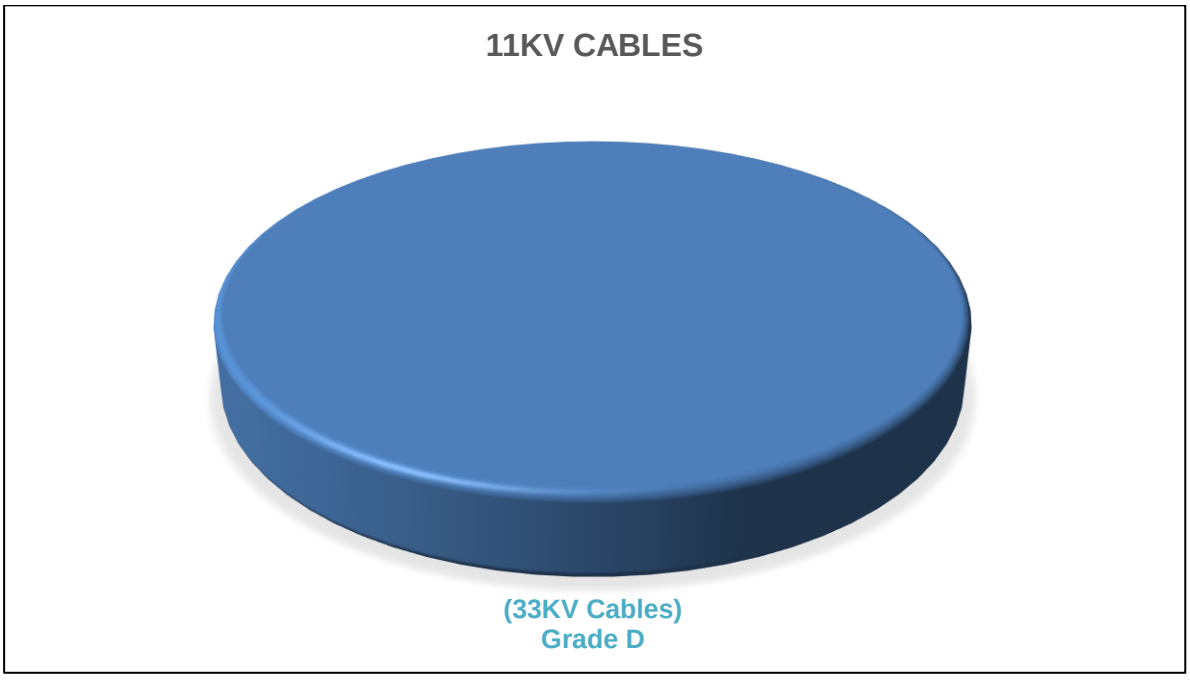


Figure 11-32: 11kV Cables Grade

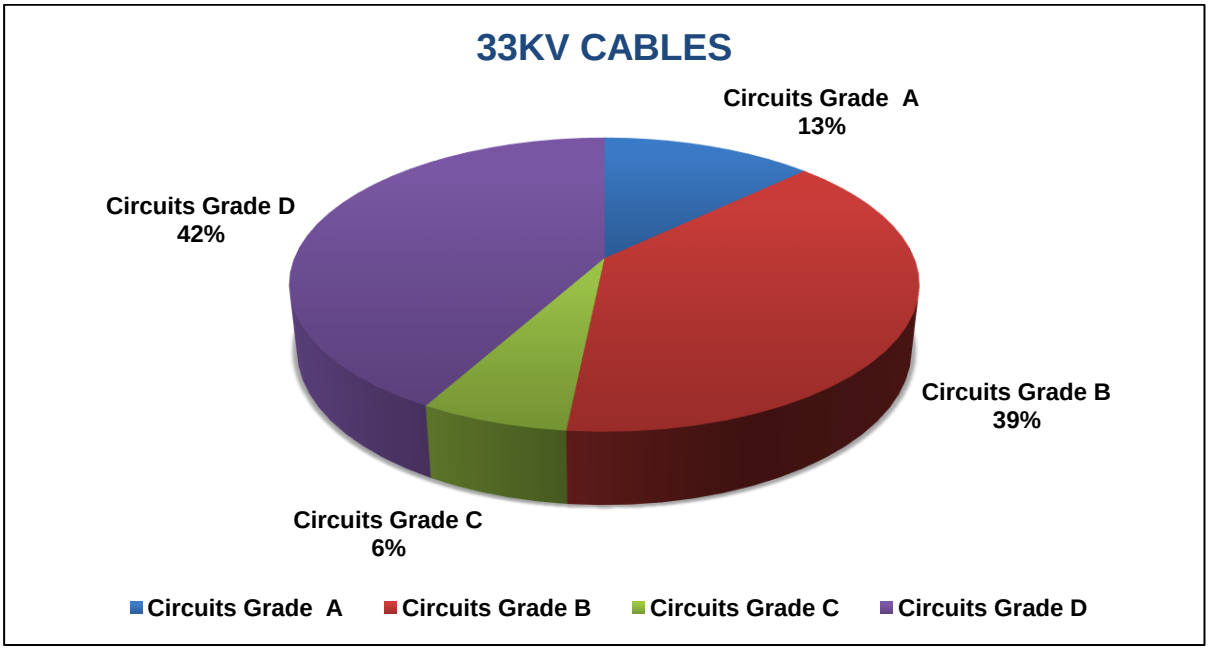


Figure 11-33; 33kV circuits grade

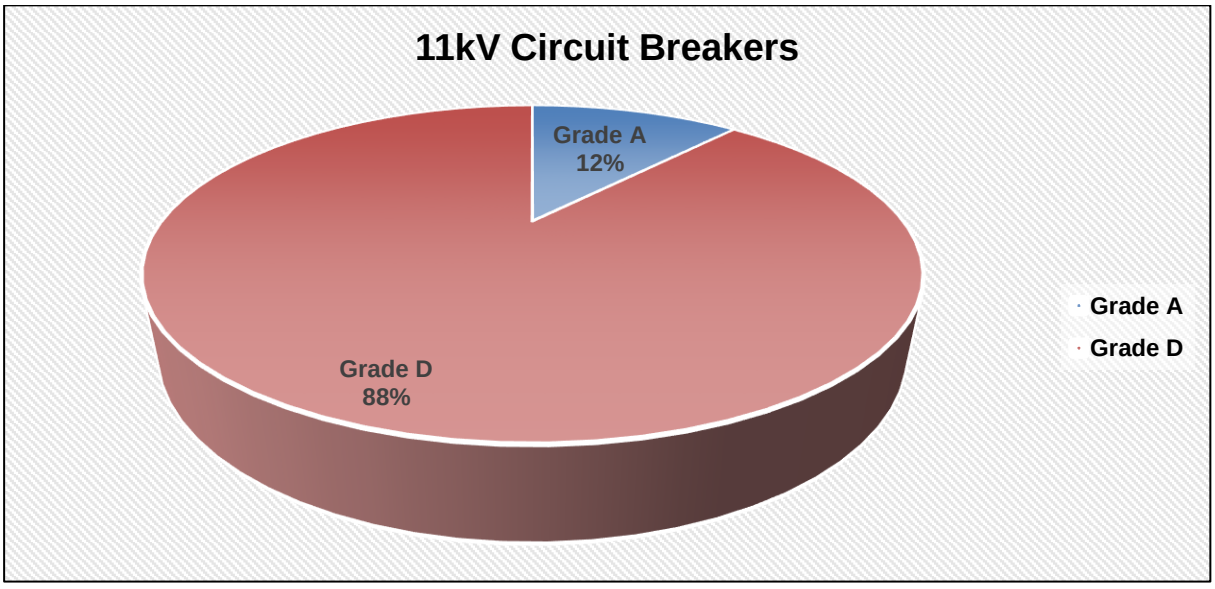


Figure 11-34: 11kV circuit breakers grade

11.5.18 SWITCHGEAR AGE INVENTORY ANALYSIS

132KV SWITCHGEAR

Figures below shows the percentage age distribution for all 132kV circuit breakers and percentage distribution for circuit breakers above 20years respectively.

it can be seen that the bulk of Distribution 132kV circuit breakers are way over their technical life of 20 years and are due for replacement. Fig. shows a breakdown of the switchgear above 20years and network performance and safety is at risk as 68% of the circuit breakers are above

20 years are now over 40 years thereby requiring urgent attention. This situation is untenable as supply system security and safety standards can no longer be guaranteed. This group of breakers is frequently failing and due to obsolescence, the breakers are often bypassed thereby compromising the network protection configuration, effectiveness and efficiency and increasing risk of damage to plant and equipment due to lack of protection.

