

Propelling the Nation's Economic Growth through Critical Infrastructural Development: The Chemical (Process) Engineering Perspectives on the Nigerian Refineries and the Future Energy

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Abstract

The best practice in engineering and technology is through the establishment of workable institutional framework which culminate with quality manpower and efficient maintenance at minimum cost to achieving a higher yield of production and services. However, the advancement of technology has not only improved human life progressively, but has added a meaningful value to it.

A good infrastructural development, excellent maintenance and room for future expansion will help Nigeria and global world to achieving a desirable progress in the social-political and economic development. For instance, the existing Nigerian-refineries need a holistic attention with enacted disciplines of the government and all the stakeholders. The challenges of these refinery infrastructures rested on adequate commitment, poor maintenance, saboteurs and no-current-plan for upgrading/expanding the existing facilities to cater for both domestic needs and possibly foreign supply of refined crude.

The quest of this paper is to driving at ways forward toward improving the Nigerian refineries' existing infrastructures, collaboration of experts [locally and internationally] and possible expansion projects which will not only address fraudulent activities in the oil sector, but equally increase the nation's gross domestic projects [GDP]. This paper is calling on the government and policy makers to develop sustainable policies that would wholly address the decaying infrastructures of Nigerian refineries and the future of hydrogen energy.

Keywords: Energy, Facilities, Improvement, Sustainability, Refinery and GDP.

1. Introduction

The infrastructure is important for faster economic growth and alleviation of poverty in the country. The adequate *infrastructure* in the form of road and railway transport system, ports, power, airports and their efficient working is also needed for integration of the nation's economy with other economies of the world. A country like Nigeria must rededicate her commitment with practicable template to consolidate a robust vigour toward the public infrastructural development and integration with quality maintenance. The results to achieving this objective would reposition the nations' on the footing of progressive nation for advancement.

A larger stock of *infrastructure* is thought to fuel *economic growth* by reducing the cost of production and transportation of

goods and services; by increasing the productivity of input factors; and by creating indirect positive externalities. Amongst the large-scale public systems, services, and facilities like (i) *energy and power*, (ii) *water supplies*, (iii) *public transportation*, (iv) *telecommunications*, (v) *buildings*, (vi) *roads*, and (vii) *schools* and institutions of higher learning etc.

Energy and Power

Energy and power are an essential commodity that would help in advancing national development. Nigeria as a country is not doing well in this sector, upon the gifted natural resources of black-gold and solid minerals etc. No nation that toiled with its power sector that would achieve the required national energy-needs for the industries and citizenry uses. Nigeria must take a leave from other nations like Saudi Arabia, Oman and Qatar etc., on energy sector progress and development. Diversifying the nation econ-

omy through the harnessing of solid mineral like coal is another step that would improve the national grid [1].

Water Supplies

The challenges of water resources in Nigeria are enormous, because of many factors like; lack of proper maintenance of water processing facilities, upgrading, expansion of existing water plants and construction of new ones. Secondly, apart from the nation’s abundance fossil fuel, diversifying the economy through construction of new hydropower generation and expanding the existing facilities can never be over-emphasised. In these efforts, the incessant and serious flooding which has claimed many life and billion naira worth of properties across the country and the global world can be minimised [1].

Public Transportation

The transportation sector is still under-developed and requires greater commitment to achieve the objective. Transportations can be categorised into three segments: road, air and sea. Fundamentally, the little and existing public transport system lack proper coordination, no-holistic accountability on the various partners. Equally, these only exist in the central cities around the country, which is state capitals and Abuja in most cases. Nigeria should take a leaf from nations like the US, UK and China to improve on the existing infrastructure of public transportation.

Telecommunications

The telecommunication costs remain very expensive in Nigeria. Although we have recorded a good progress on the advent of global-mobile systems at present. However, the trunking-system of communication in Nigeria is left in comatose and non-existence. This is not the right-practice as can be sign from the advanced world like the US, UK, Germany, France etc.

Building Constructions

Quality buildings and infrastructure in the country may be referred to exist mostly in the central cities of the country. However, the most worrying situation is the non-compliance of the engineering designs specification, professional ethics and competence etc., of some infrastructural buildings in Nigeria, these results on the building-collapses in the country. Many reported cases are in Lagos, Abuja etc. Government should prosecute the offenders to a logical conclusion, to serve as deterrent to others.

