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Yakub Abiola Hammed [1]

COMPRESSED NATURAL GAS (CNG) AS AN ALTERNATIVE FUEL TO PREMIUM MOTOR SPIRIT (PMS): THE BENEFITS AND DISADVANTAGES

1. Introduction

In recent years, the search for alternative fuels to replace conventional fossil-based products such as Premium Motor Spirit (PMS) has gained significant attention. One of the most promising alternatives that has emerged is Compressed Natural Gas (CNG), a cleaner, cost-effective fuel option. CNG is a by-product of natural gas that has been compressed to a high pressure to enable proper storage and ease of transportation. It is primarily composed of methane and is used as a fuel for vehicles, offering several advantages over PMS. However, despite its benefits, CNG also comes with certain challenges that must be addressed before it can become a widespread replacement for PMS globally. This article explores the benefits and disadvantages of CNG as an alternative to Premium Motor Spirit (PMS).

2. What is CNG and How Does it Work?

Compressed Natural Gas (CNG) is a type of natural gas that is stored at high pressure in specially designed cylinders. Natural gas is predominantly composed of methane, a colorless, odorless, and highly combustible compound. CNG is produced by compressing this gas to less than 1% of its volume at standard atmospheric pressure, making it easier to store and transport.[2] Unlike PMS, which is a liquid fuel, CNG is a gaseous fuel. When used in internal combustion engines, CNG must be injected into

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[1] **Yakub Hammed Abiola, P.A. to the Managing Partner, S. P. A. Ajibade & Co., Lagos State, Nigeria. Mondaq Thought Leadership Award Winner (Ranked 2nd), Autumn 2024, Technology.**

[2] Wikipedia (2024) "Compressed natural gas" available at https://en.wikipedia.org/wiki/Compressed_natural_gas accessed on 26th November, 2024.

the engine in a controlled manner, similar to how gasoline or diesel is injected into traditional engines. CNG is stored in cylindrical tanks that are typically mounted on the vehicle, and it is released into the engine's combustion chamber where it is ignited to produce energy. This process results in fewer harmful emissions, making CNG an environmentally friendly fuel option.

3. The Benefits of Using CNG

The benefits of using CNG as an alternative fuel to PMS are enumerated and discussed below.

3.1 Environmental Benefit

One of the primary advantages of using CNG as an alternative to PMS is its positive impact on the environment. CNG is a cleaner-burning fuel compared to PMS. When combusted, it produces significantly fewer harmful pollutants such as carbon dioxide, nitrogen oxides, carbon monoxide and other harmful particles. Specifically, CNG emits up to 30% less carbon dioxide than gasoline/PMS, reducing the overall carbon footprint of vehicles. The reduction of nitrogen oxide and particulate matter also helps improve air quality, particularly in urban areas where traffic congestion contributes to high levels of air pollution.[3] By reducing the emission of greenhouse gases, CNG can play a significant role in mitigating the effects of climate change.

3.2 Cost-Effectiveness

Another compelling reason for the adoption of CNG is its cost-effectiveness. CNG is generally less expensive than PMS on a per-unit basis, primarily due to the lower cost of natural gas compared to gasoline or diesel. The price of CNG is often more stable than petroleum products, which are subject to fluctuations in global oil prices. For fleet operators, public transportation systems, and private vehicle owners, switching to CNG can result in significant savings on fuel costs. Additionally, the higher energy content of CNG relative to its volume means that vehicles powered by CNG can travel similar distances to those running on conventional fuels without the need for frequent re-fueling.

3.3 Energy Security

The global reliance on petroleum imports for PMS has created significant concerns about energy security, especially for countries that do not have substantial domestic oil reserves. In contrast, natural gas is abundant in many regions and is often locally

[3] IndianOil-Adani Gas Pvt. Ltd., (2024) "What are the Benefits of CNG?" available at https://ioagpl.com/what-are-the-benefits-of-cng/ accessed on 12th December, 2024.

sourced. By transitioning to CNG, countries can reduce their dependence on imported oil and diversify their energy sources, which enhances their energy security. Moreover, natural gas is more widely distributed than petroleum, making CNG a more accessible and viable alternative for many nations. This shift toward domestically sourced energy can also reduce the geopolitical risks associated with oil imports and price volatility.

3.4 Improved Engine Performance

CNG-powered engines tend to perform better in terms of engine longevity and maintenance costs. Because CNG burns more cleanly than PMS, there is less carbon build-up in the engine, which can reduce the need for frequent engine repairs and prolong the life of engine components. Vehicles powered by CNG experience less wear and tear on critical components such as spark plugs and exhaust systems. Furthermore, CNG engines operate with smoother acceleration and quieter operation, contributing to a more comfortable driving experience. For fleet operators, this translates into lower maintenance and repair costs, as well as fewer vehicle downtimes.

3.5 Reduced Noise Pollution

CNG-powered vehicles are quieter than their PMS or diesel counterparts, which is an important benefit, particularly in densely populated urban areas. PMS and diesel engines tend to generate significant noise pollution, which can be disruptive to both human and animal life. Due to the way the fuel burns more cleanly and efficiently in CNG vehicles, they produce less noise, contributing to a more peaceful environment free of noise pollution.

