

**Report On**  
**Sustainable Procurement in LPG Industry**

**By**

**Name: Abdullah Al Mahadi Rahat**

**Student ID: 19282005**

**An internship report submitted to the BRAC Institute of Governance and Development (BIGD) in partial fulfillment of the requirements for the degree of MASTERS IN PROCUREMENT AND SUPPLY MANAGEMENT (MPSM)**

**BRAC Institute of Governance and Development (BIGD)**  
**Brac University**  
**November 2022**

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## **Declaration**

It is hereby declared that

- i. The internship report submitted is my/our own original work while completing degree at Brac University.
- ii. The report does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
- iii. The report does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
- iv. I/We have acknowledged all main sources of help.

### **Student's Full Name & Signature:**

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**Abdullah Al Mahdi**  
Student ID: 19282005

### **Supervisor's Full Name & Signature:**

---

**Masud Akther Khan**  
BRAC Institute of Governance and Development (BIGD)  
BRAC University

## Letter of Transmittal

Masud Akther Khan

BRAC Institute of Governance and Development (BIGD)

BRAC University

66 Mohakhali, Dhaka-1212

Subject: Submission of report on ‘Sustainable Procurement in LPG Industry’

Dear Sir,

With due respect, I would like to take the privilege to submit my report entitled ‘Sustainable Procurement in LPG Industry’ as a prerequisite to fulfill my Master’s degree in Procurement and Supply Management (MPSM), BIGD, BRAC University.

I’ve tried my best to make the report as concise and thorough as possible while still including the necessary details and possibilities. I am positive this report will best satisfy the requirements of an academic paper.

Sincerely yours,

---

Student Full Name: Abdullah Al Mahdi

Student ID: 19282005

BRAC Institute of Governance and Development (BIGD)

BRAC University

Date: November 14, 2022

## **Non-Disclosure Agreement**

This agreement is made and entered into by and between United Aygaz Lpg Limited and the undersigned student at Brac University.

Dr. Tafannum Parvin.  
Procurement manager,  
Procurement.  
Archroma Int Ltd.

Abdullah Al Mahdi  
ID: 20282005  
Brac University

## **Acknowledgement**

I'm thankful to Allah for giving energy finishing this paper. The respected academic supervisor, Masud Akther Khan, who helped me in every manner to finish the study, is also someone I would love to articulate my thankfulness to. I also want to express my thankfulness to Dr. Tafannum Parvin, my respected supervisor at work, who occasionally gave me advice. While researching and writing this paper, I learned a lot in-depth information that has improved my understanding of the issue. I'm appreciative of the management at United AYGaz Ltd. for giving me this chance to grow.

## **Executive Summary**

This report illustrates the influence of environmentally friendly supply management and acquisition methods within the LPG sector. It emphasizes their significance within the national economy, and the associated standards that affect various aspects of the industry's functioning, strategic development, and commitment to sustainability. Moreover, this study outlines how the LPG industry in Bangladesh orchestrates its supply chain and procurement processes in alignment with consumer demands, market fluctuations, and other variables. To enhance its present operational effectiveness and efficiency, the report concludes by offering optimal recommendations and actionable measures.

**Keywords:** LPG industry; sourcing & procurement and supply management; sustainability.

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## **List of Acronyms**

LPG	Liquefied petroleum gas
CAGR	Compound annual growth rate
TCF	Trillion cubic feet
WLPGA	World LP Gas Association
GCC	Gulf Cooperation Council

