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Policy Advisory on Steel Economy

Engr. Bayo Olarewaju-Alo
National President, NSChE

Leveraging Natural Gas

Engr. Sir Osondu Opara, *FNSChE*

Sugar Industry

Engr. Olubunmi Oke, *FNSChE*

SAFETY & STRATEGIES PRACTICES IN THE UPSTREAM PETROLEUM INDUSTRY

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From The Editorial SUITE

Engr. Donatus Uweh, *FNSChE*
(Editor-in-Chief)

Another season is here and we are delighted to make available to our teeming readers another edition of our widely read magazine. Education is for life and our readers continue to be excited as they get fresh information and insights on Oil & Gas, Chemical Process Industry, Engineering and contemporary matters.

In this edition, the ball is set rolling by Engr. Anthony Ogheneovo, FNSChE, FNSE, Executive Secretary of Nigerian Society of Chemical Engineers (NSChE) who makes his presentation on the topic: **"CONTEMPORARY ISSUES IN THE NIGERIAN ENGINEERING PROFESSION."** Obviously, there should be several ways engineering can make greater impact on Nigeria's economy to facilitate rapid growth. Check inside for his recommendations. NSChE is a very dynamic professional society. The body has not rested on her oars in proffering solutions to the challenges besetting our country. The Steel Industry in Nigeria is a case in point. Check inside for **POLICY ADVISORY ON STEEL ECONOMY.** The 'promise land' does not need to remain far and elusive in Nigeria's journey to leap-frog into a key global steel manufacturing country. Check out for NSChE's recommendations in this edition.

The first article in this edition is on the topic: **"SAFETY STRATEGIES AND PRACTICES IN THE UPSTREAM PETROLEUM INDUSTRY"** by Engr. Oluwole Ayokunle, BSc Chem. Eng., MBA (Engineering Manager, Integrity Programs, Seplat Energy) The article dwells comprehensively on Process Safety and Occupational Safety matters in the Upstream Petroleum Industry. The article's opening statement: "The upstream petroleum industry operates at the frontier of technical complexity and operational hazard" gives credence to the thorough and careful discourse on the subject of safety. It is a lucid presentation and worth reading even by those not in the Oil & Gas Industry. Good lessons are there for everyone in the Manufacturing sector. The 2nd part of the article shall be published in Vol. 9 No. 1 edition.

The second article on the topic: **"LEVERAGING NATURAL GAS FOR SUSTAINABLE INDUSTRIAL GROWTH: INTEGRATING ENGINEERING INNOVATION WITH POLICY AND INDUSTRY PRACTICE IN NIGERIA"** by Engr. Sir Osondu Opara FNSChE, FNSE (Oil & Gas/ Front-End Project Engineering Expert) The abundance of natural gas is a blessing to Nigeria. As professionals continue to draw the attention of stakeholders on how to harness the abundant natural gas resources to the benefit of Nigeria, the populace remains hopeful that the needful would be done and the manifestations would show forth in improved quality of life. The recommendations in this article are worth being taken seriously to move the Nigerian economy forward.

The 3rd article is entitled: "Sugar Industry in Nigeria". It is written by a professional Chemical Engineer actively involved in the Sugar Industry for several years. Engr. Olubunmi Oke, (B.Sc., M.Sc., MNSE, FNSChE), presents a very comprehensive treatise on Nigeria's sugar industry. It is a sound repertoire of information for knowledge seekers, particularly those who need information on the sugar industry. Dangote, BUA, Golden Penny and other players are presented. Check out for details in this edition.

We deeply appreciate the article contributors for sharing knowledge. We also appreciate all others who played different roles in making this edition to be published successfully.

Relax and enjoy your reading!

Engr. Donatus Uweh, *FNSChE*
Editor-in-Chief

CONTEMPORARY ISSUES IN THE NIGERIAN ENGINEERING PROFESSION

Engineering is a key driver of economic growth, industrialization, and national development. In Nigeria, engineers play critical roles in infrastructure development, manufacturing, energy, transportation, agriculture, telecommunications, healthcare, and environmental management. However, the profession faces several contemporary challenges that affect its growth and contribution to national development, as listed below:

Engr. Anthony Ogheneovo,
FNSChE, FNSE
(Executive Secretary, NSChE)

Infrastructure Deficit, Brain Drain (Japa Syndrome), Rapid Technological Advancement, Engineering Education and Skills Gap, Regulation and Professional Ethics, Quackery, Sustainability and Climate Change, Local Content Development, Digital Transformation, Energy Transition, Occupational Health and Safety, Research, Innovation and Commercialization, Industrialization and Manufacturing, Artificial Intelligence and Future of Engineering, Professional Development, Policy and Government Support.

The responsibility for advancing the profession does not rest on engineers alone. Government must provide an enabling environment through sound policies, increased investment in infrastructure, support for research and innovation, and effective enforcement of engineering standards. Industry should strengthen partnerships with universities and research institutions to bridge the gap between academic knowledge and practical application, while professional bodies should continue to uphold ethical standards, promote lifelong learning, mentor young engineers, and advocate policies that enhance the profession's contribution to national development.

Engineering education must also evolve to meet contemporary demands by emphasizing practical skills, entrepreneurship, digital competence, sustainability, and interdisciplinary collaboration. Producing graduates who are innovative, adaptable, and industry-ready will enhance Nigeria's capacity to solve complex engineering problems and compete effectively on the global stage.

Ultimately, the future of the Nigerian engineering profession will be determined by its ability to adapt to emerging technologies, uphold professionalism and ethical conduct, foster innovation, and actively contribute to national transformation. With visionary leadership, strategic investment, effective collaboration among stakeholders, and an unwavering commitment to excellence, Nigerian engineers can become key drivers of industrial growth, technological advancement, environmental sustainability, and improved quality of life for all citizens. The engineering profession, therefore, remains not only a cornerstone of Nigeria's development agenda but also a catalyst for building a resilient, prosperous, and globally competitive nation.

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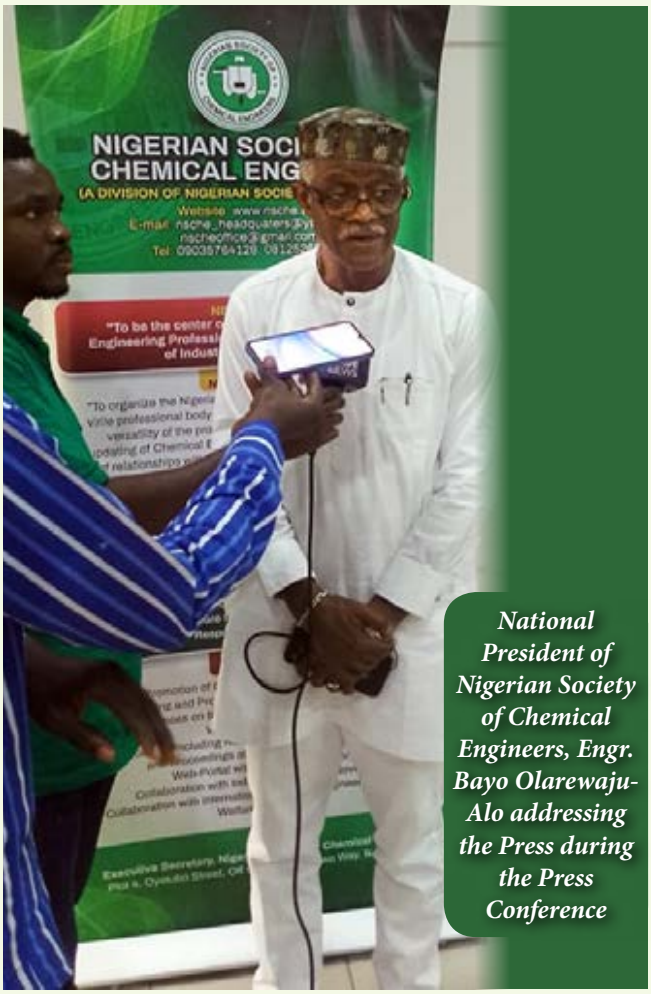
NSChE ACTIVITIES IN PICTURES

NSChE PRESIDENTIAL PRESS CONFERENCE HELD AT THE CHEMICAL ENGINEERING DEPARTMENT, UNILAG, AKOKA, YABA, LAGOS ON MONDAY, 1ST OF JUNE, 2026

Cross-section of Attendees during the Press Conference

Past President of the Nigerian Society of Chemical Engineers, Engr. Babajide Soyode, addressing members of the Press

Picture from the Press Conference: L-R), Engr. Anthony Ogheneovo, Executive Secretary, NSChE; Dr. N.J.D Erinne, Past President, NSChE; Engr. Bayo Olarewaju-Alo, National President, NSChE; Engr. Babajide Soyode, Past President, NSChE; Prof. S.S Adefila, Past President, NSChE and Prof. Usman Mohammed, Director, UNILAG Consult, during the Press Conference



National President of Nigerian Society of Chemical Engineers, Engr. Bayo Olarewaju-Alo addressing the Press during the Press Conference

NSChE PRESIDENTIAL VISIT TO NSCHE EDO/DELTA STATES CHAPTER, 19TH – 20TH JUNE 2026

Visit of NSChE Delegation to NEPL/ND Western JV, in Warri, on Friday, 19th of June, 2026, led by the National President of NSChE, Engr. Bayo, Olarewaju-Alo, accompanied by the Executive Secretary, NSChE, Engr. Anthony Ogheneovo, the Chairman of the Edo/ Delta Chapter, Dr. Onome Odisu, EXCO of the Edo/Delta States Chapter and Senior Fellows of the Chapter.

National President of NSChE, Engr. Bayo Olarewaju-Alo, the Executive Secretary of the NSChE, with members of the Edo/Delta States Chapter after the monthly meeting of the Chapter, held on the 20th of June, 2026 at PTI, Warri, Delta State

NIGERIAN SOCIETY OF CHEMICAL ENGINEERS (NSChE)

POLICY ADVISORY ON BUILDING A COMPETITIVE, INVESTMENT-GRADE STEEL ECONOMY IN NIGERIA

This is a recent NSChE comprehensive position paper as a policy advisory on repositioning Nigeria as a dominant steel manufacturing force in Sub-Saharan Africa, with credible long-term potential to compete in selected global steel value chains.

Steel is the backbone of industrialization, underpinning infrastructure, manufacturing, energy systems, and national security. Nigeria today has significant demand for steel but remains heavily import dependent. This represents both a structural vulnerability and a major opportunity for transformation.

Nigeria must transition from an asset-centric approach to a system-driven industrial strategy. The focus should shift from solely attempting to revive legacy assets as ends in themselves to building a modern, efficient, and investment-driven steel ecosystem.

Within this framework, the Ajaokuta Steel Complex should be repositioned as a pilot industrial hub and early catalyst—a low-hanging opportunity for quick wins—rather than the central anchor of national steel development.

It is critical to confront key realities. Much of the legacy infrastructure dates back to the 1980s and is unlikely to be competitive with modern technologies. The global steel industry operates on modest margins, and overly optimistic projections risk undermining policy credibility. Furthermore, logistics, energy costs, and supply chain inefficiencies significantly affect competitiveness. Nigeria's steel future must, therefore, be anchored on modern production routes, particularly gas-based Direct Reduced Iron and Electric Arc Furnace technologies. These routes would enable modular, scalable, and cost-efficient production aligned with Nigeria's natural gas advantage.

