
LPG/C in Algeria: A Strategic Lever for Sustainable Mobility?

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Abstract:

In the context of the global energy transition, Liquefied Petroleum Gas as a fuel (LPG/C) represents a strategic alternative to conventional fuels, offering significant economic and environmental benefits. This article analyzes the evolution of the global LPG/C market, highlighting the successful experiences of Turkey, Italy, and Poland. In Algeria, despite considerable potential and incentive measures, the development of LPG/C remains hindered by technical, regulatory, and infrastructural challenges. This study explores these obstacles and proposes recommendations to strengthen LPG/C adoption through infrastructure improvements, financial incentives, and awareness campaigns. The expansion of LPG/C could thus contribute to more sustainable mobility and reduce Algeria's dependence on fossil fuels.

Keywords: LPG/C adoption; mobility; Sustainability; Energy; Fuel.

Jel Classification Codes : Q42, R41.

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1. Introduction:

In a global context marked by growing energy challenges, the transition to more sustainable energy sources has become a strategic priority for many countries. Algeria, heavily dependent on hydrocarbons, seeks to optimize the use of its energy resources while reducing its vulnerability to fluctuations in international oil and gas markets. The transport sector, a major consumer of fossil fuels, represents a key lever for initiating this transition.

Liquefied Petroleum Gas fuel (LPG/c) emerges as an attractive alternative to conventional fuels due to several factors: its lower cost compared to gasoline and diesel, its reduced pollutant emissions, and its local production, which strengthens the country's energy independence. Thanks to these advantages, Algeria has undertaken a policy to promote LPG/c for several years through incentive measures such as conversion subsidies, low-interest loans, and the expansion of the network of adapted service stations. These efforts have led to a notable increase in the number of vehicles converted to LPG/c, thereby improving the national energy balance by reducing refined fuel imports.

However, despite these advances, several challenges still hinder the widespread adoption of LPG/c. Vehicle conversion remains below expectations due to various structural and behavioral obstacles: the initial installation cost, motorists' perceptions regarding LPG/c performance, the still insufficient number of refueling stations, and certain regulatory restrictions, such as the ban on parking in underground garages. These constraints limit the development of this sector, despite its economic and environmental benefits.

Furthermore, Algeria possesses significant natural gas reserves, part of which is used to produce LPG/c. This abundance gives this energy source a strategic character, as it reduces the country's dependence on imported fuels and improves its energy security. By efficiently exploiting its local resources, Algeria could not only strengthen its energy autonomy but also create an industrial dynamic around LPG/c production and distribution. This transition is part of a broader perspective of sustainable development, where optimizing natural resources and reducing greenhouse gas emissions become priorities.

While Compressed Natural Gas (CNG) is another potential alternative, its development remains limited due to infrastructure and technological constraints. In comparison, LPG/c appears to be a more accessible solution, better integrated into existing infrastructures. Its widespread adoption could foster the emergence of a more robust and competitive local energy sector while offering consumers a viable economic and ecological alternative.

1.1 Problem Statement and Hypotheses

In this context, a central question arises: **Can LPG/c truly constitute a strategic lever for sustainable mobility in Algeria, or will its adoption remain limited by structural and behavioral constraints?**

We formulate the following hypotheses:

- The adoption of LPG/c in Algeria is hindered by economic, regulatory, and infrastructural barriers.
- Public policies and financial incentives play a crucial role in the growth of the LPG/c market.

1.2 Study Objectives

This study aims to achieve three main objectives. First, it seeks to evaluate the dynamics of the LPG/c market in Algeria by analyzing the evolution of converted vehicles, the impact of public policies, and infrastructure development. Second, the study aims to identify the main obstacles to LPG/c adoption, whether economic, regulatory, technological, or behavioral. Finally, it aims to propose strategic recommendations to accelerate LPG/c adoption in Algeria, focusing on financial incentives, infrastructure strengthening, and consumer awareness.

1.3 Methodology

To achieve these objectives, the study adopts a mixed methodological approach combining qualitative and quantitative analysis. A literature review will be conducted to examine global trends and public policies related to LPG/C. Statistical data analysis will help assess consumption and the evolution of the LPG/C market in Algeria and internationally. The study will also draw on the examination of successful experiences in certain countries that have integrated LPG/C as an alternative energy source, in order to derive lessons applicable to the Algerian context. Additionally, an in-depth analysis of Algerian policies and regulations promoting LPG/C will be carried out, highlighting incentive measures and potential barriers to its development.

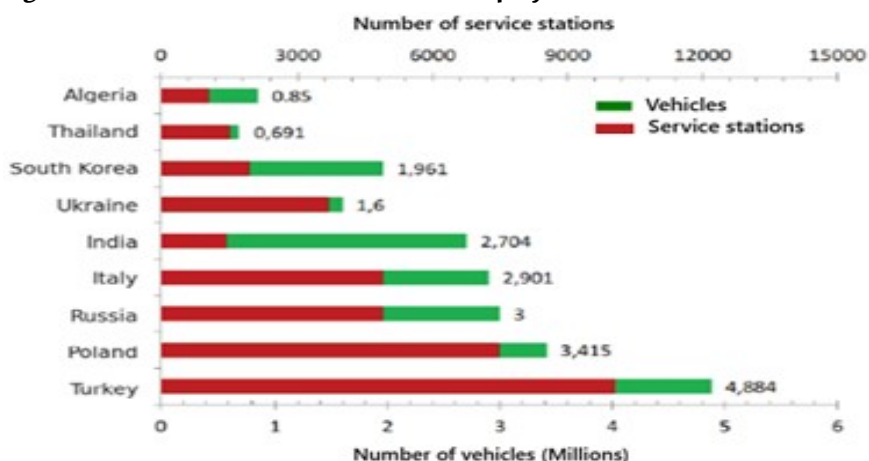
2. The Development of LPG/C on a Global Scale

The development of LPG/C is part of the energy transition and the reduction of dependence on fossil fuels. Its growth is driven by environmental concerns, energy diversification, and fluctuations in oil prices. Many countries are promoting its large-scale adoption through incentive policies, technological innovations, and expanding infrastructure.

