

# CNG: A Viable Fuel Option for Nigeria

## Abstract

The recent subsidy removal in Nigeria's petroleum sector has caused an increase in fuel prices affecting the costs of transportation, cooking and inflation in the prices of goods and services, thereby presenting an opportunity to explore alternative fuels like Compressed Natural Gas (CNG). As the country navigates this transition, it's essential to acknowledge the gradual yet significant impact of small changes, much like adding a drop of red dye to an Olympic-sized pool daily. Consistently promoting CNG as a viable alternative can yield substantial benefits, including the fall in fossil fuel pump prices, normality of the prices of goods and services, reduced greenhouse gas emissions and lower operating costs. By embracing CNG, Nigeria can mitigate the economic and environmental challenges posed by fossil fuel dependence. Hence, the Government, Engineers and researchers can play a crucial role in harnessing CNG's potential, ensuring a smoother transition and paving the way for a more sustainable energy future in Nigeria, as well as the ways of enlightening the general public on the benefits and impact of the CNG as an alternative fuel to stem the hick in fossil fuel pump prices caused by subsidy removal.

**Keywords:** Compressed natural gas (CNG), alternative fuel, fuel subsidy removal, energy transition, Nigeria and public awareness.

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## Introduction

The Nigerian economy has subsided in various ways for many years and this includes fuel, education, electricity etc. Fuel subsidies began in the 1970s and became institutionalized in 1977, following the promulgation of the Price Control Act which made it illegal for some products (including petrol) to be sold above the regulated price. While the concept of subsidy itself is noble, its administration in Nigeria has been plagued with serious allegations of corruption and mismanagement. Thirteen years after diesel was deregulated, the kerosene subsidy was removed in 2016. However, the subsidy on Petroleum Motor Spirit (PMS) has proven to be the biggest challenge to the managers of the Nigerian economy. On an annual basis, a substantial portion of the national inflow is committed to funding the subsidy scheme. Of course, there are good reasons for the astronomical growth in subsidy amount - the price of crude oil in the international market, volume of PMS consumed albeit debatable, and Naira devaluation are some drivers. Given the significance of the amount committed to funding the subsidy regime, there is a need to have a close look at this scheme.

A year has elapsed since Nigeria's decision to abolish fuel (petrol) subsidy triggered more than just rumblings of public discontent over the move's domino effect. The subsidy has been in place since the 1970s, cushioning Nigerian consumers from the petroleum price shocks that most other parts of the world suffered through the decades. Suddenly, in May 2023, President Bola Ahmed Tinubu's government announced that it was time to end a fuel subsidy regime that has been draining the exchequer to levels that have long become unsustainable. While the move is done and dusted, ordinary Nigerians continue to reel from its side effects. This has raised the cost of public and private transportation exponentially, alongside an increase in the overall cost of living in Africa's most populous country. So what is the government doing to stem the tide even as it sticks to a tough decision that experts believe needs to be taken at some point? A structured shift to compressed natural gas, or CNG, is the new bulwark against the country's energy woes. To reduce the burden of the increase in pump price on the masses, the government set aside N50 billion to purchase 5,500 CNG-powered buses and tricycles, 100 electric vehicles, and CNG conversion kits. The idea is to use the country's available natural gas resources to first mitigate the impact of subsidy removal on the cost of living and gradually scale up to focus on growing the economy.

## Background to the Study

The natural gas used in natural gas vehicles is the same natural gas that is used in the domestic sector, for cooking and heating. CNG is produced by compressing the conventional natural gas (which is mainly composed of methane – CH<sub>4</sub>) to less than 1% of the volume it occupies at standard atmospheric pressure. It is stored and distributed in a rigid container at a pressure of 200-248 bar (2900-3600psi), usually in cylindrical shapes metallic cylinders. The use of CNG as a vehicle fuel was discovered back in early 1930 in Italy, but the first retro which experienced considerable activity started in the 1970s, when natural gas was witnessed as a promising fuel aftermath of the oil crisis. When oil prices rose during the late 1970s and early 1980s, the market for CNG vehicles became more attractive. However, the subsequent period up to 2000, has made it challenging for CNG to strive as vehicular fuel. But after the 2000s, the oil prices rose (Khan *et al.*, 2015). Worldwide quantities of natural gas vehicles are increasing so speedily that the statistics lag and no consistent sources of information are available. However, as per the recent authentic sources, the world leader in NGVs (for the moment) is Iran, with 4.07 million NGVs (Khan *et al.*, 2015).

