

# Impact of Physics on the Economy of Nigeria: Roles, Contributions, and Relevance of Physics in Real Life Situations

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## Abstract

Physics is an engine of discovery and innovation that contributes significantly to the economy in all areas, spurs growth, and produces highly skilled jobs that lead to wealth and long-term economic progress. In Nigeria, physics is crucial in various sectors such as technology innovation, energy, education, transportation, and healthcare. To comprehend physics' possibility and impact on various industries, it is imperative to have a national conversation about the subject's future. This study looks into how physics has influenced Nigeria's economic growth. The roles, contributions, and relevance of physics in the real life will be used to investigate how physics affects economic activity in Nigeria, looking at several areas including technology, energy, infrastructure, healthcare, environmental sustainability, education, and workforce development. This paper attempts to provide insights into how physics contributes to Nigeria's economic growth and propose possible areas for further development and investment by reviewing current literature, government records, and empirical data. The results of this study will not only further knowledge of the relationship between physics and economic development, but they will also give policymakers and other interested parties useful information for promoting steady economic progress in Nigeria.

**Keywords:** *Economic, Impact, Development, Physics, Nigeria*

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### **Background to the Study**

One of the most fundamental scientific fields is Physics, whose primary objective is to comprehend the behavior of the cosmos. Since physics has no defined limits, it interacts with many other interdisciplinary fields of study, including biophysics and quantum chemistry. New technologies are frequently made possible by physics advances. For instance, developments in the fields of nuclear physics, solid-state physics, and electromagnetic directly resulted in the creation of novel goods that fundamentally altered contemporary civilization, such as television, computers, home appliances, and nuclear weapons; advancements in thermodynamics fueled industrialization, and advancements influenced mathematics in mechanics (Young, and Freedman, 2014). As a foundational subject, physics supports various technical developments and inventions that propel economic expansion. The essential components of any given economy are its culture, values, education, history, technological advancements, social structure, political system, legal framework, and natural resources (Mankiw, 2017). These elements provide context, and content, and provide the guidelines and limitations that govern how an economy operates. Production, which requires labour, capital, and natural resources, drives economic activity. Technology, innovation (new goods, services, procedures, growing markets, market diversification, niche markets, increased revenue functions), and changes in industrial relations (most notably, the replacement of child labour in some regions of the world with universal access to education) have all contributed to its evolution over time (Wikipedia, 2024).

Countless industries allow the contributions of physics which help to improve the quality of life of the people and thereby improve the economy, industries like medical physics for healthcare, nuclear physics for food storage, Seed preservation, Space physics for aviation, and communications are all products of the knowledge of Physics. Physics has a strong effect or influence on the society's daily activities that generate the country's economy (Wikipedia, 2024). The National Education Policy 2023 (NEP-2023) is a revolutionary policy that replaces a framework in place for three decades and aims to create a modern education system that is inclusive of all students. The 2004 National Policy on Education promotes the development of individuals capable of using knowledge to enhance the environment and find solutions for humankind's benefit. The Nigerian Educational Research and Development Council (NERDC), with assistance from the United Nations Development Program (UNDP), created the Nigerian National Environmental Education core curriculum in 1996 by the country's educational strategy. This curriculum was developed seven years following the 1989 National Policy Environment's creation and 1999 revision. The opinions of Awokoya (1999), stated that a teacher must complete an internship similar to that of a doctor, lawyer, or accountant before entering the field to be trained in teaching skills under an experienced educator. This professional competence aids in the teacher's development of self-confidence, which in turn influences how he views the material he is teaching.

Around the world, education is viewed as a means of preserving cultural legacy, bringing about stability in the present, and enhancing or transforming people's futures. In this sense, it is widely acknowledged that the school system plays a significant role in education. As a result, the teacher becomes a crucial component of the educational process. Currently, it is

believed that teacher education serves as the cornerstone for relevance and quality in education across the board (Osokoya & Israel (2010)).