2.1 Growth of the LPG/C Market Worldwide

In recent decades, the LPG/C market has expanded considerably, reaching 27 million vehicles in circulation and benefiting from a steadily growing distribution network (Commissariat aux Énergies Renouvelables et à l'Efficacité Énergétique, 2024). This growth underscores the rising attractiveness of LPG/C as an alternative to conventional fossil fuels, driven by its cost-effectiveness and environmental benefits.

Fig N°1: Global Distribution of LPG/C Deployment as of the End of 2022



Source: Prepared by the author based on data from the International Energy Agency, 2023.

As illustrated in Figure 1, Europe dominates the global LPG/C market, largely due to incentive policies implemented in countries such as Italy, Poland, and Turkey. Favorable tax measures and a well-structured distribution network have encouraged widespread adoption. In Asia, growth is also significant, particularly in South Korea and India, where strict environmental regulations promote the transition to LPG/C as a means to reduce emissions. In South America, while Argentina has developed a strong market, growth remains more moderate in Brazil, where other alternatives like ethanol continue to dominate.

The trends presented in Figure 1 highlight the key role of public policies and economic incentives in driving LPG/C adoption. In Europe, the alignment of infrastructure and tax benefits facilitates its expansion. In Asia, efforts to combat urban pollution are a major driver of its growth. In South America, although energy diversification is a priority, LPG/C development faces competition from other energy sources.

In Algeria, despite a fleet of 850,000 LPG/C-converted vehicles, market growth remains hindered by an insufficient distribution network, limiting accessibility and large-scale adoption. The experience of leading countries in this sector underscores the importance of a well-adapted regulatory framework and reinforced infrastructure to support this energy transition.

2.2 Factors Driving the Growth of LPG/C

The global development of LPG/C relies on several key drivers that have enabled its expansion in many countries. Among these factors, public policies and financial incentives play a crucial role in creating a favorable framework for its adoption. Additionally, technological innovations and infrastructure development have enhanced its efficiency, availability, and competitiveness compared to conventional fuels.

2.2.1 Public Policies and Financial Incentives

Governments play a central role in promoting LPG/C by implementing policies and incentive measures aimed at encouraging its adoption by consumers and businesses. These policies take various forms:

a) Tax Measures and Direct Subsidies

The growth of LPG/C in several countries is driven by effective public policies, attractive financial incentives, and significant infrastructure development. Three countries stand out in this dynamic: Turkey, Italy, and Poland. Each has adopted a specific but effective strategy to promote this alternative fuel, thereby reducing their dependence on conventional fossil fuels.

In Turkey, the success of LPG/C is linked to lower taxes compared to gasoline and diesel, as well as subsidies facilitating vehicle conversion. With more than 10,000 service stations in 2023, its accessibility has encouraged widespread adoption, increasing the number of LPG/C vehicles from 2 million in 2010 to 5 million in 2023 (CEREE, 2024).

In Italy, an attractive tax policy (reduced VAT, tax exemptions) and financial aid have allowed LPG/C to account for 10% of the vehicle fleet, reaching 4 million vehicles in 2023. Preferential access to low-emission zones and a dense network of 4,500 service stations have strengthened its appeal (European Alternative Fuels Observatory, 2023).

In Poland, the adoption of LPG/C is encouraged by a price two to three times lower than gasoline and a network of 7,500 service stations. Thanks to these advantages and enhanced safety standards, the country had 3.5 million LPG/C vehicles in 2023, up from 2 million in 2010. (PSPA, 2024)

b) Regulations Promoting LPG/C Adoption

Several countries have introduced specific regulations to encourage the adoption of LPG/C as an alternative to conventional fuels. One key measure involves the mandatory integration of LPG/C into public and corporate fleets. Some government agencies and transport companies are required to include a certain percentage of LPG/C vehicles in their fleets. This initiative aims to stimulate market growth while serving as an example to consumers, demonstrating that LPG/C is a viable and efficient solution for reducing dependence on traditional fossil fuels (World LPG Association (WLPGA) & Liquid Gas Europe, 2020).

Additionally, the transition to LPG/C is supported by the progressive ban on conventional fuels in certain urban areas. Many states and municipalities are implementing restrictive policies on diesel vehicles, limiting their access to city centers or imposing additional taxes. These measures encourage motorists to switch to cleaner alternatives, with LPG/C standing out due to its lower emissions of fine particles and greenhouse gases.

Finally, to ensure the safety and reliability of LPG/C, strict standards have been established for the approval of converted vehicles. Conversion installations must meet rigorous criteria, and storage tanks undergo quality and safety inspections before being put into circulation. These regulations guarantee the safe use of LPG/C while reinforcing consumer confidence in this technology.

c) Awareness and Information Programs

Awareness and information programs play a key role in promoting LPG/C as an alternative to conventional fuels. Governments and industry stakeholders implement various communication campaigns aimed at educating motorists about the economic and environmental advantages of this fuel. These campaigns emphasize fuel cost reductions for consumers as well as lower pollutant emissions, contributing to improved air quality and climate change mitigation.