It is well known that oil reserves are being depleted at an alarming rate. In addition, the burning of these conventional fuels by the transport sector contributes greatly to atmospheric pollution that threatens the very survival of life on this planet. The function of current IC engines needs to be reviewed today, from the perspective of these two main crises. The energy crises and serious environmental pollution around the world have triggered the development of low-emission and high-fuel-efficient vehicles to become major research objects. Various alternative fuels have been introduced into the transport sector e.g. LPG, propane, bio-diesel, hydrogen, fuel cells. Out of these available alternative fuels compressed natural gas (CNG) is the one which is meeting the maximum needs of countries worldwide, who want to switch over to alternative fuels. CNG has been considered one of the best solutions to fossil fuel substitution because of its inherent clean nature of combustion.

## **Research Problem Definition**

The role of government in creating and implementing practical solutions has drawn a lot of attention as the hick in fuel pump prices becomes a more pressing national concern in Nigeria. With the help of renewable energy technology, resilient infrastructure designs, policy-making and sustainable planning, the Nigerian Government have looked into considering Compressed Natural Gas (CNG) as an alternative fuel for the transportation sector to combat the hick in fossil fuel pump prices, greenhouse gas emission, inflation in the prices of goods and services, and environmental pollution. This project will comprehensively examine this approach and intervention. This study aims to evaluate the benefits and effectiveness of CNG. This study aims to provide a thorough understanding of Compressed Natural Gas (CNG) and its potential as an alternative fuel, as well as the action and impact of the government towards achieving this goal. It does so by examining the interaction between the government and engineering innovations and their effect on society, the environment, and policy framework. The results of this research are expected to guide policy choices, encourage interdisciplinary collaborations, and help develop a more comprehensive strategy for resolving the intricate problem brought on by fossil fuel and the removal of fuel subsidies.

## **Survey of Literature Review**

Compressed Natural Gas is composed primarily of methane ( $\text{CH}_4$ ), and other hydrocarbons such as ethane, propane and butane. According to Alternative Fuel Data Centre (2004), the composition of CNG is further enriched with other gases such as carbon dioxide, hydrogen sulphide, nitrogen, helium and water vapour. The content of CNG was believed to originate from plants and animal remains which had decomposed for millions of years (Info Comm, 2005). Natural gas is formed deep underground trapped between layers of rock and sand in reservoirs underneath the Earth, like other fossil fuels. Due to its lower density characteristics, CNG will float above other trapped substances such as crude oil and water. A drilling rig is used to penetrate the Earth's surface to draw out the natural gas. The extract is then refined to remove impurities and transmitted through a series of pipelines to processing plants and then sent to transmission companies before reaching the end-user (NaturalGas.org, 2004). Natural gas was first used as fuel to boil water, and light

street lamps and gained worldwide acceptance to be used in residential homes as water heaters, clothes dryers and in cooking. The Pacific Gas and Electric Company (2003) reported that the 6 natural gas boom period began in the 1950s in the United States where a huge network of facilities and distribution pipes were constructed to promote the use of natural gas. The use of natural gas in the transportation sector began as early as the 1930s and had little development since then (NaturalGas.org, 2004). Without the support of the public, the use of Natural Gas Vehicles (NGV) is limited mostly to the public transportation sector. Natural gas is compressed as CNG to be used as fuel in the vehicles with the alternative being Liquefied Natural Gas (LNG). The former is most widely used in alternative fuel vehicles. It promotes environmental friendliness with its low emission of harmful gases and comparable engine performance (U.S. Environmental Protection Agency, 2002).

### **Extent of Past Research**

1. Ikechukwu Obiuto Ibeneme and Joshua O. Ighalo; Implementation of CNG as an Alternative Fuel for Automobiles in Nigeria: Benefit and Recommendation, August 2020.
2. Wong Wei Loon 2005; Compressed Natural Gas as an Alternative Fuel in Diesel Engines.
3. Ubani E. Chikwendy and Ikpaisong S. Ubong 2018; Use of CNG as Autofuel in Nigeria.