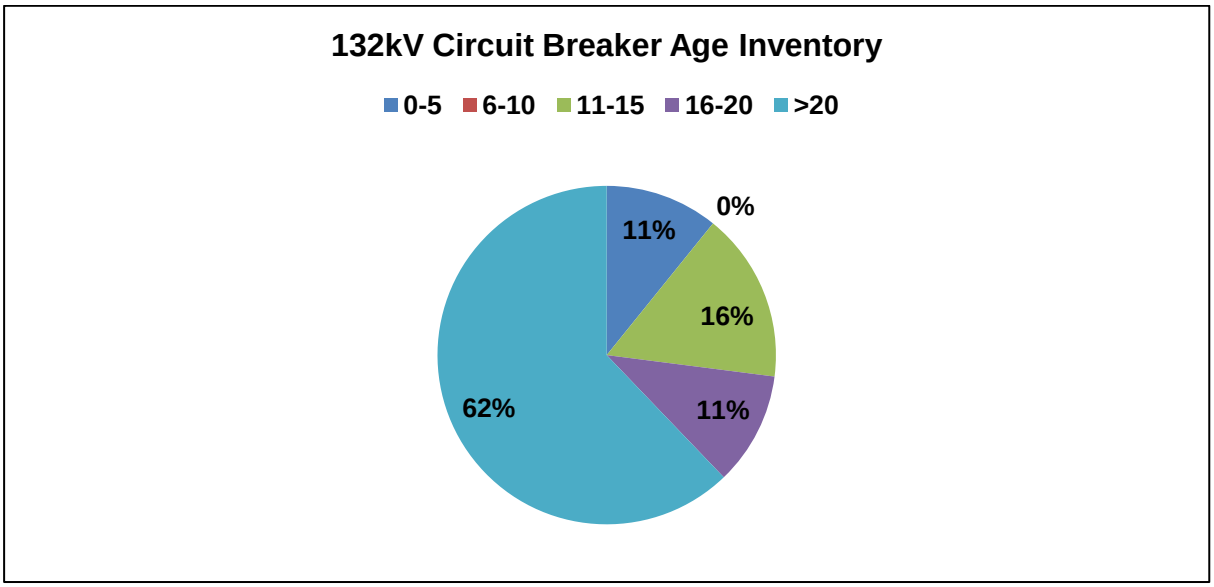


Figure 11-35: 132kV circuit breaker percentage distribution

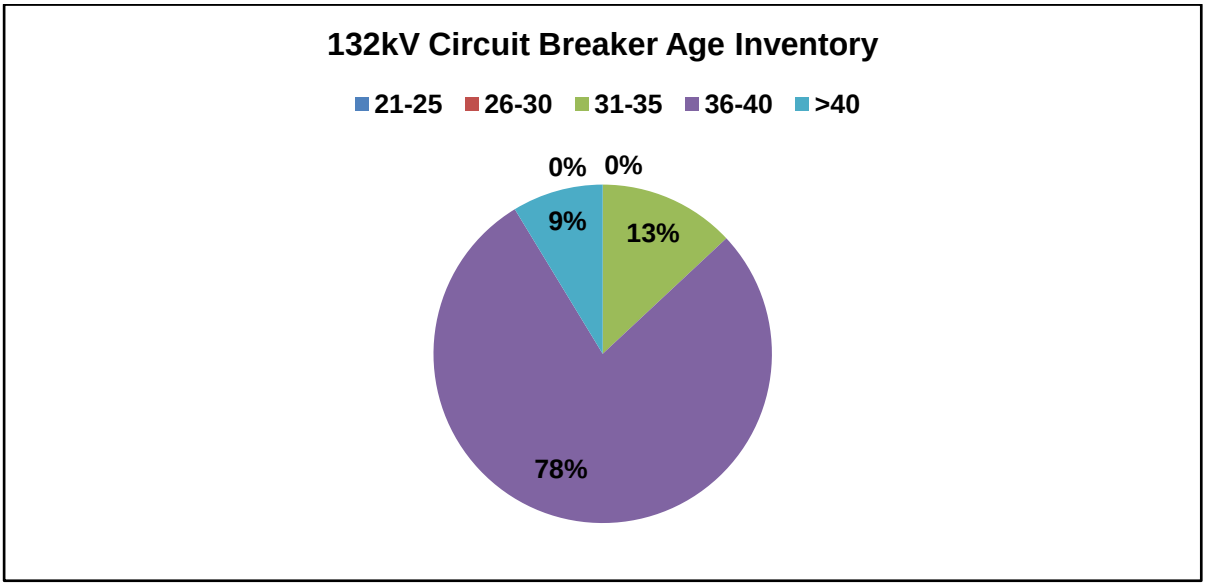


Figure 11-36: Percentage distribution of 132kV circuit breakers above 20years

33kV Switchgear

Figure below show the percentage age distribution for all 33kV circuit breakers.

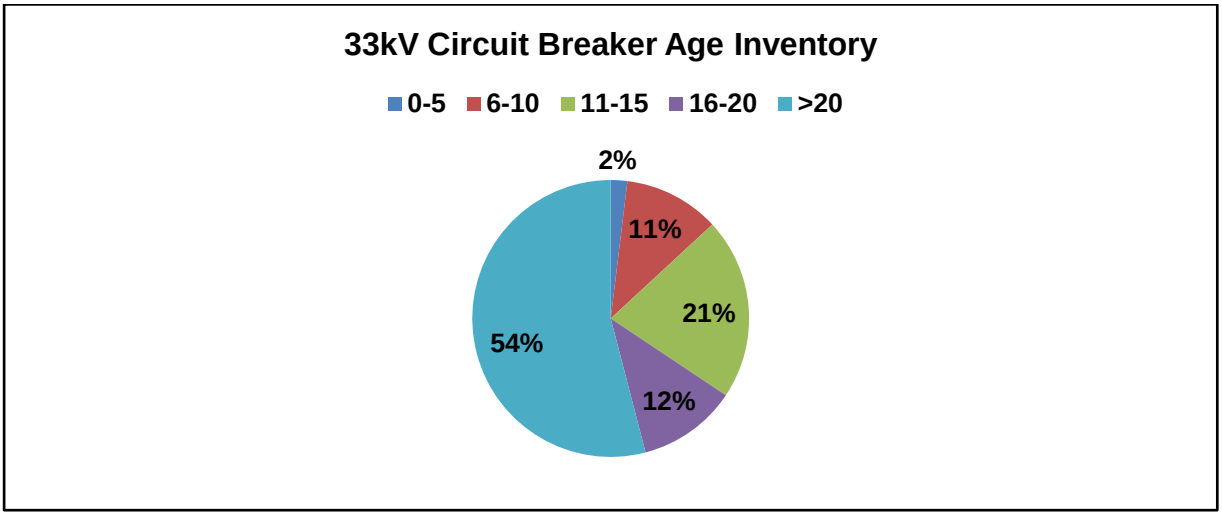


Figure 11-37: 33kV CB percentage age distribution

The chats above shows there is risk to security of supply, safety of personnel and risk of damage to plant and equipment as 74 % of the switchgear is above the 20 year useful service life and only 26% are below 20 years.

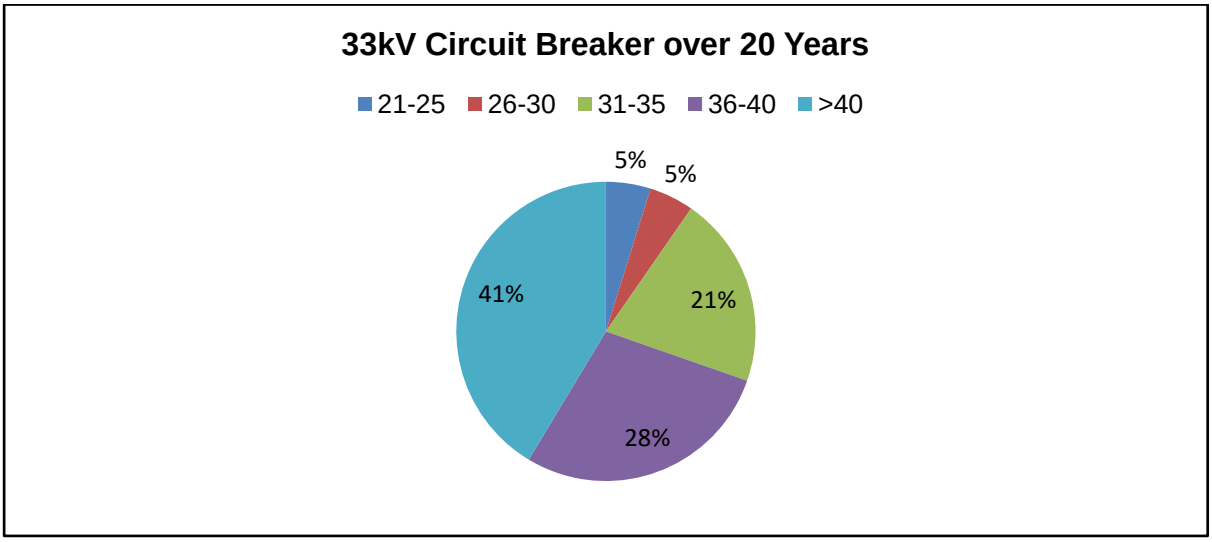


Figure 11-38: 33kV Circuit breaker age

The chat above shows a percentage breakdown of switchgear above 20 years of age up to 40years.The statistics shows that only 41% of the breakers are below 30years, with 6% being in the 31-35 year age group. The remaining 53% breakers in this category are above 36 years of service life. Of that figure, 50% of circuit breakers are above 40years.These circuit breakers are obsolete and therefore no spares are available for effective maintenance. The breakers have become a safety hazard to personnel as their performance can no longer be guaranteed. The situation is worsened by the fact that most of them are no longer operable remotely.

11kV SWITCHGEAR

Figures below show the percentage age distribution for all 11kV circuit breakers.

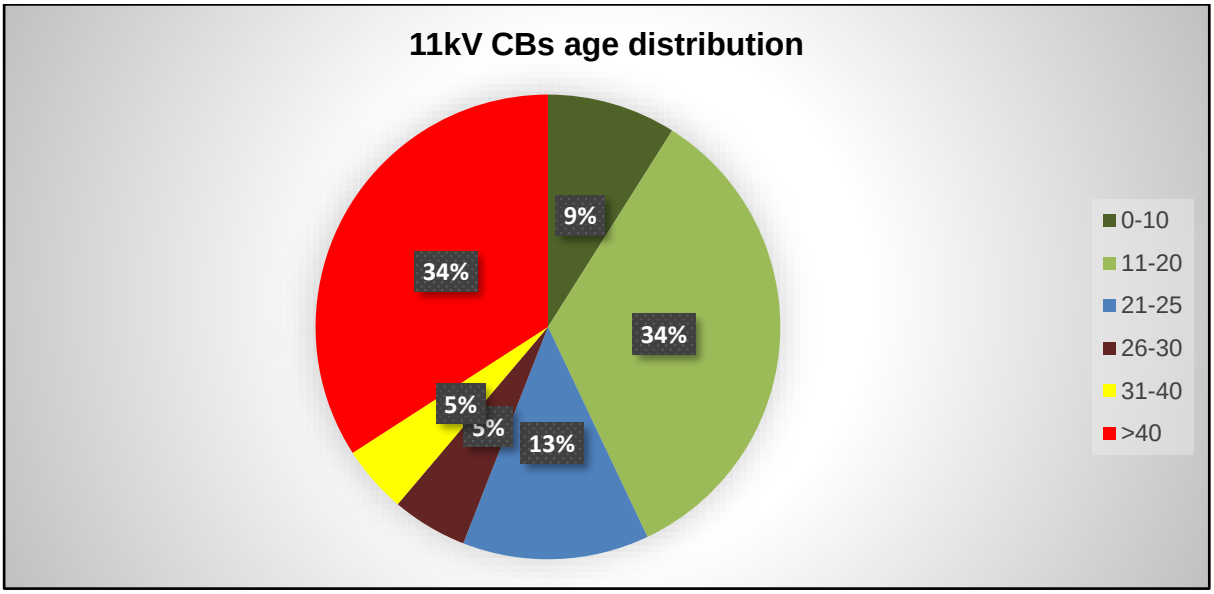


Figure 11-39: 11kV Circuit breaker age

The statistics shows that 57% of the 11kV circuit breakers are above their technical useful life. This presents supply system security, safety and reliabilty challenges on the network as only 43% are below 20 years. 34% of the switchgear is above 40 years service life. The switchgear is now obsolete, in bad condition with some boards having only a few breakers in service and cannot meet present day demands and standards on safety and reliabilty. This has been evidenced by the high fault rates of the switchgear partucularly for switchgear installed in the 1970s. The breakdowns have been characterised by explosions presenting a serious safety hazard to personnel, plant and equipment.These faults are having a substantial negative impact on the company's revenue inflows with customers going for days without supplies.