At the same time, in some countries, partnerships with vehicle manufacturers and dealerships are established to facilitate LPG/C adoption. These agreements allow pre-equipped vehicles to be offered at competitive prices, reducing initial costs for consumers and encouraging a faster transition to this energy solution. These combined initiatives aim to accelerate public acceptance and adoption of LPG/C by highlighting its economic and environmental benefits.

2.2.2 Technological Innovations and Infrastructure Development

The rise of LPG/c is not solely based on financial and regulatory incentives but also on technological advancements that have enhanced its performance and facilitated its large-scale deployment. These improvements are mainly observed in three areas: the enhancement of vehicle conversion technologies, the expansion of distribution infrastructure, and continuous research aimed at optimizing its use.

a) Improvements in Vehicle Conversion Technologies

Vehicle conversion technologies for LPG/c have significantly evolved over the years. Early systems could lead to power loss and compatibility issues with certain engines. Today, thanks to innovations such as liquid LPG injection, combustion efficiency has greatly improved, minimizing these drawbacks.

Furthermore, some manufacturers are now developing engines specifically designed to run on LPG/c, eliminating the need for conversion costs while ensuring optimal performance.

In addition, optimizing fuel range has been a major breakthrough. Enhancements in storage tanks and injection systems allow vehicles to travel longer distances without frequent refueling, offering greater flexibility to users and reducing the constraints associated with LPG/c usage.

b) Expansion of the Distribution Network and Modernization of Infrastructure

The expansion of the distribution network and the modernization of infrastructure have played a crucial role in promoting LPG/c as an alternative to conventional fuels. In several countries where this fuel is widely adopted, the number of service stations equipped for LPG/c distribution has significantly increased, making refueling more accessible. Turkey exemplifies this trend with over 10,000 service stations, making it one of the world's leaders in LPG/c adoption. Italy also boasts a dense network, ensuring refueling is as convenient as gasoline or diesel (Aygaz, 2023).

At the same time, the development of automated service stations has streamlined the refueling process. The automation of pumps and the integration of fast payment systems have improved the user experience, accelerating the transition to LPG/c by offering motorists a more practical and efficient solution.

Moreover, the modernization of storage infrastructure has enhanced safety and alleviated concerns about explosion or leakage risks. Thanks to stricter safety standards and innovations in storage technology, consumer and regulatory confidence has increased, further promoting the widespread adoption of LPG/c as a viable energy alternative.

c) Research and Development to Optimize LPG/c Usage

Beyond infrastructure development, research and innovation play a key role in the continuous improvement of LPG/c. Investments are being made to refine dedicated engines, increase energy efficiency, and reduce pollutant emissions.

Additionally, integrating new technologies, such as hybrid LPG/electric systems, opens promising prospects. By combining the advantages of LPG/c and electrification, these systems enhance fuel range while further reducing environmental impact, contributing to energy transition objectives.

2.3.1 Success Factors and Adoption of LPG/c

LPG/c has established itself as an economic and ecological alternative to traditional fuels, mainly due to its low pollutant emissions and reduced cost. Its adoption varies depending on public policies, tax incentives, and the distribution infrastructure network. Here's how three European countries have successfully structured and developed this market:

- **Turkey:** As the world leader in LPG/c usage, Turkey has over 40% of its vehicle fleet converted. This success is driven by a proactive government policy combining financial incentives, favorable taxation, and a large-scale expansion of the distribution network, with over 10,000 equipped service stations. Additionally, conversion costs are relatively affordable and quickly offset by fuel savings.
- **Italy:** With more than 4 million LPG/c-powered vehicles, Italy has one of the most dynamic markets in Europe. The growth of this fuel is supported by public subsidies for LPG kit installation, reduced taxation, and environmental regulations favoring low-emission vehicles. Moreover, Italy benefits from a dense network of service stations, facilitating large-scale adoption.
- **Poland:** With approximately 3.5 million LPG/c vehicles, Poland is one of the European countries where this fuel is most widespread. Its success is attributed to a significantly lower price compared to gasoline and diesel, a well-developed infrastructure with over 7,000 service stations, and affordable conversion costs. Favorable taxation and flexible regulations have also played a key role in its massive adoption. (World LPG Association (WLPGA) & Liquid Gas Europe, 2020).

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While Turkey relies on tax incentives and infrastructure, Italy uses subsidies and environmental policies, while Poland attracts motorists with competitive prices. These varied approaches demonstrate effective strategies to promote LPG/C as an alternative fuel.

2.3.2 Key Success Factors

The large-scale adoption of LPG/C in countries like Turkey, Italy, and Poland results from strategic economic, regulatory, and infrastructural measures.

- **Turkey:** The success of LPG/c in Turkey is supported by a proactive government policy combining attractive tax incentives (lower taxes compared to conventional fuels), subsidies for vehicle conversion, and a massive expansion of the distribution network. By the end of 2023, more than 10,000 service stations were equipped to supply LPG/c, ensuring easy access for motorists. Additionally, the government has simplified administrative procedures related to conversion, facilitating large-scale adoption and reducing costs for users.
- **Italy:** Italy has implemented an incentive framework that has significantly boosted LPG/c adoption. Key measures include a reduced VAT on fuel, tax exemptions for clean vehicles, and conversion grants allowing motorists to finance part of the LPG kit installation costs. Moreover, LPG vehicles benefit from privileged access to low-emission zones, a major advantage for urban drivers concerned about environmental restrictions.
- **Poland:** In Poland, LPG/C adoption is driven by its competitive price compared to gasoline and diesel, a dense network of over 7,000 service stations, and strengthened regulations enforcing strict safety standards, ensuring reliable and secure installations to encourage its use.