The sector should be developed through distributed production clusters located near demand centers, gas infrastructure, and logistics corridors. Each cluster should integrate upstream inputs, steelmaking, and downstream manufacturing such as fabrication, pipes, and engineering products.

Government cannot finance or operate this transformation alone. Private sector participation is essential. However, private capital will only flow where governance is credible and risks are clearly managed. Government must regulate the sector but should not interfere in operational decisions. Structures that retain discretionary control, such as intrusive golden shares, will deter serious investors.

To attract credible global and domestic players, Nigeria must deploy targeted and competitive incentives. These include long-term fiscal and regulatory stability, zero-duty regimes for steel plant equipment, guaranteed gas supply frameworks, infrastructure support, foreign exchange assurances, and performance-based incentives tied to output and employment.

Equally important is a strong legislative foundation. A National Steel and Metals Industry Act should be enacted to provide investment stability, clarify institutional roles, ensure fast-track approvals, guarantee offtake frameworks, enable dispute resolution, and support credit enhancement mechanisms. Such legislation will significantly reduce financing risk and lower the cost of capital.

The steel sector must be developed with strict capital discipline, emphasizing modular investments, phased expansion, early revenue generation, and independent technical validation. Projects must be benchmarked against global standards to ensure competitiveness.

Steel competitiveness also depends on reliable raw material supply and efficient logistics. Iron ore beneficiation, pelletization, rail connectivity, and port infrastructure must be developed in an integrated manner. Government policy must ensure competitive neutrality across the sector. Existing private operators should not be disadvantaged. Instead, all efficient producers should be supported within a level playing field.

Environmental and social standards must also be enforced to attract international capital and ensure sustainability. Implementation should proceed in phases. The first phase should focus on policy approval, legislative action, incentive deployment, and activation of quick-win opportunities. The second phase should deliver modular steel clusters and infrastructure integration. The third phase should drive expansion, exports, and downstream industrialization.

Nigeria must move beyond the temptation to revive legacy assets as the solution to local steel production. The objective is not only to complete past projects, but to build a competitive steel economy for the future. With disciplined policy, modern technology, credible governance, and strong private sector participation, Nigeria can emerge as the steel hub of Sub-Saharan Africa and a respected global player.

NSChE's recommendations include: *Establishment of a National Steel Transformation Framework; Establishment of a Presidential Steel Council; Enactment of enabling legislation; Deployment of targeted incentives, and the repositioning of Ajaokuta Steel as a catalyst within a broader ecosystem.*

Engr. Bayo Olarewaju-Alo, *FNSChE, FNSE, FAEng*
National President
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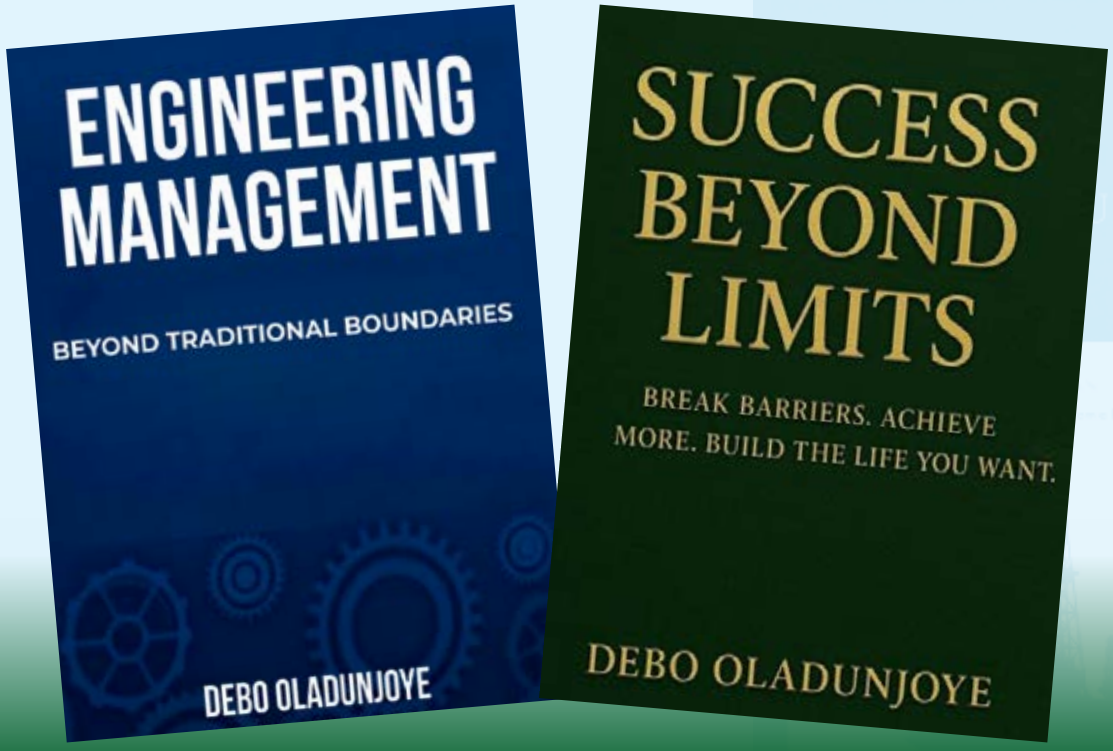

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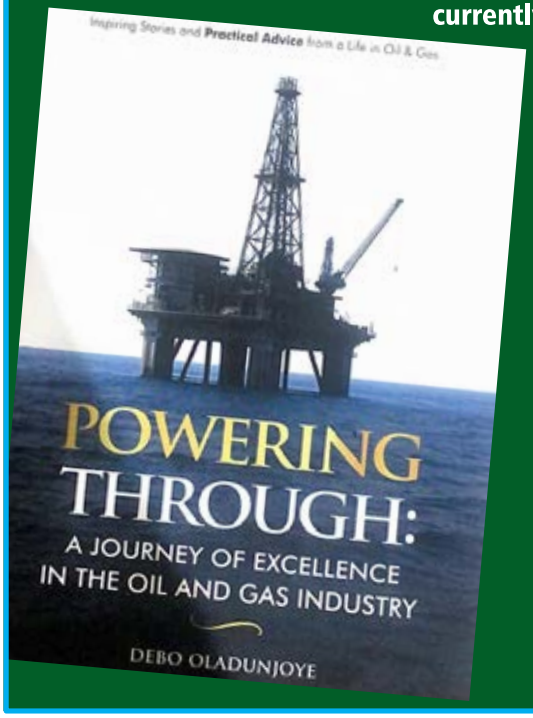

1. ENGINEERING MANAGEMENT BEYOND TRADITIONAL BOUNDARIES
2. SUCCESS BEYOND LIMITS
3. POWERING THROUGH: A JOURNEY OF EXCELLENCE IN THE OIL & GAS INDUSTRY

Engr. Debo Oladunjoye, *FNSE, FNSChE, MCIArb, MAPM (CEO, Litilo Energy Ltd)*

SAFETY STRATEGIES AND PRACTICES IN THE UPSTREAM PETROLEUM INDUSTRY

ABSTRACT

The upstream petroleum industry operates at the frontier of technical complexity and operational hazard. From onshore gathering stations in the Niger Delta to deep-water facilities in the Gulf of Guinea, the threats to human life, infrastructure, and the environment are persistent and consequential. This article explores the strategies towards bridging personal safety and process safety for sustainable operations in the upstream petroleum industry. The article examines the full spectrum of safety strategies and practices essential for upstream petroleum operations, encompassing both personal (occupational) safety and process safety management. It draws on global frameworks, landmark incident case studies—including Piper Alpha (1988), Texas City (2005), and Deepwater Horizon (2010)—as well as Nigerian-specific contexts such as the FPSO Trinity Spirit explosion (2022) and the chronic challenge of pipeline integrity in the Niger Delta. The article argues that sustained operational safety requires more than regulatory compliance; it demands a deeply embedded safety culture, robust engineering controls, disciplined operational practices, and competent personnel at every level of an organisation.

Engr. Oluwole Ayokunle, *BSc Chem. Eng., MBA (Engineering Manager, Integrity Programs, Seplat Energy)*

1.0 INTRODUCTION

The upstream petroleum sector—encompassing exploration, drilling, well completion, production, and primary processing—is recognised globally as one of the most hazardous industrial environments. The combination of flammable hydrocarbons, high-pressure systems, remote locations, rotating equipment, toxic gas exposure, and the involvement of large workforces creates a unique and layered risk environment that demands structured, systematic, and persistent safety management.

Nigeria's export sector remains heavily dependent on petroleum, with crude oil accounting for approximately 80–83% of total exports throughout 2023, according to National Bureau of Statistics foreign trade data (National Bureau of Statistics [NBS], 2023, 2024). The upstream petroleum industry also generates significant direct and indirect employment opportunities throughout Nigeria's economy. Yet, the industry has been associated with recurring incidents—asset fires, oil spills, well blowouts, and occupational fatalities—that impose significant costs covering human, environmental, financial, and reputational indices. According to the Nigerian National Oil Spill Detection and Response Agency (NOSDRA), hundreds of oil spill incidents are recorded annually in Nigeria, a significant proportion of which are attributable to equipment failure and corrosion rather than sabotage alone (NOSDRA Annual Report, 2022).

Safety in this industry is not a monolithic concept. It encompasses at least two interconnected but distinct domains: personal (occupational) safety, which addresses the risks faced by individual workers in their day-to-day activities, and process safety, which addresses the systemic risks of hazardous material releases and major accident events. Historically, the industry has invested more visibly in personal safety metrics—lost time injury rates, total recordable incident rates—while the more catastrophic process safety risks received comparatively less structured attention until a series of devastating incidents demanded otherwise.

This article provides a comprehensive review of both domains, the relationship between them, and the strategies that organisations—particularly those operating in the Nigerian upstream context—must deploy to achieve a genuinely safe and productive operation.

2.0 PERSONAL SAFETY IN UPSTREAM PETROLEUM OPERATIONS

2.1 DEFINING OCCUPATIONAL SAFETY IN THE UPSTREAM CONTEXT

Personal or occupational safety refers to the body of practices, systems, and controls designed to protect individual workers from harm arising from their work activities. In the upstream petroleum industry, these hazards include falls from height, struck-by incidents, manual handling injuries, vehicle and marine transport

accidents, electrical hazards, exposure to noise and chemical agents, confined space entry, and man-overboard events in offshore settings.

The International Labour Organization (ILO) estimates that over 2.3 million workers die annually from work-related accidents and diseases globally, with the extractive industries—including oil and gas—consistently ranked among the most dangerous sectors (ILO, 2022). In Nigeria, the Federal Ministry of Labour and Employment and the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) have both documented recurring fatalities in upstream operations, though underreporting remains a structural challenge across the industry.

2.2 KEY PERSONAL SAFETY HAZARDS AND CONTROLS

2.2.1 Working at Height

Working at height on drilling rigs, production platforms, flare stacks, and storage tanks represents one of the most significant sources of fatalities in upstream operations. Falls from height consistently appear in global industry statistics as a leading cause of fatal occupational injury (International Association of Oil and Gas Producers [IOGP], 2022 Safety Performance Indicators Report). Fig. 1 shows oil drilling rig.

Controls include: installation of fixed handrails and guardrails; mandatory use of personal fall arrest systems (PFAS); scaffolding erection under competent supervision; implementation of working at height permit systems; mandatory working at height trainings, use of rescue team and tool tethering programmes to prevent dropped objects.

