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College of Engineering



Department of Mechanical Engineering

A Sustainable Natural Gas Pricing Policy for the Kingdom of Bahrain

A Thesis Submitted in Partial Fulfilment of the Requirements for the Master's Degree in Engineering Management Program

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☐ **Without making any changes to the thesis.**

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Disclaimer

The findings and recommendations presented in this thesis regarding the reform of Bahrain's Natural Gas Pricing Policies are based on comprehensive research and analysis. While the proposed policy reform aims to optimise the natural gas pricing framework, it must be recognised that the outcomes will not result in an entirely ideal or flawless scenario. Rather, the reform will improve the current system. The implementation of these reforms is, however, a step in the right direction toward addressing the long-term challenges facing the country's energy sector.

The options for reform have been rigorously assessed, and the most effective and appropriate solution has been proposed. Nonetheless, any changes in pricing policy are likely to yield economic consequences. The selected reform option, however, is expected to minimise these impacts to the greatest extent compared to other potential alternatives. Various stakeholders, including the government, industries, and the general population, will feel the economic effects.

Given the increasing unsustainability of Bahrain's natural gas sales revenue, securing alternative sources of income to sustain government finances is paramount. Bahrain's ability to maintain fiscal stability in the long run will be compromised without such diversification. Should the country choose to forego gas importation, it will face a significant gas supply shortage, which would severely impact the nation's energy security and lead to even more challenging circumstances.

Conversely, if gas importation is pursued but the proposed reform is not enacted, the financial strain on the government could become insurmountable. Without adequate financial support, the government would face severe difficulties in managing the economic pressures stemming from increased energy costs and importation requirements, thus jeopardising the sustainability of the nation's energy policy.

In conclusion, while the reform proposal presented in this thesis does not promise a perfect resolution, it presents the most viable and sustainable path forward by mitigating the impact on the economy across stakeholders and securing Bahrain's energy security. This reform offers a strategic framework for the country to navigate its energy and fiscal challenges in the coming years.

Abstract

Ensuring a sustainable and economically viable natural gas pricing policy presents a critical challenge for Kingdom of Bahrain, particularly in declining domestic production and increasing reliance on Liquified Natural Gas (LNG) imports. Although natural gas has historically supported Bahrain's economic growth, the current pricing structure is no longer sustainable, necessitating urgent reform. However, research on the long-term impact of natural gas pricing reforms on Bahrain's energy security, economic stability, and industrial competitiveness remains limited.

The main objective of this study is to develop a sustainable natural gas pricing policy that balances economic feasibility, energy security and industrial competitiveness while limiting fiscal pressure on the government. The study evaluates various pricing models and policy reforms, selecting the most appropriate approach based on economic analysis and stakeholder considerations.

The study employed macroeconomic simulations and scenario analysis to evaluate pricing policy implications under varying conditions. In addition, structured interviews were conducted with key stakeholders in the energy sector, particularly those involved in the natural gas market. These interviews provided critical insights into the potential impacts associated with the reform proposals.

The findings indicate that while pricing reform will have economic consequences, the proposed hybrid model minimises disruptions while ensuring long-term fiscal sustainability. The results highlight that without reform, Bahrain's reliance on imported LNG will lead to severe financial burdens, threatening energy security and industrial growth. The study also underscores the necessity of diversifying energy revenue streams, improving energy efficiency, and integrating renewable energy to mitigate economic risks. These findings carry significant policy implications for Bahrain's energy and fiscal planning. A well-structured gas pricing reform, coupled with strategic investments in alternative energy and efficiency improvements, will enhance Bahrain's economic resilience.

This study provides a strategic framework for policymakers to implement a phased and balanced transition toward a more sustainable economy.

Keywords: Bahrain Natural Gas Market, Economic Sustainability, Energy Security, LNG Importation, Natural Gas Pricing, Policy Reform, Regulatory Framework, Renewable Energy.

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Finally, I am deeply grateful to **My Family** and **Friends**, whose encouragement, patience, and unwavering belief in me have been my most significant source of strength. Their support has been instrumental in overcoming challenges and achieving this milestone.

Dedication

This Thesis is dedicated to my Family, whose unwavering belief in me has been my most significant source of strength. Their continuous support and encouragement have made this achievement possible.

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List of Abbreviations

Abbreviation	Full Name
ADP	ALBA Distribution Point
BIM	Bilateral Monopoly
CCUS	Carbon Capture, Utilization and Storage
DDP	AL Dur Distribution Point
EDB	Economic Development Board
EIA	Energy Information Administration
EU	European Union
FERC	Federal Energy Regulatory Commission
FSU	Floating Storage Unit
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GDN	Gas Distribution Network
GOG	Gas-on-Gas Competition
GTN	Gas Transmition Network
IEA	International Energy Agency
IGU	International Gas Union
IRR	Internal Rate of Return
JCC	Japan Customs Cleared
JKM	Japan-Korea Marker
LNG	Liquefied Natural Gas
MARR	Minimum Attractive Rate of Return
MOFNE	Ministry of Finance and National Economy
MoOE	Ministry of Oil and Environment
MMBtu	Million British Thermal Units
MMScfd	Million Standard Cubic Feet per Day
MSA	Master Sales Agreement
NBP	National Balancing Point
NET	Netback from Final Product
NGSA	Natural Gas Supply Agreement
NK	Not Known

NP	No Price
NPV	Net Present Value
OPE	Oil Price Escalation
RBC	Regulation: Below Cost
RCS	Regulation: Cost of Service
RDP	Riffa Distribution Point
RPS	Riffa Power Station
RSI	Revenue Stability Index
RSP	Regulation: Social and Political
SPA	Sales and Purchase Agreement
TTF	Title Transfer Facility
TUA	Terminal Use Agreement
WACC	Weighted Average Cost of Capital
WACOG	Weighted Average Cost of Gas

Chapter One: Introduction

1.1 Introduction

This chapter introduces the study by outlining the context and rationale for reforming Bahrain's natural gas pricing policy. It addresses the country's growing reliance on high-cost LNG imports amid declining domestic gas production, resulting in the current pricing policy becoming economically unsustainable. The chapter defines the research problem, outlines the major and minor research questions, and presents the study's objectives to propose a cost-reflective, sustainable pricing policy that ensures energy, economic and fiscal security.

This chapter also establishes the foundation for understanding Bahrain's natural gas market by identifying the key stakeholders and clarifying their respective roles. It situates the study within the broader policy context, highlighting the importance of balancing the economic and social implications of pricing reforms, safeguarding industrial competitiveness, and maintaining the government's fiscal responsibility. The chapter concludes by outlining the thesis structure, providing a clear roadmap for the study's progression.

1.2 Background

1.2.1 Bahrain's Natural Gas Market Review

The natural gas market covered indigenous gas production, infrastructure, and consumption. This section provides a detailed overview of the natural gas market in Bahrain, including a review of the country's primary natural gas consumers.

The Role of Natural Gas in Bahrain's Energy Mix:

Natural gas plays a central role in Bahrain's energy mix, serving as the primary and almost exclusive source of energy for both power generation and industrial operations. The kingdom relies entirely on domestically produced natural gas to generate the needed electricity and supply the industries demands of natural gas, such as aluminium production and petrochemicals, sectors. This reliance has

enabled Bahrain to maintain a stable and affordable energy supply, but it also exposes the country to significant risks as domestic gas reserves face increasing pressure and the transition to importing LNG adds to the economic burden.

Challenges Facing Bahrain in the Natural Gas Market:

Bahrain is currently facing significant challenges in the natural gas sector as it transitions from relying on domestic gas production to the importation of LNG. One of the foremost challenges is the substantial price disparity between imported LNG and domestically produced natural gas.

The high cost of LNG, driven by global market volatility, transportation, and processing expenses, presents a financial strain on both the government and end-users. This transition poses a significant economic burden, particularly as LNG costs may need to be passed on to customers to ensure financial sustainability.

Another pressing challenge is the technical issues regarding LNG specifications, which differ from Bahrain's domestic gas. These variations necessitate costly upgrades to infrastructure and equipment for some industrial customers to accommodate the different gas characteristics. The burden of these adjustments could fall on customers, adding complexity to the already challenging transition.

Moreover, Bahrain's power generation depends on natural gas, with limited access to the GCC electricity grid as an alternative. This creates a critical dependency on gas as the primary energy source. Should there be disruptions in gas supply or challenges in LNG imports, the country would face severe energy shortages, undermining its energy security.

The combination of LNG importation risks, infrastructure upgrades, and heavy reliance on natural gas for power generation presents Bahrain's complex and pressing challenge. Addressing these issues requires strategic planning to mitigate risks and ensure a sustainable energy future.

Main Participants in Bahrain Gas Sector:

This section focuses on the operating structure of the existing natural gas stakeholders and their pertinent roles in Bahrain's energy and industrial sectors. The list covers the Ministry of Finance and National Economy (MOFNE), Ministry of Oil and Environment (MoOE), Regulator and its various subsidiaries, and major gas consumers.

A. Ministry of Finance and National Economy (MOFNE):

MOFNE is the legal owner of all natural gas resources in Bahrain. It allocates the national gas budget, receives revenues from gas sales, and funds the gas supplier operations. Although it does not directly manage gas production or distribution, it plays a central financial role and influences pricing policy through its oversight of national fiscal planning.

B. Ministry of Oil and Environment (MoOE) and Regulator:

MoOE is responsible for setting energy strategies and regulations in Bahrain. It acts as the government's policy arm in the energy sector. Regulator, under MoOE, manages the Kingdom's commercial interests across the oil and gas value chain. Regulator overseas subsidiaries, ensuring the implementation of national strategies while maintaining operational and investment efficiency.

C. Gas Supplier:

Gas Supplier operates the Bahrain Field and manages gas supply to all customers. It also handles Natural Gas Supply Agreements (NGSAs), customer connections, metering, and invoicing. It ensures uninterrupted gas delivery and supports infrastructure readiness for LNG importation and supply.

D. Natural Gas Customers:

1. Customer 1
2. Customer 2

3. Customer 3
4. Customer 4
5. Customer 5
6. Customer 6
7. Customer 7
8. Small Customers

1. Customer 1

Customer 1 is Bahrain's largest gas consumer, using it to generate electricity and desalinate water. It operates both public and independent power and water plants. Gas's reliable supply is critical to national energy security and public service delivery, making it a top priority in gas allocation.

Customer 1 Power Plants:

- Power Plant No. 1
- Power Plant No. 2
- Power Plant No. 3
- Power Plant No. 4:
  - Phase I
  - Phase II

Figures 1.1 and 1.2 illustrate Customer 1 actual gas consumption, presented monthly for 2024 and a yearly basis for the period 2022–2024, respectively. In Figure 1.1, a percentage variation relative to the month with the lowest average consumption is incorporated to emphasize seasonal fluctuations and to provide a clearer representation of the consumption balance between summer and winter months.

Customer 1 gas consumption pattern is strongly correlated with electricity demand, which exhibits distinct seasonal variability. Gas demand typically increases during the summer months (Q2 and Q3), primarily due to higher

electricity consumption associated with intensive air-conditioning usage and declines during the cooler winter months (Q1 and Q4).

While Customer 1 gas consumption exhibits pronounced seasonal variability, the monthly gas consumption for other customers remains relatively stable throughout the year.

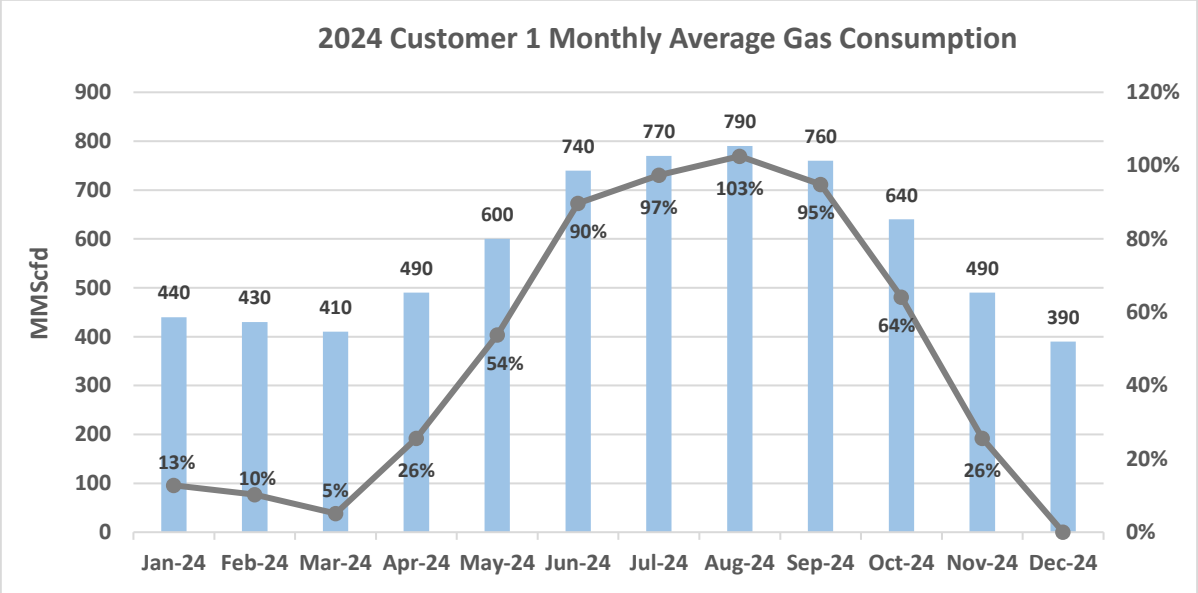


Figure 1.1: 2024 Customer 1 Monthly Average Gas Consumption

Source: Gas Supplier. (2024). Gas Data Reports.