These three examples demonstrate how a combination of well-adapted public policies, financial incentives, and infrastructure development can drive the transition to LPG/c as a credible alternative to traditional fuels.

2.3.3 Achieved Results

The rise of LPG/c in countries such as Turkey, Italy, and Poland illustrate its progressive development over the years. The following data highlight the evolution of converted vehicle numbers, the expansion of the distribution network, and the increase in LPG/c market share in these countries.

Table N°1: Evolution of the LPG/c Market in Turkey, Italy, and Poland (2010-2023)

Year	Turkey		Italy		Poland	
	Number of LPG/c vehicles	Number of LPG/c stations	LPG/c market share	Number of LPG/c stations	Number of LPG/c vehicles	Number of LPG/c stations
2010	2 millions	6,000	6%	3,500	2 millions	5,000
2015	3.5 millions	8,000	8%	4,000	2.8 millions	6,500
2023	5 millions	10,000	10%	4,500	3.5 millions	7,500

Source: Prepared by the author based on data from the World LPG Association.

The table analysis highlights sustained growth of LPG/c in Turkey, where the number of equipped vehicles more than doubled between 2010 and 2023, reaching 5 million units. This progress is driven by attractive financial incentives, subsidies facilitating vehicle conversion, and the continuous expansion of the distribution network, which increased from 6,000 to 10,000 stations in 13 years.

In Italy, the market share of LPG/c followed a steady increase, rising from 6% in 2010 to 10% in 2023. This trend is explained by favorable taxation and environmental policies encouraging the acquisition of clean vehicles. At the same time, the number of service stations offering LPG/c has grown, although at a more moderate rate compared to Turkey.

In Poland, the success of LPG/c is mainly based on its competitive price compared to conventional fuels and a well-developed distribution network. The number of converted vehicles reached 3.5 million in 2023, accompanied by a 50% increase in service stations over 13 years, ensuring better fuel accessibility across the country.

3. LPG/c in Algeria: A Contrasting Development

LPG/c represents an alternative to conventional fuels in Algeria, mainly due to its relatively low cost and reduced environmental impact. The government has encouraged its development through various incentive measures. However, despite a significant increase in the number of converted vehicles and the expansion of infrastructure, the LPG/c sector faces several challenges that limit its growth.

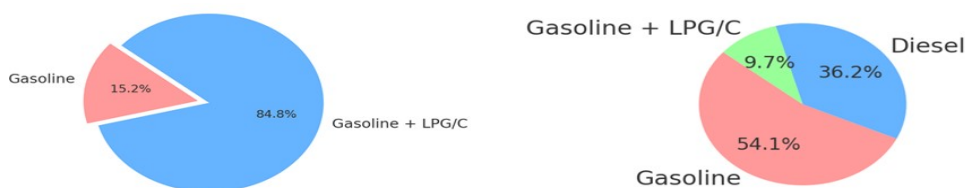
3.1 State of the LPG/c Sector in Algeria

3.1.1 LPG/c Conversion and Consumption Trends

The rise of LPG/c-powered vehicles in Algeria follows a trend driven by incentive public policies and the evolution of fuel prices. Although the conversion of gasoline vehicles to LPG/c has progressed over the years, it remains relatively modest compared to the overall national vehicle fleet.

The analysis of Figure 2 highlights a conversion rate of gasoline vehicles to LPG/c of 9.7% by the end of 2020, representing approximately 750,000 vehicles, which accounts for 15.2% of the gasoline-powered fleet. Despite this progress, the conversion remains insufficient to significantly reduce the dominance of gasoline-only vehicles, which still constitute 84.8% of the total fleet.

Fig N°2. Configuration of the National Vehicle Fleet and Conversion Rate of Gasoline Vehicles to LPG/C at the End of 2020



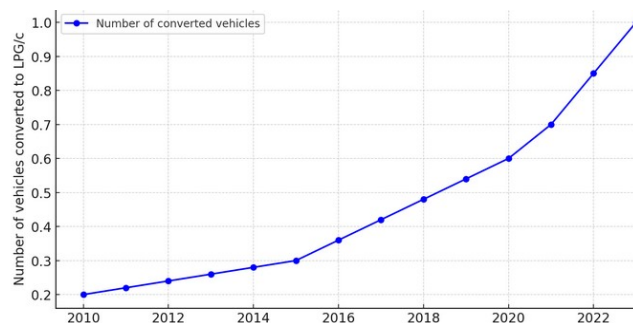
Source: Prepared by the author from the latest report published by the former Ministry of Energy Transition and Renewable Energies (July 2022)

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The analysis of Figure 3 illustrates a significant increase in the number of vehicles converted to LPG/c. Between 2010 and 2020, their number rose from 200,000 to 600,000, driven by government incentive policies, including subsidies and tax benefits. After 2020, this growth accelerated, reaching nearly one million vehicles in 2023.

This trend is mainly explained by the rise in traditional fuel prices, which made LPG/c more competitive, as well as by the strengthening of state support programs. Furthermore, the development of distribution infrastructure has improved access to this fuel, encouraging more motorists to adopt this alternative.