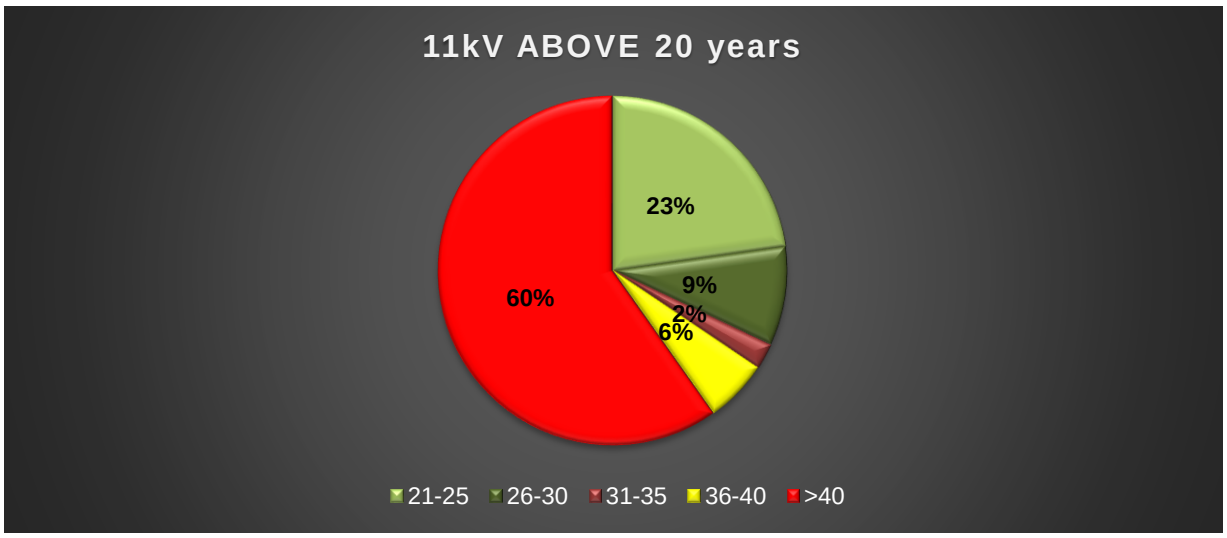


Figure 11-40: Switchgear above 20 years

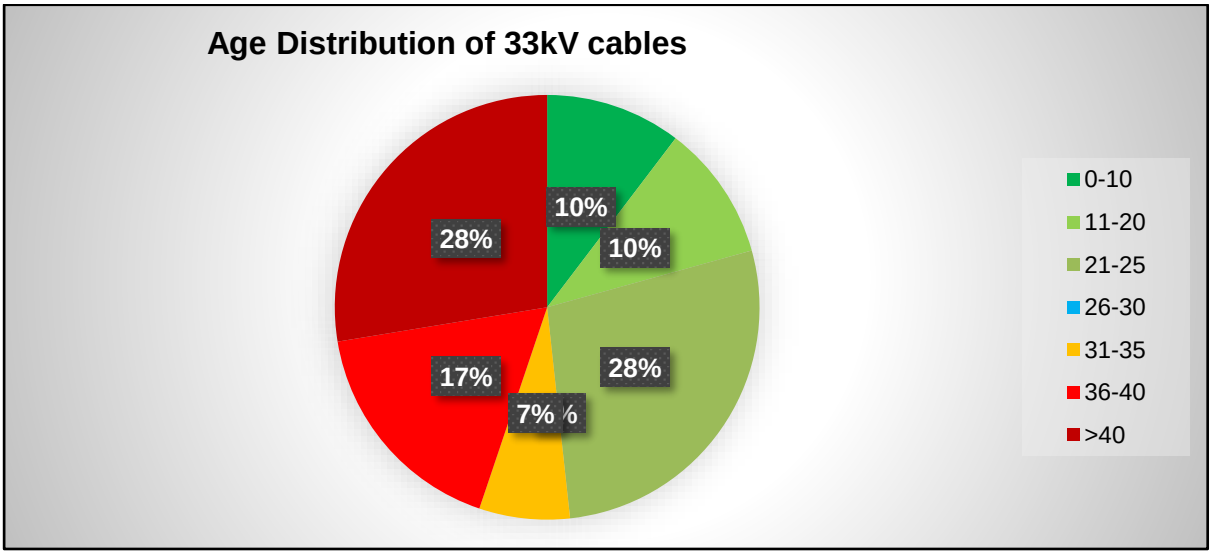


Figure 11-41: 33kV cables age

The chat above shows the 33kV cables age profile and those that are above 20 years old (service life of older cables). Statistics show that a lot of cables are de-rated according to age and depth. This presents overloading problems on the already deteriorating cables. 80% of the 33 kV cable are above 20 years service life. Some cables are now obsolete and in bad condition.This has been evidenced by the high fault rates of the cables particularly for cables commissioned in the 1970s. These faults presents a network reliablity problem and negative impact on the revenue collection as they are associated with long fault location and repairs. Customers are therefore subjected and expose to long duration faults and repeat faults.

CURRENT TRANSFORMERS AGE ANALYSIS

132 kV CTs

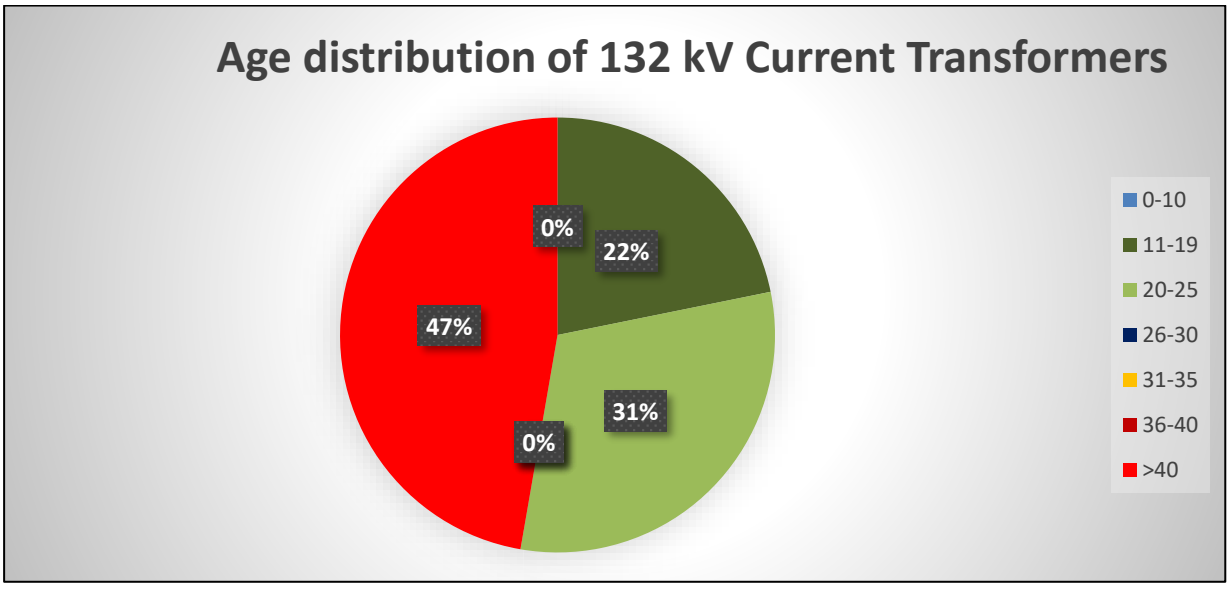


Figure 11-42: 132kV Transformers age

132kV Current Transformers

Figures 5.10 above shows the percentage age distribution for all 132kV current transformers. it can be seen that the bulk of the 132kV current transformers are way over their technical useful life of 25 years and are due for replacement. The situation is risky as 48% of the current transformers are above 40 years. This situation is a problem to the system as system security, safety standards, reliability and proper accuracy for protection and metering can no longer be guaranteed. This may lead to false alarms, mulfunctioning, cause of unknown faults and risk of damage to plant and equipment.