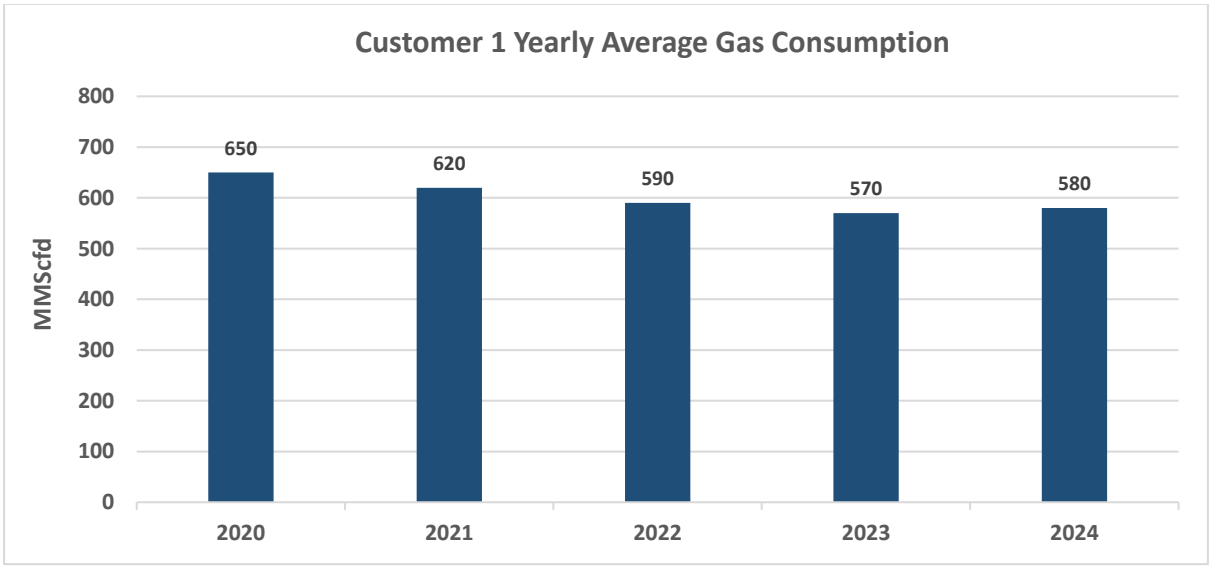


Figure 1.2: Customer 1 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

2. Customer 2

Customer 2 is one of the largest aluminium smelters in the world and a major industrial gas consumer in Bahrain. It uses natural gas in electrolysis processes and power generation for its facilities. Customer 2 operations are economically and socially significant, with a substantial export contribution and workforce. Figure 1.3 below present Customer 2 yearly average Gas Consumption from 2020 to 2024.

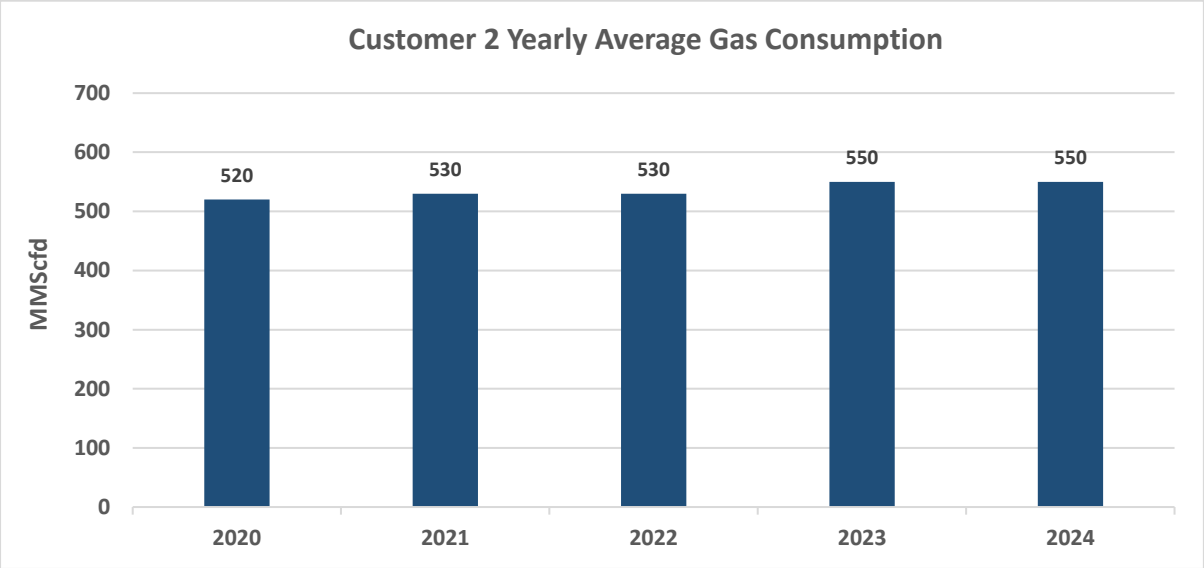


Figure 1.3: Customer 2 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

3. Customer 3

Customer 3 is responsible for oil and gas exploration, production, and field development. Utilizes natural gas as fuel for carrying out all its operations.

Figure 1.4 below present Customer 3 yearly average gas consumption from 2020 to 2024.

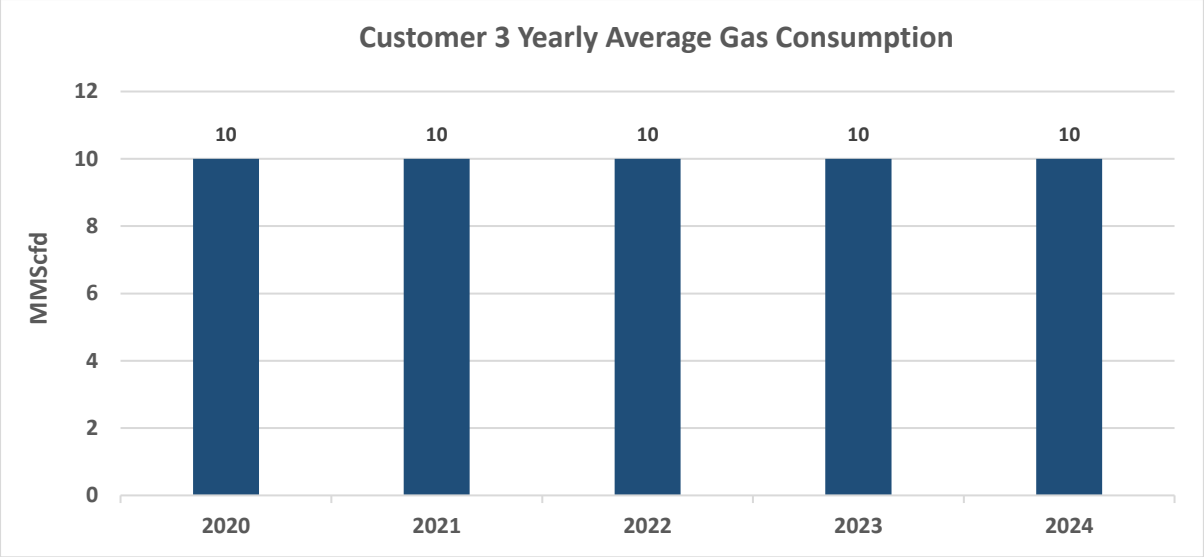


Figure 1.4: Customer 3 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

4. Customer 4

Customer 4 refines crude oil into petroleum products for domestic use and export. It is undergoing a modernisation program to enhance its refining capabilities, improve operational efficiency, and ensure long-term sustainability. Utilizes natural gas primarily as a fuel and feedstock for hydrogen production. Figure 1.5 below present Customer 4 yearly average gas consumption from 2020 to 2024.

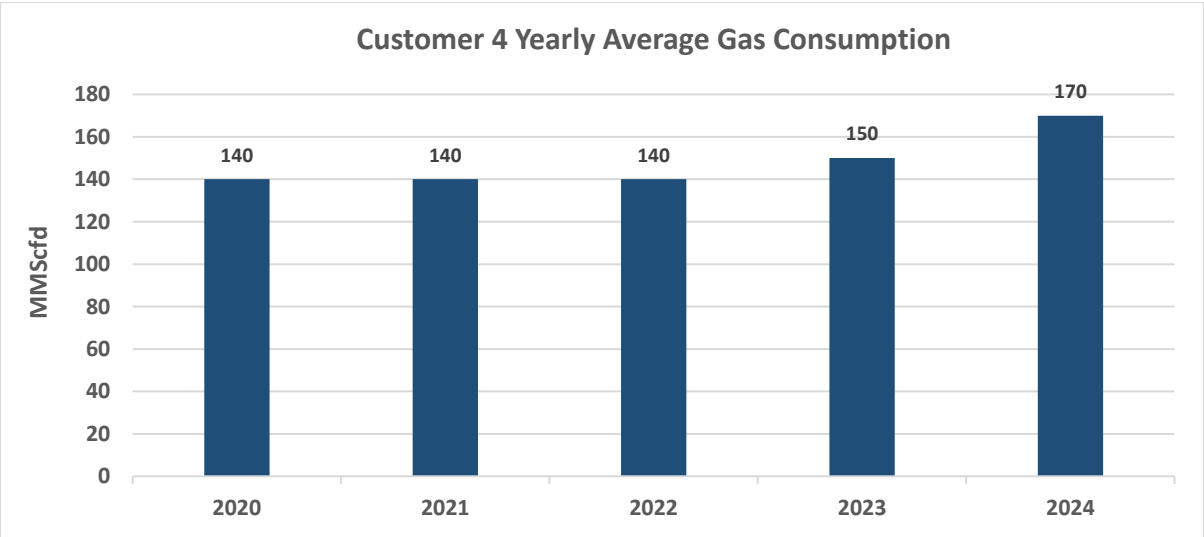


Figure 1.5: Customer 4 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

5. Customer 5

Customer 5 utilizes natural gas as feedstock for producing methanol, ammonia, and urea. It exports petrochemical products globally and contributes to Bahrain's non-oil industrial base. Its gas usage is linked more to product yield than energy production.

Figure 1.6 below present Customer 5 yearly average gas consumption from 2020 to 2024.

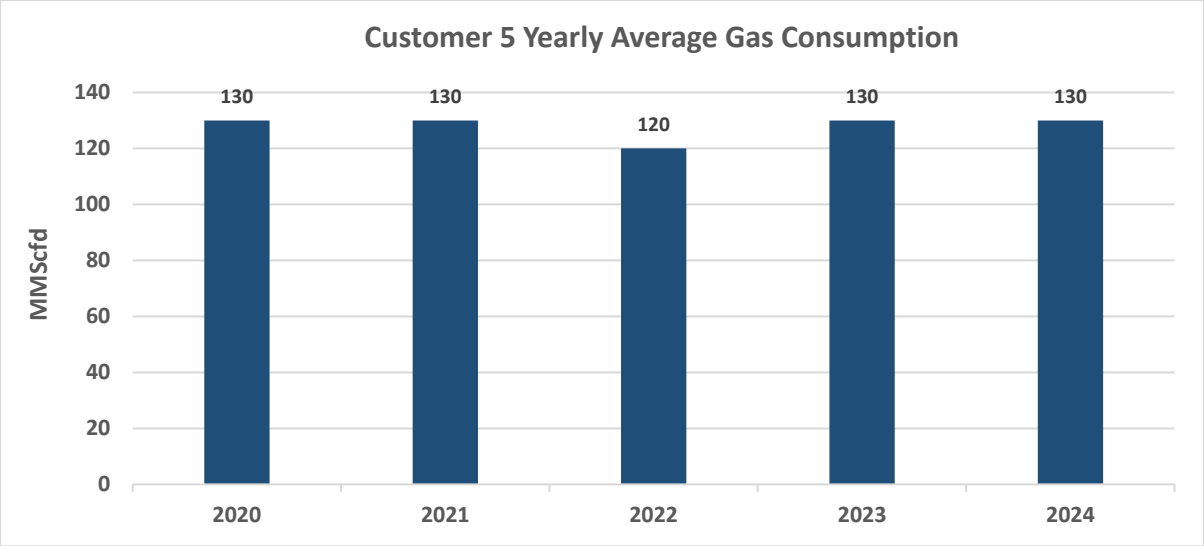


Figure 1.6: Customer 5 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

6. Customer 6

Customer 6 is a major iron and steel company in Bahrain and one of the leading pellet producers in the region. It plays a significant role in supporting the growth of the steel industry and contributes to both local and export markets.

Figures 1.7 below presents Customer 6 yearly average gas consumption from 2020 to 2024.

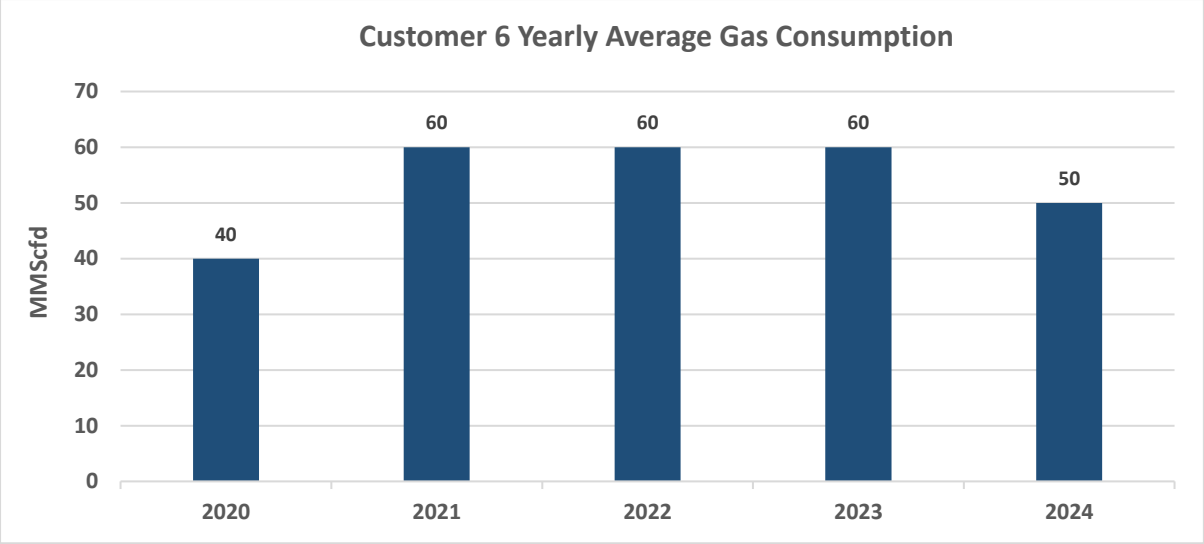


Figure 1.7: Customer 6 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

7. Customer 7

Customer 7 is an integrated steel producer, covering the full production chain from pelletizing to finished steel products. It plays a vital role in supporting Bahrain's steel industry and regional construction markets.

Figures 1.8 below present Customer 7 yearly average gas consumption from 2020 to 2024.