The rapid improvement and advancement of the economy reflect if the study and the appreciation of the subject matter are given high regard. Nigeria has the biggest economy in Africa, ranking 30th globally by PPP, and is the 31st largest in terms of nominal GDP (GDP Per Capita by country, 2022). As of 2022, the GDP (PPP) per capita is US\$9,148, which is somewhat more than that of Ghana or the Ivory Coast but less than that of South Africa, Egypt, or Morocco. Nigeria leads Africa in terms of energy production, banking, medicines, and entertainment. Nigeria boasts an abundance of natural resources and a lower-middle-income economy (World Bank Group, 2019). In addition to coal, bauxite, tantalite, gold, tin, iron ore, limestone, niobium, lead, and zinc, it has a vast array of underutilized mineral resources. Nigeria's mining sector is still in its infancy, despite the country's massive reserves of natural resources. Years of military control, corruption, and poor management restricted economic development before 1999. Opportunities for the economy have been strengthened by the restoration of democracy and the subsequent economic reforms. And this has immensely had its role in the Nigerian Economy. To improve the lives of Nigerians, a policy was articulated during the Olusegun Obasanjo Administration from 1999 to 2007 to make Nigeria one of the twenty largest economies in the world by the year 2020, named Vision 20:2020. Making Nigerians' lives better is the primary objective of NV20:2020. (FAO., 2009)

In this direction, the Vision aims to reduce the problems of hunger, poverty, poor healthcare, inadequate housing, low-quality human capital, gender imbalance, low productivity, and poor basic facilities by 2020. To achieve these and more the need to encourage and incorporate the knowledge of physics in the development of the nation is of utmost importance. Whether we like it or not it is easy to see that physics has been of existence in the building and advancement of the economy of the country. Understanding how physics has shaped Nigeria's economy is crucial for the nation working toward sustained economic growth (Jegede & Adedayo, 2012).

### **Physics and technological innovation**

Technological innovation is a new or better process or product with technological features that are notably different from previous ones. New goods or applications of existing methods that have been introduced to the market are considered implemented technological product innovations (OECD, 2000). These innovations are fuelled by basic discoveries made in physics. The basic knowledge of the natural principles controlling the universe, including thermodynamics, quantum mechanics, electromagnetic, and mechanics, is provided by the subject of Physics. The subject informs humanity about energy principles, natural occurrences, and fundamental technological concepts, whereas technology benefits our economy by making life easier. It has helped in the development of technologies such as MRI scanners, X-rays, Ultrasonography, Chemotherapy for cancer patients, and home appliances like microwaves, televisions, computers, refrigerators, etc. (NEET UG, 2024). Physics is a branch of science that holds great significance in today's world. It evokes both our greatest hopes and deepest fears for the future. For example, a nuclear weapon has the potential to

destroy the entire universe; medical physics has the potential to destroy cancer cells; and geophysics is useful in both exploration of natural resources and warfare (Okwueze, 2010). Creating new technologies is established on the understanding of some of the topic areas taught in the school system which were invented by some of our scientists like Galileo Galilei, Isaac Newton, Robert Hook, Archimedes, and Lord Kelvin, just to mention a few. Many technical advances are a result of discoveries acquired by some of these great men. The study of semiconductors led to the development of the transistor, which completely changed the electronics industry and has given rise to products like Laptops, palmtops, and smartphones.