Road Constructions

Nigerian road is a death-trap and the worse-case across the globe. Road infrastructures remain one of the essential commodities that reduce human-stress, daily-routine activities and easy movements. More worrisome, the local farmers found it very difficult to transport farm-produce to market. The major roads in the country are very dangerous because of maintenance. The government should rededicate itself to repairs the essential roads in the country. More importantly, all tiers of government should institute period checks, dedicated fund to repairs the major roads in the country.

Schools and Higher Educational Institutions

The advents of tertiary education trust fund [TETFund] have helped in the financial sustainability of the country educational systems. The TETFund is meant only for the tertiary institution, which does not include Secondary and Primary education. However, much still need to be done to resuscitate the Nigerian educational systems. The government should improve the public school by appropriating more funding to sustain the goal-achievement.

The aim of this paper is to propelling the nation’s economic growth through critical infrastructural development [as highlighted above] through chemical [process] engineering perspectives using the case-study on the Nigerian refineries.

The NNPC Refineries Operations

The Nigerian national petroleum corporation [NNPC] is the government umbrella body on petroleum operations in Nigeria. The downstream industry in Nigeria is well established and currently the NNPC has 11-subidiaries which includes; Hyson, IDSL, KRPC, NETCO, NGC, NPDC, NAPIMS, PHRC, PPMC, EPCL, and WRPC.

The NNPC has four functional refineries although operating below design/operating capacities. The KRPC Kaduna, two-PHRC Port Harcourt and WRPC Warri have a combined installed capacity of 445,000 bpd, NNPC website. A comprehensive network of pipelines and depots strategically located throughout Nigeria links these refineries. Table 1 represent the designed/ installed and current operating capacities of the 3-refineries of NNPC.

Table 1: Current operations of the 3-refineries of the NNPC

NNPC Refinery	Design/Installed Capacities		Operating Capacities	
	Barrel/day (bpd)	Percent (%)	Barrel/day (bpd)	Percent (%)
KRPC	133,500	30	60,075	45
PHRC	178,000	40	97,900	55
WRPC	133,500	30	80,100	60
Total	445,000	100	238,075	53.50

Source: NNPC, (2016-2020)

The KRPC produces linear alkyl benzene [LAB], benzene, heavy alkylate and deparafinated kerosene at its Kaduna Refinery complex. The PHRC has the largest design capacity among the three refineries aiming at providing the nation with domestic PMS consumption. However, their operations below the installed capacity are situation which must be fully re-streamed to achieve the quality and quantity target for the nation. The WRPC has 35,000 metric ton per annum [mtpa] of polypropylene processing plant and an 18,000 mtpa carbon black plant.

Re-streaming Nigerian Refinery to Full Operating Capacity and Investment in Downstream Sector

The Federal Government initial approach toward revitalising the nation’s downstream processing system is much welcome by inviting the refineries conceptual designer and construction company [Chiyoda Chemical Company, [CCC], Tokyo Japan], because their unique technology which should be studied by the Nigerian young engineers and scientist. Employing of fresh and young brains amongst the Nigerian graduates and skilled youth to acquire experience from the foreign experts through train-the-trainer scheme must be initiated and instituted.

In the course of achieving this target, there would be a qualitative hand that would be able to manage the re-streamed refineries properly. In the advent of inviting the Chiyoda Company, a memorandum of understanding, MOU should be reached as follows:

- They should use and/or source the local material as where possible.
- They should work closely with our indigenous engineers and technologist in the design and construction.
- If possible, they should have an extension of their services permanently in Nigeria.
- All design and construction procedure should be provided to our engineers and technologist.
- Expert and free advice services toward sustainability of the refineries as when due.
- Seconded staff of the Chiyoda Company to the refinery should be considered.

Table 2: Possible operation after restreaming of the 3-refineries of the NNPC

NNPC Refinery	Design/Installed Capacities		Operating Capacities	
	Barrel/day (bpd)	Percent (%)	Barrel/day (bpd)	Percent (%)
KRPC	133,500	30	113,475	85
PHRC	178,000	40	151,300	85
WRPC	133,500	30	113,475	85
Total	445,000	100	378,250	85

Source: NNPC, (2016-2020)

From Table 2, it is observed that after restreaming the 3-refineries a net increase in production operations 140,175 bpd, this is based on grand percentage of 85% operating capacities. The 85% is set as the minimum achievable of the refinery restreaming. However, the exceed above the 85% criteria of the operating capacities, that is, 85 – 95% operations, the net increase in production would be above 140,175 - 184,675 bpd.