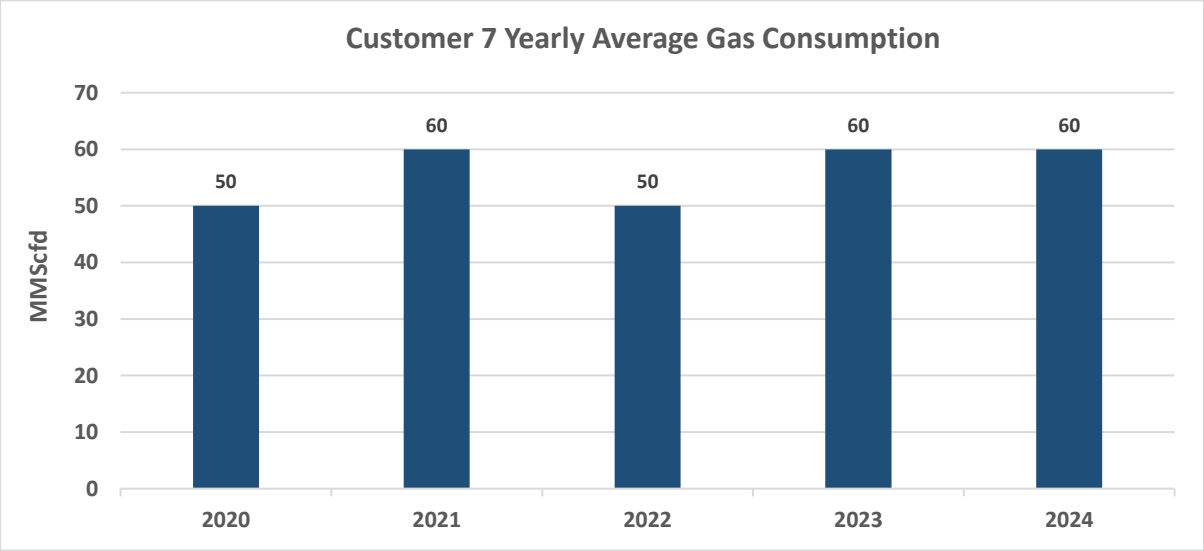


Figure 1.8: Customer 7 Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

8. Small Customers

There are approximately 20 small industrial customers in Bahrain, whose combined gas consumption represents around 2% of the country's total. These customers span a diverse range of sectors, including food production, fiberglass, textiles, cement, and other light manufacturing industries. Geographically, the majority are located in the Alba industrial area and Hidd industrial area. Additionally, a few customers operate within the Sitra Industrial Area, while the remainder are distributed across other locations in the Kingdom, collectively referred to as Other industrial areas.

Although these customers are economically diverse, their limited gas consumption means they have minimal influence on national gas pricing policies. As such, small industrial customers are not a central focus of this study. Nevertheless, they are included for completeness and to provide a comprehensive understanding of Bahrain's overall industrial gas consumption landscape.

Figure 1.9 below present Small Customers' yearly average gas consumption from 2020 to 2024.

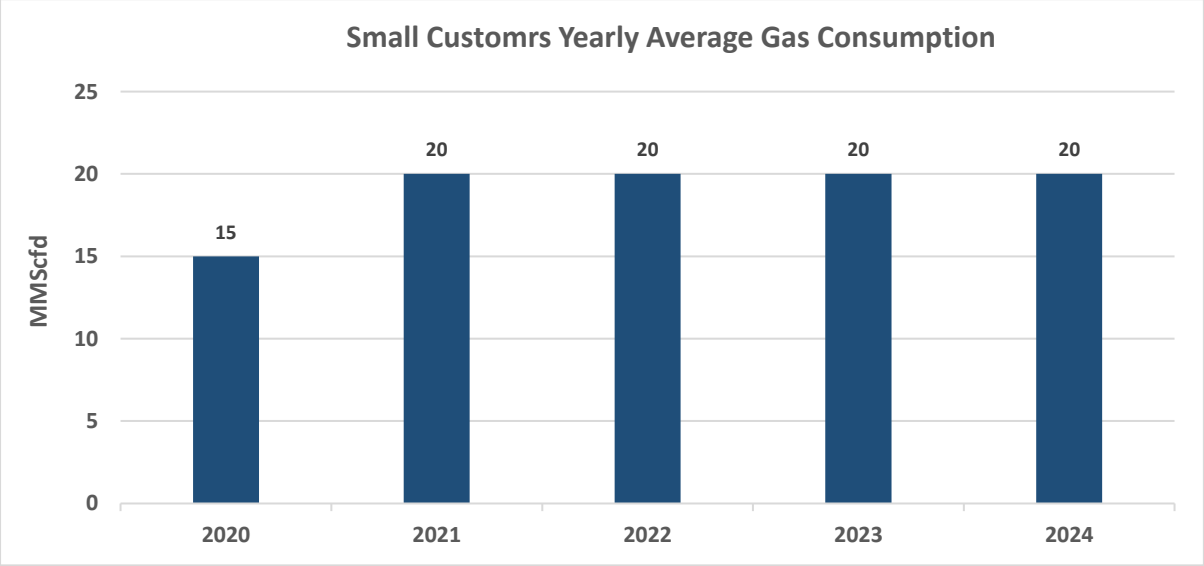


Figure 1.9: Small Customers Yearly Average Gas Consumption (2020-2024)

Source: Gas Supplier. (2024). Gas Data Reports.

1.2.2 Bahrain’s Economy

Bahrain's economy heavily depends on natural gas, as it is the primary fuel for the power plants that supply electricity to residential, commercial, and industrial sectors. Additionally, natural gas is a crucial fuel and feedstock for Bahrain's industrial sector, supporting key industries and driving economic growth (MOFNE, 2023).

Main Economic Indicators:

Gross Domestic Product (GDP) and GDP per capita are two key economic indicators that provide insights into a country's economic performance. GDP represents the total value of goods and services produced within a country over a specific period, serving as a measure of overall economic activity. On the other hand, GDP per capita is calculated by dividing GDP by the total population, offering a per- person assessment of economic output and an indicator of average income levels.

These indicators are crucial for understanding economic growth, productivity, and the overall well-being of a nation. A rising GDP indicates economic expansion, while GDP per capita helps assess income distribution and the standard of living.

A diverse and dynamic structure, with both, characterise Bahrain’s economy, with oil and non-oil sectors playing crucial roles in national development. While the oil and gas sector has historically been the backbone of Bahrain’s economy, significant efforts have been made to diversify economic activities and reduce reliance on hydrocarbons. According to the Bahrain Economic Report 2023 published by the Ministry of Finance and National Economy, the non-oil sector contributed 83.9% to Bahrain’s real GDP, underscoring the country’s commitment to economic diversification.

Figure 1.10 below represent Bahrain's 2023 GDP contribution per sector.

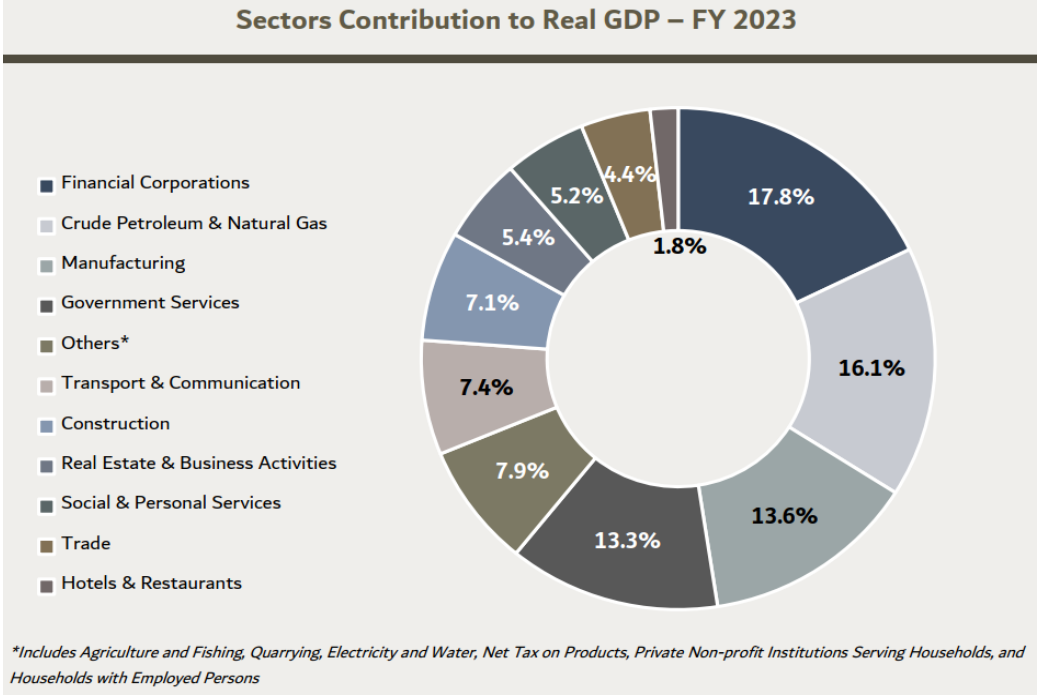


Figure 1.10: Sectors Contribution to Bahrain GDP in 2023

Source: Ministry of Finance and National Economy. (2023). Bahrain Economic Report.

According to Trading Economics, figures 1.11 and 1.12 below present Bahrain Actual GDP and GDP per Capita from 2020 to 2024.

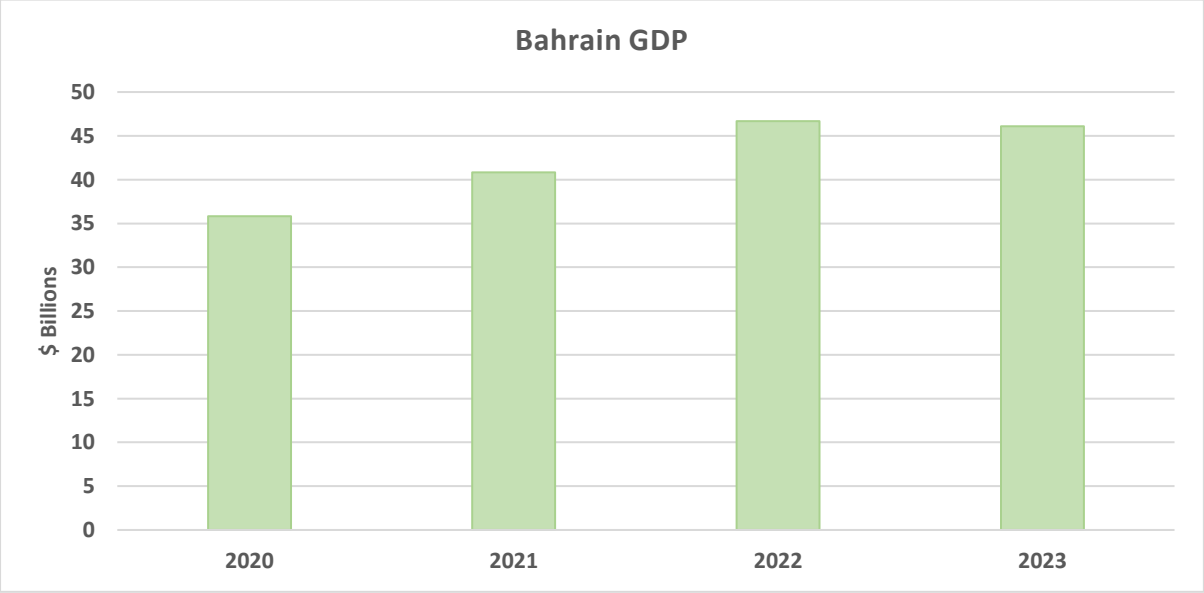


Figure 1.11: Bahrain GDP (2020-2024)

Source: Author's own construction based on data from Trading Economics (n.d.).

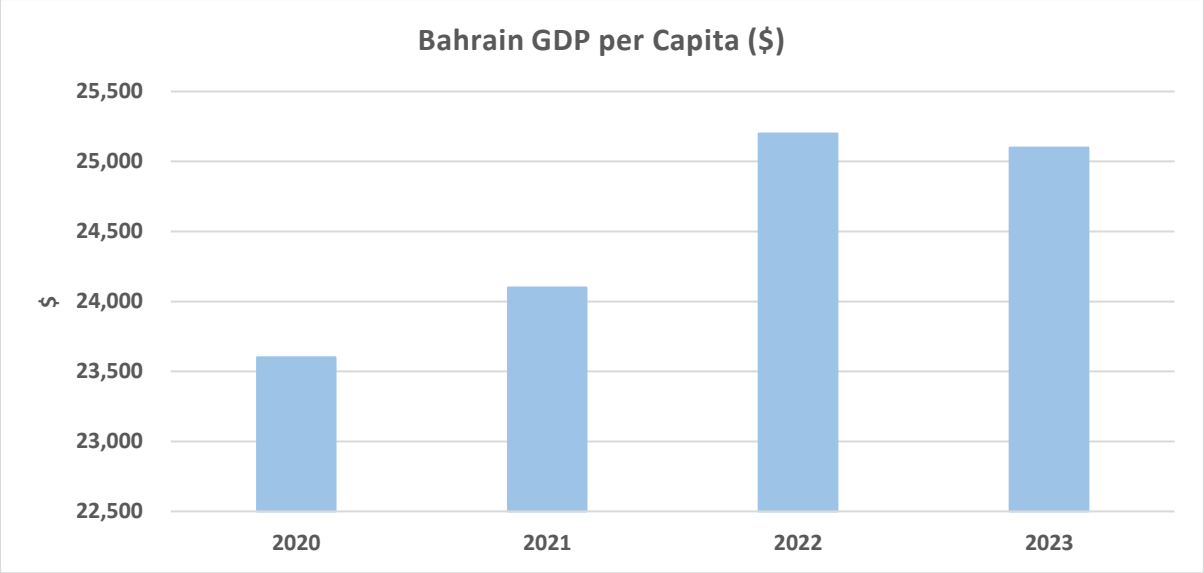


Figure 1.12: Bahrain GDP per Capita (2020-2024)

Source: Author's own construction based on data from Trading Economics (n.d.).

Bahrain's Economic Vision 2030:

Bahrain's Economic Vision 2030 aims to transform the country from an oil-dependent economy into a productive, globally competitive one driven by a thriving private sector. The vision is built on three guiding principles: sustainability, competitiveness, and fairness, all of which are critical in shaping a sustainable natural gas pricing policy.

- **Sustainability and the Transition from Oil & Gas:**
  - Bahrain's economy has historically relied on oil revenues, but declining reserves necessitate diversification. The government aims to reduce its dependence on oil and gas revenues, encouraging the private sector to drive economic growth.
  - A sustainable energy transition is crucial, making renewable energy integration is a key priority.
- **Competitiveness in Energy Pricing and LNG Imports:**
  - Bahrain must remain competitive in energy pricing while ensuring fair access to affordable energy for industries and households.