### **Aim and Objectives**

The aim of this research work is to evaluate the potential of compressed Natural Gas (CNG) as a cleaner and more cost-effective alternative fuel in Nigeria and assess the economic and environmental implications of removing fuel subsidies and adopting CNG as well as public awareness.

### **Objectives**

1. To evaluate the environmental benefits of CNG adoption, including reduced greenhouse gas emissions and air pollution.
2. To evaluate the potential for CNG to improve energy security, reduce dependence on imported fuels, and promote economic growth in Nigeria.
3. To investigate the infrastructure requirements for widespread CNG adoption in Nigeria.

4. To clearly state the means of communicating the benefits of CNG to the general public in both urban and rural parts of Nigeria.

### **Scope of the Research**

The scope of this study is limited to evaluating the potential environmental benefits of switching to compressed natural gas, public awareness and acceptance, the cost impact of subsidy removal and the potential benefits of switching to CNG.

### **Feasibility of the Research**

The feasibility of this study is based on the availability of researchers with expertise in energy economics, policy analysis, and environmental impact assessment, alignment of the research with current policy priorities and interest in Nigeria. This study is based on its clear research focus on examining the potential, effectiveness and means of making CNG known as an alternative fuel in Nigeria.

### **The intention of the Research**

The intention of this research work is to evaluate the potential of CNG as a cleaner and more cost-effective alternative to traditional fuels, its environmental implications of removing fuel subsidies and adopting CNG and contribute to the global debate on alternative fuels and energy transition, with a focus on the Nigerian context.

### **Impact of the Study**

The impact of this study includes contributing to the development of a sustainable energy policy that balances economic, environmental, and social considerations, promoting the adoption of cleaner fuel, reducing greenhouse gas emissions and air pollution, reducing fuel import costs, improving trade balances, and increasing economic growth. This study also increases energy security by reducing dependence on imported fuels, thereby improving energy self-sufficiency.

### **Benefits of Subsidy Removal and Adoption of CNG**

- 1.Reduces government borrowing and the associated huge deficit

Fuel subsidy has been a major source of government expenditure in Nigeria, with huge sums being spent annually to keep petrol prices artificially low. This has led to the government borrowing heavily to finance the subsidy, which in turn increases the country's deficit. By removing the subsidy, the government can reduce its borrowing and the associated huge deficit, freeing up resources for other important sectors.

## 2. Free resources for investment in other critical sectors

With the removal of fuel subsidy, the government can free up resources that would have been spent on the subsidy to invest in other critical sectors such as education, healthcare, security and infrastructure. This will not only improve the standard of living for citizens but also enhance economic growth.

## 3. Reduce/remove incentive for smuggling and associated security risk

The subsidy has created a huge incentive for the smuggling of fuel to neighbouring countries where it can be sold at higher prices. This has resulted in security risks, as smuggling has also led to illegal refining, pipeline vandalism, and other criminal activities. By removing the subsidy, the incentive for smuggling will be reduced or eliminated, which will lead to a reduction in security risks associated with fuel smuggling.

## 4. Improved sovereign credit rating

Nigeria's sovereign credit rating has been adversely affected by its low revenue, high debt levels, rising deficit, and vulnerability to oil price shocks. Removal of the subsidy will increase the government's revenue, and reduce borrowing and the associated deficit, leading to an improvement in the country's sovereign credit rating and lower cost of borrowing.

## **CNG as an Alternative Fuel in Nigeria**

Compressed Natural Gas (CNG) has been proposed as a promising alternative to petrol in Nigeria due to the country's significant natural gas reserves. This has several potential advantages, including lower cost, reduced emissions, and improved fuel efficiency. One of the most significant benefits of CNG is that it is considerably cheaper than petrol, which could result in substantial savings for vehicle owners. Additionally, the cost of CNG is more stable than the volatile price

fluctuations experienced by petrol. Also, the use of CNG could reduce vehicle maintenance costs due to its cleaner burning properties, which produce fewer engine deposits that clog up the engine over time. However, the adoption of CNG in Nigeria also presents some challenges. These challenges include the initial investment required to retrofit existing vehicles with CNG engines, the need to establish a robust distribution infrastructure for CNG, and the need for government policies and incentives to promote the use of CNG. While CNG presents several benefits compared to PMS, there are challenges to its adoption making it an unlikely alternative to petrol in the short to medium term.