33KV CURRENT TRANSFORMERS

Fig below shows the age distribution of 33kV current transformers

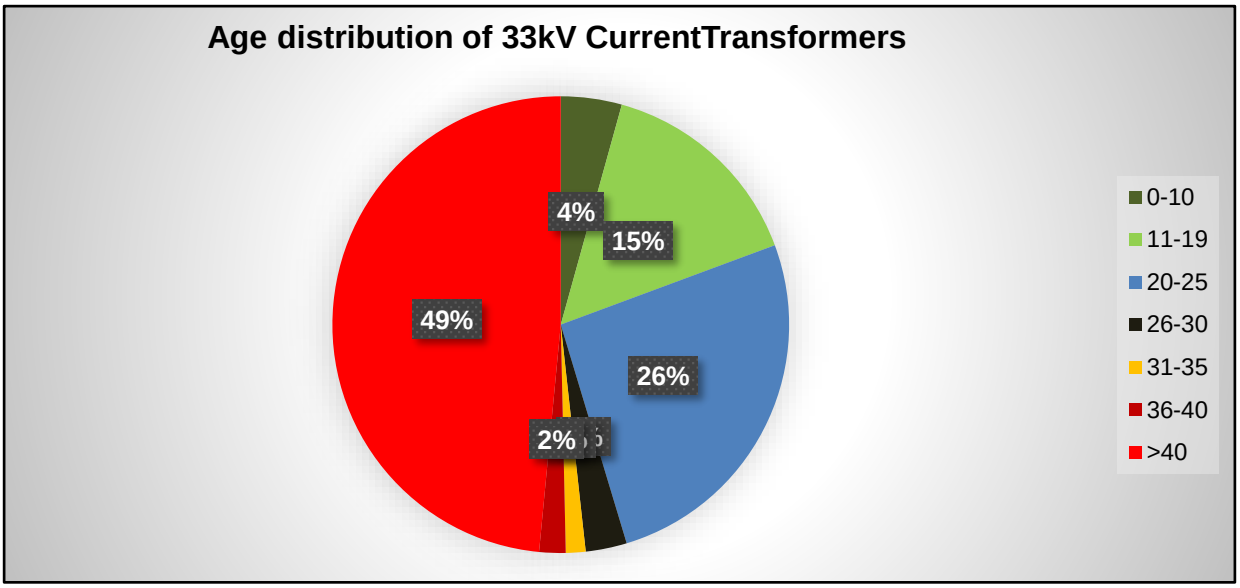


Figure 11-43: Age distribution of 33KV CTs

The chart shows there is risk to security of supply, personnel safety and risk of damage to plant and equipment as 81 % of the current transformers are above the 20 years. It is important to note that 49% of the current transformers are now overdue for replacement as they are above 40 years.

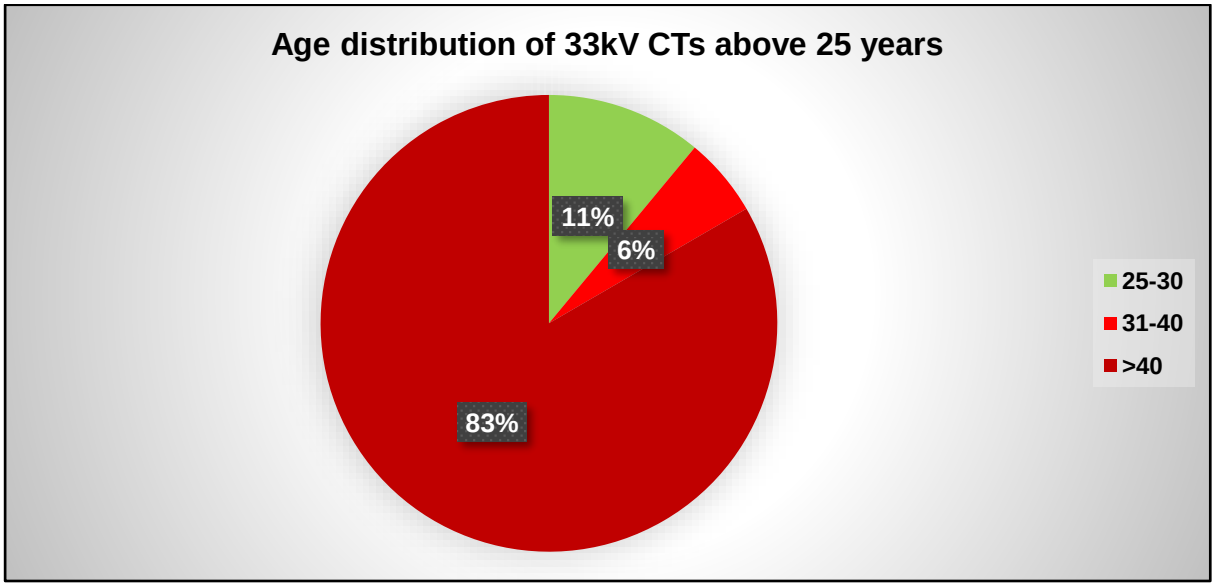


Figure 11-44: 33kV CTs above 25 years

11.5.19 ZETDC TRANSMISSION AND DISTRIBUTION MAINTENANCE ANALYSIS

Table 11-22: Maintenance analysis

Maintenance Category	**2020**
	Overall
Distribution Planned Maintenance : %	**41.25**
Overheard line wayleaves (km): 24,720	2521.14
Overheard line inspections (km): 26,037	9536.34
Overhead line maintenance (%):100	54.27
Pole Mounted Transformers and Ground Mounted Transformers inspections (number): 32,437	2942
Pole Mounted Transformers and Ground Mounted Transformers maintenance (number): 32,437	2318
Pole replacement (number): 27,352	4738
Disc insulator change (number): 878	1476
Switchgear (number): 2597	777
Primary transformer (number): 2597	206
Basic Housekeeping (number):100%	57
Primary substation maintenance and housekeeping (number): 1806	1189
Transmission Planned Maintenance : %	**78.09**
Wayleave – National Grid (%)	87.78

Wayleave – Sub transmission (%)	60.35
Transformers (%)	85.77
Transformer Bays (%)	110.88
Feeder bays (%)	69.62
Reactors (%)	68.75
Capacitors (%)	50
Compensation equipment (%)	0
Compressor plants (%)	100
Battery installations (%)	100
Condition Monitoring National Grid (NG) (%)	59.07
Condition Monitoring sub transmission (%)	54.88
Statutory inspection and maintenance	
Distribution fire extinguishers (%):100	68.75
Distribution lifting gear (%):100	66.67
Transmission fire extinguishers (%)	100
Transmission lifting gear (%)	81.08
Breakdown maintenance	
Distribution breakdown maintenance (%)	80
Transmission breakdown maintenance (%)	66.65

F59. Source: ZETDC 2020 4th Quarter MD's Brief

DISTRIBUTION SYSTEM MAINTENANCE SUMMARY AT A GLANCE

Table 11-23: Distribution system maintenance summary

Maintenance Area	Total Length (km)
Overheard Lines Wayleaves	1.9% of Asset Base
Overheard Lines Inspections	7% of Asset Base
Overheard line Maintenance	54.27%
Pole Mounted Transformers Inspections (number): 32,437	9%
Pole Mounted Transformers Maintenance	7%
Pole replacement (number): 27,352	17%

Switchgear Maintenance (number): 2597	30%
Primary transformer Maintenance (number): 2597	34.5%
Primary substation maintenance and housekeeping (number): 1806	65%
Distribution breakdown maintenance (%)	80%
Statutory inspection and maintenance	68%

The distribution network is vast with an estimated number power transformers of 35000 and cumulative line length in excess of 135000km. The 2020 system maintenance report show very constrained maintenance coverage across the system with power lines and transformers with the highest risk exposure. ZETDC was unable to carry out appreciable overhead line wayleave clearance and inspections in the year 2020 and yet it reported a relatively high level of overheard line maintenance. The high level of overhead line maintenance is therefore viewed as inconsistent. The Distribution System Business Unit is the most extensive part of the network and has unsustainable and crippling levels of maintenance.

TRANSMISSION SYSTEM MAINTENANCE SUMMARY

The Transmission System level of maintenance is high relative to the distribution network across all maintenance areas. This network is substantially smaller than that of the distribution network and where maintenance resource constraints are prevalent, this part of the network can relatively be covered easily with resource prioritisation towards it.

11.5.20 TRANSMISION AND DISTRIBUTION NETWORK PERFOMANCE

Table 11-24: Distribution performance parameters

Distribution Performance	2013	2014	2015	2016	2020
Energy Sales /GWh	8,295	8,280	7,474	7,292	6,903
Faults reported at all voltages	114,987	129,630	133,008	136,218	120,184
Average arrival time at a fault in minutes. (Urban)	255	342	340	387	586
Average arrival time at a fault in minutes. (Rural)					917
% interruption restored within 3 hrs	41	40	36	40	39
% interrupt. restored within 24 hrs	83	82	52	62	57

Distribution Performance	2013	2014	2015	2016	2020
Minutes lost per connected customer	58	26	12	31	13

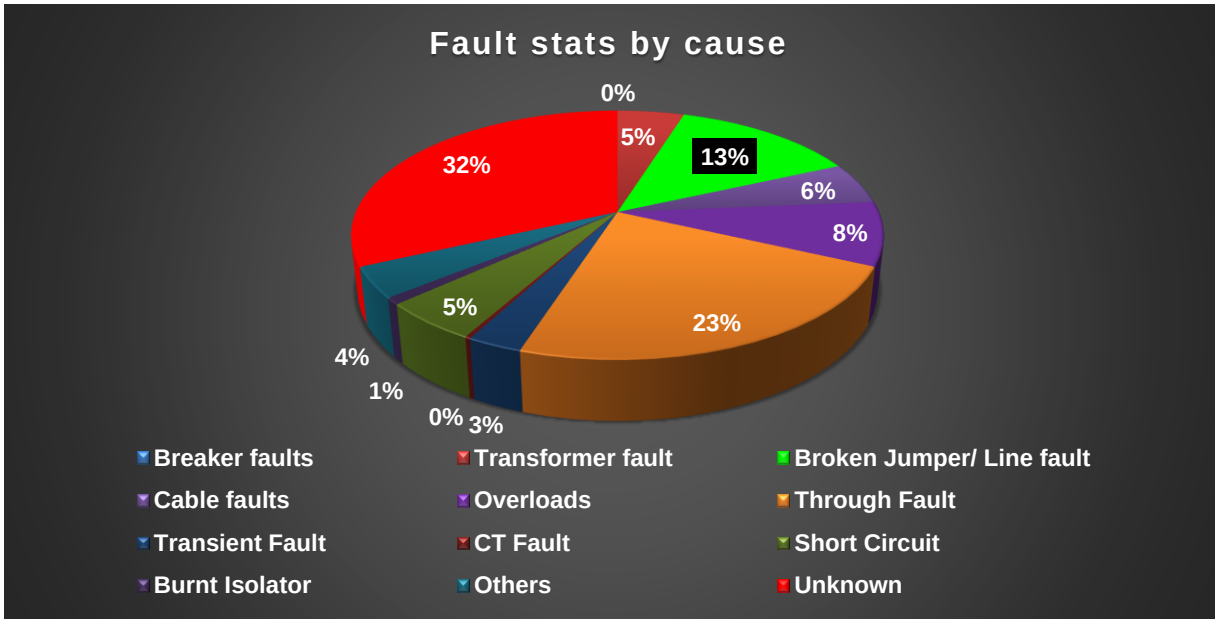


Figure 11-45: Fault distribution by cause

As shown on the above charts, the majority of the faults (32%) are due to unknown reasons followed by through faults which constituted 23% of the faults. There are high number of Overhead line faults experienced especially the rain season.