2.2.2 Dropped Objects

Dropped objects are a perennial hazard on drilling rigs and offshore platforms where work takes place at multiple elevations simultaneously. The IOGP and the Dropped Objects Prevention Scheme (DROPS) have developed industry frameworks for dropped object prevention, including exclusion zones, tool tethering, and regular inspection of overhead equipment fixtures.

Fig. 1: An oil drilling rig

2.2.3 Vehicle and Marine Transport

In onshore Nigerian operations, road accidents involving crew buses, supply vehicles, and heavy equipment can lead to significant occupational injuries and fatalities. The Oil Producers Trade Section (OPTS) of the Lagos Chamber of Commerce and Industry has historically engaged member companies on road safety as a priority life-saving rule. Defensive driving programmes, journey management systems, speed limiters, and driver fitness assessments are standard industry controls.

Offshore, helicopter transport and personnel transfer between vessels and platforms introduce additional risks. The Norwegian Petroleum Safety Authority (PSA) and the UK Health and Safety Executive (HSE) have both published guidance on helicopter safety and gangway transfer operations, reflecting lessons from offshore fatalities in the North Sea and Gulf of Mexico (PSA, 2021). Offshore helicopter and personnel transfer safety require certified helideck standards with motion monitoring on moving platforms, mandatory immersion suits, mandatory personnel training, and for vessel transfers, pre-job risk assessment, safety nets, and defined stop-work criteria when sea state or visibility deteriorates.

2.2.4 Confined Space Entry

Storage tanks, vessels, pipelines, and bilge spaces present confined space hazards including oxygen deficiency, toxic atmospheres, and engulfment. Effective confined space entry programmes require atmospheric testing, standby personnel, rescue plans, communication protocols, and permit-to-work systems.

2.2.5 Chemical and Toxic Exposure

Workers in upstream operations may encounter hydrogen sulphide (H2S), benzene, mercury, methanol, corrosion inhibitors, and other hazardous substances. H2S exposure is of particular concern in sour gas fields, where concentrations above 100 ppm can cause rapid incapacitation and death. Industry best practice requires personal H2S monitors, cascade breathing air systems, pre-job H2S briefings, and regular evacuation drills (American Petroleum Institute [API] RP 55, 1995).

2.3 THE SAFETY MANAGEMENT SYSTEM FOUNDATION

Effective occupational safety is not achieved through isolated interventions but through a systematic, structured management approach. The international

standard ISO 45001:2018 (Occupational Health and Safety Management Systems) provides a recognised framework for establishing policies, identifying hazards, assessing risks, implementing controls, and driving continual improvement. Leading oil and gas companies—including TotalEnergies, Shell, and Seplat Energy—have aligned their safety management systems with ISO 45001 principles, integrating them within broader operational integrity frameworks.

2.4 LIFE-SAVING RULES

One of the most practical and impactful occupational safety innovations in the industry has been the codification of Life-Saving Rules (LSRs): a small set of non-negotiable safety behaviours where non-compliance carries severe consequences including immediate removal from site. The IOGP's nine Life-Saving Rules—covering areas such as working at height, confined space entry, driving, bypassing safety controls, and hot work—have been adopted by operators across Nigeria, including ExxonMobil, Chevron, TotalEnergies, and Seplat Energy.

The power of LSRs lies in their clarity and universality: they are applicable regardless of role, contractor status, or seniority. Evidence from companies that implemented LSRs consistently shows reductions in high-potential incident rates, particularly in the specific hazard categories addressed (IOGP, 2018).

3.0 PROCESS SAFETY MANAGEMENT IN UPSTREAM OPERATIONS

3.1 UNDERSTANDING PROCESS SAFETY

While personal safety addresses risks to individual workers, process safety addresses the risk of catastrophic events arising from the loss of containment of hazardous energy or materials. These are typically low-frequency, high-consequence events. They include fires, explosions, toxic releases, and major structural failures that can result in multiple fatalities, widespread environmental damage, and significant financial losses. The Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE) defines process safety as a disciplined framework for managing the integrity of operating systems and processes that handle hazardous substances, by applying good design principles, engineering, and operating practices (CCPS, 2007). The OSHA Process Safety Management (PSM) Standard (29 CFR 1910.119) in the United States establishes 14 mandatory elements for managing highly hazardous chemicals in industrial settings—a framework widely referenced even in jurisdictions outside the US, including Nigeria.

3.2 THE DISTINCTION FROM PERSONAL SAFETY—AND WHY IT MATTERS

A critical and often misunderstood distinction is that a facility can have excellent personal safety performance—zero lost time injuries, high personal protection equipment (PPE) compliance, no vehicle incidents—while simultaneously accumulating the preconditions for a catastrophic process safety event. The BP Texas City Refinery explosion of March 2005, which killed 15 workers and injured 180 others, occurred at a facility that had recorded years of improving personal safety metrics, even as critical process safety indicators—overpressure protection integrity, HAZOP revalidation status, and process alarm management—had been declining (US Chemical Safety and Hazard Investigation Board [CSB], 2007).

This distinction has direct relevance for Nigerian upstream operators, where investment in personal safety programmes—PPE supply, safety officer deployment, incident recording—has historically outpaced investment in process safety disciplines such as systematic hazard identification, safety critical equipment management, and management of change.

4.0 ELEMENTS OF AN EFFECTIVE PROCESS SAFETY MANAGEMENT SYSTEM

4.1 SAFETY LEADERSHIP AND CULTURE

Safety leadership is not a communication exercise or a policy statement—it is a set of observable behaviours, resource allocation decisions, and accountability structures that define what an organisation truly prioritises. The foundational work of James Reason on organisational accidents, and subsequent industry studies including the Baker Panel Report on Texas City (Baker et al., 2007), established unequivocally that organisational culture—shaped primarily by leadership behaviour—is the single most powerful determinant of process safety performance.

Major operators have codified this through integrated safety management systems: ExxonMobil's Operations Integrity Management System (OIMS), Chevron's Operational Excellence Management System (OEMS), and TotalEnergies' One MAESTRO framework all place leadership commitment as the first and foundational element, from which all other safety management activities derive their energy and authority.

In practical terms, effective safety leadership means that senior managers conduct meaningful process safety verifications—not just site tours—and that they

"Management of Change...is arguably the process safety element most frequently implicated in major accidents."

hold subordinate managers accountable not only for production targets but for the health of safety barriers. It means that safety concerns raised by front-line workers are investigated and acted upon, not administratively closed. And it means that a worker at any level can stop an unsafe operation without fear of career consequences—what the industry calls a stop work authority culture.

4.2 PROCESS HAZARD ANALYSIS

Process Hazard Analysis (PHA) is the systematic identification and evaluation of hazards associated with industrial processes. It is not a single technique but a family of methods matched to the lifecycle stage of the facility and the nature of the hazard being investigated.

During concept and front-end engineering design (FEED), Hazard Identification (HAZID) studies and preliminary risk assessments are used to identify major accident hazards, influence facility layout, and select inherently safer design options. During detailed design, Hazard and Operability Studies (HAZOP) and Safety Integrity Level (SIL) / Layer of Protection Analysis (LOPA) studies are used to define instrumented safeguards, alarm philosophy, and safety function requirements. During operations, periodic HAZOP revalidation, BowTie analysis, and Job Safety Analysis (JSA) are used to confirm that hazard controls remain effective as equipment ages and operational conditions evolve.

A recurring concern is the treatment of PHA as a documentation exercise required for regulatory submission —rather than as a living tool for operational risk management. Studies from comparable contexts suggest that HAZOP findings that are not tracked to implementation and verified on-site may account for a significant proportion of the residual hazard burden in upstream facilities (CCPS, 2007).

4.3 MECHANICAL INTEGRITY

Mechanical integrity (MI) is the element of PSM that ensures critical equipment performs its intended safety function throughout its operational life. In the upstream context, this covers pressure vessels, pipelines and piping systems, emergency shutdown (ESD) and pressure safety valves (PSVs), fired equipment, rotating machinery, and fire and gas detection systems.

The importance of mechanical integrity in the Nigerian upstream context cannot be overstated. Studies cited in engineering literature indicate that corrosion contributes to approximately 25–45% of oil and gas asset failures in Nigeria and may account for 15-50% of recorded oil spills (Achebe, Nneke and Anisiji, 2012; Nwilo, P. C., & Badejo, O. T. (2006). The FPSO Trinity Spirit incident of February 2022—in which an aged, poorly maintained vessel caught fire, exploded, and sank off Delta State with reported fatalities—is a stark illustration of the consequences of deferred mechanical integrity management (Associated Press, 2022).

An effective MI programme begins with the identification of safety-critical equipment (SCE)—those items whose failure could directly cause or fail to prevent a major accident event. For each SCE, the degradation mechanisms must be identified (corrosion, erosion, fatigue, embrittlement, etc.), the appropriate inspection and testing regime defined (non-destructive testing, function testing, risk-based inspection), maintenance and repair readiness ensured, and inspection records continuously reviewed against acceptance criteria and performance standards.

4.4 MANAGEMENT OF CHANGE

Management of Change (MoC) is arguably the process safety element most frequently implicated in major accidents. The underlying principle is simple: changes to facilities, processes, equipment, organisation, or procedures carry the potential to introduce new hazards or invalidate existing safeguards. Change, therefore, requires systematic review and approval before implementation.

The Piper Alpha disaster of 1988—discussed in detail below—was fundamentally a failure of both MoC and permit-to-work. The retrofitting of a gas processing facility onto what had been designed as an oil-only platform was not subjected to a rigorous MoC process. The new gas facilities were located in proximity to the control room, accommodation area, and primary escape routes, with catastrophic consequences (Cullen, 1990).

A robust MoC process captures all proposed changes, classifies them by risk category, subjects higher-risk changes to formal hazard assessment and multi-disciplinary review. It requires authorisation at appropriate seniority levels, mandates a pre-startup safety review (PSSR) to avoid reintroduction of hazards. It ensures that all affected documentation—drawings, procedures, training records—is updated.

4.5 OPERATING AND MAINTENANCE PROCEDURES

Procedures are the translation of design intent and process safety knowledge into the day-to-day execution of work. They define how equipment is started up, operated within safe limits, shut down, isolated, and maintained. They also define the responses to abnormal and emergency conditions.

The critical discipline here is that procedures must reflect operational reality, not a theoretical ideal that field personnel have learned to work around. Procedures that

are outdated, inaccessible, too lengthy for practical use, or inconsistent with actual plant configuration are worse than useless—they erode trust in the procedure system as a whole and encourage improvisation. The industry maxim applies directly: well-written procedures do not prevent accidents; well-used, well-maintained procedures do.

4.6 STANDARD WORK PRACTICES

4.6.1 Job Safety Analysis (JSA)

A Job Safety Analysis (JSA)—also referred to in some organisations as a Job Hazard Analysis (JHA) or Task Risk Assessment (TRA)—is a structured, pre-task risk assessment conducted by the work team immediately before commencing a non-routine or higher-risk activity. It is arguably the most practically important frontline safety tool in the upstream petroleum industry, bridging the gap between written procedures and the specific conditions encountered in the field on a given day.

The JSA process involves four sequential steps: (1) breaking the job down into discrete tasks or steps; (2) identifying the hazards associated with each step—physical, chemical, mechanical, electrical, and environmental; (3) evaluating the risk of each hazard, considering existing controls; and (4) defining additional controls or mitigations required before and during work execution. The JSA is documented, reviewed, and signed off by all members of the work team and the supervising authority before work commences.