### **Usage of Compressed Natural Gas**

NaturalGas.org (2004) reported that natural gas was originally used by the Chinese as a fuel to process seawater to separate its salt contents and make it drinkable. In Europe, Britain was the first country to commercialize the use of natural gas although its use was limited only to street lighting (Gas-Lite Manufacturing, 2004). The method then spread to other parts of the world including the United States. After the Second World War, improvements were made to the transportation and storage of natural gas with extensive use of the technology available then (NaturalGas.org, 2004). As predicted, with the increased area coverage of natural gas supplies, it became an increasingly popular source of energy for the public. Intense research was performed to analyze the feasibility of using natural gas as a substitute for conventional fuels like gasoline and diesel. According to Shamsudin & Yusaf (1995), Italy became the leading country in research of natural gas as an alternative fuel and had around 235,000 vehicles converted to be powered by the fuel. The United States is now the world's highest consumer of natural gas with 28.8% consumption followed by the Russian Federation (BP Global, 2005). Almost 130,000 NGVs are operational in the United States with an approximation of 2.5 million vehicles worldwide (NaturalGas.org, 2004). The Pacific Gas and Electric Company (2003) reported that there are more than 40 natural gas vehicle manufacturing companies available worldwide. This shows a significant expansion in the field of research on NGVs. CNG is primarily used as fuel for transit buses, taxi cabs, heavy duty trucks and other public vehicle fleet worldwide. The high fuel usage of these vehicles makes conversion to CNG fuel more economical and decreases the payback period of the conversion cost. Due to the environmental benefits of CNG as an alternative fuel, the American Government is investing heavily in the field of Research & Development and providing subsidies to support NGVs to

encourage the use of natural gas (Natural Gas Vehicle Coalition, 2005). In Malaysia, the popularity of NGV is limited and the majority of vehicles are still running on conventional fuel due to the inadequate fuelling stations and long fuelling time for natural gas. Although Malaysia has an abundant natural gas reserve estimated at around 82.5 trillion cubic feet (Autoworld, 2004), the market penetration remains minimal and the majority of natural gas is exported. However, steps are being implemented to promote the use of NGVs through publications and education to instil customer awareness of its vast benefits. PETRONAS Company, through its subsidiary, PETRONAS NGV Sdn. Bhd. has been promoting the use of CNG to Malaysian motorists by providing services and fuelling facilities (Autoworld, 2004). Apart from that, Malaysia has been selected as the host nation for the Asia Pacific Natural Gas Vehicles Association (ANGVA) conference in 2005 to discuss the technological developments in the use of NGVs.

### Natural Gas Composition

Natural gas generally consists of a mixture of hydrocarbons with methane (CH<sub>4</sub>) as the main constituent. Ethane, propane, butane, nitrogen and carbon dioxide gases contribute to the remaining composition while traces of water vapour and hydrogen sulphide may be present in some natural gases. The properties of natural gas will vary depending on the location, processing and refining facilities. Usually, the 8 maximum and minimum compositions are specified to enable comparisons to be made.

Composition	Typical	Maximum	Minimum
Methane	87.3%	92.8%	79.0%
Ethane	7.1%	10.3%	3.8%
Propane	1.8%	3.3%	0.4%
Butane	0.7%	1.2%	0.1%
Nitrogen	2.2%	8.7%	0.5%
Carbon Dioxide	0.9%	2.5%	0.2%

Table 1: Typical Composition of Natural Gas in Percentage (Wong, 2005).