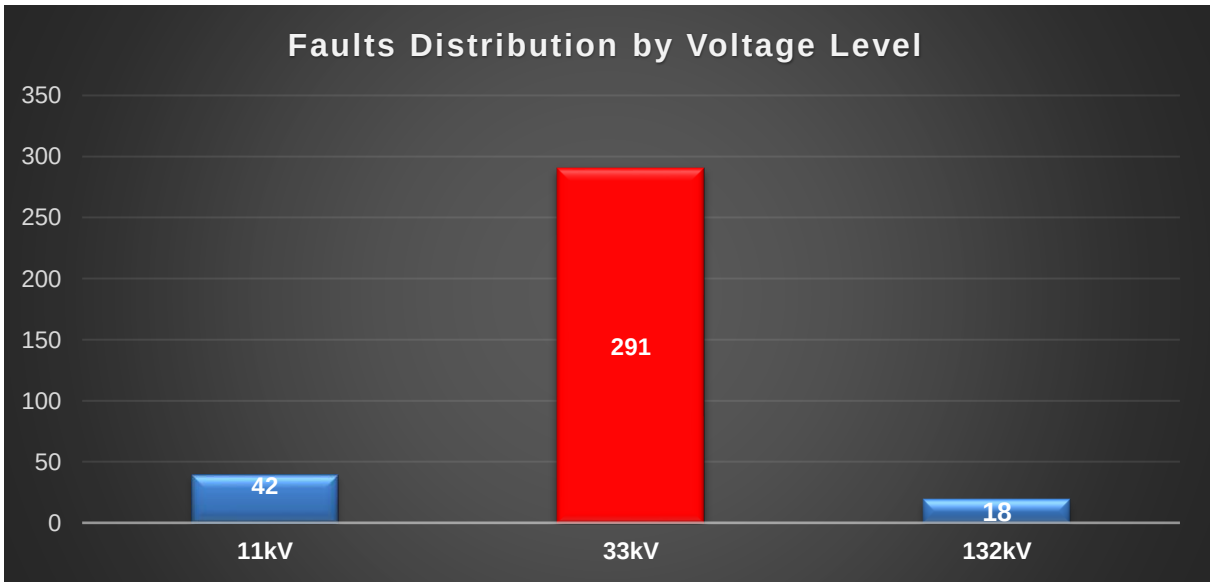


Figure 11-46: Fault distribution by voltage level

The majority of faults on the primary network occurred on the 33kV network followed by 11KV tie links and 11kV boards.

Table 11-25: Transmission Performance Statistics 2020

CATEGORY	**2020**
System Minutes	63
Transmission System Minutes	5
Sub-Transmission System Minutes	122
Number of Supply Interruptions	126
Average Duration of Interruptions (minutes)	79
No. of Frequency Excursions outside Statutory Limits*	0
No. of Voltage excursions outside Statutory Limits	492
No. of supply interruptions due to primary equipment failure*	16
No. of supply interruptions due to secondary equipment failure*	27
No. of supply interruptions due to human error	6
No. of supply interruptions due to lightning	12
No. of supply interruptions due to bush fires	16
No. of supply interruptions due to unknown reasons**	19
No. of supply interruptions due to other reasons	1
Unserved Energy Attributable to Transmission (MWh)	1832

The transmission system performance is substantially higher relative to the distribution network, it operates within acceptable thermal loading levels and with acceptable fault level performance. Number of system faults are relatively low. The system availability and reliability is high. The number of voltages outside statutory limits is very high due to inadequate voltage compensation equipment.

ZETDC ISSUES THAT AFFECT INFRASTRUCTURE PERFORMANCE

Table 11-26: Infrastructure performance challenges

MAJOR FINANCIAL CHALLENGES	MITIGATION MEASURES
Funding constraints: a) **Unsustainably Low Tariffs** b) **Foreign Currency Constraints – continue to negatively impact on** ➢ Power Import Bills Settlement ➢ Availability of Strategic Spares, Prepayment Meters (120k), Transformers (4,700) ➢ Financing of EPC Projects	**Shareholder engagement for intervention on:** ✓ Cost-reflective tariffs, and ✓ Foreign currency allocation from the Central Bank.
High number of faults with long duration due to low maintenance activities – negatively impacting on revenue collection and client satisfaction	**High number of faults:** ➢ Infrastructure rehabilitation, refurbishment, prioritising equipment maintenance We require 25,000 wooden poles, about 4,600 Distribution transformers, switchgear replacement;
Limited Budget for: ¥ Maintenance ¥ Inadequate Tools and Equipment ¥ Inadequate Operational vehicles ¥ Synchronised aged equipment overdue for replacement ¥ Overloaded infrastructure	**Cost-reflective tariffs,**
High System Losses 19%	**Network investments**

Poor service quality	**Poor service delivery –** Use of ICT systems, establishment of a Contact Centre, Billing System upgrade.
High accident levels: ▪ Fatalities ▪ Injuries ▪ Property damage ▪ Loss of livestock	Accidents prevention through, among other measures: • Switching authorisation training • Awareness campaigns on safety • Disconnecting unsafe installations Statutory inspections of installations

11.5.21 ZETDC ASSETS RANKING

ZETDC assets are split into Transmission and Distribution Categories for the purposes of condition ranking.

RANKING CRITERIA

A World-class	B Fit for The Future	C Satisfactory For Now	D At Risk of Failure	E Unfit For Purpose
Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure pressure from unusual events.	Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents.	Infrastructure condition is acceptable, although stressed at peak periods. It will need investment in the current Medium-Term Expenditure Framework period to avoid serious deficiencies.	Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience, and even danger, without prompt action.	Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate action is required.

TRANSMISSION ASSETS RANKING

The main Transmission System Assets used for the purpose of Ranking are Lines, Transformers and Substations. Protection and power network control systems condition are appraised from the overall performance of the system without separating them into discrete areas in this study.

The following areas of network performance are evaluated

Parameter	Transformers GRADE	Lines GRADE	Switchgear GRADE
Network Assets Age	B	B	C
Maintenance Level across Fleet	B	B	B
Consistency of Maintenance	C	C	C
Quality of Maintenance	B	B	B
Reliability Performance	B	B	C
Network Stability	B	B	C
Voltage Compliance	D	D	B
Network Capacity	B	B	C
Network Safety	C	B	C
Network Efficiency	B	B	B
Network Security	B	B	C
OVERALL GRADE	**C**	**C**	**C**

DISTRIBUTION SYSTEM RANKING

Parameter	Transformers GRADE	O/H Lines GRADE	CABLES GRADE	Switchgear GRADE
Network Assets Age	D	B	D	D
Maintenance Level across Fleet	D	B	D	D
Consistency of Maintenance	D	C	D	D
Quality of Maintenance	D	D	D	D
Reliability Performance	D	D	D	C
Network Stability	D	D	D	D
Voltage Compliance	E	E	D	E
Network Capacity	D	D		D
Network Safety	D	E	E	E
Network Efficiency	D	D	D	D
Network Security	D	D	D	D
OVERALL GRADE	**D**	**D**	**D**	**D**

The distribution network is vast, aged and undermaintained. Equipment has been subjected to prolonged periods of under maintenance with the effect of reduced useful life (premature failure) and limiting chances of assets delivering a useful life that is way above design life. There are major synchronized age related replacement requirements that are extremely challenging to finance especially with such a vast network with poor reliability and a weak capitalization capacity. Some network components are now absolute and without supply of parts and other assets are no longer operable and some are known for frequent faults yet still cant be replaced. Situation is nation wide, severe and onerous. Safety performance of the network is poor, challenging and unacceptable with loss of human life, live stock and private property due both poor levels of maintenance and aged assets that are operating some beyond useful life.

Urgent intervention is required with innovative effective asset management approaches. Asset maintenance alone is not adequate under the circumstances.

11.5.22 ZETDC FINANCIAL HIGHLIGHTS AFFECTING SECTOR

ZETDC is the main and largest bulk power off-taker in country and to all IPPs that are operating or that choose to operate in the sector as grid connected. It has a poor credit rating from several factors affecting its business and its government ownership. An uncompetitive credit rating affects its capacity and that of its suppliers (new and old) to secure conventional finance from the market at competitive levels. ZETDC is licenced to operate the National Grid and therefore the electricity market. Its performance has a direct impact to market confidence and participation of new players. This is particularly critical as the market has been opened up by government through ZERA for participation by private developers at all levels of electricity sector value chain.

ZETDC has operated for period in excess of 15 years without cost reflective tariff and that is a strong compelling history that is excessive to render the organisation a low credit rating. Lack of cost reflective tariffs results in inadequate revenues to meet ZETDC requirements.

The historic, current and future financial standing and performance of ZETDC therefore has a direct impact on itself, ZPC and IPPs and therefore the entire electricity infrastructure owners capacity to maintain and reinvest in an efficient, economical, adequate and timely manner. The sustainability of a quality electricity infrastructure is directly related to the performance of this key and currently only system operator.