- With the transition to LNG imports, a well-structured pricing mechanism is needed to balance economic growth, industrial sustainability, and government revenue stability.

- **Fairness: Balancing Economic Growth and Social Impact:**
  - A gradual transition period is necessary to minimise the impact of gas price reforms on the consumers.
  - Major customers like Customer 1 and Customer 2 must be prioritised based on their economic and social contributions.
  - Investment in renewable energy and alternative sources should be accelerated to reduce the financial burden of energy subsidies while maintaining economic stability.

Bahrain's Economic Vision 2030 aligns with the objectives of the natural gas pricing reform, emphasising the need for a gradual, well-balanced transition that supports economic growth, energy security, and fiscal sustainability.

1.2.3 Bahrain’s Gas Supply

At present, Bahrain's primary source of Indigenous natural gas production is the Bahrain Field. Gas supplier operates high-pressure gas (Khuff Gas) and low-pressure gas (Residue Gas) Gas Distribution Network (GDN) to supply natural gas to the gas customers in Bahrain, including the Power Plants and Industries. Both khuff and residue gas are supplied to the consumers, and both have similar specifications (Gas Supplier, 2024).

Khuff Gas is received from the upstream field via Gas Transmition Network (GTN) at three main Gas Distribution Points viz. Alba Distribution Point (ADP), Riffa Distribution Point (RDP) and Al Dur Distribution Point (DDP).

From these distribution points, gas is supplied to all customers by a GDN of pipelines with strategically located Distribution Points, Valve Stations &

Metering Stations. Low-pressure Residue Gas is received only at ADP, from where it is distributed to Customer 2 and Customer 4.

The GDN is designed, operated, and maintained using the best practices to ensure the safety and reliability of the network. All the Businesses depend entirely on continuous gas supply to ensure their operations' longevity.

A GDN Enhancement Program is in place to enhance the distribution network flexibility and prepare it for importation.

Bahrain's Total Gas Consumption:

Figures 1.13 and 1.14 below present the total gas consumption in Bahrain from 2020 to 2024, including gas consumption by Customer 1, major industries, and other customers.

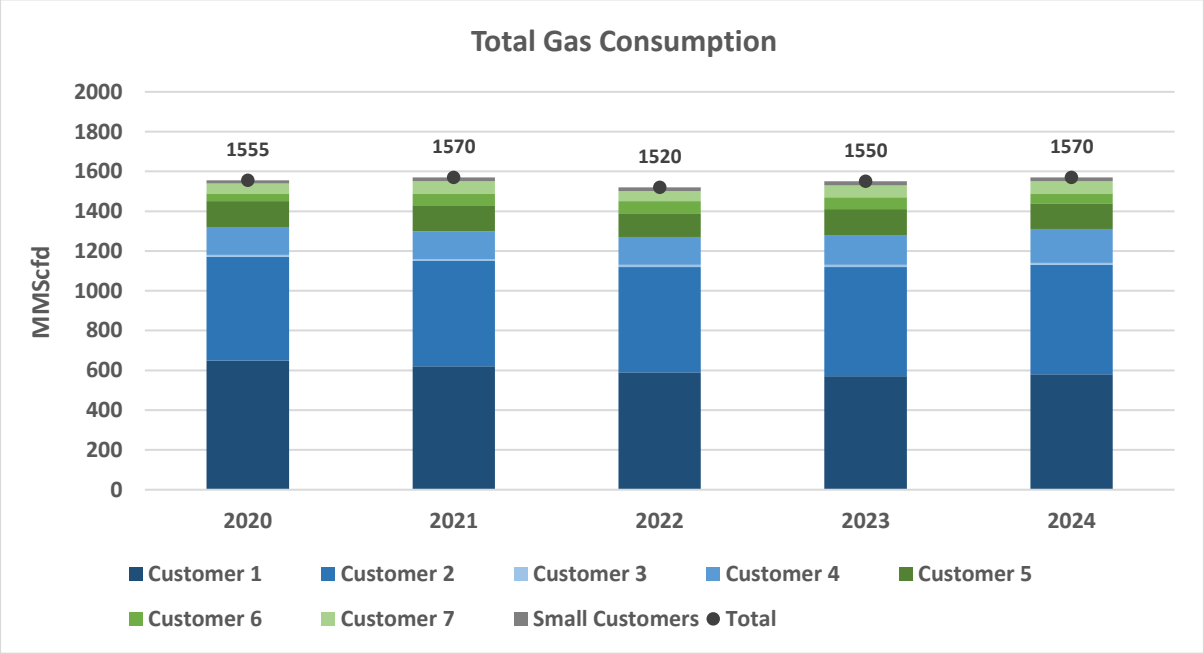


Figure 1.13: Total Gas Consumption per Customer for the last 5 years

Source: Gas Supplier. (2024). Gas Data Reports.

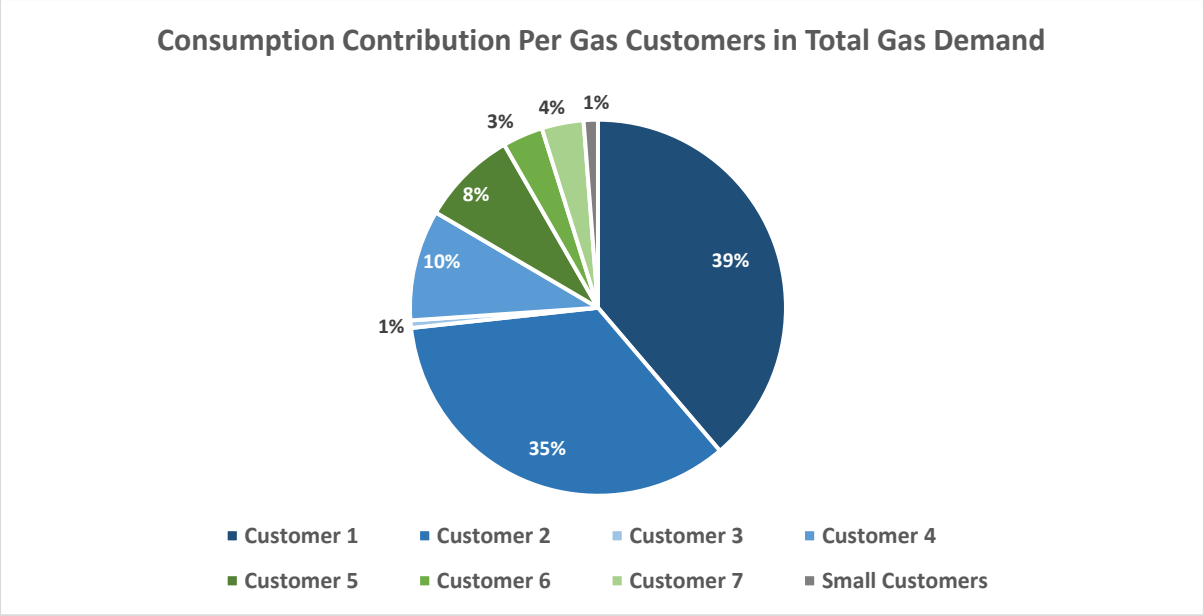


Figure 1.14: Consumption Contribution Per Gas Customers in Total Gas Demand for the last 5 years

Source: Gas Supplier. (2024). Gas Data Reports.

Natural Gas Supply Agreement (NGSA):

Gas supply to all customers is governed by a Natural Gas Supply Agreement (NGSA).

Once a gas allocation has been granted and the customer has obtained the Final Conditional Approval from MoOE, the gas contract with gas supplier is issued, and the gas supply project starts. Gas supplier is responsible for executing the NGSA with customers and physically connecting and commissioning gas supply facilities.

Once the customer is connected to the gas supply system, gas supplier remains responsible for gas metering and invoicing. However, invoices are payable directly to MOFNE rather than to gas supplier. Gas supplier is responsible for managing the complete gas distribution supply chain.

The main body of the NGSA contains clauses that are standard to all customers and details such as the initial contract gas price, delivery point, gas specifications, gas quantities, take-or-pay, etc.

Natural Gas Prices:

Table 1.1 below presents the historical natural gas prices in Bahrain, highlighting that since 2022, the price has been set at $4 per MMBtu without any increases until today. However, this table also includes reference prices for natural gas at the Henry Hub, which is a major pricing point in the United States used as a benchmark for gas traded via pipelines. These Henry Hub prices reflect the historical volatility of pipeline-based gas pricing, which fluctuates year by year in response to changes in global supply and demand dynamics.

The table illustrates how Bahrain's gas pricing has increased gradually over time, moving from $0.75/MMBtu before 2005 to $4/MMBtu by 2022. This gradual adjustment reflects the country's attempt to balance economic realities with industrial competitiveness and consumer protection.

While the current gas price remains affordable for customers, maintaining this price level is not economically sustainable in the long term especially with the upcoming shift toward LNG importation. A price adjustment is necessary to ensure the economic viability of gas supply while balancing affordability for consumers.

Table 1.1: The History of Natural Gas Prices

Period	Bahrain Gas Price ($/MMBtu)	World Gas Price (Henry Hub) ($/MMBtu) *
Before Nov. 2005	0.75	8.1
Nov. 2005 to Mar. 2007	1	7.8
Apr. 2007 to Mar. 2008	1.1	7.5
Apr. 2008 to Mar. 2009	1.2	6.4
Apr. 2009 to Mar. 2010	1.3	4.2
Apr. 2010 to Mar. 2011	1.4	4.4
Apr. 2011 to Dec. 2011	1.5	5.4
Jan. 2012 to Mar. 2015	2.25	3.8

Apr. 2015 to Mar. 2016	2.5	2.6
Apr. 2016 to Mar. 2017	2.75	2.5
Apr. 2017 to Mar. 2018	3	3.0
Apr. 2018 to Mar. 2019	3.25	2.9
Apr. 2019 to Mar. 2020	3.5	2.7
Apr. 2020 to Mar. 2022	3.75	3.2
Apr. 2022 Up to date	4	3.8

*Note: World Gas Prices are based on data from the U.S. Energy Information Administration (2024).

1.2.4 Bahrain's Energy Strategy

Regulator is spearheading the development of a national energy strategy, aiming to optimise the utilisation of national resources and pave the way for a low-carbon future in alignment with Bahrain's net-zero targets. The strategy focuses on transformation from a conventional oil and gas company into a more diversified energy entity (Regulator, 2024).

- **Energy Efficiency Improvements:** Incorporate energy-efficient technologies and practices across all operations to reduce energy consumption and optimize resource utilisation.
- **Carbon Emissions Reduction:** Collaborate with industries in the Kingdom to develop solutions such as Carbon Capture, Utilisation and Storage (CCUS) clusters and ramp up alternative energy sources, accelerating progress towards emission reduction targets (30% reduction by 2035 and Net Zero emissions by 2060)
- **Renewable Energy Integration:** Diversify the Kingdom of Bahrain's energy mix by investing in renewable energy projects and fostering partnerships to promote sustainable and clean energy solutions.

1.2.5 Liquefied Natural Gas (LNG)

LNG is natural gas cooled to approximately -162°C (-260°F), converting it into a liquid state. This liquefaction process reduces its volume by about 600 times,

making LNG an efficient option for storage and transportation over long distances where pipelines are not viable. LNG primarily consists of methane and minor quantities of ethane, propane, and other hydrocarbons. The process enables exporting countries to monetise their natural gas resources while helping importing nations diversify their energy supply and improve energy security.

The global LNG market has grown rapidly in recent years, fuelled by rising global energy demand and the shift towards cleaner energy sources. LNG is often considered a cleaner-burning fuel than coal and oil, as it produces fewer greenhouse gas emissions and air pollutants when burned. This has positioned LNG as an important component of energy transition strategies, particularly in power generation and industrial applications. Its flexibility in transportation also makes it a valuable resource for regions that lack pipeline infrastructure.

LNG operations are capital-intensive. LNG pricing differs significantly from domestic natural gas, as it is often linked to global indices such as Henry Hub in the United States or regional spot markets in Asia and Europe. Transitioning from domestic natural gas to LNG presents challenges for policymakers, particularly in pricing reforms. Countries must balance consumer affordability, sustainability goals, and the financial burden of importing LNG while ensuring that the pricing model aligns with international market dynamics (IGU, 2023).

Why do countries import LNG?

- No other source of gas (e.g., Japan, Korea) - Limited pipeline capacity, especially where demand is seasonal.
- Other sources of gas are inadequate to meet market growth (e.g., China, India) - Provides flexibility.
- Indigenous gas declining (e.g., Northwest Europe, Pakistan, Bangladesh, Indonesia, Malaysia, Thailand) - Quicker route to gas supply than pipeline gas.

- Security of supply (e.g., Poland, Lithuania, Jordan, Germany) - Means of Storing gas.

Bahrain LNG:

Bahrain LNG was established in December 2015. Bahrain LNG owns and operates an offshore LNG terminal where liquefied natural gas is received and stored. The Bahrain LNG facility has a regasification capacity of up to 800 MMScfd. LNG carriers supply LNG to the terminal, which is received and stored in the Seapeak Bahrain acts as a floating storage unit (FSU). The regasification of the LNG is done on the offshore regasification platform, with the gas being transported to the onshore receiving facility through a subsea pipeline. Onshore, the regasified LNG is transported through another pipeline to the gas delivery point at the Hidd Metering Station at the Gas Distribution Network (Bahrain LNG, 2025)

LNG Import Strategy:

In the global LNG market, importing countries commonly adopt long-term, medium-term, and short-term LNG import strategies to secure gas supply and manage market exposure. Long-term contracts are typically used to ensure a stable and predictable gas supply over extended periods, offering protection against market volatility and sudden price fluctuations. These contracts often play a significant role in supporting sectors where consistent energy availability is essential, such as power generation and large-scale industrial operations (IGU, 2023).

Short-term and medium-term contracts, on the other hand, provide flexibility to respond to changing demand patterns and global market dynamics. Many LNG-importing countries, including Japan, South Korea, and India, combine these contract types to balance supply security with adaptability to market conditions. This approach reflects international practices in LNG procurement, where supply

diversification and contractual flexibility are key factors in managing energy security and pricing risks.