Current research on natural gas vehicles found that engine performance and emission are greatly affected by varying compositions of natural gas (Ly, 2002). It was also reported that the heating value, efficiency, and concentration of un-burnt hydrocarbon and other emission particles would

highly depend on the source of supply of natural gas as the main fuel. Ly (2002) also mentioned that this effect is especially dominant in heavy-duty engines with high compression ratio applications due to the increased amount of engine "knocking". Engine knocks are caused by the pre-mature ignition of the air-fuel mixture in the combustion cylinder, causing the engine to overheat and run inefficiently. According to Natural Gas.org (2004), raw natural gas is processed to remove impurities such as oil, condensate and water particles. The presence of these particles may obstruct the smooth flow of fuel into the engine when in use and may even bring the engine to a halt. 'Dry' natural gas, which consists of almost entirely methane, is then obtained by distilling the other hydrocarbons.

### **Natural Gas Properties**

Natural gas in its original form is non-toxic, colourless and odourless (Questar Gas, undated). A chemical substance called Mercaptan is added to natural gas to add a scent of rotten egg as a safety precaution so that leakage may be detected by the human olfactory sense (Info Comm, 2005). Inhalation of natural gas will not interfere with the body's functions or cause detrimental health damage to our body. Barbotti CNG (2002) mentioned that natural gas does not emit any aldehydes and other air toxins, which may be an issue with other fuel types. Apart from that, natural gas is also lighter than air due to its low density. According to Clean Air Technologies Information Pool (2005), a natural gas spill would be less dangerous compared to a gasoline or diesel oil spill since the natural gas vapour would dissipate into the air and not accumulate on the ground. The non-corrosive characteristic of natural gas is favourable to prevent oxidation of storage tanks and hence will reduce the possibility of contamination. Table 2 provides a comparison of the physical properties of compressed natural gas (CNG) and conventional diesel fuel. As can be seen, natural gas comprises primarily of CH<sub>4</sub> while the hydrocarbon chains in diesel are longer and more complex. CNG also shows a lower molecular weight and specific gravity compared to diesel. Research has shown that natural gas has a narrow combustion limit between 5 to 15 per cent (Questar Gas, undated). This implies that the combustion of natural gas will only take place when the concentration of natural gas in the air lies in the range mentioned. Combined with its high ignition temperature, natural gas can be safely used without the high risk of accidental explosion.

Property	Compressed Natural Gas (CNG)
Chemical formula	CH <sub>4</sub>
Molecular Weight	16.04
<b>Composition by weight, %</b>	
Carbon	75
Hydrogen	25
Specific gravity	0.424
Density, kg/m <sup>3</sup>	128
Boiling temperature °C	-31.7
Freezing point °C	-182
Flashpoint °C	-184
Auto-ignition temperature °C	540
<b>Flammability limits, % volume</b>	
Lower	5.3
Higher	15

Table 2: Properties of Natural Gas (Wong, 2005).

According to P.C. McKenzie Company (undated), the octane number of CNG is 120 compared to 87-93 for gasoline. The octane number measures the potential of "knocking" in the engine due to fuel selection. A high octane number signifies a higher resistance to engine "knocking" and increased efficiency of a smooth power transmission. A direct comparison cannot be made with diesel fuel as it operates in a compression-ignition engine and is measured with a property called cetane number.

## **Benefits of CNG as an Alternative Fuel in Nigeria**

### 1. Reduction in Air Pollutants and Noise Pollution from the Transport Sector

Automobiles that use gasoline and diesel emit air pollutants and air particles that are very dangerous to human health. These pollutants can increase the risk of developing stroke, heart failure, myocardial infarctions, respiratory diseases, cancer, etc. Hence there is a need for an

alternative fuel with fewer air pollutants than gasoline and diesel. It is observed that there are very high concentrations of emission of HC (hydrocarbon), O<sub>2</sub> and NO<sub>x</sub> (nitrogen oxides) in Lagos roads and suggested that a fuel switch to CNG would be the best for the environment (Ikechukwu *et al.*, 2020). CNG as fuel has great environmental potential as there is a reduction in air pollutants emissions when it is used as fuel. In comparison to gasoline and diesel, CNG has reduced CO<sub>2</sub> emissions by 23% -35%, almost zero particulate matter (PM) emissions, 87% - 90% reduction in NO<sub>x</sub> emissions, and 67% - 76% reduction in HC emissions. This is also values, which stated that there is a significant reduction in the emission of CO by 70%, non-methane organic gas by 87%, NO<sub>x</sub> by 87% and CO<sub>2</sub> by 20%. A study of both Delhi and Brazil has significantly shown how the use of CNG automobiles can cut down emissions. These places showed a drastic reduction in air pollutants from the time they adopted the use of CNG automobiles. Also, further study of Dhaka shows that the use of CNG as automobile fuel can greatly improve air quality and reduce premature death. Additionally, CNG automobiles make less noise than gasoline and diesel automobiles. This implies a reduction in noise pollution when CNG automobiles are used instead of conventional fuel automobiles (Ikechukwu *et al.*, 2020).