Table 11-27: Statement of Comprehensive Income for Quarter Ending 31 December 2020

	Actual 2020 (ZWL$)	**Actual 2020 USD**
Total Revenue	$23,830,000,000.00	$291,676,866.59
Total Expenditure	$33,578,000,000.00	$410,991,432.07
Operating Surplus (Deficit) before Finance charges	-$9,748,000,000.00	-$119,314,565.48

Finance Charges	- $58,297,000,000.00	- $713,549,571.60
Net Surplus/(Deficit)	$48,549,000,000.00	$594,235,006.12

KEY FINANCIAL STATISTICS ZETDC 2012 – 2016

As can be seen from the table, ZETDC has been loss making since 2012 except in 2013. In 2020 it would have operated with a net loss if it wasn't for the adjustment on finance charges.

	2012	2013	2014	2015	2016
EBITDA (%)	-2%	11%	-4%	10%	-12%
EBIT (%)	-19%	4%	-12%	-10%	-22%
PBT (%)	-22%	2%	-13%	-13%	-25%

ZETDC assets are capital intensive in terms of both maintenance, replacement, reinvestments and expansion. A sustained loss making position cannot provide a strong platform for the organisation to service its financial commitments to its suppliers and maintain an adequate later on world class electricity infrastructure. The foundation of a sustainable, performing smart electricity sector is undermined and threatened.

ZETDC Sales Revenue Analysis by year

ENERGY SALES

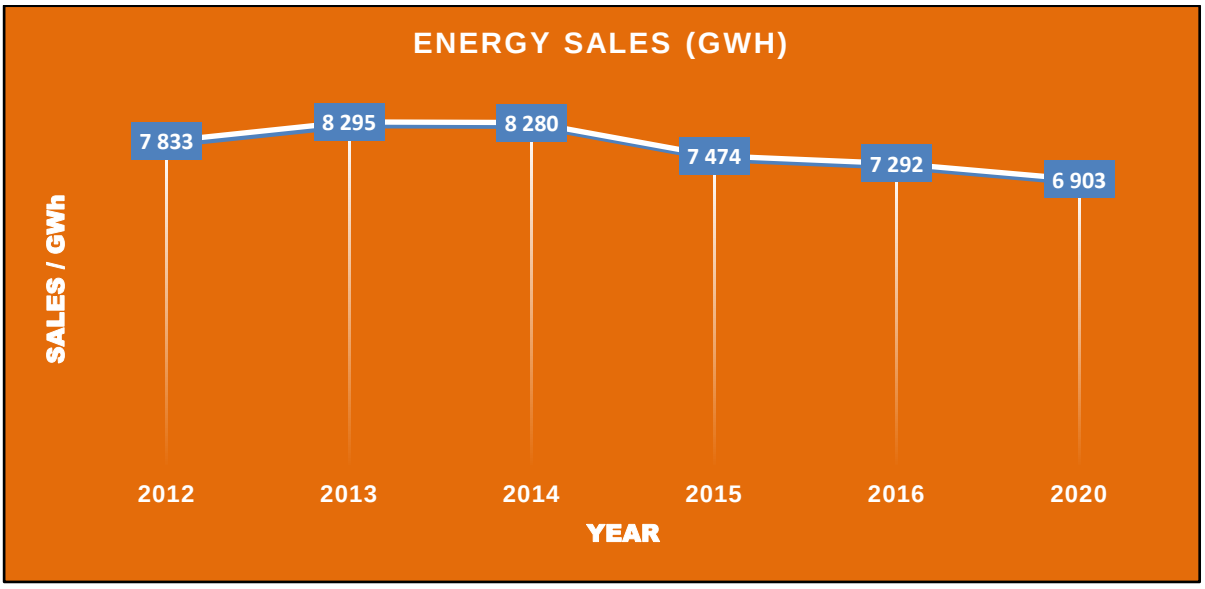


Figure 11-47: Energy sales

The energy sales declined since 2012 to 2020 as indicated on the graph above. There are several factors influencing this compelling trend, including but not limited to sustained growth in customer and market driven usage of energy efficient and conservation measures,

penetration of rooftop solar PV systems and renewable energy technologies, a shift of clients from electricity usage to LPG gas for heating and cooking and nationwide usage of energy efficient lighting. It is however interesting to note that National GDP has been growing against this trend of a decline in energy usage.

ZETDC ELECTRICITY SALES

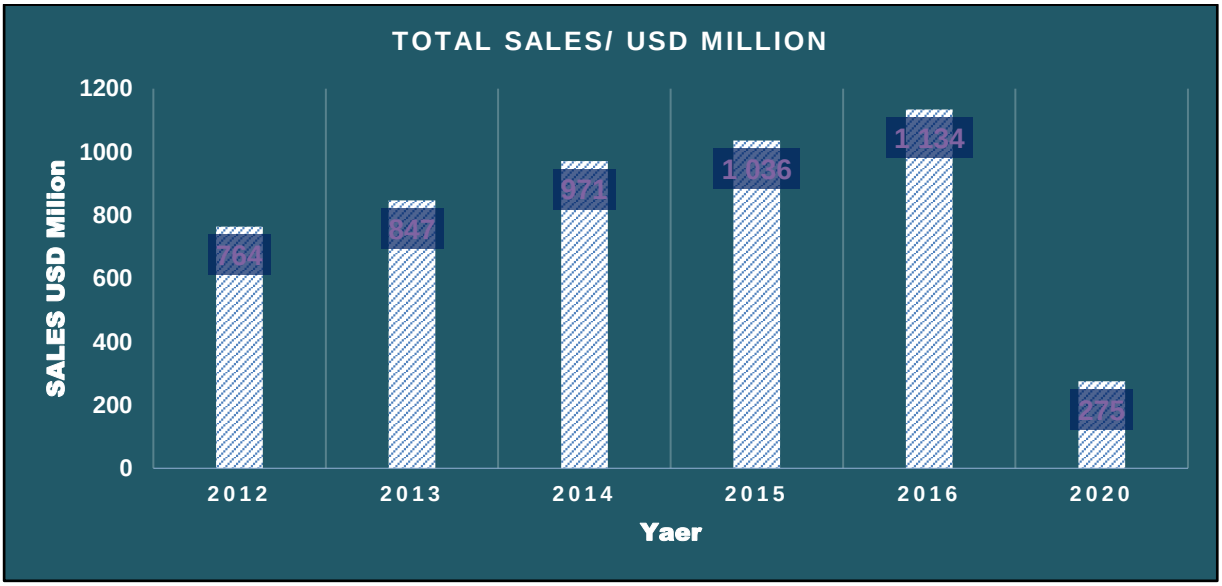


Figure 11-48: ZETDC sales

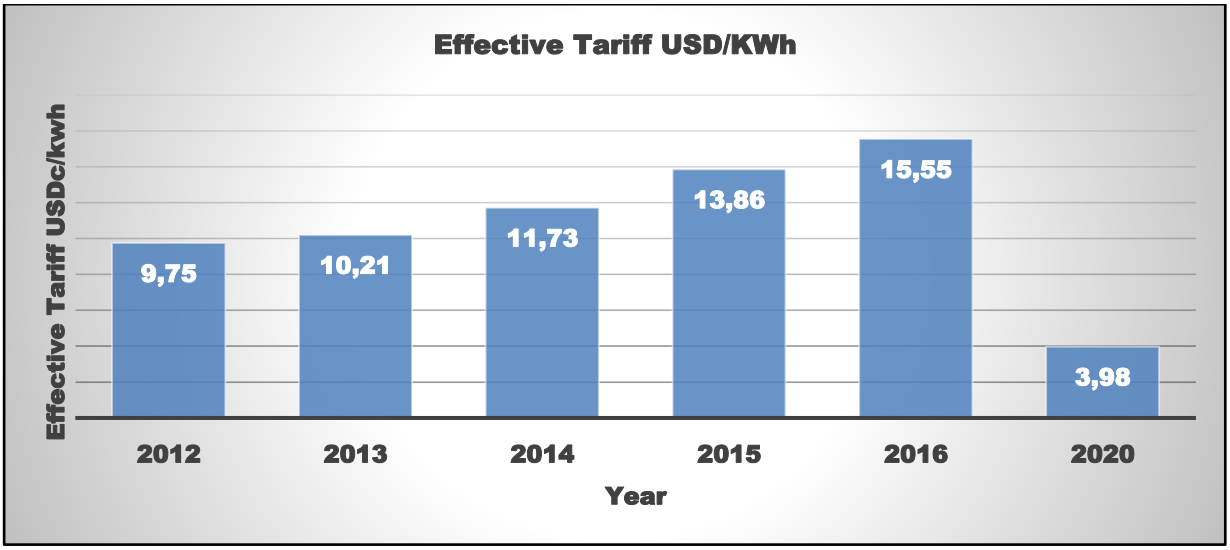


Figure 11-49: Effective tariff

Electricity Sales revenue has however been growing from 2012 to the period of change of currency form USD to RTGS then later own $ZW. The main causes of revenue increase are initial steps taken by government to review electricity tariffs to improve the performance of the

national electricity utility company and stoppage of load shedding around 2015. It is important to note that as revenues improved, the power supply situation stabilised and the overall performance of the electricity utility improved for a few years as evidenced by reduced load shedding and improved network performance. This trend has already been discussed above. During this time of growth of revenues, the utility remained under funded through a government restrain on the electricity tariff. As at 2020 ZETDC revenue reduced to 24% of 2016 levels due the settling impact of currency change and a heavy restrain on tariff adjustment to reflect market rates. It can be seen that the effective ZETDC electricity retail average price correlates precisely with revenues collected. It is therefore clear the impact of electricity pricing to revenues collected.

The 2020 ZETDC Financial performance clearly show that ZETDC revenue was 70% of its operating expenses. These 2020 operating expenses were inadequate to support maintenance of existing assets, asset replacements or refurbishment, before network expansion could be considered amongst other things. Very limited infrastructure maintenance could be carried out under such conditions. This is evidenced by very low levels of maintenance achieved in the Distribution network in 2020. ZPC was equally affected by the same constraints in the same period.