# **Chapter 1**

## **Introduction**

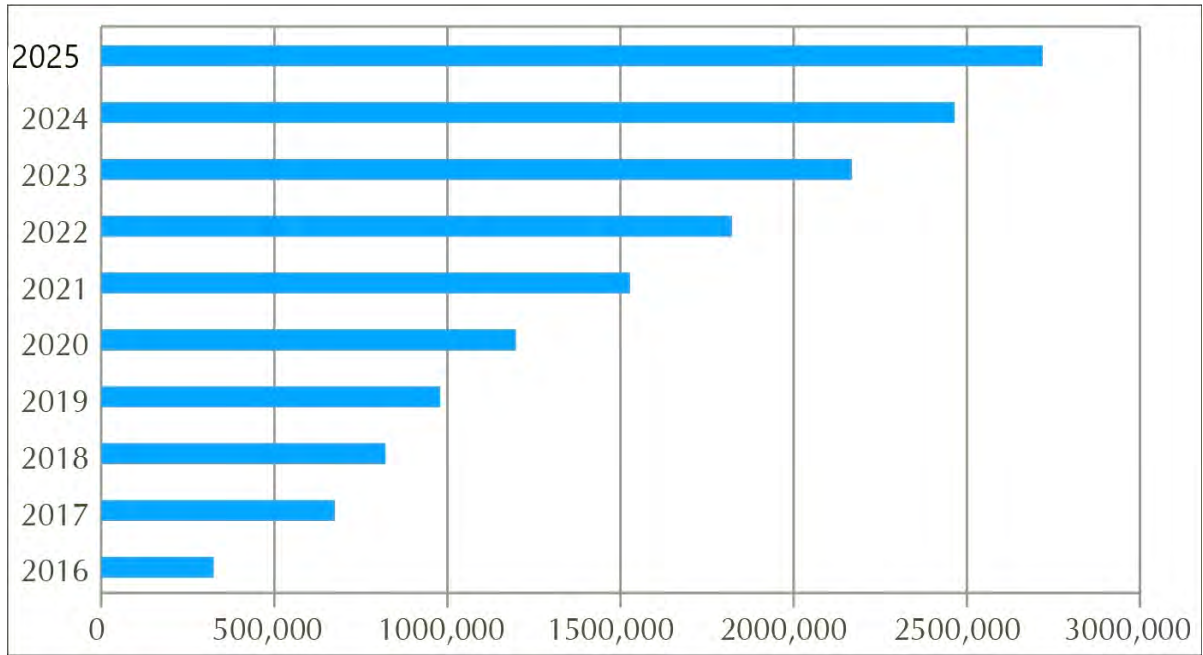
### **1.1 Background of LPG Industry**

The LPG market had a value of \$129.17 billion in 2021. It is projected to grow significantly to \$211.96 billion by 2028, exhibiting a Compound Annual Growth Rate (CAGR) of 7.3% during the period from 2021 to 2028. The global impact of COVID-19 has been remarkable, with the demand for LP gas not showing any positive trends amid the global pandemic. In 2020, the global market for LPG witnessed a decline of -2.22% compared to previous years, as reported by the WLPGA.

LPG possesses easy storage characteristics, making it a highly portable fuel option and a versatile energy source for businesses situated in remote locations. Its eco-friendliness further positions LPG as a preferred choice over other fossil fuels. The adoption of LPG could have a positive influence on the automotive sector, addressing the increasing demand for environmentally friendly fuels. The primary driving force behind many governments' aggressive promotion of auto gas and other alternative fuels is environmental concerns.

### **1.2 Bangladesh LPG Industry**

Around 700,000 metric tons of LPG were imported and distributed in the domestic market in 2017, which nearly doubled compared to the previous year, 2016. The estimated import quantities and their corresponding growth are depicted in the chart below. Presently, the market comprises approximately 50 LPG license holders. Currently, 23 LPG stations have been constructed, and plans are in place for the construction of an additional 16 stations. Suppliers are rapidly expanding their operations to meet the country's increasing demand for LPG.



*Figure 1: Yearly LPG consumption by Bangladesh*

However, a major challenge faced by LPG businesses in Bangladesh is establishing a dedicated customer base that is loyal to a particular brand. The market is predominantly influenced by dealers who largely benefit when prices decrease. Customers have minimal influence in determining the choice of brand.