4. The Disadvantages of Using CNG

In spite of the benefits of using CNG discussed above, it is not without its challenges and disadvantages, which are also explained below.

4.1 Limited Re-fueling Infrastructure

One of the major drawbacks of adopting CNG as a mainstream fuel is the limited availability of re-fueling infrastructure. CNG re-fueling stations are not as widespread as traditional PMS stations, especially in rural or less-developed regions. This limited network of re-fueling stations presents a significant challenge for CNG adoption, particularly for long-distance drivers or commercial fleet operators who rely on extensive re-fueling options. The lack of infrastructure creates a chicken-and-egg problem. Without a large number of vehicles using CNG, there is little incentive to invest in building new re-fueling stations, and without a robust network of re-fueling stations, consumers are reluctant to purchase CNG-powered vehicles.

4.2 **Vehicle Conversion and Cost of CNG Vehicles**

While there are a growing number of vehicles designed to run on CNG, many vehicles on the road are still powered by PMS. Converting these vehicles to run on CNG can be a costly and complicated process. The conversion requires specialized equipment, including high-pressure storage tanks and CNG injection systems, which can be expensive to purchase and install. Additionally, the vehicle's engine may require modifications to accommodate the new fuel type. For consumers and fleet operators, the initial investment in converting existing vehicles to CNG may be considered too expensive and uneconomical, causing them to become discouraged.

4.3 **Limited Storage Capacity**

Because CNG is stored in high-pressure tanks with about 10mm thickness or even more, its volume of concentration, by weight or the capacity it occupies, is lower than that of PMS or diesel. This means that, unlike PMS or diesel storage tank (which is less thick), CNG storage tank (cylinder) has lesser space for storage. While advancements in tank technology have improved the storage capacity of CNG tanks, it remains a disadvantage when compared to PMS or diesel storage tank. Furthermore, the bulkiness of CNG storage tank reduces the available space in vehicles, which can be a concern for certain types of vehicles, such as passenger cars or commercial trucks that require significant cargo space.[4]

4.4 **Safety Concerns**

While CNG is considered a safe fuel, there are concerns about the safety of high-pressure tanks and the potential risks of leaks. CNG is a highly flammable gas, and any leaks in the storage or fuel delivery system could lead to an explosion or fire outbreak. Although modern CNG tanks are designed with safety features to prevent these accidents, the risk of a leak remains a concern, particularly in the event of a crash. Because CNG is lighter than air, leaks may not always be immediately noticeable, thereby increasing the hazard of unnoticed accumulation of gas in confined spaces. Strict regulations and safety standards must be enforced to minimize these risks and ensure the safe use of CNG-powered vehicles.[5]

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[4] Caleb Obiowo (2024) “Inside the CNG conversion journey in Lagos” available at https://nairametrics.com/2024/10/03/inside-the-cng-conversion-journey-in-lagos/ accessed on 23rd December, 2024.

[5] Adeyinka Adedipe (2024) “CNG car explosion injures three in Edo” available at https://punchng.com/cng-car-explosion-injures-three-in-edo/ accessed on 23rd December, 2024.

4.5 **Environmental Impact of Natural Gas Extraction**

While CNG is cleaner than PMS in terms of emissions, its environmental impact during extraction and transportation is still a concern. Natural gas is primarily extracted through drilling, including methods like hydraulic fracturing (often called hydrofracking or fracking), which have raised environmental concerns related to water usage, groundwater contamination, and seismic activity. The extraction of natural gas also involves methane leaks, a potent greenhouse gas, which can offset some of the climate benefits associated with CNG.[6] Therefore, while CNG is a cleaner fuel compared to PMS, it is not without its own environmental challenges, particularly relating to its production.

5. Conclusion

Compressed Natural Gas (CNG) presents a promising alternative to Premium Motor Spirit (PMS) for powering motor vehicles. Its environmental benefits, cost-effectiveness and potential to improve energy security make it an attractive option for many countries and industries. However, the adoption of CNG by vehicle users faces significant barriers, including grossly limited CNG re-fueling stations/infrastructure, high cost of vehicle conversion kits as well as safety concerns. To address these issues, more investments need to go into providing these essential CNG equipment and infrastructure, to be supported by intensive and extensive advocacy and education on the benefits of adopting CNG as an alternative fuel.

While CNG may not fully replace PMS in the short term, it remains a viable transitional fuel that can contribute to reducing global dependence on petroleum-based fuels and decreasing environmental pollution - ultimately contributing to the attainment of the United Nations' Sustainable Development Goals 6 (Clean Water & Sanitation) and 7 (Affordable and Clean Energy) by 2030.

For further information on this article and area of law,
please contact **Yakub Hammed Abiola** at:
S. P. A. Ajibade & Co., Lagos by
Telephone (+234 1 472 9890), Fax (+234 1 4605092)
Mobile (+234 705 828 2258, +234 816 403 4208)
Email: yhammed@spaajibade.com
www.spaajibade.com

[6] U.S. Energy Information Administration, (2024) "Natural gas explained - Natural gas and the environment" available at https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php accessed on 18th December, 2024.