The power of the JSA lies not merely in the document it produces but in the conversation it requires. When conducted properly—with active participation from all team members, including the most junior—the JSA surfaces local knowledge about site-specific hazards, current equipment conditions, and operational context that no generic procedure can capture. It empowers workers to raise concerns before work begins, rather than making safety decisions under time pressure in the field.

Common deficiencies include: JSAs completed by supervisors without worker participation; generic, copy-and-paste JSAs that do not reflect the actual work being performed; and JSAs signed off without a walk-down of the work site. These failures transform the JSA from a risk control into a compliance document—one that consumes time but provides no safety value. Leading companies address this by periodically sampling JSA quality against defined criteria, coaching supervisors on facilitation skills, and celebrating examples where JSAs correctly identified and controlled hazards that would otherwise have resulted in incidents.

4.6.2 Permit-to-Work (PTW) Systems

The Permit-to-Work (PTW) system is a formal, documented, and auditable control framework that authorises specific non-routine activities in defined locations under defined conditions for a specific period of time. It is the primary administrative barrier against simultaneous operations conflicts, inadvertent energisation of isolated equipment, and the commencement of work in hazardous conditions.

In upstream petroleum operations, PTW systems typically govern: hot work (welding, grinding, cutting) in or near hazardous areas; cold work on pressurised, energised, or chemically contaminated systems; confined space entry; excavation and ground disturbance; electrical work on live or recently de-energised systems; and work at height on structures without permanent access systems. The most safety-critical element of the PTW system is the isolation and energy control (LOTO—Lockout/Tagout) process, which ensures that equipment is positively isolated from all sources of hazardous energy before work commences and that it cannot be inadvertently re-energised while work is in progress.

An effective PTW system has several essential characteristics. It must be comprehensive—capturing all nonroutine, higher-risk activities on the facility. It must be clear—the permit must communicate the scope, location, hazards, controls, and isolation status unambiguously to both the authorising authority and the work team. It must be verified—the authorising supervisor or area authority must physically confirm that isolations are in place, atmospheric conditions are acceptable, and the work area is safe before signing the permit. And it must be closed out—at the end of the work period or shift, the permit must be formally closed, reinstatement verified, and systems restored to service only through a defined recommissioning process.

The importance of shift handover within the PTW system deserves specific emphasis. One of the contributing factors to the Piper Alpha disaster was the absence of a structured mechanism for communicating open maintenance activities between shifts. Modern PTW systems address this through formal shift handover logs, mandatory review of all open permits at shift change, and clear rules about whether work can continue across a shift boundary without re-authorisation. In Nigeria, several upstream operators have reinforced this by implementing electronic PTW systems that provide real-time visibility of all open permits across a facility, significantly reducing the risk of communication failures at shift change.

The relationship between the PTW system and the JSA is complementary rather than duplicative. The PTW establishes the formal authorisation framework and ensures that isolations and physical preconditions are met; the JSA ensures that the work team has thought through the specific hazards and controls for the task they are about to perform. Both are necessary; neither is sufficient without the other.

4.6.3 Simultaneous Operations (SIMOPS) Management

Simultaneous Operations (SIMOPS) arise when two or more activities are conducted concurrently in the same location or in locations where they may interact—for example, a drilling campaign conducted alongside a producing platform, or hot work conducted in a module adjacent to an open process vessel. SIMOPS create hazard interaction pathways that may not exist when each activity is considered in isolation, and they require dedicated risk assessment and coordination controls beyond the individual JSA and PTW for each activity.

SIMOPS are common during brownfield modification projects on producing facilities, during the management of multiple simultaneous well workovers, and during loading and offloading operations on FPSOs with concurrent production. Effective SIMOPS management requires a SIMOPS matrix—a systematic review of all concurrent activities and their potential interactions—a designated SIMOPS coordinator with authority to halt conflicting activities, and clear communication protocols among all parties involved.

4.7 TRAINING AND COMPETENCE

People represent both the most important defence against major accidents and, under conditions of inadequate knowledge and training, a potential contributor to them. The Swiss Cheese model of accident causation (Reason, 1990) illustrates how human errors—themselves often rooted in gaps in training, knowledge, or procedures—penetrate multiple layers of engineered and administrative safeguards to produce catastrophic outcomes.

Effective competency management in the upstream industry requires more than attendance at training courses. It requires the definition of competency standards for each safety-critical role, formal assessment of individuals against those standards. It also requires gap-based training design, and periodic revalidation—particularly following changes in role, technology, or operating context. Safety-critical tasks, including Emergency Shutdown (ESD) system overrides, PTW authorisation, and emergency response command, require verified competency, not assumed competency by job title.

4.8 INCIDENT INVESTIGATION AND LEARNING

Every incident—whether it results in injury, loss of containment, equipment damage, or is a near-miss—contains information about the state of an organisation's defences. The purpose of incident investigation in a process safety context is not to assign blame but to identify the root and systemic causes of barrier failures and to generate corrective actions that reduce the probability of recurrence.

Structured root cause analysis methodologies—TapRoot, Bow-Tie analysis, the 5-Why technique, fishbone diagrams—provide systematic frameworks for moving beyond immediate technical failures to the organisational, management system, and cultural factors that allowed them to occur. The CSB's investigation of the Texas City explosion identified not a single equipment failure or operator error but a web of organisational conditions: inadequate process safety leadership, deferred maintenance, underfunded safety improvements, and a corporate culture that prioritised cost reduction over process risk (CSB, 2007).

The failure to share lessons learned from incidents—within a company, across a joint venture, and across the industry—represents a lost opportunity that the industry has only partially addressed. Platforms such as the IOGP Safety Performance Indicators database, the Energy Institute's Process Safety Performance Indicators framework, and NUPRC's incident reporting system provide mechanisms for industry-wide learning, but their value depends on the quality and completeness of the data submitted.

4.9 EMERGENCY PLANNING AND PREPAREDNESS

No set of preventive controls is infallible. Effective emergency planning and preparedness acknowledges this reality and ensures that when preventive barriers fail, consequence management barriers are ready to perform. In upstream petroleum operations, credible emergency scenarios include well blowout, gas release and explosion, major fire, toxic release, vessel sinking, and oil spill.

Emergency preparedness requires documented emergency response plans (ERPs) that are realistic, scenario-specific, and current; reliable detection and alarm systems; escape equipment and routes that are unobstructed and adequate for maximum personnel on board; trained emergency response teams; regular and realistic drills with post-drill reviews; and clear communication with external response agencies.

In the Nigerian context, effective emergency preparedness also requires engagement with National Emergency Management Agency (NEMA), National Oil Spill Detection and Response Agency (NOSDRA), the Nigerian Navy, and other oil companies through the Clean Nigeria Associates (CNA) oil spill response cooperative. Joint industry exercises, although conducted less frequently than is ideal, have demonstrated value in testing inter-agency coordination and identifying capability gaps before they are exposed by a real emergency.

…continues next in Vol. 9 No. 1 edition

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LEVERAGING NATURAL GAS FOR SUSTAINABLE INDUSTRIAL GROWTH:

INTEGRATING ENGINEERING INNOVATION WITH POLICY AND INDUSTRY PRACTICE IN NIGERIA

1.0 INTRODUCTION

Engr. Sir Osondu Opara *FNSChE, FNSE (Oil & Gas/ Front-End Project Engineering Expert)*

Nigeria possesses one of the largest natural gas reserves in Africa, estimated at over 200 trillion cubic feet, positioning the country as a strategic energy hub for industrial transformation and economic diversification. Despite this abundance, the nation has historically struggled with inadequate gas infrastructure, persistent gas flaring, underutilization of associated gas, and inconsistent policy implementation. As global energy systems transition toward cleaner fuels, natural gas presents Nigeria with a practical bridge between economic growth and environmental sustainability.

Natural gas is increasingly recognized as a transition fuel capable of supporting industrialization while reducing dependence on more carbon-intensive fuels such as diesel and coal. In Nigeria, its applications extend across power generation, fertilizer production, petrochemicals, cement manufacturing, transportation, and domestic energy supply. See Figs. 1, 2, 3, 4, 5 & 6.

The challenge, however, lies in aligning engineering innovation, regulatory frameworks, and industry practices to unlock the full economic and environmental value of the country's gas resources.

This article examines how Nigeria can leverage natural gas for sustainable industrial growth through integrated engineering solutions, supportive public policy, and coordinated industry participation.

Fig. 1: Natural gas substitutes as fuel for transportation

Fig. 2: Petrochemicals production from natural gas feedstock

Fig. 3: Electrical power grid fed with power generated from natural gas

Fig. 4: Natural gas supply for domestic use

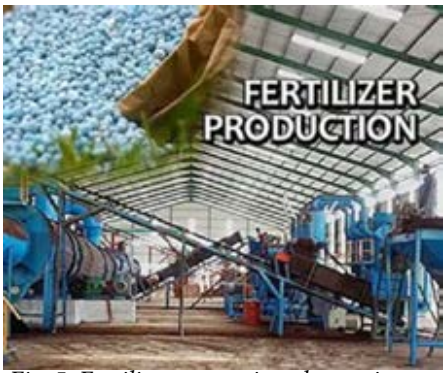

Fig. 5: Fertilizer processing plant using natural gas feedstock

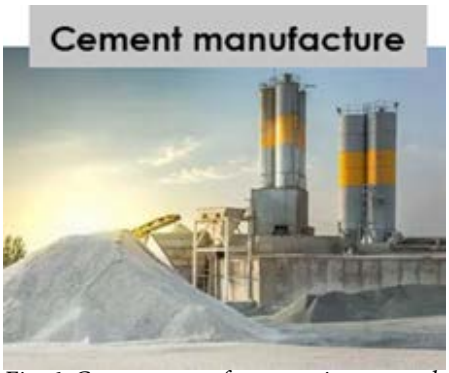

Fig. 6: Cement manufacture using natural gas as fuel

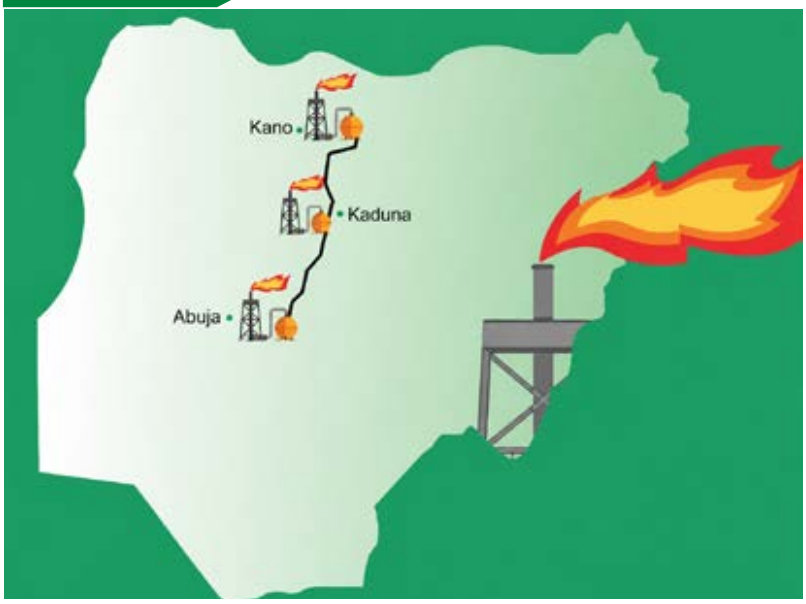

Fig. 7: The Ajaokuta - Kaduna - Kano gas pipeline

2.0 NIGERIA'S NATURAL GAS POTENTIAL AND INDUSTRIAL RELEVANCE

Nigeria's gas reserves remain significantly underexploited despite decades of hydrocarbon production. Historically, oil extraction dominated national energy priorities, while associated gas produced alongside crude oil was frequently flared or reinjected. Substantial volumes of gas are still being wasted due to inadequate infrastructure, weak commercialization frameworks, and limited domestic market integration.