Fig N° 3: Evolution of the number of vehicles converted to LPG/c

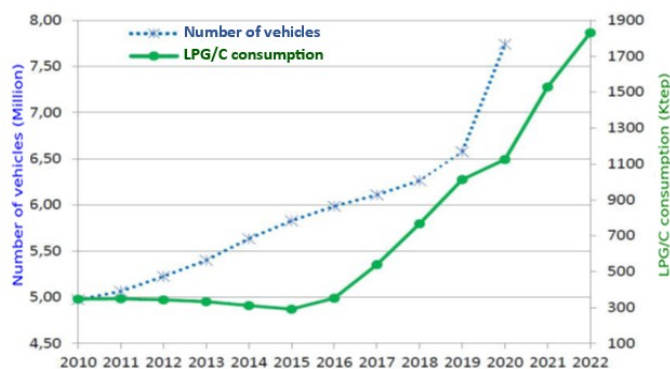


Source: Prepared by the author from Naftal data.

The analysis of Figure 4 highlights a significant increase in LPG/c demand, which only became truly noticeable after 2016. Before this date, annual consumption ranged between 300 and 350 Ktoe. From 2016 onwards, a notable surge was observed, bringing consumption to 1,830 Ktoe in 2022.

This trend is explained by the successive fuel price adjustments introduced by the Finance Laws of 2016, 2017, 2018, and 2020. These pricing changes widened the price gap between gasoline and LPG/c, reaching 36.62 DA/liter in 2020, making LPG/c significantly more attractive.

Fig N°4: Evolution of the vehicle fleet and LPG/c consumption between 2010 and 2022

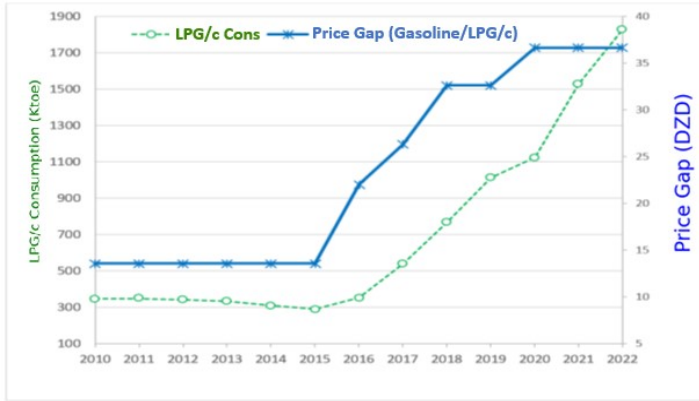


Source: Prepared by the author from the latest report published by the former Ministry of Energy Transition and Renewable Energies (July 2022).

The growth in demand is therefore mainly driven by price effects, supported by public incentives. However, despite this favorable trend, the vehicle conversion rate remains below the national production and distribution capacities, highlighting the need to strengthen infrastructure and increase awareness of the economic and environmental benefits of LPG/c.

The analysis of Figure 5 confirms that the widening price gap between gasoline and LPG/c has effectively stimulated vehicle conversion. Since 2016, LPG/c demand has continued to rise, increasing from 290 Ktoe in 2015 to over 1,800 Ktoe in 2022. This growth is directly linked to the expansion of the price differential between the two fuels, encouraging a growing number of drivers to opt for this more cost-effective alternative.

Fig N°5: Impact of the widening price gap between gasoline and LPG/c on LPG/c demand.



Source: Prepared by the author based on data from the latest report published by the former Ministry of Energy Transition and Renewable Energies (July 2022).

3.1.2 Analysis of Public Policies on Incentives

The observation of Table 2 highlights the various incentive measures implemented by the Algerian government to encourage the use of LPG/C. These measures are part of a strategy aimed at reducing dependence on conventional fuels and promoting a gradual energy transition.

Table N° 2: Incentive Measures by the Algerian Government for the Promotion of LPG/C

Incentive Measures	Description
Conversion Subsidies	The state covers part of the cost of converting gasoline vehicles to LPG/C through dedicated programs.
Tax Reductions	LPG/C benefits from advantageous taxation, reducing its price compared to other fuels.
Support for Conversion Workshops	Financial aid is provided to mechanics to encourage investment in the necessary equipment for installing LPG/C kits.
Gradual Obligation of Use	Certain vehicle categories, notably taxis and public transport, are strongly encouraged to adopt LPG/C.

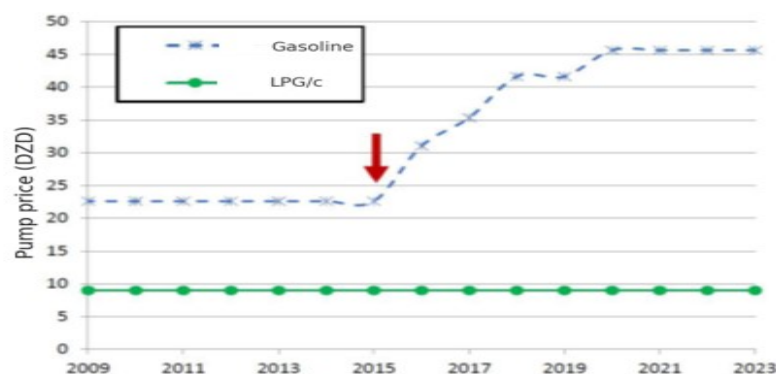
Source: Prepared by the author.

These measures aim to accelerate the adoption of LPG/C in Algeria. Subsidies and tax reductions make this fuel more accessible to motorists, while support for conversion workshops promotes the development of the necessary infrastructure for its widespread use. Additionally, the gradual obligation for certain vehicle categories contributes to driving this transition forward.