The Local Contents Usage

The enacted of local content law is an aforementioned step toward foreign dependence on expatriates to import goods and services from overseas. Driving the local contents and the use of indigenous technology in the restreaming the existing refineries and the constructions of new ones is an added advantage. Among the benefits these would bring to the nation are as follows:

- The progressive growth of the nation’s economy through technology and innovations.
- It equally creates job opportunities to the teaming Nigerian youths.
- Way to expand and diversifying the research and development, R & D of the oil and gas sector of the economy.
- It helps in the utilisation of Nigeria human and material resources.
- It increases the investment in the local facilities.

- Increase the training capacity of the young engineers, scientist and the technologist in the oil and gas sector.
- An easy way to develop the other sector of the economics, e.g. transport and health sectors of the economy.

Construction of 6-New Refineries in the Six-Geographical Zones

Nigeria’s population is about 162 million with possible growth rate of 3.2 – 5% yearly [3].

The nation is classified as the sixth largest population in the world. The drive to cushion the effect of any developing nation is to inculcate the population growth in the planning of her development strategy. We have identified that even if all the current 4-refineries are operating on full capacities, the refined products cannot solve the domestic demands. Therefore, the needs to construct new refineries each in the six-geopolitical zones namely; South-South SS, South-East SE, South-West SW, North-Central NC, North-East NE and North-West NW.

The importance of constructing new refineries to each of the six-geographical zones will successfully cushion the shortfall on the domestic demand of the refined crude and most importantly the stoppage on the importation of petroleum products into the country.

Table 3: Profile of the proposed 6-refinery operations in the six geopolitical zones

NNPC Refinery	Design/Installed Capacities		Operating Capacities	
	Barrel/day (bpd)	Percent (%)	Barrel/day (bpd)	Percent (%)
NC	133,500	16.7	127,492.5	16
NE	133,500	16.7	127,492.5	16
NW	133,500	16.7	127,492.5	16
SE	133,500	16.7	127,492.5	16
SW	133,500	16.7	127,492.5	16
SS	133,500	16.7	127,492.5	16
Total	801,000	100	764,955.0	96

From Table 3, a net production of the PMS of 764,955 bpd would be achieved from the proposed 6-newly constructed across the six-geopolitical zones operating at equal capacities.

The Nigerian Nation Petroleum Corporation LTD [NNPCL] Refineries Infrastructural Upgrading as A Tool for Economic Consistence Growth

The NNPC is the ivory of the government and must be reposition to exponent the required progress and development of the nation's energy sector to its fullest. These require comprehensive collaborations, dually commitment and less-politics to achieve and advance growth within a short-pace of time. If the NNPC got it right, definitely all the other sectors which are been coordinated by the government agencies would have follow suite. However, the most important thing is for the country to reposition her development strategies to improve all various sectors that requires urgent attention.

Recent Development in NNPC

All cannot be reported in negative approach about the progress and development in our national petroleum corporation been the government arm of all petroleum business in Nigeria. A very remarkable development is the recent flag-off of new NNPC products [engine oil] which was launched at the national conference centre, Abuja. The products ranges for all types of motor engine and are customised to suit Nigeria motors [TNT 2020].

The Future of the NNPC for Cleaner Energy

The NNPC must play strategic roles in Africa on the global-path for cleaner energy production [like hydrogen energy]. As the world responds to the challenges of climatic change, energy systems are evolving, and evolving fast. The world is shifting to a low carbon future and so far indications point towards hydrogen energy. The combustion of hydrogen with oxygen produce water as its only by-product, a better result than fossil fuels, such as coal or natural gas [e.g. liquefied natural gas, LNG], which produce CO₂ and other pollutants such as SO₂ and NO.

Developing Countries as the Biggest Winners from Hydrogen Economy

The world needs pioneers who are willing to take the lead and bear the cost of 'first movers' for hydrogen energy, just like Germany did for solar power technology. Developing countries could tap their renewable energy resources to produce hydrogen and export it to other countries, as is readily done with LNG [4-11].

2. Conclusions

In conclusion, the best practice in engineering and technology is to abide by the ethics and principles through the establishment of workable institutional framework which culminate with quality manpower and efficient maintenance at minimum cost to achieving a higher yield of production and services. However, the advancement of technology has not only improved human life progressively, but equally has added meaningful values to it.

A good infrastructural development, excellent maintenance and room for future expansion will help Nigeria and global world to achieving a desirable progress in the social-political and economic development. For instance, the existing 4-refineries need a holistic attention with enacted disciplines of the government and all the stakeholders. The challenges of these refinery infrastructures rested on adequate commitment, poor maintenance, saboteurs and no-current-plan for upgrading/expanding the existing facilities to cater for both domestic needs and possibly foreign supply of refined crude.

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