Natural gas offers major industrial advantages because it:

- Provides cleaner combustion compared to coal and diesel
- Supports reliable electricity generation
- Serves as feedstock for petrochemical and fertilizer industries
- Enhances manufacturing competitiveness through lower energy costs
- Reduces greenhouse gas emissions when flaring is minimized

Industrial sectors such as cement manufacturing, steel production, fertilizer processing, food manufacturing, and transport logistics increasingly depend on stable gas supply to improve productivity and reduce operational costs.

The expansion of gas infrastructure projects such as the Ajaokuta – Kaduna – Kano (AKK) pipeline reflects Nigeria's ambition to stimulate industrial growth corridors, particularly in underserved northern regions. See Fig. 7. Recent report indicates that the AKK pipeline is expected to support fertilizer plants, gas-powered industries, and industrial parks across Kaduna, Kano, Abuja, and Ajaokuta (Reuters December 29, 2025).

3.0 ENGINEERING INNOVATION AS A CATALYST FOR GAS-BASED INDUSTRIALIZATION

Engineering innovation is central to transforming Nigeria's gas resources into sustainable industrial assets. Advances in gas processing, transmission, storage, and utilization technologies are improving the economic viability of gas commercialization projects.

3.1 GAS GATHERING AND FLARE REDUCTION TECHNOLOGIES

Gas flaring remains one of the most critical environmental and economic challenges in Nigeria's petroleum sector. Although regulatory efforts have reduced flare intensity over time, large volumes of associated gas are still wasted annually.

Emerging engineering solutions now enable the capture and productive use of flare gas through:

- Gas-to-power systems
- Natural Gas Liquids (NGL) recovery
- Mini-LNG technologies
- Compressed Natural Gas (CNG) systems
- Gas-to-fertilizer conversion
- Gas-to-hydrogen pathways

Recent engineering assessments suggest that integrated systems combining gas-to-power generation and NGL recovery are particularly suitable for Nigeria's Niger Delta operations because they simultaneously address electricity shortages and create commercially valuable products.

Digital monitoring systems, process simulation tools, and automation platforms also improve operational efficiency and emissions management. Advanced flare monitoring technologies integrated with predictive analytics can optimize gas recovery decisions and reduce methane leakage.

3.2 PIPELINE AND DISTRIBUTION INFRASTRUCTURE

Pipeline infrastructure remains fundamental to industrial gas utilization. Engineering investments in transmission networks enable industries to access reliable fuel supply while supporting

"Nigeria's National Gas Expansion Programme (NGEP) promotes increased domestic gas utilization in transportation, manufacturing, and power generation."

regional economic integration.

Nigeria's Gas Master Plan emphasizes infrastructure expansion through pipeline interconnections, processing facilities, and distribution hubs. Projects such as the OB3 pipeline and AKK pipeline are designed to improve connectivity between gas-producing regions and industrial demand centres.

Engineering innovations in modular pipeline systems, corrosion-resistant materials, smart metering, and leak detection technologies are improving pipeline safety and operational reliability.

3.3 DECENTRALIZED ENERGY SYSTEMS

Small-scale gas technologies are increasingly important for Nigeria's industrial clusters and rural manufacturing zones. Modular gas plants, microturbines, and distributed gas-fired generation systems allow industries to bypass unreliable grid infrastructure.

Compressed Natural Gas (CNG) adoption also supports cleaner transportation systems and industrial mobility. The expansion of decentralized gas utilization reduces diesel dependence while lowering production costs and emissions.

4.0 POLICY FRAMEWORKS DRIVING SUSTAINABLE GAS UTILIZATION

Engineering innovation alone cannot achieve sustainable industrial growth without coherent policy support. Nigeria has introduced several regulatory initiatives aimed at enhancing gas commercialization and reducing environmental waste.

4.1 NIGERIAN GAS FLARE COMMERCIALISATION PROGRAMME (NGFCP)

The Nigerian Gas Flare Commercialisation Programme represents one of the country's most significant policy interventions for reducing flare gas waste. The programme encourages private-sector participation in flare gas capture and commercialization projects through competitive licensing arrangements.

Recent developments indicate that permits have been granted to multiple companies under the programme, with projections of substantial investment inflows, job creation, and electricity generation capacity.

The NGFCP demonstrates how regulatory policy can convert environmental liabilities into industrial assets by creating market incentives for gas recovery technologies.

4.2 PETROLEUM INDUSTRY ACT (PIA) AND ENVIRONMENTAL REGULATION

The Petroleum Industry Act (PIA) introduced reforms intended to improve transparency, governance, and investment conditions within Nigeria's energy sector. Complementary regulations on flaring, venting, and methane emissions seek to align industry operations with environmental sustainability goals.

These regulations strengthen:

- Emissions accountability
- Commercial access to flare gas
- Environmental compliance obligations
- Investor confidence in gas infrastructure projects

Effective enforcement, however, remains essential. Community concerns regarding environmental degradation in the Niger Delta continue to highlight gaps between regulatory intent and practical implementation.

4.3 GAS-BASED INDUSTRIAL POLICY

Nigeria's National Gas Expansion Programme (NGEP) promotes increased domestic gas utilization in transportation, manufacturing, and power generation. The policy supports CNG adoption, LNG development, and industrial fuel substitution.

Industrial policies that prioritize local gas utilization can stimulate:

- Domestic manufacturing competitiveness
- Employment generation
- Energy security
- Import substitution
- Regional industrialization

Stable fiscal terms, transparent pricing mechanisms, and predictable regulatory processes remain critical to attracting long-term private investment.

"The successful integration of natural gas into Nigeria's industrial economy requires collaboration among government agencies, engineering firms, energy companies, financial institutions, and manufacturing industries."

4.4 INDUSTRY PRACTICE AND PUBLIC-PRIVATE COLLABORATION

The successful integration of natural gas into Nigeria's industrial economy requires collaboration among government agencies, engineering firms, energy companies, financial institutions, and manufacturing industries.

4.4.1 Private Sector Participation

Major industrial firms are increasingly integrating natural gas into their operational strategies. Recent agreements involving gas supply expansion for refinery, fertilizer, and cement operations demonstrate growing industrial demand for cleaner and more reliable fuel systems.

Private investment is particularly important in:

- Gas processing facilities
- LNG infrastructure
- Pipeline construction
- Industrial energy systems
- Flare capture projects

Public-private partnerships can accelerate infrastructure deployment while reducing government financing burdens.

4.4.2 Local Engineering Capacity Development

Sustainable industrial growth depends on strengthening indigenous engineering expertise. Nigeria must invest in:

- Technical education
- Research and development
- Industrial training programs
- Innovation hubs
- University-industry collaboration

Local content policies should encourage technology transfer and domestic participation in gas engineering projects. Indigenous engineering firms can play a larger role in fabrication, maintenance, automation, and infrastructure development.

4.5 ESG & SUSTAINABLE INDUSTRIAL PRACTICE

Global investors increasingly prioritize Environmental, Social, and Governance (ESG) performance. Nigerian industries adopting cleaner gas technologies can improve their international competitiveness and access to sustainable financing.

Sustainable industry practice should include:

- Methane emissions monitoring
- Carbon reduction strategies
- Community engagement
- Occupational safety systems
- Environmental remediation measures

Industries that integrate ESG principles into gas utilization strategies are more likely to achieve long-term operational resilience.

5.0 CHALLENGES LIMITING GAS-DRIVEN INDUSTRIAL GROWTH

Despite significant opportunities, several structural barriers continue to hinder Nigeria's gas-based industrial transformation.

i. Infrastructure Deficits: Insufficient pipeline networks, storage facilities, and processing plants limit gas accessibility for industries. Remote production sites often lack economically viable evacuation infrastructure.

ii. Financing Constraints: Gas infrastructure projects require substantial capital investment and long payback periods. Currency instability, regulatory uncertainty, and investment risks can discourage financiers.

iii. Regulatory Inconsistency: Frequent policy shifts and implementation delays undermine investor confidence. Regulatory coordination among agencies also requires improvement.

iv. Security and Vandalism: Pipeline vandalism, oil theft, and insecurity in producing regions increase operational costs and disrupt supply reliability.

v. Environmental and Social Concerns:

"Natural gas presents Nigeria with a transformative opportunity to achieve sustainable industrial growth while addressing energy poverty, environmental degradation, and economic diversification challenges."

Communities affected by gas flaring and hydrocarbon pollution continue to experience environmental degradation and health challenges. Sustainable industrialization must therefore incorporate social justice and environmental protection.

6.0 STRATEGIC PATHWAYS FORWARD

To maximize natural gas as a driver of sustainable industrial growth, Nigeria should pursue integrated strategic actions as recommended below:

i. Expand national gas infrastructure through public-private investment models
ii. Strengthen enforcement of anti-flaring and methane reduction regulations
iii. Accelerate deployment of modular gas utilization technologies
iv. Improve policy consistency and fiscal transparency
v. Promote indigenous engineering innovation and technical capacity development
vi. Support gas-based industrial clusters and special economic zones
vii. Encourage ESG-driven industrial operations and environmental accountability
viii. Enhance regional gas distribution for manufacturing and power generation
ix. Foster research partnerships between universities, regulators, and industry
x. Integrate energy transition planning into long-term industrial policy

7.0 CONCLUSION

Natural gas presents Nigeria with a transformative opportunity to achieve sustainable industrial growth while addressing energy poverty, environmental degradation, and economic diversification challenges. Engineering innovation, when supported by coherent policy frameworks and responsible industry practice, can convert Nigeria's vast gas reserves into engines of industrial productivity and national development.

The transition toward a gas-based industrial economy requires more than resource abundance; it demands coordinated infrastructure investment, regulatory discipline, technological modernization, and inclusive stakeholder collaboration. By integrating engineering solutions with sound governance and sustainable industry practices, Nigeria can position natural gas not merely as a transitional fuel, but as a foundation for resilient industrial transformation in the twenty-first century.

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SUGAR INDUSTRY IN NIGERIA

1.0 INTRODUCTION

Engr. Olubunmi Oke *(B.Sc., M.Sc., MNSE, FNSChE) Dangote Sugar Refinery Plc, Apapa, Lagos State, Nigeria*

Nigeria is a net importer of raw sugar, relying on imports for a significant portion of its sugar consumption. Despite the possession of fertile land suitable for sugarcane farming, the country faces many challenges that have made the goals of making Nigeria self-sufficient in raw sugar output a difficult task. There are four fundamental determinants of the global sugar flow. These are production, consumption, exports and imports. Available statistics from the International Sugar Organization (ISO) reports reveal that Nigeria only belongs to the category of sugar importers, where it ranked 4th highest in 2009 ((ISO, 2009). Nigeria imports brown sugar of very high polarity (VHP), refines it locally to meet most of its sugar requirements.