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However, several challenges remain. The initial conversion cost remains a barrier for many individuals, and public awareness of the economic and environmental benefits of LPG/C is still insufficient. Furthermore, the number of service stations equipped for LPG/C remains limited, hindering its large-scale adoption.

Fig N°6. Evolution of Gasoline and LPG/C Pump Prices Between 2009 and 2023.



Source: Prepared by the author based on data from Naftal.

Moreover, the gradual increase in gasoline and diesel prices, implemented through the finance laws of 2016, 2017, 2018, and 2020, has widened the gap between the price of LPG/C and conventional fuels. As illustrated in Figure 6, this gap reached 36.62 DA/liter in 2020, making LPG/C more competitive. This trend has encouraged a growing number of motorists to opt for this alternative, thereby contributing to the steady increase in demand.

2.1.3 Expansion of Refueling Stations and Infrastructure Development

The development of the LPG/C sector in Algeria largely depends on improving distribution infrastructure. Over the years, there has been a significant increase in the number of service stations equipped to supply LPG/C, reflecting a political and economic commitment to promoting this alternative fuel. The growing involvement of both public and private stakeholders has enhanced access to LPG/C, particularly in urban and peri-urban areas. However, disparities persist in some inland regions, where limited refueling infrastructure continues to hinder the widespread adoption of this fuel. This trend is illustrated in Table 3, which presents the evolution of LPG/C-equipped service stations in Algeria.

Table N° 3: Evolution of the Number of LPG/C-Equipped Service Stations in Algeria

Year	Number of LPG/C Service Stations	Major Players Involved	Observations
2010	A few hundred	Mainly Naftal	Limited availability, developing infrastructure
2020	More than 1,200	Naftal and private actors	Significant expansion due to public and private investments
2023	More than 1,600	Naftal and private actors	Ongoing expansion with a national coverage objective

Source: Prepared by the author based on NAFTAL documents.

3.2 Opportunities and Advantages of LPG/C for Algeria

Liquefied Petroleum Gas for fuel (LPG/C) represents a strategic alternative for Algeria in terms of energy diversification and transitioning toward a more balanced energy mix. Its increasing adoption is based on several major advantages, including economic, environmental, and technical benefits.

3.2.1 Economic Advantages

Algeria, as a hydrocarbon-producing country, possesses significant reserves of natural gas and LPG, enabling it to locally enhance a resource often underutilized in the energy sector. The development of LPG/C thus offers several economic benefits both for consumers and the national economy.

One of the main advantages of LPG/C lies in its significantly lower cost compared to conventional fuels. In Algeria, where fuel prices are subsidized, LPG/C is offered at 9 DA per liter compared to 45.62 DA per liter for unleaded gasoline. This results in a direct saving of 36.62 DA per liter, representing a reduction of 80.28 percent. This price difference allows motorists to quickly recover the initial cost of converting their vehicles, making the investment particularly attractive. Although LPG/C consumption is approximately 17 percent higher due to its lower calorific value, this overconsumption is largely offset by its low cost, making its use economically advantageous.

At the macroeconomic level, the widespread adoption of LPG/C helps reduce the import bill for refined fuels. By decreasing dependence on gasoline and diesel, some of which is imported due to insufficient national refining capacity, it directly contributes to reducing the energy trade deficit. For instance, gasoline consumption in Algeria dropped from 4.391 million tons in 2015 to 3.303 million tons in 2022, a reduction of 1.088 million tons thanks to the massive conversion of vehicles to LPG/C (Mousli, A. & Oukaci, K., 2022).

The development of LPG/C also boosts the local automotive conversion industry. By stimulating the market for LPG/C equipment installation and maintenance, this sector creates new investment and employment opportunities in specialized workshops and associated services. The expansion of this industry strengthens the national economic fabric by providing opportunities for local businesses and promoting the development of technical skills.

Finally, the increased use of LPG/C allows Algeria to optimize the exploitation of its local energy resources. By substituting LPG/C for petroleum refined fuels, the country frees up more crude oil for export, generating foreign currency revenues. Moreover, by utilizing its domestic gas for mobility purposes, Algeria reduces losses associated with the export of raw gas and enhances its energy independence (Mousli A, 2019).

3.2.2 Environmental Advantages

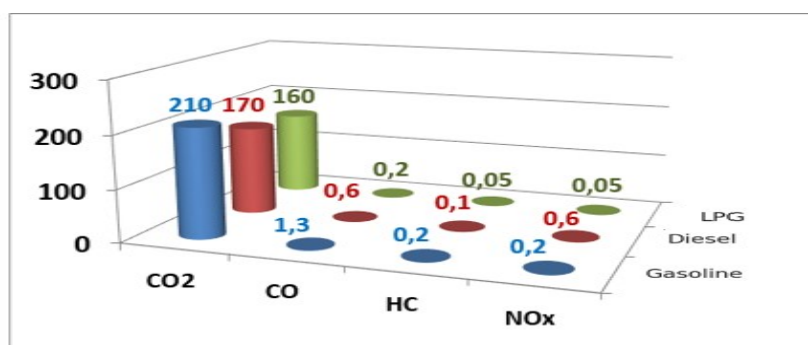
LPG/C represents a more environmentally friendly alternative compared to conventional fuels such as gasoline and diesel. Its combustion generates approximately 15 to 20 percent less CO₂, thereby reducing its

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carbon footprint and contributing to the fight against climate change. It also produces lower amounts of carbon monoxide (CO) and nitrogen oxides (NO_x), which are the main contributors to air pollution (IEA, 2021).