Table 11-28: ZETDC performance

Parameters	2012	2013	2014	2015	2016	2020
Net Power Supply/Energy sent out (GWh)	9,433	9,924	9,706	9,005	9,023	8466
Units sold (GWh)	7,833	8,295	8,280	7,474	7,292	6,903
Total client base	620,624	639,744	669,246	682,408	-	807,227
Transmission Loss (%)	4.4%	4.1%	3.8%	2.8%	4.8%	3.81%
Distribution Loss (%)	13.1%	12.8%	12.5%	14.6%	15.1%	15.25%
Total Losses (%)	17.5%	16.9%	16.3%	17.4%	19.9%	19.06

Electricity losses have risen between 2012 and 2020 and require investments to achieve desirable efficiencies. These speak hidden insights about the condition and performance of the entire system. Total system losses for 2020 (1608GWh) are 68% of total 2020 Hwange production. Losses are therefore too high above benchmarks.

11.5.23 INVESTMENT TRENDS

Table 11-29: ZETDC PROJECTS COSTS

CATEGORY	*ESTIMATED PROJECT COST (USD Million)*
Total – Generation Connection Projects	***264.4***
Total – Transmission Projects	***201.7***
Total – Sub-Transmission Projects	***135.4***
Total – Other Projects	***0***
Total – Distribution Projects	***66.5***
GRAND TOTAL	***668.0***

ZETDC Distribution network is vast and much bigger than the transmission network. The distribution network is legging behind the Transmission network in areas of investments, maintenance and performance. The distribution network has widespread regulatory noncompliance, very high losses in excess of 15%, poor safety performance with high accidents, wide spread lack of firm capacity, wide spread voltage noncompliance, limited redundancy and a much higher concentration of aged infrastructure and associated asset replacement.

The synchronised asset replacement burden in distribution is extremely challenging and require urgency and a purposeful systematic asset management approach as well as effective project implementation. The volume of projects planned and the associated approach to secure funding does not reflect the state of the Distribution Network and its needs. Aggressive and funding solicitation should be considered to finance a Distribution Master Plan project that speaks to the current needs and prioritise.

Table 11-30: ZPC PROJECTS

OTHER KEY ZPC PROJECTS					
Project	**Start Date**	**End Date**	**Estimated Project Cost**	**2020 Major Milestones**	**2021 Planned Activities**
Deka Pipeline Upgrade	Dec 2020 (Est)	June 2022 (Est)	US$48.1 million (EPC)	• Tendering and Contract Negotiations. • Due Diligence.	• Contract Signing. • Commencement. • Procurement. • Detailed surveys and designs. Pipeline civil and mechanical works.
Deka Extension	1 April 2021 (Est)	30 June 2022 (Est)	US$35 million (Est)	Feasibility Study.	• Tendering and Contract Negotiations. • Due Diligence. • Contract Signing. • Commencement. • Procurement. • Construction.
Hwange Life Extension	In line with Unit M/O outages	In line with Unit M/O outages	US$450 million (Est)	USD310 million LoC from Exim Bank of India was made effective.	• Documentation of detailed RFP. • Development of user requirements specifications and scope • Authorisation of plant improvement for stage one units.
Bulawayo Repowering	TBA	TBA	US$110 million (Est)	• Closing of tender. • Completion of Technical Bid Adjudication. • Commencement of Financial Envelope Adjudication.	• Tender Award, due diligence and EPC Contract signing. • Secure Coal and Coal Transportation, and Limestone Supply Agreements. • Review Water Supply Agreement with BCC. • Commencement of EPC works.
Munyati Repowering	TBA	TBA	US$149.5 million (Est)	Project was on hold in 2020.	• Conducting Desktop Due Diligence on EPC Contractor and manufacturers. • EPC Contract Signing. • Acquisition of ESIA certificate. • Application for National Project Status. • Procurement of PMC Services. • Procurement of Cooling Towers.
Plasma Ignition Combustion System (PICS)	Jan 2021	Pilot Unit to be done in 2021	US$19.33 million (EPC)	US$3.2 million funding for the pilot unit under the Afreximbank facility.	• National Project Status application. • Project implementation. •
Gairezi Hydro-Power	TBA	TBA	US$110 million (EPC)	The Board resolved that the project be terminated.	GoZ now intends to fund part of dam construction costs as there will be downstream benefits for the communities in terms of irrigation schemes.
Gwanda Solar	TBA	TBA	US$139 million (Est)	Restated Contract Negotiation.	• Redo of 2015 Feasibility Study. • Restated Contract Due Diligence. • Restated Contract Signing. • Commencement, Procurement and Part construction.
Batoka	TBA	TBA	US$4.8 – 7.1 billion (Est)	• Submission of Developer's Bankable Feasibility Studies. • Public disclosure of final ESIA report. • Setting aside and Excision of Batoka	• Finalise evaluation of Developer's Alternative Proposal based on findings from feasibility studies. • Contract negotiations and signing of agreements with the Developer. • Agree on the final roadmap with the Developer.

RANKING AT A GLANCE

RANKING CRITERIA

A World-class	B Fit for The Future	C Satisfactory For Now	D At Risk of Failure	E Unfit For Purpose
Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure pressure from unusual events.	Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents.	Infrastructure condition is acceptable, although stressed at peak periods. It will need investment in the current Medium-Term Expenditure Framework period to avoid serious deficiencies.	Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience, and even danger, without prompt action.	Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate action is required.

Table 11-31: ZPC ASSETS RANKING

Parameter	ASSET RANK/GRADE
Hwange Stage 1 & 2	E
Kariba 1 & 2	A
Bulawayo	E
Munyati	E
Harare	E

All ZPC Thermal power stations fully satisfy grade D as they cannot cope with demand anymore and are poorly maintained. Plants have been downrated for a period exceeding 10

years with sustained loss of installed capacity ranging from 85% for small thermals to 66% on Hwange stage 1 and 2. Plants are frequently failing and that

TRANSMISSION ASSETS RANKING

The main Transmission System Assets used for the purpose of Ranking are Lines, Transformers and Substations. Protection and power network control systems condition are appraised from the overall performance of the system without separating them into discrete areas in this study.

The following areas of network performance are evaluated:

Parameter	**Transformers GRADE**	**Lines GRADE**	**Switchgear GRADE**
Network Assets Age	B	B	C
Maintenance Level across Fleet	B	B	B
Consistency of Maintenance	C	C	C
Quality of Maintenance	B	B	B
Reliability Performance	B	B	C
Network Stability	B	B	C
Voltage Compliance	D	D	B
Network Capacity	B	B	C
Network Safety	C	B	C
Network Efficiency	B	B	B
Network Security	B	B	C

OVERALL GRADE	**C**	**C**	**C**

DISTRIBUTION SYSTEM RANKING

Parameter	**Transformers GRADE**	**O/H Lines GRADE**	**CABLES GRADE**	**Switchgear GRADE**
Network Assets Age	D	B	D	D
Maintenance Level across Fleet	D	B	D	D
Consistency of Maintenance	D	C	D	D
Quality of Maintenance	D	D	D	D
Reliability Performance	D	D	D	C
Network Stability	D	D	D	D
Voltage Compliance	E	E	D	E
Network Capacity	D	D		D
Network Safety	D	E	E	E
Network Efficiency	D	D	D	D
Network Security	D	D	D	D

OVERALL GRADE	**D**	**D**	**D**	**D**

11.5.24 CONCLUSION

ZETDC and ZPC assets are capital intensive in terms of both maintenance, replacement, reinvestments and expansion. Most of the ZPC and ZETDC assets are mature and aged.

Of all ZPC Power stations, Kariba is in technically excellent condition subject to availability of water. All the ZPC thermal stations are in E grade and under normal circumstances credible and compelling candidates for decommissioning. All interventions employed to them for the past 10 years have had limited effect. Since decommissioning is not an option due to national power supply situation and lack of alternatives, a new different approach to that employed in the past 10 years should be considered to ensure different, lasting and efficient results.

ZETDC assets are vast, mature, aged and distributed nationwide. Transmission Assets have received prioritisation on investments and maintenance to date. Although the network is mature and aged as demonstrated, its performance is acceptable although it can be improved. Assets, with improvements in maintenance and continuous maintenance can certainly achieve a useful life above design life.

ZETDC Distribution network is vast and much bigger than the transmission network. The distribution network is legging behind the Transmission network in areas of investments, maintenance and performance. The distribution network has widespread regulatory noncompliance, very high losses in excess of 15%, poor safety performance with high accidents, wide spread lack of firm capacity, wide spread voltage noncompliance, limited redundancy and a much higher concentration of aged infrastructure and associated asset replacement. Assets are in an onerous state compelling prioritisation in investments, maintenance and budgets. Business as usual is unacceptable. Asset Replacements should planned and commenced. At this stage there is synchronised aging and poor performance. If unmitigated widespread synchronised failure will be experienced.

The National Electricity System sustainability is dependent on ZETDC preforming and operating as a viable business unit. All power producers and consumers connected the National Grid depend directly on the all round performance of the System Operator who in this instance is also the asset owner and developer. ZETDC has to operate profitably and viably in order to create a platform for growth of the sector. ZETDC is has operated in loss making position for too long and it can not implement effective Asset Management approaches in serving the nation with reliable, quality and safe electricity supplies now and in the future while persistently operating in a loss making quadrant. Electricity tariffs approval regime has persistently deprived the organisation sufficient revenue to run sustainably an efficient electricity business. A health balance of political interests and responsible revenue required for sustainability is required.