## 2. Energy Security

An alternative transportation fuel with low carbon emissions would increase energy security. This is very likely as there would not be much dependence on conventional gasoline and diesel in Nigeria. Especially since oil prices are very volatile and there is also an occasional scarcity of oil supply. In Nigeria, the gasoline market is very volatile and we often experience scarcity of products. During these times, gasoline is usually sold at a very high price and this affects the cost of every other thing, making it more difficult for Nigerians to survive. This scarcity is most felt by the automobile sector therefore the use of CNG as an alternative fuel for automobiles would greatly abate the effect of the volatile gasoline market in Nigeria. Certainly, with the increasing demand for transportation, there is a need for cleaner alternative transportation and CNG is one of the best for Nigeria.

## 3. Increased Productivity

Energy is an important factor for socio-economic development therefore, with an alternative fuel of low-carbon emission, productivity would increase. Transportation would also be cheaper and

people would find it easier to move around. CNG is locally generated unlike gasoline and diesel that is mostly imported it has the potential to conserve foreign reserves in Nigeria. This is because less amount of money would be spent on the importation of gasoline and diesel.

#### 4. Low Operation and Maintenance Cost

CNG vehicles are normally gasoline vehicles with added components to store and feed CNG to the engine. Long-term maintenance costs can be lower, because CNG is a cleaner-burning fuel and generates less wear-and-tear on some engine components. In addition, due to the absence of additives like lead and benzene in CNG, lead fouling of spark plugs is reduced to the barest minimum. There is an increase in the life of lubricating oils, as CNG does not contaminate and dilute the crankcase oil. This is mainly because it enters the engine as gas while petrol comes in as spray or mist which washes down the lubricating oil from the piston ring area to raise the rate of engine depreciation. This reduces maintenance costs and engine life (Ubani *et al.*, 2018).

#### **Limitations of Compressed Natural Gas (CNG)**

NGVs are mostly used in the fleet transportation industry compared to private vehicle owners due to the high initial cost of engine conversion. According to the Natural Gas Vehicle Coalition (2005), this is caused by low production volumes of NGVs to accommodate economies of scale. Although the government is paving the way to encourage CNG usage, customer awareness remains low due to vague marketing strategies which lack focus (Natural Gas Vehicle Coalition, 2005). Research has shown a slight decrease in engine performance- around 10-15% in CNG-fuelled vehicles (Indian Energy Sector, 2000). Wong, (2005) researched that the lower compression ratios with dedicated CNG engines compared to diesel engines is the main reason for this power decrease. The spark ignition (SI) engine in dedicated NGVs will not operate above the 11.5:1 ratio (Clean Air Power, undated) but the problem may be resolved by using a dual-fuel engine which will be discussed later. Wong, (2005) revealed that another factor which causes NGVs to be unpopular among consumers is the lack of refuelling stations available in most countries. For instance in Malaysia, the availability of CNG refuelling stations is limited as only a subsidiary company, PETRONAS NGV is currently offering the facility. From personal communication with NGV vehicle owners, the long decompression and fill time of CNG fuel usually causes an outstretched queue in refuelling stations, much to the inconvenience of NGV owners.