In the Nigerian Sugar Master Plan (NSMP), Nigeria is expected to be self-sufficient in sugar production but the implementation of the plan from 2012 to 2023 has not yielded the required results. This brought about the extension of the implementation by another ten-year period. The National Sugar Development Council revealed that the second phase of NSMP is targeted at boosting production up to two million metric tons annually which requires an investment of about $5billion. The NSMP ten-year blueprint is geared towards self-sufficiency in sugar production and is expected to exceed the current annual consumption of about 1.8million metric tons. With the extension of the NSMP to phase II, the Nigerian sugar industry is expected to experience significant growth, with sugar production projected to increase from 63,600 metric tons to more than 1.8 million metric tons by 2033. This article brings to the fore various perspectives of sugar industry in Nigeria.

2.0 BRIEF HISTORY OF SUGAR COMPANIES IN NIGERIA

The first integrated industrial sugar factory in Nigeria, Nigerian Sugar Company (NISUCO) Bacita, was established in 1961 by the government, with an installed capacity of 40,000 tonnes of refined sugar per annum. Sugar production began in 1964, and the highest sugar production of 35,000 tonnes was recorded in 1973/74 crushing season. However, production activities began to decline in the 1980s due to various fields, factory, and management factors (FAOSTAT 2019).

The second sugar company was the Savannah Sugar Company Limited (SSCL) Numan, which started production in 1980/81 with an installed capacity of 50,000 tonnes of refined sugar per annum. SSCL recorded its highest production of 23,000 tonnes in 1991/92 crushing season. From inception, the company faced challenges such as poor contract management, insufficient government funding, and a debilitating debt (USDA, 2020). In the late 1990s, the Nigerian government decided to privatize both companies, and they were respectively sold to Josepdam Group and Dangote Group. Although the government tried to establish other sugar companies in Lafiagi and Sunti, they did not take off until BUA Group and Golden Sugar Company acquired them in 2014 (Wada and Gbabo, 2019).

The Jigawa State Government also started a 1500tcd sugar factory in Hadejia in 2005, but the project remains incomplete. Additionally, several mini sugar plants with capacities in the range of 10 to 250tcd were established by private and state governments, but their combined production is negligible (NSDC, 2012). Meanwhile, sugar consumption in Nigeria increased from 43,000 tonnes in 1955 to around 450,000 tonnes in 1974. By 1982, demand had risen to almost 1.0 million tonnes, while only about 40,000 tonnes (4%) were being produced. Even after privatization in 2003/04, the fortunes of the sugar companies did not improve much, with only SSCL producing about 12,000 tonnes in 2008/09, while Nigeria's sugar consumption was already well over a million tonnes. The shortfall had always been filled by imports, which had steadily risen to about 1.5 million tonnes by 2009. The collapse of the sugar industry had adverse effects on employment, poverty

"The...installed capacity of the sugar refineries...about 3.63 million metric tons...is estimated at about 70-75%..."

alleviation, and rural development and constituted a significant drain on the country's foreign reserves. The Federal Government of Nigeria directed the National Sugar Development Council to develop a roadmap to self-sufficiency within the shortest possible time frame to address these issues (NSMP. 2010).

After privatization of NISUCO and SSCL the sugar business in Nigeria shifted towards private investment. The Dangote Sugar Refinery Plc was established in March 2000 as the first sugar refinery built in Nigeria, with an initial refining capacity of 600,000 metric tons annually. The facility later undergone two major upgrades which turned it into the largest sugar refinery in Sub-Saharan Africa with 1.44million metric tons annual refining capacity, location in Apapa, Lagos State (Dangote Sugar, 2025). BUA Sugar (now part of BUA Foods) also entered the sugar refining market in 2005 to further solidify private sector involvement. BUA Sugar Refinery was built with a 720,000 metric tons per annum sugar refinery in Apapa, Lagos State in 2008. In 2019, BUA Sugar completed the installation of the Eastern Sugar Refinery in Port-Harcourt, Rivers State. The two BUA sugar refineries have a total combined installed refining capacity of 1.5 million metric tons (BUA, 2025).

The Golden Sugar Company (GSC), Apapa refinery, commenced operation in June 2013 and has an installed annual refining capacity of 750,000 metric tons (Golden, 2025). The combined installed capacity of the sugar refineries operated by the three major players is about 3.63 million metric tons, the operating capacity is estimated at about 70-75% of the installed capacity. The local sugar refining capacity is considered significant.

The three major sugar producing companies in Nigeria with sugar plantation are the following.

a. Dangote Sugar operates three plantations: Savannah (32,500 hectares) in Adamawa State, Lau Tau (30,000 hectares) in Taraba State and Tunga (78,000 hectares) in Nasarawa State.
b. Sunti Golden Sugar Estates (SGSE), which is owned and operated by Golden Sugar Company (GSC). Sunti Golden Sugar Estate located at Sunti, Niger State consists of a 17,000 hectares irrigable farmland/estate with 3,500-hectare sugarcane plantation and 100,000 tons per annum Sugar Mill.
c. BUA Sugar owns two plantations, LASUCO in Kwara State and Bassa in Kogi. Both plantations have a total size of 70,000 hectares.

In line with the Federal Government's Backward Integration Programme on self-sufficiency in sugar, all the sugar producing companies are working to ensure that the Sugar Master Plan is achievable. However, there is a general view that the pace of achievement so far is slow.

The following are the companies in sugar industry in Nigeria:

i. Sugar Refinery:
- Dangote Sugar Refinery PLC, Apapa, Lagos State (Dangote Sugar)
- BUA Sugar Refinery, Apapa Lagos State (BUA Sugar)
- Golden Sugar Company Limited, Apapa, Lagos State (Golden Penny Sugar)
- Eastern Sugar Refinery, Port Harcourt, River State (BUA Sugar)

ii. Large Scale Sugar Factories:
- Josepdam Sugar Company Limited, Bacita, Kwara State (KIA Africa Group/Keystone Bank)- Not in operation
- Savannah Sugar Company Company Limited, Numan, Adamawa State (Dangote Group)
- Lafiaji Sugar Company Limited, Lafiaji, Kwara State (BUA Group Project)
- Sunti Golden Sugar Estate Limited, Sunti, Niger State. (FMN Group)
- Nasarawa Sugar Company Limited, Tunga, Nasarawa State (Dangote Group Project)

iii. Small Scale Sugar Companies/Projects:
- Oyo Sugar Processors Limited, Iseyin, Oyo State (Brent Sugar Limited Project: 3000TCD sugar mill, 6000Ha irrigated field and 5000Ha out-grower)
- Goronyo Sugar Company, Goronyo, Sokoto State
- Lau/Tau Sugar Project, Taraba State (Dangote Group Project)
- Great Northern Agribusiness Limited, Gagarawa, Jigawa State (5000TCD project in Hadejia)- Lee Group (Hongkong registered company)

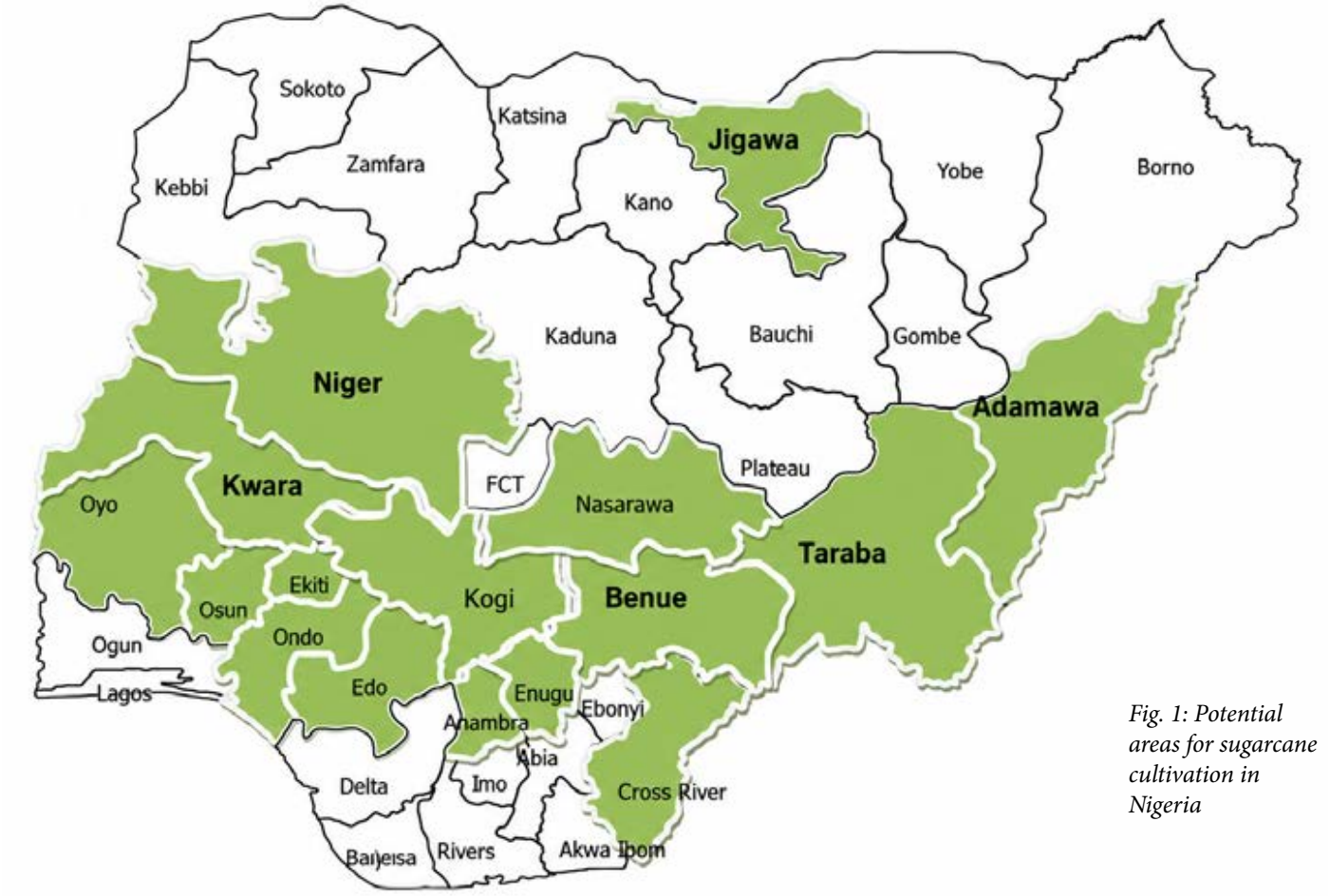

Fig. 1: Potential areas for sugarcane cultivation in Nigeria

- Lee Group Operates in Jigawa State
- Niger Foods: Developing 250,000hectares in Niger State
- Others: new Sugar Company located in Kogi State, Gombe State, etc

iv. Sugar Cubing and Packaging Plant:

- DOGAN'S Sugar Company
- McNichols Cubing Company

3.0 SUGARCANE: A BRIEF DISCOURSE ON CULTIVATION IN NIGERIA

Sugarcane and sugar beet are the two major sugar crops worldwide. In Nigeria, sugarcane is the sugar crop cultivated. Sugarcane is a perennial crop that grows mainly in tropical and subtropical regions. It is very sensitive to climate, soil type, irrigation, and harvest period. The same plants can be harvested for several years in ratoons, although yields decline over time. Sugarcane is used mainly to produce sugar and ethanol; it can also be used to produce derivatives such as electricity (through bagasse surplus) and bioplastics. It remains a water-intensive crop. Conversely, sugar beet is an annual crop, cultivated mostly in temperate zones. This crop is used to produce a wide range of products, including food (sugar), feed, bio-based products for the industry (pharmaceuticals, plastics, textiles, and chemicals), and ethanol. Sugarcane accounts for around 86% of the sugar crops and sugar beet makes up for the remainder.