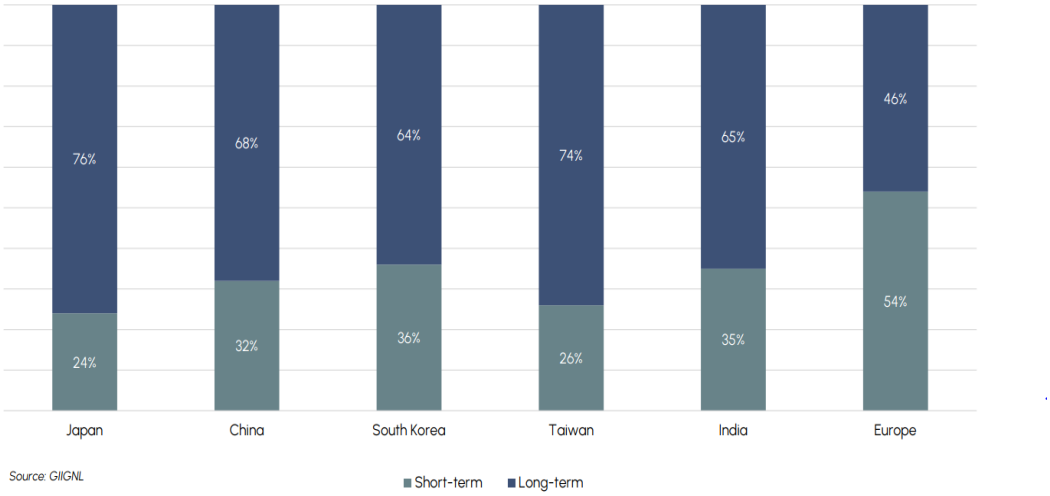


Figure 1.15: Long versus short and long-term LNG imports in 2023

Source: International Gas Union (2023). World LNG Report.

LNG Contracts:

There are several contracts for LNG. Table 1.2 below summarises some of these contracts.

Table 1.2: Some of LNG Contracts

Contract	Counterparties	Covers
Sales and Purchase Agreement (SPA)	Buyer and Seller of LNG	Terms and conditions for the sale of LNG, typically over multiple years
Terminal Use Agreement (TUA)	Regasification terminal company and capacity user	Terms and conditions for services in respect of the provision of regasification capacity (receipt of LNG, storage, regasification and send out)
Master Sales Agreement (MSA)	Prospective spot cargo(s) seller and buyer	Terms and conditions for sale of one or a few cargoes. Used in conjunction with Confirmation notice
Gas Sales Agreement	Buyer and Seller of gas	Terms and conditions for the sale of gas

Historically, most contracts are long-term (~20 years). Changes in the business environment has led to short-term contracts (e.g. up to 2 years) or medium term (3-10 years).

LNG Price Forecast:

Brent Crude Oil vs. Henry Hub Natural Gas Prices:

Brent Crude Oil and Henry Hub Natural Gas are two key benchmarks in the energy market, each playing a vital role in global commerce and industry. Brent Crude, extracted from the North Sea, is the leading international benchmark for oil prices, influencing trading decisions and market dynamics worldwide.

Conversely, Henry Hub Natural Gas, located in Louisiana, USA, is the benchmark for natural gas prices in North America, reflecting supply and demand dynamics in the continent's gas market. Both benchmarks serve as crucial indicators for investors, policymakers, and energy stakeholders, shaping strategies and decisions within the complex energy trading and investment realm.

Market Analysis Giants: Information Administration (EIA), Platts, Wood Mackenzie, and Bloomberg:

In the realm of LNG and natural gas markets, key entities such as the EIA, Platts, Wood Mackenzie, and Bloomberg play critical roles as providers of essential insights, data, and analysis. These organisations are indispensable to market participants, offering invaluable information and perspectives that shape decision-making, risk management, and market participation.

Together, these entities form an essential ecosystem of information and analysis for participants in the LNG and natural gas markets, playing pivotal roles in shaping market understanding, facilitating transactions, and driving strategic decision- making processes.

1.3 Problem Statement

The Kingdom of Bahrain is facing a critical challenge due to the natural depletion of its gas reserves and the increasing reliance on imported gas, particularly in the form of LNG. Bahrain has yet to diversify its energy portfolio with renewable or alternative energy sources.

Unlike other countries in the region, Bahrain has not significantly invested in renewable energies or nuclear power, nor does it utilise oil as a significant energy source in its power generation mix. This heavy dependence on natural gas limits the country's energy security and increases its vulnerability to gas supply and pricing fluctuations, particularly as the transition to LNG importation progresses.

Bahrain's energy needs have traditionally been met through indigenous gas production, enabling the Kingdom to maintain low natural gas prices. However, the demand for electricity generated entirely from gas is rising due to population growth. As domestic reservoirs decline, the gap between gas supply and demand is widening and must be filled by more expensive gas imports, presenting both financial and strategic risks.

The government-managed gas pricing policy, which sets prices below international market levels, has historically supported local industries and kept consumer energy costs low. However, this structure is becoming unsustainable in the face of escalating LNG import costs. MOFNE's revenue from gas sales is increasingly exposed to global market volatility, placing further fiscal pressure on the national budget.

Moreover, key domestic sectors such as power generation and industry are directly vulnerable to any rise in gas prices. The volatility in global energy markets increases these challenges, making it imperative for Bahrain to adapt its natural gas pricing policy to reflect current and future market realities.

To maintain energy security and economic stability, Bahrain must reform its gas pricing structure to align with global conditions, manage the economic risks associated with LNG importation, and retain the competitiveness of key industries.

1.4 Research Objectives and Expected Outcomes

Research Objectives:

1. To develop a sustainable natural gas pricing policy for the Kingdom of Bahrain against global price volatility and sources' availability and limitations.
2. To enable a manageable, robust transition towards a market-related pricing structure.
3. To evaluate the impact of varying natural gas sources and imported gas price volatility on all stakeholders (government and natural gas customers).
4. To provide actionable recommendations for the government based on the study's outcomes.

Expected Outcomes:

1. A sustainable natural gas pricing policy aligned with Bahrain's economic and development goals, along with a proper and clear implementation mechanism.
2. Minimize the impact of the gas price volatility and varying sources on stakeholders.

1.5 Research Questions

Major Research Question: What is the most effective approach to developing a sustainable natural gas pricing policy for the Kingdom of Bahrain that ensures long-term energy security and minimises the economic impact on all stakeholders?

Minor Research Questions:

1. What are the current cost structures and price gaps between domestic gas and imported LNG in Bahrain?
2. How can Bahrain develop a sustainable gas pricing policy that ensures cost recovery while maintaining energy affordability?
3. What policy frameworks can help mitigate government fiscal exposure due to rising LNG imports?
4. How can a pricing reform strategy support Bahrain's long-term economic and energy transition goals?

1.6 Significance of the Study

This research is of paramount importance for Bahrain as the nation transitions from relying on domestically produced natural gas to the importation of high-priced LNG. The current domestic gas pricing, which has been historically low, poses a major challenge for accommodating the significant cost disparity of LNG in the global market. Without implementing a comprehensive reform to restructure the natural gas pricing mechanism, the government will face difficulties maintaining its ability to import LNG and ensure a stable supply for its consumers.

The adjustment in natural gas pricing is not without consequences. While necessary for securing LNG supplies, a price increase will inevitably have economic implications for gas consumers and the government. This research highlights the critical need to develop a sustainable natural gas pricing policy that minimizes the financial burden on stakeholders while maintaining economic competitiveness. Such a policy is essential for supporting Bahrain's long-term economic stability and ensuring the continued operation of key sectors that rely on natural gas, including power generation and heavy industries.

The inability to secure LNG would exacerbate gas shortages in Bahrain, leading to a potential energy crisis. With power plants heavily dependent on natural gas and limited integration with the Gulf Cooperation Council (GCC) electricity grid, ensuring a reliable gas supply is critical for maintaining uninterrupted electricity for the kingdom. This research also explores the broader economic impacts, as revenue from natural gas sales has historically been a significant funding source for vital government services, such as education and healthcare. A sustainable pricing framework is necessary to sustain this revenue stream and support national development priorities.

Furthermore, the research underscores the importance of energy security and diversification. By benchmarking with global best practices, Bahrain can address its dependency on natural gas by exploring renewable energy investments and improving energy efficiency in the industrial and residential sectors. This will reduce vulnerabilities associated with LNG price volatility and supply disruptions, creating a more resilient energy system.

Ultimately, this research provides a roadmap for implementing a balanced and sustainable natural gas pricing reform, ensuring that Bahrain can meet its energy needs while maintaining economic growth and stability in an increasingly challenging global energy landscape.

1.7 Research Limitations

This study has two key limitations that affect the accuracy and depth of its findings:

1. Lack of Economic and Financial Data on Gas Customers

One of the main challenges of this study is the lack of detailed economic and financial data for gas customers. Without this information, it is not easy to accurately assess the impact of gas price increases on different customer segments.

The financial resilience of industries, power plants, and other major consumers remains unclear, which limits the ability to predict how price adjustments may affect their operations and overall market dynamics. However, this study investigated the case of Customer 2, public company, and the same can be done for the remaining customers once the data is available.

2. Gas Supply and Demand Data

Another limitation is the lack of precise figures for future gas supply and demand and, more importantly, the projected decline in gas production. A clear and accurate forecast is essential for estimating the extent of gas shortages, planning for importation needs, and determining pricing strategies.

The assumptions used in this study are based on historical trends and best estimates. However, actual figures will need to be confirmed and updated by relevant authorities to improve the reliability of the conclusions.

1.8 Structure of the Thesis

This thesis is composed of six chapters and is supported by six appendices that provide critical supplementary material. The structure is designed to guide the reader through the background, analysis, and outcomes of the research in a clear and logical progression.

- **Chapter One: Introduction**

Introduces the research context, outlines the research problem and objectives, presents the significance and limitations of the study, and provides an overview of the energy landscape in Bahrain.

- **Chapter Two: Literature Review**

Examines key theoretical foundations, international practices in gas pricing, relevant economic frameworks, and identifies gaps in current research literature.

- **Chapter Three: Research Methodology**

Details the methodological framework, including the pricing model design, stakeholder interviews, scenarios and assumptions.

- **Chapter Four: Results**

Presents the findings from model outputs, including projected gas prices, government revenues, customer impacts, and scenario-based comparisons.

- **Chapter Five: Analysis**

Evaluates the economic, fiscal, and strategic implications of gas pricing reform options. It includes supply-demand forecasting, scenario comparisons, hedging strategies, and customer impact assessments to support policy decisions.

- **Chapter Six: Conclusions and Recommendations**

Summarizes the study's contributions, evaluates the research outcomes, presents strategic policy recommendations, an implementation plan and future research areas.

- **Appendices:**

Appendix A (Expert Interview): Summarizes insights from interviews with key stakeholders, including regulator, industry experts, and gas supplier. These interviews informed model assumptions and validated the feasibility of proposed pricing reforms.

Appendix B (Customer 2 - 2023 Financial Statement): Financial performance data for Customer 2, including operational revenue and cost figures relevant to the gas pricing impact analysis.

Appendix C (Bahrain 2023 Consolidated Final Account Report): Government revenue, gas sales, and expenditure breakdown for the year 2023, sourced from MOFNE.

Appendix D (World Bank Income Groups): Classification of countries by income levels based on gross net income per capita, as defined by the World Bank, supporting the comparative economic positioning of Bahrain.

Appendix E (Implementation Plan): Outlines the phased implementation of the proposed gas pricing policy from 2025 onward, including transitional pricing stages, stakeholder engagement, policy resolution steps, and key monitoring areas such as gas price stability, economic impact, and customer feedback.

1.9 Summary

This chapter introduces the context and significance of the study, emphasizing the urgent need for natural gas pricing reform in the Kingdom of Bahrain. It outlines Bahrain's historical reliance on domestic natural gas and the economic challenges arising from increasing LNG import costs. The problem statement underscores the necessity of transitioning to a sustainable pricing policy that ensures a balance between economic growth and fiscal responsibility.

The chapter lays the foundation for the study by examining Bahrain's natural gas sector, broader economic structure, and national energy strategy. It highlights the pivotal role of natural gas in supporting key industries and power generation, while also identifying the risks and challenges posed by the shift toward LNG imports. This comprehensive background provides the necessary context for assessing and formulating a sustainable natural gas pricing policy tailored to Bahrain's evolving energy landscape.

Chapter Two: Literature Review

2.1 Introduction

Natural gas pricing reform has been the subject of extensive research, particularly in the context of transitioning from subsidized systems to market-based models. Scholars such as Coady et al. (2019) and Putriastuti et al. (2021) emphasize that aligning energy prices with market signals is essential for achieving fiscal sustainability, economic efficiency, and long-term energy security. In economies facing rising import costs and budgetary constraints, like Bahrain, reforming gas pricing is no longer optional but a necessary step toward energy and fiscal resilience. However, the global literature is largely concentrated on liberalized or resource-rich markets, offering limited relevance to smaller, import-reliant nations.

This chapter critically reviews the theoretical, conceptual, and empirical literature relevant to natural gas pricing reform, with a particular focus on its applicability to Bahrain's unique energy landscape. Foundational frameworks such as cost-recovery pricing, energy subsidy rationalization, natural monopoly regulation, and demand elasticity are examined to understand how governments structure gas markets in response to economic and political constraints. As highlighted by Putriastuti et al. (2021), the choice between full liberalization, partial regulatory oversight, or fully subsidized models depends heavily on national development goals and institutional capacity.

In addition to theory, the chapter synthesizes international experiences from countries that have implemented natural gas pricing reforms. These case studies inform the design of a conceptual framework that links macroeconomic conditions, stakeholder dynamics, and pricing mechanisms. The chapter concludes by identifying key gaps in the literature and establishes the academic foundation for the analytical modelling and policy recommendations developed in subsequent chapters.

2.2 Theoretical Framework

The theoretical foundation for this study draws from interdisciplinary principles in public finance, regulatory economics, and energy market theory. These frameworks are essential for understanding the rationale, implications, and mechanisms through which natural gas pricing reform can be developed and implemented, particularly in a small, import-reliant economy such as the Kingdom of Bahrain.

One central principle is cost-recovery pricing, which advocates that the price of natural gas should reflect the actual cost of supply, including infrastructure investment, operation, and, in the case of Bahrain, importation of LNG. This approach ensures fiscal sustainability and allocative efficiency, particularly in the face of rising LNG costs that exceed the current gas price charged to gas consumers (Coady et al., 2018). When prices do not reflect costs, the government absorbs the difference, straining public finances and distorting market signals.