## **Safety**

In addition to its excellent emission quality where toxic gases are reduced and pose a lower health hazard to the public, Barbotti CNG (2002) reported that the fuel cylinders used to store CNG in vehicles are designed to withstand impact through several tightly scrutinized tests. A survey conducted in the United States also showed a 37% decrease in injury rate for NGVs compared to gasoline-powered fleet vehicles and no fatality rates (Barbotti CNG, 2002). The favorable physical property of CNG which enables it to dissipate into the air in case of a leakage and thus avoiding contamination is also a safety advantage. However, Wong, (2005) argued that CNG vapours formed at low temperatures from leaks will generate large clouds of flammable vapour and increase the potential of an explosion coupled with a spark. Due to its high storage pressure at a range of 20-25 MPa, the refuelling process is a safety issue since 0.2-0.3 kWh of energy per cubic meter of natural gas is required to compress it (Kojima, 2001). Kojima (2001) further exemplified a recent incident in India where five people were injured in an NGV during refuelling due to inferior gas cylinder conditions.

## **Impact of Subsidy Removal on CNG Adoption**

In Nigeria, the price of petrol is considered a major driver of the cost of living, as it is used by all including small businesses and many households given the unstable electricity supply. Therefore, any increase in fuel price could directly and immediately impact the prices of goods and services across the country. There is also the psychological impact that it tends to have because of the strong sentiment attached to cheap and affordable petrol. When petrol prices increase, small businesses tend to raise their prices to cover the increased cost of operation which can lead to higher prices for consumers. This can make it more difficult for people to afford necessities, lead to a decrease in the standard of living and contribute to poverty and inequality. However, previous attempts to remove the PMS subsidy had mostly been accompanied by hoarding and general scarcity which invariably amplified the impact of the price increase beyond just the subsidy removal. Subsidy removal creates a playing field, allowing CNG to compare fairly with petroleum products, without subsidies, petroleum products become more expensive, making CNG a more attractive option for

cost-conscious consumers, subsidy removal can generate revenue for the government, which can be invested in CNG infrastructure development and other sectors.

### **Cost Implication of CNG Adoption**

1. **Initiate investment:** The initial investment required for CNG infrastructure development, including fueling stations and vehicle conversions, is significant.
2. **Vehicle Conversion Costs:** Converting vehicles to run on CNG requires additional investment, although costs are decreasing as technology advances.
3. **Fuel Pricing:** CNG pricing is critical to its adoption. If priced competitively with subsidized petroleum products, CNG can attract users.

### **Ways of Raising Awareness about CNG as a Cleaner Alternative Fuel in Nigeria**

1. **Social Media Campaigns:** Utilize platforms like Facebook, Twitter, and Instagram to raise awareness about the benefits of CNG.
2. **Influencer Partnerships:** Collaborate with popular influencers to promote CN as a cleaner and cost-effective alternative.
3. **Workshops and Seminars:** Organize events to educate stakeholders, vehicle owners, and operators about CNG conversion and its benefits.
4. **Print Media Advertising:** Place ads in newspapers and magazines to reach a wider audience.
5. **Radio and TV Commercials:** Broadcast informative ads to raise awareness about CNG.
6. **Online Webinars:** Host webinars to discuss the advantages and conversion process of CNG.
7. **Collaborate with Government Agencies:** Partner with relevant government agencies to promote CNG adoption.
8. **Vehicle Conversion Programs:** Offer incentives and support for vehicle owners to convert to CNG.
9. **Public Awareness Events:** Host events like “CNG Day” to showcase benefits and offer free conversion services.
10. **Educational Content Creation:** Develop informative materials like brochures, informative videos, and blog posts to educate the public about CNG benefits.

## Conclusion

- At the COP26 which was held in Glasgow, Scotland in 2021, the President of Nigeria, Muhammadu Buhari signed the Climate Pact thus committing Nigeria to achieving net zero emissions by 2060. A week after the conference, President Buhari signed the Climate Change Bill into law demonstrating the country's commitment to truly achieve net zero carbon emissions. It is a contradiction for a country to subsidise the consumption of fossil fuel while at the same time seeking to reduce the country's carbon footprint. Rather than subsidising fossil fuels, the country should encourage green and renewable energy.
- CNG presents a viable alternative fuel option for Nigerians, offering environmental, energy security, and economic benefits. Subsidy removal creates a level playing field, increasing CNG adoption and generating revenue for the government. Addressing infrastructure, vehicle conversion, public awareness, and policy challenges is crucial for successful CNG adoption in Nigeria. With careful planning and implementation, CNG can play a significant role in Nigeria's transition to a cleaner, more sustainable energy future.

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