To create new materials with certain qualities and to understand the properties of existing materials, the principles taught enable an individual to be able to come up with ideas that will improve life activities. Innovations in the communication industry have connected the entire world in digital as well as commercial terms. Both the television and telecom industry work on the principles of electromagnetic waves. The German physicist Heinrich Rudolf Hertz first examined the generation of electromagnetic waves. Electromagnetic waves are a form of radiation that travels through the universe (NOAA, 2023). In today's world, communication includes traveling from one place to another. Airplanes, hence, operate on Bernoulli's principle. According to Bernoulli's principle of fluid dynamics, a fluid's potential energy or pressure will drop concomitantly with its increasing velocity. The concept is the name of the Swiss mathematician Daniel Bernoulli, who first presented it in his book *Hydrodynamics* in 1738 (Skybrary, 2024). The use of Bernoulli's principle is evident in the aviation industry which can be used to calculate the lift force on an aerofoil if the behaviour of the fluid flow in the vicinity of the foil is known. According to Bernoulli's principle, the pressure on an aircraft wing's surfaces will be lower above than below if air is passing over the top surface of the wing quicker than it is passing over the bottom. So many technological innovations would not be in existence today if a scientist in the field of physics did not contribute their quota to their respective societies to enable the economy to bloom.

### **Physics and Industrial Development**

Industrial development is the process of creating and expanding industries within an economy via the use of new technologies that improve, speed up, and ease the performance of tasks and raise corporate production and profits (Ignasia, 2021). Physics provides the scientific concepts and technologies that support a wide range of manufacturing techniques and inventions, which has a substantial impact on industrial progress. New insights into fundamental physics often lead to industrial innovation. Engineering inventions that were not the original focus of the research are frequently the result of scientific discoveries (Ulrich 2002). In all industries, manufacturing process design and optimization are guided by principles of physics. Understanding how materials react under various conditions and creating effective production techniques require an understanding of concepts like thermodynamics, mechanics, and materials science. In materials engineering, which is creating materials with certain qualities for use in industry, physics is essential. Comprehending the atomic and molecular structure-property correlations of materials facilitates the development of novel materials customized to fulfill the requirements of several industries, including electronics, automotive, and aerospace.

In an interview, Elon Musk stated, "I usually tackle things using a physics framework. Instead of reasoning by analogy, physics teaches you to reason from first principles. The design and operation of automation systems and robots used in manufacturing processes are based on fundamental principles of physics. The use of principles from mechanics, control theory, and sensor technology results in the development of industrial robots that can carry out repeated, precise operations with increased productivity. Energy-efficient technology for industrial operations is driven by physics, which lowers energy consumption and its impact on the environment. In terms of the distances of freight delivered with the same energy input, ships are thought to be among the most energy-efficient forms of transportation, accounting for 90% of all international trade. This is in contrast to land and air transportation (Joo Hock Ang, Cindy Goh, Alfredo Alan Flores Saldivar, and Yun Li, 2017). Fluid mechanics, thermodynamics, and electromagnetic principles form the foundation of techniques like heat recovery, process optimization, and the use of renewable energy sources to increase energy efficiency in manufacturing operations.

Physics-based measurement and equipment are necessary for industrial process control and monitoring. Technologies like sensors, actuators, and measurement devices enable real-time monitoring of variables like temperature, pressure, and flow rates. This facilitates the achievement of quality control and process optimization in industrial operations. Physics concepts are applied in quality control and testing procedures to ensure the dependability and safety of industrial items. Physics is difficult, unpleasant, and often irritating, but it's also frequently extremely fulfilling and profoundly rewarding. If and only if we can apply physics to solve real-world issues and gain an understanding of common phenomena, Nigeria's economy will rank among the top 20 in the world by 2020. Above all, in the human intellect's effort to comprehend our world and ourselves, physics is a magnificent achievement. We must comprehend the true physics of the environment around us before we can grow into a sizable, robust, diversified, sustainable, and competitive economy that responsibly exploits our natural resources to ensure a high standard of living and quality of life for the populace and effectively harnesses the talents and energies of our people (Evans, Evans, & Okpongkpong, 2013). Physics contributes to the creation of environmentally sustainable practices and technology, which advances industry.