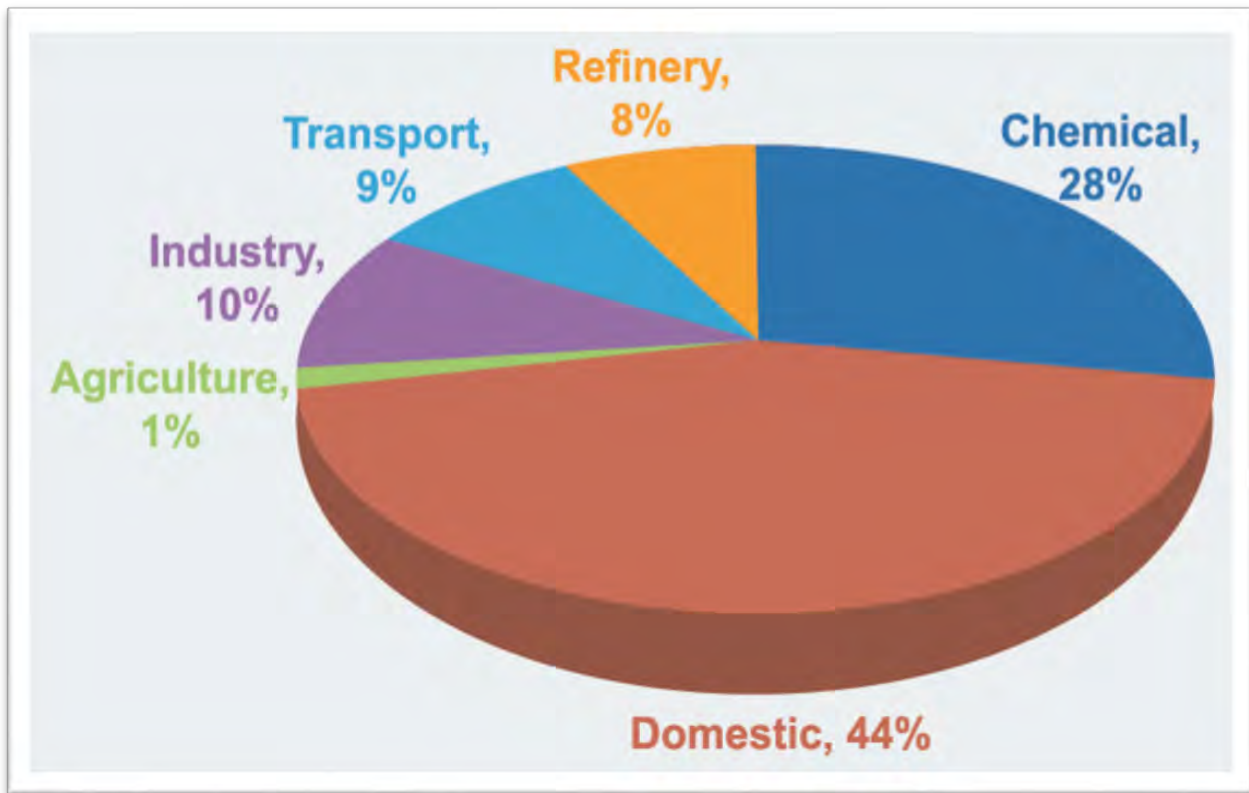


Figure 2: LPG consumption ratio by sector in Bangladesh

Here, the real-time information as my knowledge cutoff date is September 2021. However, I can give you some general information about the LPG industry in Bangladesh up to that point.

As of my last update, the LPG industry in Bangladesh was experiencing significant growth. The government of Bangladesh had been promoting the use of LPG as a clean and convenient cooking fuel to reduce reliance on traditional biomass fuels like wood and crop residues. This was part of a broader effort to improve air quality, reduce deforestation, and provide a more sustainable energy source for the population.

Key points regarding the LPG industry in Bangladesh up to 2021 included:

**Increasing Consumption:** LPG consumption in Bangladesh was on the rise, driven by government initiatives and increased consumer awareness of the benefits of LPG over traditional fuels.

**Market Players:** Several local and international companies were operating in the LPG sector, supplying LPG cylinders to consumers.

**Regulation:** The government had established regulations and standards to ensure the safety and quality of LPG products.

**Subsidies:** The government offered subsidies on LPG to make it more affordable for low-income households.

**Infrastructure Development:** There were ongoing efforts to expand the distribution infrastructure for LPG, including the construction of LPG terminals and bottling plants.

To get the most up-to-date information on the LPG industry in Bangladesh, I recommend checking recent news articles, government reports, and industry publications or contacting relevant government agencies or industry associations.

## **Chapter 2**

### **Procurement & Supply of LPG**

#### **2.1 Procurement of LPG**

LPG finds utility as a fuel in agricultural, residential, and commercial operations. However, its applications extend far beyond these domains. The consumption of LPG has been on the rise due to its affordability and efficiency, coupled with its significantly lower carbon footprint. Notably, the United States stands as the primary producer and distributor of LPG. The most commonly encountered forms of LPG are propane and butane gases. According to a procurement market intelligence report, the global market for propane gas and butane gas is anticipated to experience growth rates of 3.1% and 2.8%, respectively, during the projected period.

#### **2.2 Supply chain of LPG**

There are seven sequential steps outlined as follows:

- i. Production – The process initiates from gas and oil wells.
- ii. Upstream Transportation – Large quantities are transported through cargo vessels, railways, and pipelines.
- iii. Refining Process & Storage – In oil refineries, LPG is extracted and purified from crude oil.
- iv. Downstream Transportation – Refined LPG is transported to markets using ships, trains, trucks, and pipelines.
- v. Bottling & Storage – Storage of LPG occurs in both bulk depots and individual gas bottles.
- vi. Distribution – LPG is distributed to end consumers through bulk storage tanks and

delivery trucks.

vii. LPG End Users – Among various categories of end users, including residential, commercial, and agricultural consumers, LPG finds its usage.