Closely tied to this is the literature on energy subsidy reform, which frames energy subsidies as economically inefficient and fiscally unsustainable. According to Rentschler and Bazilian (2017), subsidies may support short-term affordability but come at the cost of long-term investment, environmental externalities, and unsustainable fiscal burdens. Bahrain's longstanding gas pricing policy has increasingly come under pressure due to LNG importation costs and global price volatility. Reforming the gas price is thus not only a matter of fiscal rationalization but also of economic modernization.

Another relevant strand of theory comes from natural monopoly regulation. Gas supply facilities exhibit natural monopoly characteristics due to high fixed costs and network economies of scale, making competitive duplication inefficient. Regulatory frameworks in such settings aim to set fair prices that cover costs while protecting consumers from monopolistic pricing. In Bahrain's case, the

government plays both the gas supplier and regulator role, necessitating transparent regulatory frameworks to maintain credibility and encourage investment (Farmer, 2022).

Furthermore, demand elasticity theory plays a critical role in assessing the potential behavioral response to pricing reform. For example, large gas consumers like Customer 1 and Customer 2 are typically price inelastic in the short run, but persistent pricing changes could affect their energy efficiency investments or long-term competitiveness (Li et al., 2022; Han et al., 2023). Understanding elasticity is key to forecasting the fiscal and economic impacts of reform.

Lastly, these economic principles are synthesized into a broader framework that links gas supply constraints, fiscal exposure, customer behavior, and regulatory intervention. The conceptual framework developed in Section 2.8 integrates these relationships and serves as a foundation for the modelling and scenario analysis presented in later chapters.

2.3 Basic Concepts

To facilitate clarity and consistency throughout the analysis, several core concepts are defined and contextualized for Bahrain's energy sector.

- **Subsidy:** A policy mechanism whereby the government offsets part of the cost of a good or service, in this case natural gas, to maintain affordability and minimize the social impact. In Bahrain, subsidies are implicit through low-price contracts that do not reflect actual LNG import costs, leading to hidden fiscal deficits.
- **Cost-Recovery Pricing:** A pricing model that ensures the revenue from gas sales is sufficient to cover the full costs of gas supply, including domestic production and importation. This is essential for maintaining fiscal sustainability without external budgetary support.

- **Natural Monopoly:** A market structure where a single gas supplier is most efficient due to high infrastructure costs, such as LNG terminal. In such cases, government regulation is needed to prevent inefficiencies and protect public interest.
- **Elasticity of Demand:** The responsiveness of consumers to changes in price. In Bahrain, demand for gas among key consumers is relatively inelastic in the short term, but prolonged price increases may influence consumption patterns over time.

These concepts underpin the natural gas pricing frameworks presented in subsequent chapters and are critical to understanding the challenges of pricing reform in Bahrain's gas sector.

2.4 Related Economic Theories

There are many studies and theories related to the subject of study. Through this group of theories, an insightful point of view can be formed about the importance of the pricing issue and its mechanisms.

Free Market Theory assumes that prices must be determined according to the forces of supply and demand without any interference from any governmental or political party, whether internationally or locally (Karacan et al., 2024).

For later theorists of the free market, it was described as a spontaneous order which results from the individual elements adapting themselves to circumstances which directly affect only some of them and which, in their totality need not be known to anyone (Farmer, 2022). In the free market, all transactions should be transparent and voluntary. (Roelof et al., 2022)

Natural Monopoly Theory assumes the necessity of government intervention and regulation to ensure the provision of the product, especially natural gas, at fair prices that suit everyone (Huseynov et al., 2023). In contrast to an unnatural

monopoly, which is so-called because of the lack of competition does not arise from any "real" fixed costs but rather from a failure of coordination between firms that act to undermine prices (Kong et al., 2024).

The large scale at which natural monopolies operate both precludes competition and when the social cost of market inefficiency is extremely high, can create justification for government ownership out of public interest (Schmid et al., 2024). The high profits that oligopolistic structures provide a strong incentive to a small group of market leaders that introduce new and successful products that replace other products (Johan, 2022).

General Equilibrium Theory is based on the assumption of visions and strategies that would price natural gas according to the requirements of the markets and the economy in general, and the occurrence of a kind of balance between the free-market theory and the natural monopoly theory (Han et al., 2023).

In general equilibrium, a competitive equilibrium is a vector of prices and a consumption bundle for each consumer, such that each consumer chooses the favourite bundle, given prices and markets clear (Gottlieb, 2022).

2.5 International Best Practices in Natural Gas Pricing Reforms

Reforming natural gas pricing is a high-stakes issue on tariffs for local and world markets. Experience in this area is available internationally, and there are three distinct models for reform: Full liberalization of the markets, a gradual model of reform, and a government-regulated model.

2.5.1 The United States Case: Liberalization of Markets and Market Opening

In the 1980s, the United States launched important reforms to liberate the natural gas market by gradually eliminating the price imposed by the government. An

important component of these reforms is the creation of valuation mechanisms focusing on the Federal Energy Regulating Committee (FERC), replacing the previous award models controlled by the Government (Kelsey & Meckling, 2018).

In addition, an important structural reform involves separating natural gas transport systems from production and distribution functions. This separation has supported the competition among companies, allowing supply and demand forces to indicate more efficiency in place and, finally, the market, eventually improving the efficiency and transparency of the market.

Therefore, market liberalisation has improved effectively by stimulating competition and encouraging investment in the entire natural gas supply chain. Customers and businesses that rely on natural gas have benefited economically from these reforms, which have also helped to stabilise long-term prices and lower overall production costs. Notwithstanding these benefits, the market's increased mechanisms have caused more volatility, particularly in real-time, indicating their susceptibility to abrupt shifts in supply and demand (Kelsey & Meckling, 2018).

2.5.2 The European Union (EU) Experience: Developing a Common Gas Market

In the past, gas market areas were usually determined by the boundaries of a Transmission System Operator network. In most EU Member States, these boundaries coincide with the Member State's geographical borders. Gas market merges have taken place within the same Member State such as Germany and France, or cross-border such as Belgium and Luxembourg (Keller et al., 2022).

Since the 1990s, the European Union has implemented a legal framework to liberate its natural gas market, promote competition among businesses and increase market efficiency. Within the framework of this transformation, regional

valuation centres such as installing Dutch transfer titles (TTF) and national equilibrium points of the United Kingdom (NBP) are established, acting as a centre throughout the natural gas price determined by supply and demand instead of long-term oil-related contracts. This change has significantly reduced the dominance of the price indexing to oil by promoting gas transactions in open markets, so the increase in gas prices is closer to real-time market dynamics (Shadrina, 2018).

The results of these reforms provide valuable information for this study. The conversion from a competitive price-based EU to the market has led to higher transparency, increased operational efficiency and long-term stability, and helped reduce consumption prices in some member countries (Bastianin, 2022).

In addition, liberalisation has improved the security of the supply by diversifying gas sources, including increasing the use of LNG. However, experience also highlights challenges such as being vulnerable to geopolitical crises, sometimes leading to price fluctuations. These lessons are primarily related to Bahrain because it plans to reform its price structure. A similar, transparent approach can help ensure the market's stability while avoiding political and social disturbances.

2.5.3 The Russian Experience: State Control with Slow Modification

The Russian experience offers a contrasting model to the liberalised approaches seen in the European Union. In Russia, the natural gas industry is primarily controlled by the State and is mainly managed by the public enterprise Gazprom. For many years, interior gas prices have been falsely inflated in a fake manner thanks to the government's support. However, since 2006, progressive efforts have been made to align local prices more closely with the international market rate. At the same time, Russia has allowed private companies to participate in

exporting LNG, even when the State's domination of the broader gas market still exists.

Russia's slow reform results highlight the limits of prolonged state control. Although the policy of improving the price progress has improved the revenue from the gas industry and contributed to the budget balance, it did not support a competitive or transparent market environment. Investing in LNG projects has increased, but the continuous dominance of public entities has hindered the development of open price mechanisms and reduced innovation and efficiency (Portela et al., 2022).

2.5.4 Argentinian Counter Reform: The Experience of Reverse Reform

Argentina provides a clear example of a reverse reform path in the natural gas sector. In the 1990s, the country liberalised its gas market, introduced competition, and attracted significant infrastructure investment. However, after an economic crisis in the early 2000s, the government brought back price controls to curb inflation and protect households. This shift reduced investment and damaged market confidence.

More recently, Argentina has started to return to market-based pricing. The government is phasing out subsidies and reintroducing competitive pricing to rebuild stability and investor trust (Kitzberger & Schuliaquer, 2022).

This experience holds important lessons. Argentina's initial liberalisation spurred investment and growth, but rolling back those reforms weakened the sector. The case highlights the risks of sudden policy changes. A gradual, consistent, communicated reform plan is essential to balance economic development and social stability.

2.5.5 Egypt’s Experience: Incremental Reform of Gas Prices

Egypt has steadily shifted from a heavily subsidised natural gas system to a market-aligned model. The government provided significant subsidies for household and industrial gas use for years. However, since 2014, Egypt has gradually reduced these subsidies, especially for large industrial users, to bring domestic prices closer to global levels.

A key step came in 2017 with the Gas Market Regulation Law, which opened the sector to private companies for importing and distributing gas. This move and the discovery of central domestic reserves like the Zohr field boosted local production and lowered reliance on imports (Ouki, 2018).

The reform outcomes have been mixed. Egypt improved its fiscal position by cutting subsidy costs and attracting new energy investment. However, higher energy prices have created challenges for consumers, especially those facing broader economic pressures.

Still, Egypt's experience supports a core argument of this research: Gradual price liberalisation backed by strong regulation and domestic production can lead to a more efficient market and long-term investment. Like in the U.S. and EU, transparency and competition help stabilise prices.

In contrast, as seen in Russia and Argentina, heavy state control can limit market growth. Linking domestic prices to global benchmarks also reduces distortions and encourages more sustainable energy use (Ouki, 2018).

2.6 Challenges Associated with Reform

Natural gas pricing reform is accompanied by several significant challenges that must be addressed through well-defined visions and strategic planning. One of the primary concerns is the social impact of rising gas prices, particularly their effect on electricity costs, which can burden households and

provoke public dissatisfaction. Political resistance also poses a significant obstacle, especially from groups that have long benefited from subsidised pricing and fear that reforms could negatively affect their economic standing. Additionally, the inherent volatility of global energy markets complicates reform efforts, as fluctuating international prices create uncertainty at the domestic level and broader economic planning. These challenges underscore the need for carefully phased reforms, accompanied by social protections and market-stabilising policies (Coady et al., 2018).

If not appropriately managed, gas price reform can be economically, socially, and market destructive. One of the most direct challenges is social and political backlash, particularly from poor and vulnerable segments and change-averse interest groups. Phased implementation of price adjustments is needed to buffer these effects, allowing sufficient time for households and industries to adapt. Besides, subsidies for low-income families can be employed to offset the social cost of increased prices. As a complement to these, public communication campaigns are crucial in mobilising support since they clarify the economic benefit of reform in the long run and the necessity of fiscal sustainability (Mohammad et al., 2024).

To achieve success, it is necessary to address market sentiment and investment problems for natural gas pricing reforms. Price stabilisation mechanisms such as strategic gas reserves or flexible pricing systems that can adapt to sudden shifts in supply and demand are needed to address price volatility risks. Diversification of energy sources also protects national markets from externalities, while promoting long-term contracts gives the consumers price certainty, which helps financial planning and operational continuity (Brehm, 2019).

On the infrastructural front, effective reform depends on the mobilisation of significant investment, which can be realised through PPPs and establishing a practical regulatory framework. Investment in physical infrastructure—pipelines,

storage, and distribution networks—is essential to ensure effective delivery and system resilience (O'Sullivan, 2018).

There is also a requirement for a balance between state control and freedom of the market. This involves establishing independent regulatory institutions to prevent monopolistic tendencies, gradually eliminating state intervention while building competitive markets, and ensuring affordable pricing for end-users. When properly regulated, a market form empowers individual choice and effective resource allocation, aligning with general economic freedom principles (Gwartney et al., 2022).

Environmental and sustainability considerations are crucial aspects of natural gas price reform, particularly about global efforts towards combating climate change. To link pricing policy to environmental goals, it is necessary to implement carbon pricing measures and introduce incentives that promote the adoption of clean energy technologies.

Additionally, promoting gas efficiency schemes can help support aggregate consumption reduction, aiding both environmental protection and economic efficiency. It is essential to ensure that gas price reforms are synchronised with general climate policies and national plans for sustainability towards achieving long-term energy and environmental objectives (Coady et al., 2018).

Successful gas pricing reform requires a balanced approach that takes into account for multiple factors including economic efficiency, social equity and market stability. By implementing gradual change, promoting competition and ensuring regulatory transparency, countries can overcome these challenges and create a more sustainable and efficient energy market (Rentschler et al., 2017).

2.7 LNG Prices

2.7.1 LNG Pricing Structures in Long-Term Contracts

Long-term liquefied natural gas (LNG) buyers and sellers desire price terms that reflect time-series market conditions. When liquid, transparent gas markets exist, such as the Title Transfer Facility (TTF) in the Netherlands, the National Balancing Point (NBP) in the United Kingdom, or the Henry Hub in the United States, contract prices will often be referenced to such indices.

In non-existent mature gas markets, oil price indexation is a common substitute. In Europe, it may take the form of fixing gas prices against oil derivative products such as fuel or diesel. In Asia, crude oil is still the principal index for LNG long-term pricing. In contrast, U.S. LNG export contracts typically draw on domestic gas prices fixed against Henry Hub.

Spot prices such as the Japan-Korea Marker (JKM) are gaining popularity in short-term LNG transactions and are also being added to long-term contracts (Ouki, 2018).

2.7.2 Asia Gas Pricing Case: Japan

Japan's experience with LNG pricing reflects a move from fixed-price contracts to oil-indexed pricing, a transition that began in the 1970s and continues to shape Asia's gas markets. The Japan Custom Cleared (JCC) price, which emerged around 1983 from earlier reliance on posted crude prices, now supports most LNG contracts, linking them to the average price of crude oil imported into Japan, a figure that tracks Brent crude movements closely (Ouki, 2018; IGU, 2023). They typically use intricate formulas to determine the monthly invoice price, making long-term contracts vulnerable to global oil market movements (IEA, 2020).

The Japan Korea Marker (JKM):

The Japan-Korea Marker (JKM) is a benchmark price assessment developed by Platts for spot physical LNG cargoes delivered ex-ship into Japan and South Korea. As these two nations represent the largest share of global LNG imports, the JKM has become a critical pricing reference for evaluating the market value of LNG from the point of origin to the destination market.