### **Physics and Energy Production**

There are some uses for physics in various spheres of human activity. For instance, the concepts of physics have been applied to the study of numerous scientific fields, including chemical, biological, medical, and neurophysics. Particularly in non-physical fields like psychology, social science, and economics, physics concepts are also relevant and helpful to human civilization (Shehu, Yohanna Josiah, & 2017). The creation of energy requires an in-depth understanding of energy and how it is transformed. Heat engines, which produce electricity in power plants from a variety of energy sources including fossil fuels, nuclear reactions, or renewable sources like sun and wind, are governed by the principles of thermodynamics. Ideas from Physics are applied to Economics to examine share market volatility or create a model for addressing and eliminating poverty (Bendre, 2015). Nigerian society is currently in need of these physics concepts to emerge from the present economic

downturn. Without a doubt, Nigeria's current society is impoverished to the point of extreme poverty due to the nation's technological and scientific backwardness. A country cannot be economically prosperous if its people are ignorant of physics (Shehu, Yohanna, Josiah, & Ayodele 2017).

Nuclear power generation requires an understanding of nuclear reactions. Nuclear power plants are based on nuclear fission, which is the process by which an atom's nucleus separates into smaller components and releases a significant quantity of energy. The sun's power source, fusion, is still being developed despite its potential for future energy generation. Bala and Pam (2012) provided evidence in support of this claim, pointing out that a country's political and economic vision has a major role in determining its progress. Even though the latter is a byproduct of the former, it is achieved through the economy's current energy supply, which includes fuel, electricity, and heat when all else is equal. Similarly, energy is a necessary component for the socioeconomic development of every country, according to Sambo (2009). The energy dilemma must be resolved for a country to remain competitive and raise the standard of living for its people worldwide. Electricity is produced at power plants using Faraday's law of electromagnetic induction, which states that an electric current is induced when a conductor passes through a magnetic field. grasp electrical systems requires a grasp of Maxwell's equations, which characterize the behavior of magnetic and electric fields. Research is being done on using quantum dots to increase the efficiency of next-generation solar cells.

The behavior of fluids like water and steam in power generation systems can be better understood by using fluid dynamics. Steam turbines in nuclear and fossil fuel power plants use the expansion of steam to produce electricity, whereas hydroelectric power plants use the flow of water to power their turbines. The development and functioning of renewable energy systems are heavily reliant on the principles of physics. While wind turbines use aerodynamics and electromagnetism to convert wind energy from kinetic to electrical, solar panels use the photovoltaic effect to turn sunlight into electricity. Institutions. According to Shehu, Yohanna, Josiah, & Ayodele (2017), The advancement of science and technology would also be lacking in any culture that does not have enough people with a background in physics. Whatever society's level of commitment to the advancement of science and technology will determine how powerful it becomes on the socioeconomic front. The importance of physics to society has led to a growing multidisciplinary approach to the study of the subject as physicists collaborate with several professionals in science and technology to comprehend and address a wide range of societal issues.

### **Physics and Infrastructural Development**

Physics, according to Bendre (2015), is an experimental science. The study of nature, matter, energy, and their interactions in order to provide answers to problems concerning natural phenomena on Earth and beyond is known as Physics. The construction of structures that can bear loads and pressures requires an understanding of fundamental physics. To guarantee the structural integrity of buildings, bridges, dams, and other infrastructure projects, ideas like Newton's laws of motion, equilibrium of forces, and material qualities are required.