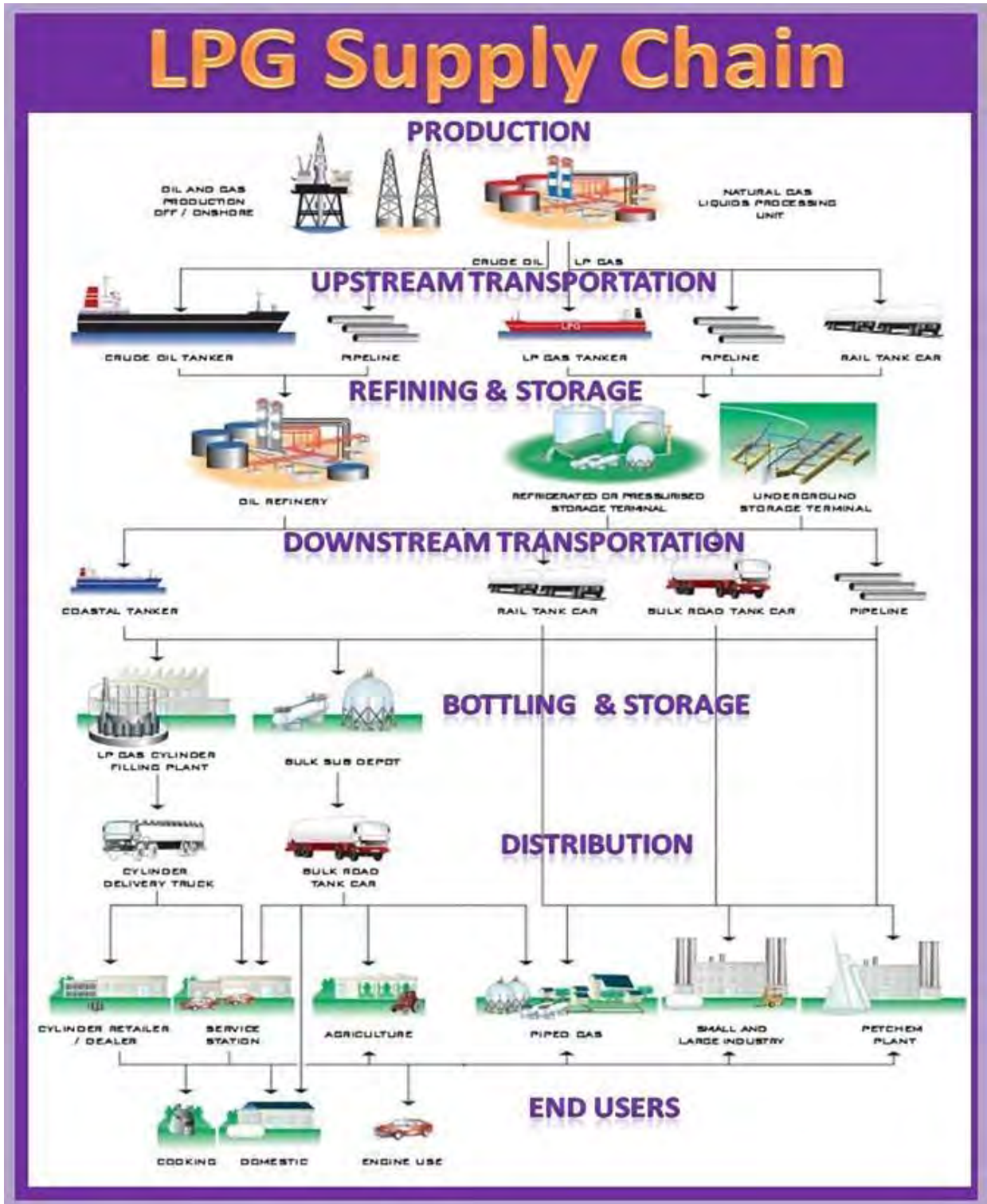


Figure 3: LPG supply chain flow chart



## **2.3 Diversity in Customer Category and Distribution Method**

The initial phase of the market is primarily characterized by the dominance of household-sized LPG cylinders, which predominantly operates within the retail business-to-consumer sector. As the market expands and diversifies, a new category known as business-to-business emerges, especially with the involvement of LPG in agricultural and industrial applications. Business clients typically have more intricate energy requirements tailored to their corporate needs. The rise in industrial LPG demand necessitates on-site bulk storage solutions that comply with local safety regulations.

The larger cylinders commonly have a capacity of 45 to 50 kg. There could be a demand for smaller cylinder sizes driven by the leisure sector's desire for more ergonomic, lightweight, and convenient options. Retail customers might have more flexibility to choose from different providers, be more mobile, and actively seek the best deal for a gas cylinder. This leads to increased competition among suppliers and higher instances of customers switching between suppliers.

In major urban areas, the market segment is approaching saturation, particularly in cities. Urban residential adoption levels might be as high as 70%. This situation presents both opportunities and challenges. The challenge is the growing public concern regarding the safety of LPG distribution and usage. With increased LPG utilization, there's an elevated risk of improperly filled or poorly maintained cylinders causing accidents. On the positive side, established LPG marketers could leverage their strong customer base in metropolitan areas to facilitate the wider expansion of LPG adoption in rural regions from financial and operational perspectives.

## 2.4 Challenges in Distribution Channel in Bangladesh LPG Market

Certainly, please proceed with discussing the major challenges in the market that you'd like to address:

- **Cross Contamination:** This poses a growing threat to the LPG sector. Illicit traders employ unauthorized methods to transfer gas from one cylinder to another, leading customers to experience weight loss, discomfort, and a false perception that the gas has been replenished. These situations can contribute to hazardous gas leaks and explosions. As stakeholder confidence wanes, legal participants in the market might curtail or cease investments in cylinders, ultimately compromising human well-being and safety.
- **Dominance of Distributors & Retailers:** Ultimate consumer prices are heavily influenced by distributors and retailers. LPG companies engage with major traders, and the pricing often hinges on a range of factors, including supply limitations, operational costs, and trends in cost of production.
- **Distribution Delays Due to Infrastructure Gaps:** Inadequate infrastructure leads to delays in distributing products through the channels to end customers.
- **Adverse Influences:** Various negative factors, such as transportation costs, lack of skilled personnel, optimal storage sites for LPG cylinders, and other challenges, impact the industry.
- **Unseen Forces and Bureaucratic Complexities:** Undisclosed factors and bureaucratic intricacies can further complicate the landscape.