Its significance lies in providing transparency and real-time price signals in the Asian LNG spot market, complementing traditional oil-linked long-term contract pricing structures and reflecting the growing role of market-based mechanisms in global LNG trade (IGU, 2023; IEA, 2020).

2.7.3 Historical Development of Oil Price link in Europe

Historically, LNG pricing in Europe followed pipeline gas models, relying heavily on oil indexation. Prices were linked to competing fuels—mainly gasoil and fuel oil—to keep gas competitive in sectors like power generation and industrial heating. Some contracts also used alternative indices, such as coal, depending on the local energy mix.

These pricing formulas often included scheduled reviews every two to five years to account for market changes. However, this system has faced increasing pressure. In many European markets, oil products are no longer the primary competing fuels, making oil-linked pricing less relevant. The rise of traded gas hubs has introduced more transparent, market-driven pricing.

While not all European countries have developed liquid hubs, buyers increasingly demand that long-term contracts be updated with hub-based or spot pricing. As a result, price reviews have become more contentious, with many disputes moving to arbitration (IGU, 2023; IEA, 2020).

2.7.4 Brent and Henry Hub LNG Prices

LNG pricing is often structured through formula-based mechanisms that tie gas prices to major oil or gas benchmarks.

Brent LNG Prices:

One widely used model is the Brent crude oil-linked formula, represented as:

Formula (2.1): $P(LNG) = A \times P(Brent) + B$

In this equation, P(LNG) represents the price of LNG in USD per MMBtu, and P(Brent) denotes the crude oil price in USD per barrel, usually calculated as a three-month average with a one-month lag. The variable A is a negotiated constant known as the slope, often expressed as a percentage of the oil price. At the same time, B accounts for transport costs, typically ranging from $0.08 to $0.12 per MMBtu in delivered contracts. This model allows buyers and sellers to manage price volatility through oil market hedging tools.

Henry Hub LNG Prices:

In the U.S., a different approach is often used based on Henry Hub pricing. The Henry Hub-linked LNG pricing model is generally structured as follows:

Formula (2.2): $P(LNG) = 115\%\ Henry\ Hub + X$

Here, Henry Hub refers to the Henry Hub spot gas price. The 15% uplift compensates for liquefaction facilities' transport and fuel usage costs. The X component represents a fixed charge, subject to inflation adjustments, that covers the capital and operational costs of the LNG plant and includes a profit margin. While this model provides buyers with flexibility, it also requires them to pay X, even if they cancel scheduled cargoes, as a capacity reservation cost.

2.8 Conceptual Framework

This section presents the conceptual framework that integrates the various dimensions influencing the sustainability of natural gas pricing policy in the Kingdom of Bahrain. The framework is built upon the theoretical and empirical foundations discussed in earlier sections, particularly the principles of cost-recovery pricing, public finance, natural monopoly regulation, and demand elasticity. It also responds to the unique conditions of Bahrain's energy market, including its increasing reliance on imported LNG and the fiscal implications of the current gas pricing policy.

The framework serves to:

- Illustrate the interactions between gas supply dynamics, demand behavior, fiscal exposure, and pricing strategy.
- Provide a structured approach for testing policy reform options in Bahrain's unique energy context.
- Support a scenario-based analysis that evaluates the implications of pricing reform on fiscal stability, energy affordability, and economic competitiveness.

Key Dimensions:

1. **Gas Supply Sources:** Bahrain's gas supply comprises two main streams: Domestic natural gas from both Khuff and Deep reservoirs and imported LNG (with higher unit costs). The relative share of these sources influences the cost of supply, pricing volatility, and security of supply.
2. **Government Fiscal Exposure:** Under the current pricing policy, the government will bear the cost differential between the current price and the higher cost of LNG imports. This creates substantial fiscal exposure that threatens long-term budget sustainability.
3. **Customer Segmentation and Demand Elasticity:** The gas market in Bahrain is dominated by a small number of large gas consumers (e.g., Customer 1 and

Customer 2). These consumers exhibit inelastic demand in the short term, but their response to pricing reforms is critical for understanding long-term consumption patterns and potential economic and social impacts.

4. **Regulatory and Pricing Strategy:** Current pricing is uniform and subsidy-driven, but policy options under review include tiered pricing, hybrid cost recovery, or weighted average pricing. These approaches differ in how they allocate costs among customers and in their implications for industrial competitiveness and revenue sustainability.

Any reform must balance fiscal efficiency with economic competitiveness, affordability, and political feasibility. This necessitates a phased, transparent, and socially sensitive pricing transition—especially for strategic or export-oriented industries.

Integrated Conceptual Model:

The conceptual framework brings these dimensions together to show how shifts in supply sources, pricing strategies, and customer behavior interact with fiscal outcomes. It supports scenario testing between reform policies, customer response, and government revenue.

Visual Representation of the Conceptual Framework:

The visual conceptual framework synthesizes the theoretical and empirical constructs introduced in Sections 2.2 and 2.3 into an applied model that reflects the structural realities of Bahrain's natural gas market. This framework illustrates how the interlinked components of gas supply, pricing policy, customer behavior, and fiscal outcomes interact to shape the sustainability of gas pricing reform.

The Conceptual Framework integrates the following elements:

1. **Gas Supply Sources:** Includes both domestic natural gas (from Khuff and Deep formations) and imported LNG, each with distinct cost implications.

2. **Pricing Mechanism:** Captures the role of policy instruments such as uniform pricing, cost-recovery, tiered models, or hybrid approaches that influence how gas costs are allocated among customer segments.
3. **Customer Segmentation and Behavior:** Reflects the differentiated impact of pricing reforms across strategic and smaller consumers. The segment-specific demand elasticity determines the responsiveness to price changes and their potential economic impacts.
4. **Government Fiscal Exposure:** Highlights the budgetary strain arising from the gap between actual supply costs, particularly LNG importation, and the current prices charged to consumers. This element represents the central fiscal risk facing the kingdom under existing pricing policies.
5. **Policy Feedback Mechanism:** Depicts the dynamic loop through which pricing decisions affect consumer behavior and government revenues, which in turn necessitate further policy adjustments. This mechanism enables the iterative refinement of reform strategies over time.

Figure 2.1 presents the conceptual framework developed for analyzing gas pricing reform in Bahrain, illustrating the key elements that link supply sources, pricing mechanisms, customer behavior, fiscal exposure, and feedback loops.



Figure 2.1: Conceptual Framework for Gas Pricing Reform in Bahrain

Source: Author's own construction based on literature review (2025).

This framework provides a coherent foundation for the quantitative modelling, scenario analysis, and policy evaluation presented in the subsequent chapters. It ensures that the study is not only practically relevant but also anchored in robust theoretical and conceptual understanding.

2.9 Studies Related to the Natural Gas Pricing Reform

In this section, we will present some critical studies that dealt with the topic of the natural gas pricing reform mechanism, where they will be clarified, and presented through some successful experiences in some countries, as well as the studies that dealt with the obstacles and challenges facing the reform processes and mechanisms and solutions, in addition to some studies that dealt with the most important results resulting from the reform of the natural gas pricing process and its impact on the economy locally and internationally.

2.9.1 Studies on the Successful Experiences for Natural Gas Pricing Reform

A policy analysis conducted on natural gas pricing reforms in China examined whether recent regulatory changes have established an effective pricing mechanism capable of enhancing market efficiency and ensuring a stable energy supply. Using a multidimensional evaluation approach that combined economic modelling, statistical analysis, and qualitative and quantitative assessments, the study compared market dynamics before and after implementing reforms. The findings indicated that while China's reforms have improved market mechanisms by reducing price distortion and improving resource allocation, inherent transparency issues and imperfect competition remain.

The study also determined that while gradual price liberalisation enabled increased investment in the gas sector, it did not result in immediate price stability due to the government's persistent intervention. Therefore, the authors recommended improving market-based pricing mechanisms and progressively eliminating state intervention to achieve long-term stability and economic efficiency in China's natural gas market (Li, 2021).

The results also highlighted the importance of developing appropriate pricing system for China's natural gas industry, which in turn would encourage more

investment and gas supply. The study shows the need to improve the transparency of pricing, as well as the need for a regulatory environment that encourages some long-term investments in the gas sector.

In a study entitled "Free Market Economy: Is the Market or Prices Free? Theory and Evidence from the United States" by Karacan et al. (2024). The study aimed to explore the relationship between the free economic model and price increases, focusing on the US economy. The researchers seek to determine whether the free economy contributes to rising prices and what the impact of the extent of government intervention is in this context.

This study utilised an Autoregressive Distributed Lag Model to evaluate the study data covering the period of 1990–2020. Property rights, encompassing the size of government within the economy and the price levels, were covered, emphasising the US economy as a free economy model.

Liberal economics positively impacted prices, implying that the liberalisation of the economy might correlate with inflation. In addition, limiting government intervention in the economy did not have the same effect on price rises, indicating that the key role played by the government might not be the most important determinant of price levels.

This study presents a novel perspective for policymakers in the fight against price instability, which is one of the economy's main challenges. Economic liberalisation policies should be reviewed to ensure price stability because the free economy model promises a price increase.

2.9.2 Studies Related to the Factors Influencing the Natural Gas Pricing Reform

Li et al. (2017) used factor analysis to identify the main drivers of natural gas prices at the Henry Hub in the United States. Their study analysed historical data

on gas prices, supply and demand, storage levels, oil prices, and climate patterns. The results showed that demand and supply work best in shifting markets because consumption and production changes directly translate into price. Extremely cold winter weather, for example, increases heating demand and prices. Rising oil prices were also linked to higher demand for gas as an alternative fuel. Low storage levels are pushed further by predictions of shortages. This starkly contrasts how geopolitical and regulatory forces counted for less. They emphasised that tracking economic and environmental variables is crucial for market stability and guiding pricing policy.

A recent survey by Mohamed et al. (2024), Gas Industry Reforms: The Current State of Emerging Markets, evaluated natural gas reform activities in emerging markets. The survey integrated political and economic analysis, case studies, and technology assessment. While most countries have begun to take measures to increase sustainability and price efficiency, issues remain—primarily poor infrastructure, scarce finance, and inadequately developed regulatory frameworks. The study highlighted adopting new technologies, which improve gas efficiency and help reduce emissions. The authors noted that successful reforms require an overarching strategy with infrastructure investment, greater regulation, adoption of technology, and stable finance.

Litvinenko (2020) examined the role of natural gas in the GCC countries' energy policies. The nations are top gas producers and exporters and have made significant infrastructure investments for local consumption and international trade. Various factors determine pricing in the region. Oversupply lowers prices, but tight supply and rising demand raise prices. Regional tensions and political unrest add to volatility by exposing supply chains to risks. The demand side includes price pressure from processing, extraction, exploration and transport costs for pipelines and LNG exports. These forces create the GCC's gas pricing environment.

Both regional and international influences guide current GCC pricing patterns. The COVID-19 crisis saw demand plummet suddenly, creating short-term price declines. Subsequently, added LNG infrastructure has increased flexibility and lowered transport costs. Prices have settled but remain sensitive to international market sentiment, political risk, the cost of production, and logistics. Increased investment in infrastructure shows the area's dedication to expanding capacity, diversifying energy sources, and improving its ranking in the global economy (Litvinenko, 2020).

2.9.3 Studies related to the Challenges Influencing the Natural Gas Pricing Reform

In their work Market Powers and Determinants of Natural Gas Import Prices in China, Wang et al. (2020) examined the challenges and evolving dynamics of China's gas price reform, such as the realignment from oil-linked to market-based pricing. The study experimented with import price data using economic and statistical modelling to establish how reforms aligned pricing with supply and demand signals.

The study uncovered a definitive shift away from oil benchmarks, with gas prices becoming more market-force-driven. This trend translated into economic benefits, including enhanced domestic performance. The study mentioned key pricing drivers such as economic growth, weather, political stability, and broader market forces. However, it also showed that uncertainty in other countries remains a significant obstacle to open pricing.

The authors concluded that China's reforms have supported national economic goals, but further policy and regulatory improvements are needed to support market-based pricing. These conclusions are pertinent for other Asian markets, demonstrating that consistent, well-executed reforms can solidify economic strength in the region (Wang et al., 2020).

2.9.4 Studies related to the Importance of Natural Gas Pricing Reform

Rampazzo (2024) conducted an exhaustive study titled What Can the EU Do to Combat High Natural Gas Prices? evaluating the management by European Union nations of rising gas prices and long-term energy stability. By applying economic analysis and cross-country comparisons regarding pricing strategy, regulatory frameworks, and market patterns, the research identified several major price volatility drivers, i.e., economic growth, atypical weather conditions, and geopolitical conflicts.

Infrastructure bottlenecks, such as pipelines, limited LNG terminal capacity, and inadequate storage facilities, were major causes of regional price variations. War, sanctions, or reliance on a single producer-induced supply disruption further increased volatility: the research emphasised supply diversification and enhanced regional cooperation to minimise such risks.

Carbon pricing and wider climate policies impacted competitiveness and gas consumption. The study found that the EU's move from regulated to market-based pricing has brought efficiency, transparency, and price stability in the long term. However, it also highlighted the need for gradual, inclusive reform-one that includes stakeholders and consistent policy support to avoid social and economic risks (Rampazzo, 2024; Knorr & Dobos, 2024).

These findings are most relevant to countries like Bahrain, where price volatility management, investment attraction, and energy affordability are ongoing issues.

2.9.5 Studies related to the Reform Mechanisms

In research on natural gas price reform, Li (2021) examined the complexity of replacing state-fixed prices with market mechanisms, focusing on China as the core case. The research identified significant barriers to reform, including price

instability, cross-subsidisation, and regulatory inefficiency due to government intervention in the long run in the gas markets.

In most cases, governments have been used to regulate natural gas prices to promote affordability and economic development. However, government policies distort the market and impose extra fiscal pressure. Economic and statistical research estimated China's path towards a liberalised pricing regime by analysing supply, demand, and price data to identify its impact on market stability and stakeholders' performance.

The findings were that reducing state control raised investment and efficiency in the market in China and other reform economies. The research illustrated that price policy drives fiscal balance, consumer affordability, and profitability for producers. Broader drivers, including economic development, geopolitical factors, and climatic patterns, also affect gas prices.

While China's reforms increased economic efficiency overall, the study underscored the need to constantly improve and create robust, transparent pricing frameworks. These findings are especially relevant to countries like Bahrain, demonstrating how properly managed, market-based reform can help balance stakeholder interests and make long-term sustainability in the energy sector possible (Li, 2021).