There is a huge potential for growing sugar cane on a large scale, particularly along the entire length and breadth of the rivers Niger and Benue (See Fig. 1). Over 800,000ha of land could support high yield sugar cane production in Nigeria.

There is a general saying that sugar is made in the farm. Through photosynthesis, sugarcane converts carbon dioxide (CO2), water (H2O) and energy from light into sugars and polysaccharides releasing oxygen (O2) into the atmosphere. The sugar produced is stored in the stems. The crop has long stems, which are produced in multiples and grows into cane stalk, the stalk is fibrous and stout jointed and is rich in sugar sucrose (used to provide about 70-80% of the world's sugar). Sucrose accumulates in the stalk internodes. The stalk consists of 14%, 68%, 15% and 3% more or less of fiber, water, soluble sugar, and non-sugar respectively. At maturity sugarcane is harvested, transported, and shredded before the juice is extracted. The juice is then filtered, evaporated,

Year	Consumption (Tons)	Production (Tons)	Importation (Tons)	Average Unit Price ($/MT)	Importation Cost ($)	Per Capita Consumption (Kg/Year)	Local Production %
1990	645,248	41,478	603,770	440	265,658,800	n/a	6.43
1991	773,463	44,893	728,570	290	211,285,300	n/a	5.80
1992	598,986	32,420	566,566	280	158,638,480	n/a	5.41
1993	405,590	28,576	377,014	300	113,104,200	6	7.05
1994	360,060	22,814	337,246	340	114,663,640	6	6.34
1995	358,038	20,000	338,038	410	138,595,580	5	5.59
1996	525,985	12,104	513,882	370	190,136,340	5	2.30
1997	552,573	15,805	535,768	320	171,445,760	6	2.86
1998	773,264	9,850	763,414	310	236,658,340	7	1.27
1999	781,782	10,000	771,782	240	185,227,680	6	1.28
2000	771,890	36,000	735,890	270	198,690,300	7	4.66
2001	1,209,480	0	1,209,480	260	314,464,800	8	n/a
2002	1,009,165	0	1,009,165	260	262,282,900	11	n/a
2003	988,441	0	988,441	260	256,994,660	8	n/a
2004	865,000	0	865,000	265	229,225,000	9	n/a
2005	1,301,494	0	1,301,494	216	281,416,777	9	n/a
2006	1,176,698	50,000	1,126,698	175	197,172,150	9	4.25
2007	1,258,996	55,000	1,203,996	260	313,038,960	9	4.37
2008	1,393,668	35,000	1,358,668	241	327,438,988	11	2.51
2009	1,220,080	39,000	1,220,041	324	395,293,284	9	3.20
2010	985,675	30,000	955,675	505	482,615,875	7	3.04
2011	1,109,410	5,000	1,104,410	595	657,123,950	8	0.45
2012	1,104,980	6,843	1,098,137	471	517,222,527	7	0.62
2013	1,379,349	5,011	1,374,338	377.6	518,950,028.80	8.10	0.36
2014	1,445,816	12,345	1,433,471	441.39	632,719,764.69	8.60	0.85
2015	1,498,212	13,488	1,484,724	372.15	552,540,036.60	8.70	0.90
2016	1,584,724	25,000	1,559,573	330.96	516,156,280.08	9.10	1.58
2017	1,306,913	20,184	1,286,729	357	459,362,253.00	7.60	1.54
2018	1,231,028	14,918	1,216,110	277.37	337,312,430.70	6.80	1.21
2019	1,401,891	38,597	1,363,294	280.42	382,294,903.48	7.6	2.75
2020	1,531,471	N/A	1,531,471	283	433,406,293.00	7.7	n/a
2021	1,603,831	35,665	1,568,166	405	635,107,230.00	7.8	2.22
2022	1,721,128	46,479	1,675,649	541	906,526,109.00	8.4	2.7
2023	1,442,097	30,053	1,412,044	657	927,712,908.00	7.1	2.08
2024*	—	—	—	—	—	—	—

Table 1: Nigeria's annual sugar production, importation & consumption

***Note (2024*):** Compilation of 2024 data is ongoing; and Consumption is taken as simple addition of yearly production and importation, although there are ending stocks that are not captured. Source: National Sugar Development Council (NSDC): https://www.nsdcnigeria.org/nigeria-sugar-data*

and crystallized to produce raw sugar. The raw sugar is further refined to remove impurities, dried, packaged as white refined sugar.

Globally, sugar production involves two stages: (a) processing of sugarcane into raw sugar and (b) processing of the raw sugar into refined granulated sugar. The sugar factories in Nigeria are designed to produce raw sugar from sugarcane and some are incorporated with facilities to refine the raw sugar to white sugar. Sugar refining which dominates the sugar industry operations in Nigeria converts imported raw sugar to refined granulated sugar.

Information from National Sugar Development Council (NSDC) website indicates that Nigeria's total annual consumption of sugar from domestically grown raw sugar stood at 38,597 metric tonnes in 2019- 2.75% of total sugar processed in Nigeria, which was 1,401,891 metric tonnes. The balance of 1,363,294 metric tonnes was from imported raw sugar. Table1 shows the annual sugar production, importation and consumption from 1990 to 2023.

"The major processing operations associated with refining of sugar include: Raw sugar melting, Clarification of Melt liquor, Filtration, Ion Exchange Resin Decolorisation, Evaporation, Crystallization, Centrifugation, Drying, Sugar Recovery, Sugar Conditioning, Fortification, Packaging and..."

4.0 SUGAR FACTORY OPERATIONS

The major processing operations in raw sugar factories include the following:

- Weighing of cane
- Cane Handling: Unloading, Conveying, cleaning, cutting with knives, shredding
- Extraction of Juice (in roller mills) - Juice extraction by crushing the cane between massive rollers or diffusion method, addition of imbibition water
- Purification of Juice: Clarification - removal of both soluble and insoluble impurities, through clarification (or defecation) process, that universally employs lime and heat as the clarifying agents
- Evaporation: Concentration of clear juice in multiple effects evaporators
- Crystallization: Development of sugar grains in single-effect vacuum pans
- Centrifugation: separation of sugar grain in centrifugal machine
- Raw sugar melting or drying
- Sugar recovery

Utility services used in raw sugar processing include: Water, steam and electrical power, and compressed air.

5.0 SUGAR REFINERY OPERATIONS

The major processing operations associated with refining of sugar include: Raw sugar melting, Clarification of Melt liquor, Filtration, Ion Exchange Resin Decolorisation, Evaporation, Crystallization, Centrifugation, Drying, Sugar Recovery, Sugar Conditioning, Fortification, Packaging and Utility services. Utilities used in the refining include: Water, steam, and power, and compressed air.

6.0 CHALLANGES OF SUGAR INDUSRTY IN NIGERIA

The common problems militating against increased sugar cane production in Nigeria are low investment and lack of required capital, lack of market outlay, biotic and abiotic stresses, high transport and production costs of hauling harvested sugar cane to the mills, low capacity building, lack of sugarcane out-growers and technologist associations, macro- and micro-environmental issues, lack of legal frameworks and lack of national and regional networking groups.

Wada et al., (2017) discussed some disturbing macro-environmental impacts that can arise from expansive sugar cane production in Nigeria and Northern African countries to include further deforestation by displaced cattle farmer, climate change and drought. The micro-environmental impacts of sugar cane production are land conflicts, human health risks, child and slave labour, erosion and soil degradation, air pollution, water pollution, high use of water, use of genetically modified sugar cane, GMOs, low wages and bad working conditions.

Some of the factors that contribute to low farm productivity of sugar cane plantations in Nigeria and Northern African countries were highlighted by Wada, A. C., et al (2017) as follows:

i. Use of exotic cane varieties
ii. Inability of some farmers to apply the necessary farm inputs
iii. Sole dependence on rainwater for irrigation
iv. High cost of starting capital and production inputs
v. Lack of technology/ knowledge and facilities on proper land preparation techniques and methods
vi. Non-availability of production credit to producers, especially to small-holder farmers

"The NSMP focuses on stimulating domestic growth in sugar production, with strategies like restricting imports and providing incentives for investors."

vii. Lack of legislative protection for the local sugar industry. There is now a 10% levy on sugar imports and 40% tariff to meet the International Sugar Organization (ISO) standard of other sugar producing countries.
viii. Lack infrastructures in the rural areas
ix. Lack of easy access to land
x. Involvement of government in sugar production with no market outlay
xi. Constant hiking of petroleum product pricess. High cost of Low Pour Fuel Oil, LPFO makes production cost of any local sugar quite high.
xii. Lack of private sector investment
xiii. Non-funding of sugar cane research and development
xiv. Lack of central coordination of the direction of research in sugar sector
xv. Lack of defined fertilization rates for optimum sugar cane and sugar yields
xvi. Lack of proper fertilizer and irrigation management as well as nitrogen fixation studies in sugar cane production
xvii. Limited biotechnological advancement in sugar cane research
xviii. Lack of biological control studies for pests and diseases
xix. Problems of crop vulnerability or biotic stresses
xx. Problems of weed infestation and lack of efficient management strategies
xxi. Lack of efficient management strategies for biotic stresses
xxii. Lack of appropriate and well-equipped laboratories
xxiii. Problems due to different harvesting systems
xxiv. Problems due to different harvesting methods. Mechanized cane cutting is more efficient but is of limited practice at present in Nigeria. Manual harvesting involves high wage bills
xxv. Problems of manual harvesting. The wages for manual harvesting are always high and add to total production cost of the processed sugar, making sugar produced costlier than the imported one.
xxvi. Problems with mechanical harvesting
xxvii. Lack of use of sugar cane bye-products and the quest for biofuel development
xxviii. Lack of political will on the part of governments. The problem is not the land and not the expertise in sugar cane production but on the non-political will to translate good ideas into concrete establishment of large sugar cane farms and appropriate distilleries to produce ethanol from the grown sugar cane.
xxix. Lack of legislative control for illegal parasites. In some countries, working with some parasites is illegal because they are under legislative control. There is no such legislative control on any pest in Nigeria
xxx. Lack of breeders' royalties
xxxi. Lack of sustainability and certification schemes.

7.0 NIGERIAN SUGAR MASTER PLAN (NSMP)

The National Sugar Development Council (NSDC) is the body responsible for implementing the National Sugar Policy and the Nigerian Sugar Master Plan (NSMP). NSDC developed the NSMP, which was approved by the Federal Government in 2012 and implementation started in 2013. The NSMP focuses on stimulating domestic growth in sugar production, with strategies like restricting imports and providing incentives for investors.

7.1 STRATEGIC OBJECTIVE OF NSMP

The Nigerian Sugar Master Plan (NSMP) came at a time when the industry needed to rethink its direction to meet the national sugar demand through local production. This would require that the industry goes beyond sugar, think more about sugarcane as a whole, and exploit market opportunities presented by multiple sugarcane products. The new thinking, therefore, requires that the industry mobilizes and invest resources in new start-ups and backward integration programmes.