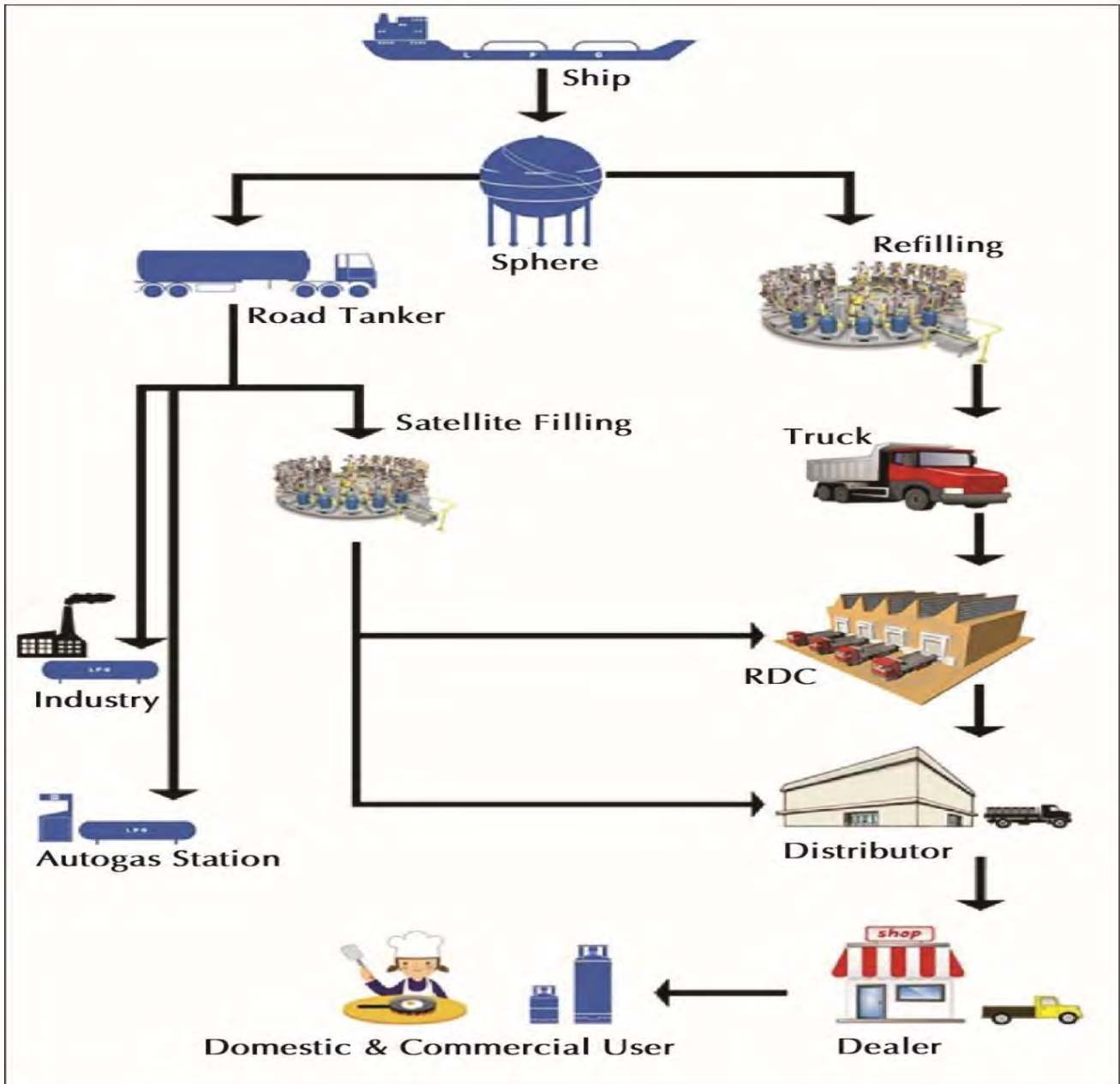


Figure 4: LPG distribution channel by private companies

The distribution of LPG (liquefied petroleum gas) in the Bangladeshi market has faced several challenges. Here are some common challenges associated with the distribution channel in the LPG market in Bangladesh:

**Infrastructure Development:** Establishing the necessary infrastructure for LPG distribution, including storage facilities, bottling plants, and transportation networks, can be costly and time-consuming. The development of such infrastructure is often a key challenge, particularly in rural or

remote areas.

**Supply Chain Logistics:** Ensuring a reliable and efficient supply chain to transport LPG from production facilities to distribution points can be challenging. Poor road conditions and transportation issues in certain regions may lead to delays and supply chain disruptions.

**Safety Concerns:** Ensuring the safe handling and transportation of LPG is paramount. Training personnel and implementing stringent safety measures are crucial. Accidents related to LPG transportation and storage can have severe consequences.

**Price Control and Subsidies:** The government of Bangladesh has historically provided subsidies to make LPG affordable for consumers. Maintaining a balance between subsidization and market dynamics can be challenging and may impact the sustainability of the distribution channel.

**Regulatory Compliance:** Compliance with government regulations and standards for the LPG industry is essential. Maintaining the proper licenses, permits, and safety standards can be complex and time-consuming.