The observation of the graph below highlights the environmental performance of LPG/C. A significant reduction in CO₂, CO, NO_x, and unburned hydrocarbons (HC) emissions can be observed compared to gasoline and diesel, illustrating its key role in improving air quality.

Fig N°7: Comparison of Fuel Emissions (g/km)



Source: Energy Balance and Prospects for the Energy Transition in Algeria, 2023.

This reduction in air pollutants has a direct impact on public health. By limiting emissions of fine particles and polycyclic aromatic hydrocarbons, such as benzene and formaldehydes, LPG/C reduces the risk of respiratory and cardiovascular diseases. Moreover, its near-total absence of sulfur helps preserve air quality in urban areas. Finally, LPG/C improves engine performance by reducing carbon deposits and injector clogging, promoting cleaner combustion and limiting pollutant emissions over the long term.

3.2.3 Technical and Safety Advantages

Contrary to some misconceptions, LPG/C is not more dangerous than other flammable fuels. It is subject to strict safety standards, ensuring its reliable use. LPG/C tanks are specially designed to withstand high pressures and temperatures, minimizing the risk of explosion in the event of an accident. Safety devices, such as relief valves and solenoid valves, prevent leaks and ensure automatic shut-off of the gas supply in case of an incident. Additionally, LPG evaporates quickly in case of a leak, unlike liquid fuels that can accumulate and ignite more easily. Its pressurized storage prevents spontaneous evaporation, further reinforcing its safety (European LPG Association (AEGPL), 2018).

Beyond its safety features, LPG/C offers technological benefits that make it a viable and sustainable solution. Due to cleaner combustion, it limits deposit accumulation and engine clogging, which extends the lifespan of mechanical components and reduces maintenance costs. It also allows for easy adaptation, as many internal combustion vehicles can be converted to LPG/C using certified conversion kits, offering an accessible alternative without requiring a massive fleet renewal. Moreover, the absence of carbon residues in LPG/C contributes to a smoother engine operation, reducing maintenance needs and minimizing breakdowns and wear.

3.3 Barriers to LPG/C Adoption in Algeria

Despite its economic and environmental benefits, the adoption of LPG/C in Algeria remains limited due to several obstacles. These challenges, summarized in Table 4, mainly relate to regulatory constraints, infrastructure deficiencies, and a lack of public awareness.

Table N°4: Main Barriers to LPG/C Adoption

Barrier	Description	Impact on Adoption
Restrictions on access to underground parking	LPG/C vehicles are often banned from underground parking due to strict safety standards.	Discourages owners from adopting LPG/C, especially in urban areas.
Limited availability of LPG/C service stations	LPG/C stations are scarce, especially in rural areas.	Reduces accessibility and convenience for motorists.
Long waiting lines at LPG/C stations	Growing demand exceeds the available supply at fueling points.	Long waiting times discourage LPG/C use.
Initial conversion cost	Although subsidies exist, the cost of installing an LPG/C kit remains a significant investment for some motorists.	Limits adoption among low-income households, slowing the energy transition.
Lack of information and insufficient awareness	Many drivers are unaware of the economic and ecological benefits of LPG/C.	Reduces demand and limits LPG/C adoption to a small segment of the population.

Source: Prepared by the author

One of the main constraints is the restriction on LPG/C vehicles in underground parking facilities due to strict safety regulations. This limitation, particularly problematic in urban areas, discourages many motorists from switching to LPG/C.

Additionally, the network of LPG/C service stations remains insufficient, particularly in rural areas, limiting accessibility and convenience. Even in regions where such stations exist, long waiting lines caused by high demand further hinder adoption (Mousli & Oukaci, 2018).

From an economic perspective, while the cost of LPG/C conversion is lower than that of other green alternatives, it still represents a significant investment for many households. Existing subsidies are not always sufficient to make this transition widely accessible. Finally, the lack of awareness regarding the economic and environmental benefits of LPG/C slows its adoption, emphasizing the need for targeted awareness campaigns to encourage more motorists to make the switch.

4. Perspectives and Recommendations for Increased Adoption of LPG/C

The widespread adoption of LPG/C in Algeria relies on an integrated approach combining infrastructure improvement, regulatory adaptation, public awareness, and technological innovations. The country's energy transition thus requires coordinated efforts between public and private actors to remove existing barriers and optimize the impact of LPG/C in the national energy mix.

4.1 Improving the Distribution Network

Expanding the LPG/C distribution network is a key lever to encourage its adoption. A dense and well-distributed network across the entire national territory ensures easy access to fuel, increases consumer confidence, and minimizes logistical constraints related to supply.

4.1.1 Current State of the Distribution Network in Algeria

As of today, around 1,200 service stations in Algeria are equipped to distribute LPG/C, representing approximately 35% of the country's total stations. Despite development efforts, some regions, particularly in the south and rural areas, remain under-equipped. The growing demand for this fuel, driven by rising conventional fuel prices and government incentives, highlights the need for a faster deployment of distribution infrastructure. (ARH, 2023).

4.1.2 Increasing the Number of LPG/C-Equipped Service Stations

The lack of refueling points is one of the main obstacles to the widespread adoption of LPG/C. To address this issue, several measures can be implemented. First, a regulatory obligation could require all new service stations to include dedicated LPG/C pumps. This measure would ensure homogeneous territorial coverage and reduce current disparities. Legislative revisions could also impose a minimum quota of LPG/C-equipped stations, guaranteeing a more equitable distribution.