Engineers optimize their designs by using physics-based simulations and modeling to forecast the behavior of structures under various circumstances. It is also important to note that the federal government has been working hard to improve the state of science, technology, and mathematics (STEM) in Nigeria. A few of these efforts include the launch of Nigeria Sat I in 2003, which is primarily responsible for detecting natural disasters like floods and earthquakes, generating data, and providing aerial pictures of Nigeria to be used for the national population census. Other efforts include the establishment of universities of technology, polytechnics, and technical colleges as well as the creation of ministries of Science and Technology, Environment, and National Mathematical Centre (NMC) as well as the formation of these institutions (Shehu, Yohanna, Josiah, & Ayodele 2017). To evaluate and lessen the impact of geological risks on infrastructure projects, such as landslides, earthquakes, and soil liquefaction, concepts like soil mechanics, fluid dynamics, and seismic waves are applied. The design and functioning of transportation networks, such as highways, railroads, ports, and airports, are governed by laws in physics. Transportation network optimization, traffic flow modeling, and the design of vehicle components are all impacted by ideas like friction, aerodynamics, and fluid dynamics. Simulations based on physics are used to assess traffic patterns, maximize the capacity of infrastructure, and enhance efficiency and safety. Infrastructure projects' environmental impact is evaluated and minimized by the application of physics concepts. As one of the 17 Sustainable Development Goals that the UN General Assembly established in 2015, Goal 9 pertains to "industry, innovation, and infrastructure" SDG 9 has three main objectives: innovation, sustainable industrialization, and building resilient infrastructure. The dispersion of air and water pollutants, the consequences of climate change, and the creation of sustainable infrastructure solutions—such as green buildings, renewable energy systems, and water treatment facilities—are all made possible by concepts found in fluid mechanics, heat transfer, and atmospheric physics. With this in mind, we can have sustainable structures.

### **Physics and Transportation System**

Physics is essential for modern, scientific, and technologically advanced living. Every aspect of human behavior is impacted by physics (Shehu, et al 2017). Take technological innovations like Tesla automobiles, for instance. To maximize vehicle performance, fuel efficiency, and safety, concepts like aerodynamics, friction, and materials science are essential. To improve vehicle designs and minimize drag, which lowers energy consumption and emissions, engineers use wind tunnel testing and physics-based simulations. Vehicle propulsion is based on physics concepts like energy conservation and Newton's equations of motion. These concepts underpin the operation of electric motors, jet engines, internal combustion engines, and propellers. It is crucial to comprehend fluid dynamics and thermodynamics to maximize engine efficiency, minimize fuel consumption, and reduce emissions. The way that cars accelerate, decelerate, and negotiate curves is influenced by ideas like centripetal force, friction, and inertia. Engineers can improve car handling and safety by optimizing suspension systems, braking systems, and stability control algorithms with the use of vehicle dynamics simulations. Transportation planners can cut travel times and enhance traffic flow by optimizing lane designs, traffic signal timings, and road networks with the aid of physics-based traffic models. Buses, trains, and subways are examples of public transportation

systems that are designed and run using principles of physics. Vehicle design, route planning, and scheduling are influenced by ideas like mass transportation, aerodynamics, and friction. The design of safety features and crashworthiness requirements for automobiles and transportation infrastructure is guided by physics. The development of alternative transportation technologies, like hydrogen fuel cells, electric automobiles, and driverless vehicles, is supported by physics. For these technologies to be designed and put into practice, concepts like electromagnetism, energy conversion, and control systems are employed. These technologies present viable answers to societal and environmental transportation problems.

### **Physics and Healthcare**

The entire field of medical science has undergone a revolution with the application of physics principles, methodologies, and techniques to clinical practice and research, improving human health and well-being in the process (Sanchari 2022). According to the online Oxford English living dictionaries, society is the group of people living in a certain nation or region with common laws, customs, and institutions. It is a collection of individuals engaged in continuous social interaction or a sizable social group occupying the same physical or social territory, usually under the control of the same political authority and prevailing cultural norms. Society requires health facilities made possible using the working principles in Physics: medical imaging, diagnostics, therapy, and biomedical research. Within the field of applied physics, medical physics applies the physical sciences to the study, prevention, and treatment of human illness. Medical imaging physics, radiation oncology physics, non-ionizing medical radiation physics, nuclear medicine physics, medical health physics, and physiological measures are some of the subcategories of medical physics (Sanchari 2022). The knowledge of Physics plays a crucial role in how radiation therapy is administered during cancer treatment. By targeting and eliminating cancer cells with ionizing radiation, methods such as brachytherapy and external beam radiation therapy minimize harm to healthy tissues. Medical physicists and radiation oncologists work together to develop treatment programs, determine radiation dosages, and guarantee the safe and efficient administration of radiation therapy through the use of cutting-edge equipment and quality control procedures. When it comes to creating and approving imaging protocols, maintaining radiation safety during nuclear medicine procedures, and calibrating equipment, medical physicists are indispensable. The design and functionality of medical equipment and gadgets used for diagnosis, monitoring, and treatment are heavily reliant on notions from physics. A few instances are surgical lasers, infusion pumps, blood pressure monitors, and electrocardiography (ECG) equipment. A strong, static magnetic field, magnetic gradients, and computer-induced radio waves are used in magnetic resonance imaging (MRI), a potent non-invasive medical imaging tool, to create high-quality, three-dimensional images of tissues and organs. The body's photons realign with the magnetic field when it is applied. Photons are then stimulated by radio waves, and photon energy (signal) is detected by MRI sensors (Sanchari 2022). The utilization of physics concepts guarantees the precise and safe application of radiation for diagnosis and therapy.