**Market Competition:** As the LPG market in Bangladesh has grown, competition among distributors and suppliers has increased. This can lead to price wars and the need for companies to differentiate themselves in terms of service quality and product offerings.

**Consumer Education:** Many consumers in Bangladesh were previously using traditional fuels like wood or crop residues for cooking. Educating consumers about the benefits of LPG and proper usage is an ongoing challenge. This includes promoting the safety and environmental advantages of LPG.

**Documentation and Record-Keeping:** Maintaining accurate records for inventory, sales, and distribution can be a logistical challenge, particularly for companies with extensive distribution networks.

**Bottleneck at Retail Outlets:** At times, there can be bottlenecks at retail outlets due to high demand, especially during festivals or peak cooking seasons. Distributors may face difficulties in meeting this surge in demand promptly.

**Sustainability and Environmental Concerns:** The environmental impact of LPG usage, such as carbon emissions, is a growing concern globally. Ensuring that LPG distribution and consumption align with environmental sustainability goals can be a challenge.

## Chapter 3

### Developing Sustainability in LPG market

#### 3.1 Problems Arising to Grow a Sustainable LPG Market:

The pursuit of a sustainable LPG market is met with several challenges that must be addressed to ensure the industry's responsible growth. Here are some key issues:

- 1. Balancing Sustainability and Profit:** Sustainable growth demands balancing economic prosperity with environmental responsibility. The challenge lies in maintaining profitability while adopting environmentally friendly practices throughout the LPG supply chain.
- 2. Ensuring Environmental Sustainability:** LPG is touted as an environmentally friendly fuel, but challenges persist in managing its impact. Adhering to strict handling, storage, and usage protocols is crucial to prevent environmental harm, especially as LPG markets expand.
- 3. Unlawful Practices and Safety Concerns:** As the LPG industry grows, unauthorized individuals may enter the market, engaging in illegal activities such as cylinder refilling without adhering to safety regulations. This poses risks to consumers, compromises safety procedures, and harms legitimate businesses. The illegal transfer of gas between cylinders exacerbates this issue.
- 4. Impact on Stakeholders:** Unlawful activities negatively impact all stakeholders in the LPG ecosystem, including legitimate LPG companies, consumers, and regulatory bodies. The reputation of the industry suffers, and consumer trust diminishes due to safety concerns.
- 5. Compliance with Safety Standards:** International safety regulations require periodic cylinder testing and prohibit the filling of damaged or expired cylinders. Ensuring compliance with these standards is essential to prevent gas leaks and explosions caused by improper cylinder usage.
- 6. Proper Cylinder Handling:** Improper cylinder handling, such as overfilling, can lead to gas leaks and explosions. Without the right tools and techniques, the risks of mishandling cylinders increase, underscoring the need for strict adherence to best practices.
- 7. Closing the Loop:** Illegal activities disrupt the closed loop system of LPG distribution; wherein legitimate stakeholders benefit from a well-regulated supply chain. Unauthorized practices erode the advantages of this system, harming legitimate businesses and consumers.
- 8. Consumer Education:** Educating consumers about safe LPG usage is critical. Ensuring that consumers understand the proper handling, storage, and usage of LPG can prevent accidents and ensure their safety.
- 9. Law Enforcement and Regulation:** Effective enforcement of laws and regulations is crucial to curbing illegal activities in the LPG industry. Strong regulatory oversight and strict penalties for unlawful practices are needed to deter violators.

In summary, the establishment of a sustainable LPG market requires the resolution of issues concerning safety, adherence to regulations, educating consumers, and combating illicit practices. Overcoming these hurdles is fundamental for the industry's lasting viability and its capacity to make a positive difference in society and the environment.

Growing a sustainable LPG (liquefied petroleum gas) market can bring numerous benefits, including reduced reliance on traditional biomass fuels, improved air quality, and environmental conservation. However, various challenges can arise in the process. Here are detailed problems that can hinder the development of a sustainable LPG market:

**Lack of Infrastructure:** Building the necessary infrastructure for LPG storage, bottling, and distribution is a substantial initial investment. This includes terminals, bottling plants, storage facilities, and transportation networks. In regions with inadequate infrastructure, this poses a significant challenge.

**Supply Chain Management:** Ensuring a smooth and efficient supply chain from the production source to distribution points is crucial. Delays, transportation issues, and disruptions can impact the availability of LPG.

**Safety Concerns:** LPG is a flammable gas, and ensuring its safe handling and transportation is critical. Accidents related to LPG storage and transportation can have severe consequences. Implementing and enforcing stringent safety measures and protocols is necessary.

**Regulatory Compliance:** The LPG industry is highly regulated to ensure safety and quality standards. Compliance with government regulations and obtaining the necessary licenses and permits can be a complex and time-consuming process.

**Subsidies and Pricing:** Governments often provide subsidies to make LPG affordable, especially for low-income households. However, maintaining a balance between subsidies and market dynamics can be challenging and may affect the sustainability of the distribution channel.

**Market Competition:** As the LPG market grows, competition among distributors and suppliers can increase. Price wars and the need to differentiate through quality and service can affect profitability and sustainability.