Second, economic incentives such as subsidies for oil operators and tax advantages could facilitate the installation of new refueling points. By reducing initial investment costs, these measures would accelerate network expansion and improve fuel accessibility.

Finally, public-private partnerships could play a crucial role by fostering collaboration with private sector actors to develop distribution infrastructure more efficiently. The state, in partnership with private investors, could modernize existing facilities while facilitating the integration of LPG/C into service station offerings.

4.1.3 International Examples

The experience of certain countries highlights the importance of a robust distribution network in promoting LPG/C adoption. In Italy, more than 4,000 service stations are equipped, thanks to government support and fiscal incentives. In Turkey, nearly 40% of vehicles run on LPG/C, supported by a well-structured and efficient distribution network. These models demonstrate that proactive and coherent policies can transform a market and drive a successful energy transition (World LPG Association (WLPGA), 2021).

4.2 Regulatory Reforms

4.2.1 Parking in Underground Garages

The ban on parking LPG/C vehicles in underground garages represents a major obstacle to adoption. To lift this restriction, it is essential to introduce updated safety standards, including mandatory gas leak detectors in

parking facilities, the creation of designated zones for LPG/C vehicles with optimized ventilation, and the implementation of strict maintenance and inspection protocols to ensure safety compliance.

International examples demonstrate the feasibility of such adaptations. In Belgium and the Netherlands, this ban has been lifted due to reinforced safety regulations, allowing for wider LPG/C usage without compromising infrastructure security (Prins Autogas, 2021).

4.3 Cultural and Behavioral Barriers to LPG/C Adoption in Algeria

4.3.1 Perceptions and Psychological Barriers

Despite its economic and environmental benefits, LPG/C still faces reluctance among Algerian motorists. Several factors explain this resistance:

On the one hand, safety concerns persist. Many still perceive LPG/C as a dangerous fuel due to assumed explosion risks. On the other hand, a cultural attachment to traditional fuels, such as gasoline and diesel, hinders its adoption. Gasoline and diesel are often seen as more powerful and reliable, while some motorists fear a loss of engine power after conversion.

4.3.2 User Experience and Service Quality

Beyond negative perceptions, practical obstacles also hinder the development of LPG/C. Long queues at service stations, due to growing demand and a still-limited supply, discourage many users. Additionally, the variable quality of conversion installations has sometimes tarnished LPG/C's image, especially due to poorly executed conversions leading to mechanical malfunctions.

Another major challenge is the absence of a structured maintenance network. The lack of specialized garages creates uncertainty for motorists, who fear not finding reliable and accessible after-sales service.

4.4 Public Awareness and Communication

An effective awareness program is essential to improve LPG/C's image and overcome consumer hesitations.

4.4.1 National Communication Campaigns

To promote LPG/C, communication campaigns should highlight its economic advantages. By emphasizing the significant price gap between LPG/C and conventional fuels, these initiatives would help change consumption habits. Moreover, scientific popularization efforts should be undertaken to reassure motorists about LPG/C's safety, notably through testimonials and technical demonstrations.

Finally, raising awareness about LPG/C's environmental benefits, particularly its contribution to reducing CO₂ emissions and urban pollution, would be an effective lever to strengthen its social acceptance.

4.4.2 Financial Incentives and Support

To accelerate LPG/C adoption, incentive measures must be implemented. Subsidizing vehicle conversion would make this option more accessible to low-income households. Additionally, facilitating access to auto loans for purchasing vehicles already equipped with LPG/C would encourage its adoption from the moment of acquiring a new car.

Finally, establishing a network of certified garages would ensure quality after-sales service, strengthening consumer confidence and ensuring a sustainable transition to LPG/C.

5. Conclusion

The development of LPG/C in Algeria aligns with a global trend toward diversifying energy sources and reducing the environmental impact of the transport sector. As a hydrocarbon-producing country, Algeria has a strategic advantage in promoting LPG/C use, both economically and energetically. Analyzing international experiences, particularly in Turkey, Italy, and Poland, shows that LPG/C success relies on strong incentive policies, well-developed infrastructure, and effective awareness strategies.

In Algeria, although significant progress has been made in infrastructure and vehicle conversion, several obstacles still hinder LPG/C expansion. These challenges include the initial conversion cost, insufficiently attractive financial incentives, and regulatory constraints limiting access to underground parking. Additionally, motorists' mixed perceptions remain a barrier to its widespread adoption.

To optimize LPG/C expansion and establish it as a genuine alternative to conventional fuels, several strategic measures must be implemented. Improving the distribution network is a priority, including mandating LPG/C pumps in all new service stations and strengthening public-private partnerships. More attractive financial incentives, such as increased subsidies and easier payment options for vehicle conversion, could also accelerate adoption.

Furthermore, a reinforced communication and awareness strategy is crucial to democratizing LPG/C use and dispelling misconceptions about its safety and efficiency. Integrating technological advancements, such as developing optimized LPG/C engines and improving conversion systems, could also enhance its appeal.

From an environmental and energy perspective, the widespread adoption of LPG/C could play a key role in Algeria's energy transition. By reducing pollutant emissions and easing pressure on hydrocarbon resources, this fuel represents a relevant intermediate solution for more sustainable mobility. However, its development must be accompanied by a long-term vision that also integrates renewable energy and transport electrification.

In summary, LPG/C represents a strategic opportunity for Algeria, but its growth will depend on the commitment of public authorities, economic players, and civil society to a bolder and more inclusive energy

policy. With an integrated and concerted approach, LPG/C could become a key driver for sustainable mobility and enhanced energy security.

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