In the light of the above, the NSMP came up with a number of policy measures as well as regimes of fiscal and investment incentives to achieve the following objectives:

A. Raise local sugar production to attain self-sufficiency through:

i. Robust monitoring and evaluation of backward integration programme
ii. Regulation of the entire regime of sugar importation through quota allocation
iii. Investors' specific fiscal incentives to attract investment into the sector

B. Stem the tide of high importation through:
i. High graduated tariff structure on sugar importation
ii. Implementation of BIP support incentives and sanctions policy
iii. Import quota allocation benchmarked on local production

C. Create huge number of job opportunities through:
i. Significant increase in cane area and factory milling capacity
ii. Re-invigorating and expanding the out-grower scheme
iii. Enlargement of sugarcane value chain players

D. Contribute to the production of ethanol and generation of electricity through:
i. Development of multipurpose sugarcane varieties
ii. Establishment of Ethanol distilleries at each new sugar project
iii. Designing of all new sugarcane processing plants with high pressure boilers for efficient co-generation

In order to ensure that the identified objectives are comprehensively addressed, a number of strategies have been formulated for each objective, as highlighted above. Sets of activities have also been identified for each strategy in order to work towards the achievement of the desired outcomes (NSMP. 2012).

The NSMP aimed to achieve self-sufficiency in sugar production within 10 years. The first phase of the NSMP was approved, lasting from 2012 to 2022. Not much was achieved. The Federal Government has approved the extension from 2023 to 2033 as the second phase of NSMP with better implementation strategy. This second phase is another 10 years for the development of the sugar industry to be self-sufficient in sugar production. This ten-year plan is expected to save $350m forex annually, create 110,000 jobs, save $65.8million on ethanol import and generate 400 megawatts of electricity (NSDC, 2022).

"The policy which formed part of the Nigerian Sugar Master Plan (NSMP), seeks to achieve self-sufficiency in sugar production and diversify the economy."

8.0 NIGERIA'S SUGAR POLICY

The National Sugar Policy aims to reduce Nigeria's reliance on sugar imports by boosting domestic production, promoting private sector involvement, and encouraging rural development. The policy which formed part of the Nigerian Sugar Master Plan (NSMP), seeks to achieve self-sufficiency in sugar production and diversify the economy.

The objectives of the National Sugar Policy are the following:

i. To develop a pool of adaptable high yielding indigenous varieties of sugar cane to replace the existing poorly performing ones and supply suitable commercial clones for new sugar projects across the country
ii. To ensure the introduction of sustainable agronomic practices to both preserve and enhance the productivity of the available soil resources
iii. To ensure an effective pest and disease (including weed) management practices through improved cultural, mechanical and chemical control measures, at least cost
iv. To facilitate the collection and analysis of a wide range of data and information on sugar and sugarcane related matters for better planning purposes as well as improvement of production efficiency.
v. To facilitate cane and sugar quality assessment and improvement through a concerted research effort that will set acceptable quality standards for both sugar and cane
vi. To enable Nigeria benefit from research efforts of similar outfits through collaboration and cooperation with countries with well-established sugar sectors

"In accordance with the Federal Government initiatives for Nigeria to be self-sufficient in sugar production, private investors are encouraged to invest in the sugar industry."

vii. To ensure an effective human resource development for better performance of both skilled and semi-skilled manpower of the sugar sector through periodic and continuous training
viii. To build a comprehensive information center on all technical and policy issues relating to sugar for the use of scientists, instructors and trainees of established Sugar Training, Research and Development Centre (STRDC)
ix. To set in motion mechanism for the formation of Sugar Technologists Association of Nigeria (STAN) with its attendant benefits. (NSDC, 2003)

9.0 BACKWARD INTEGRATION PROJECTS

In accordance with the Federal Government initiatives for Nigeria to be self-sufficient in sugar production, private investors are encouraged to invest in the sugar industry. The activities of the three major sugar industry players and other investors are described below:

9.1 DANGOTE SUGAR REFINERY

Dangote Sugar Refinery Plc is an integral part of the Federal Government of Nigeria's National Sugar Development Master Plan. Dangote Sugar's backward integration plan aims to achieve transition from port-based refiner to a fully integrated sugar producer, utilizing locally grown sugarcane. The plan is committed to becoming an integrated sugar business, serving local and export markets from integrated sugarcane plantations and factories across Nigeria, over the next 10 years. This integrated approach aims to control raw material costs, create jobs, and contribute to the Nigerian economy.

The goal is to achieve the capacity to produce 1.5 million tons of refined sugar annually from sugarcane plantations covering more than 150,000 hectares of land across a number of sites in Nigeria. This will make Nigeria to achieve self-sufficiency in sugar production and create over 100,000 new employment opportunities.

The first phase of the project is at an advanced stage with the rehabilitation and expansion of Dangote Sugar, integrated sugar estate at Numan, in Adamawa State; reintroduction of a robust out-growers scheme and the charting of a sustainable community relations and development initiatives guided by consultations and engagements with the local communities.

Further to this is the acquisition of other integrated sites at other locations close to suitable land with good irrigation. The Nasarawa Sugar Company Limited is one of Dangote Sugar Refinery Plc backward integration projects. It is the 78,000 hectare sugar project site, located at Tunga, Nasarawa State, along River Benue in Nigeria. The compensation for the land in the sum of N3.25 billion is fully paid to the landowners. The land clearing, planting and infrastructure development are ongoing at the site, as well as factory design amongst others. The engagement of the required technical competence for the project is ongoing and the various social responsibility projects lined up for execution in the immediate communities are ongoing, while some were completed. (Dangote Sugar, 2025). There is also a sugar backward integration project ongoing at Lau/Tau Project, Taraba State.

Dangote Sugar Refinery has made its Sugarcane Out-Grower Scheme Programme more robust by providing more land, seeds, fertilizer and other inputs to host community farmers as a strategy to meet up target set out by the National Sugar Development Master Plan. Dangote Sugar has so far committed over US$700million to the BIP to stem the national annual sugar import of over US$337million, so as to ensure Nigeria attains national sugar self-sufficiency which will in turn revolutionize the economy of the nation as other people-oriented infrastructures would come with the sugar projects (Dangote Sugar, 2025).

9.2 BUA FOODS

Further to the Federal Government of Nigeria's Sugar Master Plan, which incentivizes local sugar

"...planned expansion to upland areas of Sunti 2 & 3 including Toyo, Nasarawa State to boost production to 250,000 tons per annum"

production, and in response to the Nigerian Government backward integration policy in the sugar industry, BUA Foods had invested in sugar estates within Nigeria to deepen local sugar production, through the development of the LASUCO Sugar Company Limited ("LASUCO") plantation in Lafiagi, Kwara State and the establishment of the Bassa Sugar Company in Kogi State. Together BUA Foods has about 70,000 hectares of land in both locations to set up large-scale sugar plantations. Once operational, the company expects that these plantations will significantly improve the development of Nigeria's local sugar industry, enhance its competitive position, reduce its reliance on the importation of raw sugar, bolster its revenue growth, and ensure cost efficiencies from the operation of the sugar plantations.

LASUCO Sugar Company Limited has a 20,000-hectare sugar cane plantation with a crushing capacity of 10,000 MT of cane per day sugar mill and 220,000 MT annual capacity refinery which the company expects to commission.
The company expects the refinery to generate a total volume of 20 million litres of ethanol per annum, while 32 megawatts of electricity will be generated from bagasse, a by-product of sugar cane. Once operational, the company expects that LASUCO will be the largest integrated sugar factory in West Africa. The LASUCO plantation is designed to supply a large part of Nigeria's sugar consumption, and the company expects to support farmers through an out-grower scheme to increase sugar cane production and provide a springboard for the company to further expand its local sugar production. The Bassa plantation, located in Bassa, Kogi State, is 50,000 hectares of prime land which is suitable for sugar cane plantation. The produce from the plantation is expected to ultimately provide stock feed for the refineries in Apapa and Port-Harcourt (BUA, 2025). The company has invested over $200m in its integrated sugar estates

9.3 GOLDEN SUGAR

Golden Sugar Company is a wholly owned subsidiary of Flour Mills of Nigeria Plc, and a member of the FMN Group. As part of FMN's commitment to the development of the sugar value chain in Nigeria and in line with the Federal Government's backward integration policy regarding the mandatory upstream operation requirements for sugar processors, Golden Sugar Company acquired 100% equity in Sunti Golden Sugar Estates Limited (SGSE).

The N50 billion SGSE investment in Nigeria, is a concrete example of FMN's commitment to reduce sugar importation, make huge savings in foreign exchange, boost local capacity, and reduce unemployment by putting thousands of Nigerians to work in the agricultural sector.

Sunti Golden Sugar Estate located at Sunti, Niger State consists of a 17,000 hectares irrigable farmland/ estate with 3,500-hectare sugarcane plantation and 100,000 tons per annum Sugar Mill which was formally commissioned on the 15th of March 2018. There is a planned expansion to upland areas of Sunti 2 & 3 including Toyo, Nasarawa State to boost production to 250,000 tons per annum (Sunti, 2025)

9.4 OTHER SUGAR PROJECTS

There are other green-field sugar projects being developed under the NSMP in various location in Nigeria. These include the Gagarawa Sugar Project in Gagarawa, Jigawa State, the Contec Global Project in Isanlu Esa, Kogi State, Gummi Sugar Project in Zamfara State, Sean-Zara Sugar Project in Kwara State, Crystal Sugar Project in Jigawa State, Oyo State Sugar Processors Ltd, Iseyin, Oyo State, Goronyo Sugar Project in Goronyo, Sokoto State and Cocaset Sugar, Ondo State.

9.5 SUGARCANE OUT-GROWER SCHEME

The Nigerian sugar industry continues to empower local communities, integrating them into the sugar value chain as partners, workers, and stakeholders using out-grower schemes and creating employment opportunities. Sugarcane out-grower schemes involve sugar companies partnering with farmers to grow sugarcane, a key ingredient in sugar production. These schemes aim to boost sugarcane

"Nigeria's sugar industry, despite over 50 years of existence, is still in its infancy, supplying less than five percent of national demand. Nigeria sugar industry has bright prospect of becoming self-sufficient in production of sugar from raw sugarcane if..."

production, support local economies, and ensure a stable supply of raw materials for sugar processing. Every sugar project in Nigeria is required to organize and partner with the farmers around their areas of operation. NSDC's policies are to ensure that host communities benefit through revenue-sharing models, infrastructure development, and investment in social services.

The Savannah Sugarcane Out-Grower Scheme which is part of Dangote Sugar Master Plan was re-established in 2009, to facilitate increase in sugarcane production.

Farmers from the surrounding communities were incorporated into the scheme to serve as out-growers of sugarcane. The incorporation of small-scale farmers in sugarcane production remains one of the most direct ways to distribute economic benefits in the sugar industry, as farmers are expected to draw a lot of benefits from the scheme. The Savannah out-grower scheme is the most successful scheme in Nigeria sugar industry.

10.0 CONCLUSION

Nigeria's sugar industry, despite over 50 years of existence, is still in its infancy, supplying less than five percent of national demand. Nigeria sugar industry has bright prospect of becoming self-sufficient in production of sugar from raw sugarcane if the NSMP is implemented accordingly.

The benefits, to derive from the implementation, are numerous. These include increased local sugar production, reduced reliance on imported raw sugar, diversification of the country's economy, development of sugar value chain from sugarcane cultivation to refining, enhanced investment in infrastructure, promotion of rural development, job creation, diversification of sugarcane products, and promotion of sugar processing technologies.

There is no way forward for Nigeria to achieve self-sufficiency in sugar industry without adequate implementation of the Nigerian Sugar Master Plan.

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