**Consumer Education:** Many consumers are accustomed to using traditional fuels, such as wood or crop residues. Educating consumers about the benefits of LPG and promoting safe usage is an ongoing challenge. Misuse of LPG can lead to accidents and safety hazards.

**Supply Disruptions:** External factors, such as geopolitical instability, can lead to disruptions in LPG supply. This can affect the market's stability and reliability, leading to price fluctuations and uncertainty.

**Environmental Concerns:** While LPG is considered a cleaner fuel compared to many alternatives, it still produces carbon emissions when burned. Growing environmental awareness and sustainability goals may require the LPG industry to address its environmental impact.

**Bureaucracy and Red Tape:** Navigating government bureaucracy and dealing with complex administrative procedures can be a barrier to entry and expansion in the LPG market.

**Perception and Social Acceptance:** Some consumers may be skeptical of switching to LPG due to concerns about safety, or they may be attached to traditional cooking methods. Changing these perceptions and gaining social acceptance for LPG can be a slow and challenging process.

**Bottlenecks at Retail Outlets:** During peak seasons or festivals, there can be bottlenecks at retail outlets, making it difficult to meet the surge in demand promptly. This can lead to supply shortages and consumer frustration.

**Health and Safety Regulations:** Ensuring the health and safety of workers in the LPG industry is essential. Compliance with health and safety regulations can be costly and time-consuming.

To overcome these challenges and foster a sustainable LPG market, collaboration between the government, industry stakeholders, and consumers is essential. Policymakers should work on creating a conducive regulatory environment, promoting safety and education, and ensuring a reliable supply chain. Additionally, investment in research and technology for cleaner and more efficient LPG production and consumption can contribute to sustainability.

### 3.2 The Role of Government

The primary factor that plays a pivotal role in determining the accessibility of LPG usage for both households and businesses in the short, medium, and long terms, and sustaining it over an extended duration, is the presence of sufficient and well-enforced laws and regulations.

To ensure the sustained and efficient safety of the public in the use and operations of LPG, it is imperative for governments to collaborate effectively with the industry. This partnership is essential to achieve the desired level of safety and compliance in LPG utilization.

### 3.3 The World & National LPG Association's Role

Establishing a National LP Gas Association is a significant stride toward ensuring the secure expansion of the market. For the local LPG sector stakeholders, there are several advantages to joining the World LPG Association (WLPGA), which are as follows:

**Global Industry Insights:** Membership provides an understanding of worldwide industry trends, allowing participants to stay informed about developments beyond their local context.

**Safety Best Practices:** Access to safe operational methods and business practices enhances safety in operations.

**Cross-Country Experiences:** Learning from other countries' LPG industry experiences aids in addressing similar challenges and implementing effective solutions.

**Standardization and Ethics:** Participation offers a platform to contribute to the establishment of universal standards for LPG operations, safety, ethical business practices, and technological advancements.

Maintaining close communication with the local LPG industry is vital for the government. The National LPG Association must collaborate with national regulatory bodies to ensure the formulation and strict enforcement of relevant and effective laws.

For those converting vehicles to run on LPG, establishing an authorized installer system is essential. The National LPG Association, in partnership with the government, ensures the dissemination of information regarding the local benefits of LPG. It underscores LPG's role as a clean, environmentally friendly fuel that ensures energy access for all.

### **3.4 The Role of Individual LPG Marketers**

Every LPG marketer is obligated to adhere to all relevant laws, regulations, and directives. They play a critical role in enhancing the national cylinder distribution system and market structure through their investments and operations. Promoting safety awareness, they should educate existing and potential customers about the proper and safe usage of LPG. The National LPG Association should serve as the primary communication channel between LPG marketers and the government. In cases of any deviations from the established market and cylinder distribution models, as well as the presence and activities of unauthorized market participants, it is their responsibility to promptly report such incidents to the relevant authorities.

## **Chapter 4**

### **Benefits of Sustainable LPG In Nation Energy Mix**

#### **4.1 LPG's Contribution in National Power Mix**

In an evolving market landscape, LPG holds the potential to serve as a substantial energy source for both households and businesses, catering to a considerable portion of the population. As the market undergoes transition, it becomes imperative to incorporate LPG into strategic energy planning and the national energy mix. LPG's role is not limited to the present but is poised to remain integral in the energy portfolio, even in well-developed economies. It stands as a vital and economically viable complement to energy sources like natural gas and electricity.

#### **4.2 LPG Replacement of Natural Gas**

LPG usage frequently precedes the adoption of natural gas, mainly because the establishment of LPG infrastructure is less costly and more flexible in comparison to setting up a natural gas network. This approach enables the natural gas industry to reduce expenses related to pipeline construction while concurrently optimizing profits. Typically, natural gas distribution doesn't extend to smaller towns and areas beyond major industrial hubs due to the challenges associated with expanding delivery infrastructure to remote regions. The feasibility of such expansion is often hindered by commercial considerations.