11.5.25 RECOMMENDATIONS

ZPC

1. ZPC old thermal stations have exceeded their economic life. Performance is persistently poor and so far interventions have not been effective in achieving lasting gains. Considerations move away from repowering to life extension, decommissioning and asset replacement should be made and appraised with the best business solution implemented. Competent appraisal of these options should be sort.
2. ZPC and ZETDC both have a large base of matured and aged assets. Both organisations have enormous synchronised asset replacement requirements and persistent poor asset performance. Both organisations depend on asset maintenance and not comprehensive Asset Management Approaches to ensure competitive asset performance longevity. The state of assets demand quality and comprehensive Asset Management Approaches to guide in the enormous asset replacement, rehabilitation, maintenance, investments and stewardship. Non of these two organisations have a dedicated Asset Management Division.
3. Most of ZPC Projects are based on legacy identified projects. Portfolio Evaluation techniques should be employed, to assess and explore new projects and choose strategic generation investments from a pool of old and new opportunities that speaks to the market opportunities, market and positions the organisation to have strategic sustained market advantage.
4. Hwange Power Station, just like the rest of the Power Stations, does not have a documented Life of plant plan (LOPP)/ technical plan which is considered a good tool used to address issues of aging plant equipment. Refurbishment and replacement projects should form part of this plan. In the absence of a documented LOPP, the effectiveness of asset management is compromised thereby affecting business performance. It is recommended that LOPP should be developed and used across the Group.
5. ZETDC and ZPC are investing significantly through new infrastructure projects. The new infrastructure require optimum maintenance to realise excellent returns and useful life. These assets will also require loan repayments to be pay over medium to long term in foreign currency. It is not sustainable to acquire new assets and remain constrained to maintain the overall fleet of assets. The situation is unsustainable and change should start somewhere. It is important that ZETDC secures urgently, an electricity tariff that support its continuous existence and efficient competitive service delivery.

ZETDC

1. The synchronised asset replacement burden in distribution is extremely challenging, huge and require urgency and a purposeful systematic asset management approach as well as effective project implementation. There is currently no active asset replacement or intervention plan of the scale required. The volume of projects planned and the associated approach to secure funding does not match the state of the Distribution Network and its needs. Aggressive and funding solicitation should be considered to finance a Distribution Master Plan project that speaks to the current needs and prioritise.

2. A sustainable electricity tariffs approval regime and Approach is recommended. One that ensures national assets are grown efficiently and sustainably. Current approach has been applied for the longest time and is resulting in excessive unacceptable loss of assets, capacity, returns on investments and high national cost of unserved energy.
3. ZETDC Continues to loose Million of USDs of approved revenue requirement annually due to under recovery on the approved electricity tariff at Distribution Regional level. ZETDC Should investigate cause of recovery mismatch and employ solutions to ensure optimum recovery and security of approved revenue requirement.
4. ZETDC and ZPC both have a large base of matured and aged assets. Both organisations have enormous synchronised asset replacement requirements and persistent poor asset performance. Both organisations depend on asset maintenance and not comprehensive Asset Management Approaches to ensure competitive asset performance longevity. The state of assets demand quality and comprehensive Asset Management Approaches to guide in the enormous asset replacement, rehabilitation, maintenance, investments and stewardship. Non of these two organisations have a dedicated Asset Management Division.

SECTION 4: DISCUSSION AND SUMMARY

12 DISCUSSION AND SUMMARY

12.1 GENERAL

From the United Nations Reports it is clear that Africa South of the Sahara lags far behind in achieving the Sustainable Development Goals. But even those reports do not tell the full story. The United Nations reports focus on the availability of infrastructure and report on aspects such as access to water. There is no consideration how reliable the service is. There is not much use of having a tap when there is no water coming from it.

In general the main problem in Africa South of the Sahara is the dilapidated condition of infrastructure and the fact that a major portion is getting old and approaching the end of its design life. In South Africa there are still many water supply systems in smaller towns that were constructed of asbestos-cement pipes. Although not a direct threat to human health (asbestos becomes a problem when breathed in and not consumed), the pipes are brittle and subject to frequent failures. In very few cases is any money allocated to replace old and failing infrastructure.

Much of the infrastructure dates from colonial times and is not always compatible with modern equipment while spares are becoming difficult to obtain. This is especially true for the electricity generating, transmission and distribution systems where frequent unplanned interruptions are experienced.

A significant challenge is presented by vested interest. When a water supply system fails, water bowsers are deployed to provide water to communities. The owners of the water bowsers are sometimes suspected of sabotaging the supply system in order to create work for their bowsers. In South Africa the regulations that were implemented to combat the covid epidemic saw a sharp reduction in the demand for public transportation. This led to trains being set alight in order to create more demand for mini-bus taxis. Mini-bus taxis are the public transportation most used in the major cities. The taxi industry has great political influence and they vigorously oppose alternative forms of transportation in order to protect their interest. Most cities in Africa therefore suffer from congestion during peak traffic times, exposing the population to polluted air.

The individual country reports provide some insight on what is important in that particular country. No two countries are the same, but there are some commonalities.

12.2 POWER SUPPLY

This is probably one of the most pressing problems in Africa. Even in South Africa where a considerable portion of the electricity on the continent is generated and consumed, lack of electricity is stifling economic growth. Most businesses have resorted to installing generators to supply power during black-out periods. This is expensive and in the long run not sustainable.

All countries that rely on hydro power to some extent are subject to the vagaries of the weather. In drought periods power supply to domestic areas is severely curtailed and it is not unusual to find that households only receive power for a few hours per day.

The power that is supplied is expensive and most households do not use it for cooking but rely on other sources of energy such as charcoal. This again leads to air pollution and also deforestation.

The ageing and dilapidated state of the distribution systems lead to frequent interruptions in supply. Households are often left in the dark. It also creates challenges with communication. Most of Africa skipped the land-line era and jumped to the mobile phone technology. During long lasting power interruptions mobile phones cannot be charged and people use much time to shop around for phone-charging facilities. This is productive time lost .

Most of the power utilities resort to some form of load-shedding by cutting off power supply to areas where payment for electricity is low or where there is a high incidence of illegal connections.

12.3 WATER

Water supply infrastructure is well developed in the major urban areas, but still provides a challenge in the rural areas. It is not unusual for people to have to walk up to a kilometer to fetch water for domestic purposes. Under those conditions the daily per person water use remains close to what the WHO considers the minimum for healthy living.

Carrying a full jerrycan of water (20 litres) over a long distance places a heavy strain on the human body and causes long-term damage. In most cases women take their business to the water (washing is done where the water is) rather than carrying water to their business.

Water supply is also not always reliable. It is not unusual that water is only available for a few hours per day, as the supply authorities do not have sufficient capacity to keep the full system supplied. In the more affluent places people have resorted to installing tanks to store sufficient water to overcome the dry periods. This then places an additional demand on the system.

Water quality is not always considered or monitored. Although the chemical quality of the water is mostly known, the biological quality is seldomly measured. In rural areas there are two problems: The one is the quality of the water that comes from the tap, borehole or spring, while the other is the cleanliness of the vessel in which it is collected. Jerrycans are sometimes rinsed with clean water before they are filled, but not always as it uses valuable water as well as time while someone else is waiting his/her turn.

People are generally reluctant to pay for water as they believe that it falls for free from the sky. Water supply authorities face endless challenges in collecting payments for water, which again leads to a lack of funds for operation and maintenance. Controversially in some areas there is a thriving business for water vendors who will deliver full jerrycans to the doorstep for a fee. People seem to understand that it is a service to be paid for, but not if the water comes from a tap.

It should however be recognised that all persons have access to water in some way or another, but that it is the level of service and the quality that is in question.

12.4 SANITATION

Sanitation always was and remains a problem in most areas in Africa. Even large cities such as Lagos in Nigeria remain without a sewer system, relying on on-site sanitation in the form of pit latrines or conservation tanks. This has led to a significant industry to empty the pits and tanks (honeysuckers) who sometimes dispose their load indiscriminately to avoid paying the fees at designated disposal points.

Most countries have adopted the ventilated improved pit latrine (VIP) as the minimum standard for sanitation, but in the rural areas open defecation is still common. In South Africa the bucket system has still not been completely eradicated, despite the Government's stated objective to have done so some time ago.

As a result environmental contamination is common, although it is an open question on whether a thousand pit latrines pose a more significant problem than a badly operated wastewater treatment works where untreated sewage is discharged to a receiving water body.

12.5 ROADS

Most countries face two challenges. The first is the lack of roads that render some rural areas virtually inaccessible, while the second is the condition of the roads. In some instances what is a line on a map indicating a road, in reality is a track that becomes impossible to navigate under wet conditions. The opposite is also true in sandy areas where it becomes impossible to drive when the sand is dry.

Paved roads pose their own challenges when not properly maintained. A gravel road is preferable to a tarred road where potholes pose very dangerous driving conditions. In countries where long distance buses are the only mode of transport between cities, this leads to frequent accidents and loss of life.

12.6 RAILWAYS

Railways are mostly a remnant of the past and not well maintained. For instance the railway in the DRC that runs from the copper producing area to the Atlantic coast is defunct, forcing the export of copper by road to the port of Durban in South Africa. Although it is good business for Durban Harbour, the trucks that transport the copper put a heavy load on the road network.

Apart from the generally bad condition of the rail system, a problem that has to be overcome is that not all rail gauges are the same. A train can therefore not seamlessly drive from one country to the next. Another issue is that some railways are custom built to accommodate specific rolling stock. A case in point is the railway that was constructed from Mombasa to Nairobi in Kenya that was constructed according to Chinese standards.

12.7 HEALTH

There is a significant difference between private health facilities and public health facilities. The latter suffer from underfunding and bad governance. Public facilities are not always properly equipped.

In contrast the DRC reports that the rural population have better access to health facilities than the urban population.

12.8 EDUCATION

As with health facilities, there is a significant gap between private schools that provide education to international standards and public schools. Public schools are generally not well equipped and the student to teacher ratio is very high. An exception is Rwanda that is clearly investing in the education system.

12.9 PRISONS

Prisons are as a rule overcrowded and not conducive to any form of rehabilitation.

12.10 SUMMARY

Although there are some areas that are cause for optimism, in general the availability and state of infrastructure in Africa South of the Sahara does not support achieving the Sustainable development goals.

What is required is a different way of thinking from politicians who have to acknowledge that accepting donor funding for infrastructure creation creates a downstream obligation to budget for operation and maintenance costs. Objectives have to be long term to provide a service that stimulates sustainable economic growth and creates jobs that add value.

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