### **Physics and Workforce Development**

Workforce development and physics education are related because many occupations in the scientific, technology, engineering, and mathematics (STEM) sectors require a strong grasp of physics concepts. It's interesting to note that these are human-specific skills that machines or robots cannot perform; people can learn to strengthen these skills through education. In the meantime, employers are looking for a motivated and agile workforce with a mindset of lifelong learning and future-proof skills to take advantage of new opportunities through continuous retraining and upskilling. These are the skills needed to be relevant in the 21st century (Oladiran, & Folasade 2021). With its emphasis on mathematical understanding of the natural world and its ability to foster critical thinking and problem-solving skills, physics forms the cornerstone of STEM education. To prepare students for further study and careers in STEM fields, physics classes in high school and college teach them fundamental ideas including mechanics, electromagnetic, thermodynamics, and quantum mechanics. They do this by utilizing physics ideas such as mechanics, materials science, and electromagnetic. Professionals with a background in physics are essential to the development, testing, and use of new technologies. The need for new skills in the construction industry has arisen as a result of technological advancements and the introduction of information technology, which the labor pool needs to operate tools and equipment (Mackenzie et al., 2000; Cordery, 1989). Elon Musk, through his knowledge of physics, created his work environment. An understanding of physics is crucial for tackling issues related to energy and the environment through innovation, research, and policy creation. Specialists with backgrounds in physics support initiatives to enhance the generation of renewable energy, boost energy efficiency, and slow down environmental degradation. Professionals with a background in physics advance medical imaging methods, diagnostic instruments, therapies, and biomedical technology to enhance patient outcomes. For space exploration and astronomy projects, such as satellite missions, space missions, and astronomical research, physics understanding is essential. Celestial mechanics, electromagnetism, and optics are physics ideas that professionals in space-related areas use to design spacecraft, analyze astronomical data, and explore the universe. At the 2017 World Government Summit, Elon Musk emphasized the importance of physics by saying, "The best analytical framework for understanding the future is Physics." Experts with a background in physics contribute to our understanding of the universe's beginnings, systems, and cosmos. Inspiring and preparing the next generation of scientists, engineers, and innovators is a major responsibility of physics educators. From elementary school to university, physics teachers engage students in practical experiments and demonstrations, spark their interest, and encourage their passion for STEM subjects. They also introduce pupils to the wonders of the physical world.

### **Conclusion**

This study will add to the larger conversation on science, technology, and economic growth in Nigeria by clarifying the various ways that physics affects technological innovation, industrial development, energy production, infrastructural development, transportation system, healthcare, and workforce developmental activity there. Governments, academic institutions, and businesses can create a workforce capable of tackling intricate problems and promoting innovation and advancement across various industries and sectors by allocating resources

towards physics education and training programs. Policymakers, investors, and other users may profit from the paper's findings about how crucial it is to build a climate that is, receptive to the physics-related investigation, instruction, and development to propel Nigeria's economy forward sustainably.

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