### **4.3 LPG in Electricity Cost Reduction**

Many countries, including Bangladesh, are currently focused on two critical goals: reducing electricity costs and ensuring a reliable electricity supply. LPG has emerged as a viable alternative in achieving these objectives. It can effectively replace electricity consumption in applications such as heating and cooking, offering a more economical energy source. The transition to LPG can be strategically implemented over the long term to alleviate load on the electrical load curve, or it can be part of a broader demand reduction initiative.

In this approach, LPG serves as a substitute or backup energy source, effectively reducing the strain on the electricity grid. This kind of energy switching holds substantial potential in various regions across the globe, as it offers a practical solution to both reducing electricity expenses and maintaining a steady power supply.

### **4.4 Conclusion**

While LPG constitutes a relatively small proportion of the energy mix in countries with low- and middle-income economies, its influence can be profound on significant portions of the population. This is particularly true for nations like Bangladesh. LPG competes directly with electricity and an array of other fuel sources, with notable prominence in industrial and residential sectors. Consequently, ensuring the sustainable sourcing of LPG holds global significance.

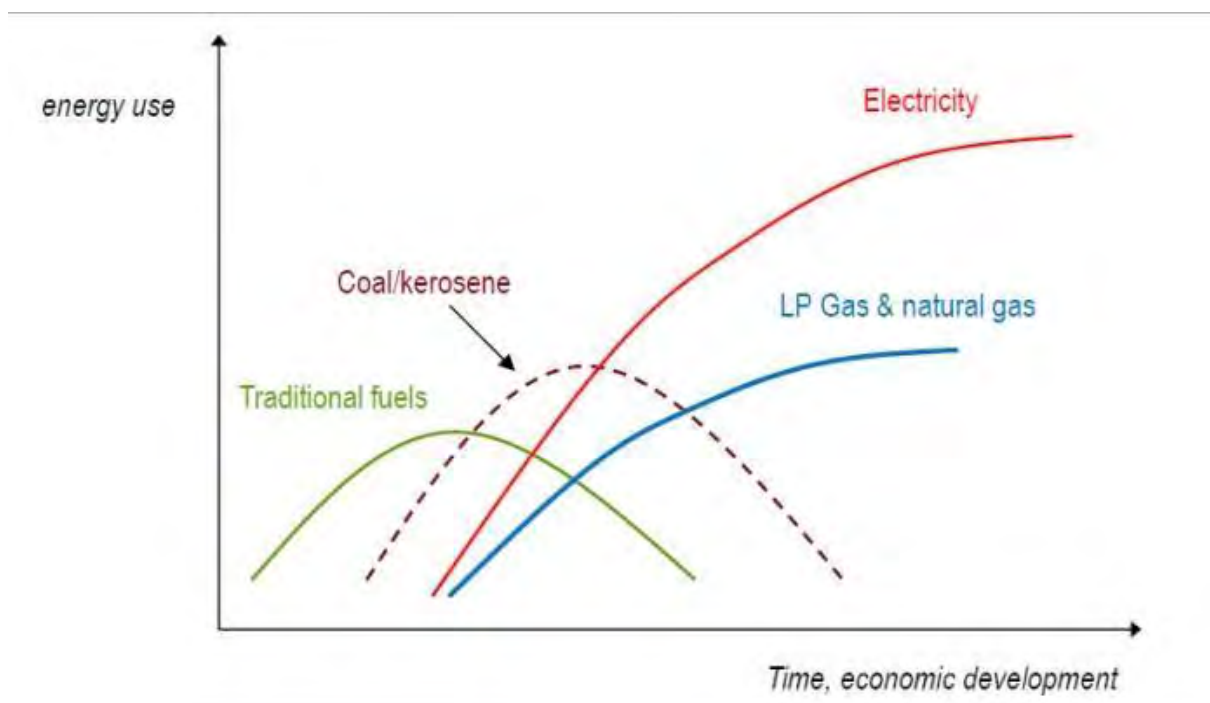
Despite being a relatively minor player in the energy sector, LPG offers several external benefits that often go unrecognized in economic considerations. These advantages contribute to its importance and positive impact on communities, especially in regions where accessibility to energy resources is a challenge.

## References

- [1] Engr. Md. Jakaria Jalal, "Sustainability Of LPG Industry In Bangladesh," March 2019.
- [2] Md. Saidul Islam, "LPG: A SUPPLY CHAIN CHALLENGE," retived 10 October  
from  
<https://epbd.com/view/details/article/MTc0Nw%3D%3D/title?q=LPG%3A+A+Supply+Chain+Challenge>
- [3] Alex Evan and Ron Kearney, "Guidelines for the Development of Sustainable LPG Markets,"June, 2015.
- [4] Tijiani Abubakar, A Study of Sustainability in the Oil and Gas Supply Chain, March 2014.

## Appendix A.

The provided diagram illustrating the progression of energy consumption within developing energy markets over time underscores the significance of LPG as an eco-friendly alternative fuel. As time advances, the diagram highlights the growing importance of LPG, which serves as a greener energy option, addressing environmental concerns and offering a viable substitute within these evolving markets.



**Fig: Generalized National Energy Use by Fuel Type as a Function of Economic Development (WLPGA)**