2.9.6 Other related Studies

Fadiran et al. (2019) conducted a cross-country panel study to explore the relationship between natural gas consumption and economic growth in 67 countries and determine whether the two variables were unidirectional or bidirectional. Using panel integration techniques and error correction models, the authors considered both the short—and long-run dynamics founded on an economically and energy-consumption-defined timeframe. The results showed a long-run equilibrium relationship between natural gas consumption and

economic growth, with proof of bidirectional causality in both the short and long term for most countries.

These findings confirm not only that increased natural gas consumption promotes economic development but also that more economic activity promotes increased demand for gas. This reverse causation emphasises the importance of natural gas in national development planning and reinforces policy initiatives promoting efficient energy use and ongoing investment in gas infrastructure. The study has important policy implications for energy policy, especially for gas-reliant economies seeking to balance energy growth with economic planning (Fadiran et al., 2019).

Chiou-Wei et al. (2020) conducted an empirical analysis of the relationship between commodity price fluctuations, particularly energy prices, and GDP per capita of countries grouped by income level. The results showed a consistently negative relationship between rising energy prices and economic performance across all income groups.

The article emphasised that the economic exposure of a nation to energy price shocks is strongly determined by whether it is a net producer or not. The most negatively impacted were high-income economies. For instance, the estimated coefficient for high-income nations was –0.190, meaning that a rise in energy prices by 1% would reduce GDP per capita by 0.19%. These results highlight the significance of balanced policy instruments, such as tiered pricing or targeted subsidies, to contain inflationary pressure and ensure economic competitiveness within the framework of gas pricing reforms.

In another similar study, Şen et al. (2024) analysed the effect of global commodity price volatility on GDP per capita by income groups, particularly energy prices. The research established a long-run negative relationship between rising energy prices and GDP per capita for all income groups. This suggests rising energy

prices can slow economic growth through higher production costs and reduced consumer purchasing power.

2.10 International Gas Pricing Policies Review

This section presents a comprehensive review of international gas pricing practices in different regions and countries to identify potential lessons and implications for Bahrain and to provide relevant background information for the next section of the report on the gas pricing options.

Markets around the world are increasingly unbundling the various elements in the gas chain, especially as the markets become exposed to international trade, with clear separation of the pricing of the commodity (gas) and the transportation and infrastructure elements.

There is one apparent overall message and lesson that needs to be taken on board in moving from a regulated low gas price regime to one which incorporates the importation of gas supplies at international prices: It is inevitable that domestic gas prices would have to be adjusted significantly, and an appropriate pricing mechanism put in place to take into consideration the mix of Indigenous and costlier imported gas supplies.

Trading hubs can also be anywhere on the system, typically somewhere on the transmission pipelines, like Henry Hub in the US, or a virtual hub like the National Balancing Point (NBP) in the UK, which is, in effect the whole of the transmission system because of the entry-exit nature of the pipeline system.

To some extent, the pricing points in the gas chain follow the physical flow and system structure. The wellhead price is when gas leaves the producer's wells, travelling on a gathering system, where it may be processed before entering into the transmission pipeline, probably at or near the hub, where a wholesale price would be quoted.

At the end of the transmission system, there may be a city-gate price, and after being transported to the distribution system, there will finally be an end-user or retail price.

The Natural Gas Chain:

Figure 2.2 illustrates the natural gas supply chain from production to end-user sectors.

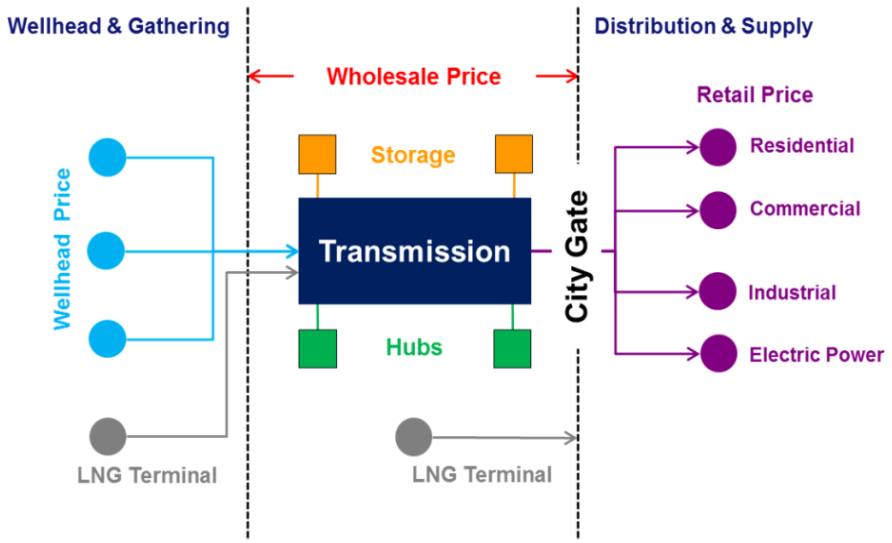


Figure 2.2: Natural Gas Supply Chain

Source: Author's own construction based on literature review (2024).

2.10.1 IGU Wholesale Gas Price Survey

Natural gas is priced globally through a range of mechanisms that reflect both market forces and regulatory frameworks. According to the International Gas Union (2023), these mechanisms can be broadly categorized as follows:

Price Formation Mechanisms:

- **Oil Price Escalation (OPE):** The wholesale gas price is linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil and/or fuel oil. In some cases, coal prices can be used as can electricity prices.

- **Gas-on-Gas Competition (GOG):** The wholesale gas price is determined by the interplay of direct gas supply and demand – gas-on-gas competition – and is traded over a variety of different periods (daily, monthly, annually or other periods). This includes gas traded on a short-term hub-priced basis and longer-term contracts that use gas price indices to determine the monthly price.
- **Bilateral Monopoly (BIM):** The price is determined by bilateral discussions and agreements between a large seller and a large buyer, with the price being fixed for a period of time – typically one year. There may be a written contract in place but often the arrangement is at the Government or state-owned company level.
- **Netback from Final Product (NET):** The price received by the gas supplier is a function of the price received by the buyer for the final product the buyer produces. This may occur where the gas is used as a feedstock in chemical plants, such as ammonia or methanol, and is the major variable cost in producing the product.
- **Regulation: Cost of Service (RCS):** The price is determined, or approved, formally by a regulatory authority, or possibly a Ministry, but the level is set to cover the "cost of service", including the recovery of investment and a reasonable rate of return.
- **Regulation: Social and Political (RSP):** The price is set, on an irregular basis on a political/social basis, in response to the need to cover increasing costs, or possibly as a revenue raising exercise – a hybrid between RCS and RBC.
- **Regulation: Below Cost (RBC):** The price is knowingly set below the average cost of producing and transporting the gas often as a form of state subsidy to the population.
- **No Price (NP):** The gas produced is either provided free to the population and industry, possibly as a feedstock for chemical and fertilizer plants, or in

refinery processes and enhanced oil recovery. The gas produced maybe associated with oil and/or liquids and treated as a by-product.

- **Not Known (NK):** No data or evidence

Price Formation in the Middle East and Global Trends Toward Market-Based Gas Pricing, the Middle East relies heavily on regulated price mechanisms, particularly in GCC countries, where gas prices are set based on socio-political priorities. Compared to Europe or North America, the region has not widely adopted Gas-on-Gas (GOG) pricing, indicating the need for reform towards market-based systems.

Global Shifts in Pricing Mechanisms (2005–2022):

Figure 2.3 below shows the global distribution of price formation mechanisms for total natural gas consumption from 2005–2022. It highlights the steady rise of GOG, which increased from 31.5% in 2005 to 51% in 2022, becoming the dominant mechanism. This growth has primarily come at the expense of OPE, which fell from 24% to 18%, and regulated mechanisms like RSP and RBC, which also saw a decline. The transition reflects a global trend toward liberalized and market-driven gas pricing, particularly in Europe and North America (IGU, 2023).

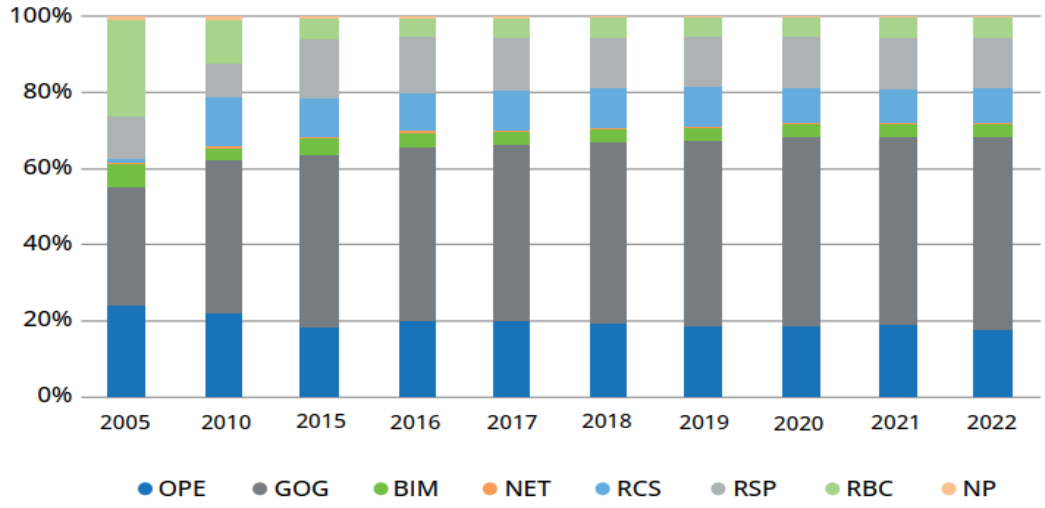


Figure 2.3: World Price Formation From 2005 to 2022

Source: International Gas Union (2023). Wholesale Gas Price Survey Report.

Wholesale Prices Levels by Price Formation Mechanism (2005-2022):

Figure 2.4 below highlights trends in gas pricing across mechanisms such as GOG, OPE, and regulated pricing. GOG and OPE mechanisms showed significant price volatility, particularly during the 2021–2022 energy crisis, with GOG experiencing sharp spikes due to LNG spot market activity. OPE prices rose with oil prices while regulated prices remained more stable. However, they increased post-2015 as many countries moved toward cost-reflective pricing. The chart reflects the higher volatility of market-linked mechanisms compared to regulated pricing (IGU, 2023).

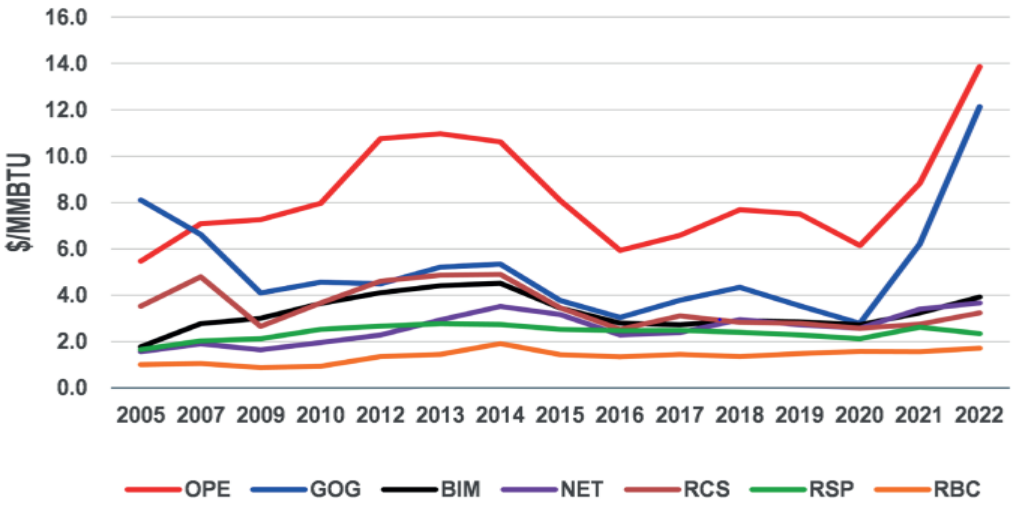


Figure 2.4: Wholesale Prices Levels From 2005 to 2022

Source: International Gas Union (2023). Wholesale Gas Price Survey Report.

Spot Prices (2019-2023):

Figure 2.5 below illustrates the volatility of global spot gas prices across key markets from 2019 to 2023. It highlights a sharp rise in spot prices starting in 2021 due to post-pandemic demand recovery, which intensified in 2022 following supply disruptions from the Russia- Ukraine conflict. Europe experienced the highest price spikes as it shifted to LNG imports to replace Russian pipeline gas, while Asia's prices also surged due to strong LNG demand. North America

maintained relatively lower and stable spot prices due to domestic shale gas production (IGU, 2023).

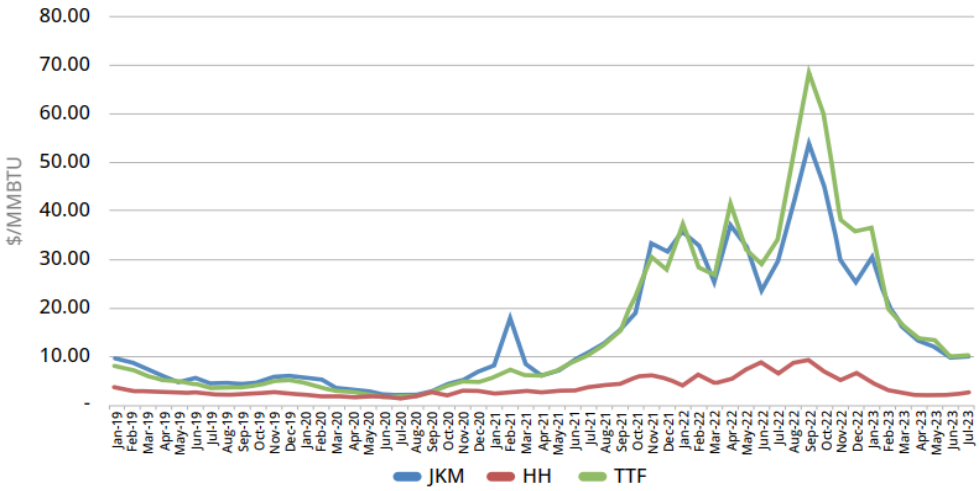


Figure 2.5: Spot Prices From 2019 to 2023

Source: International Gas Union (2023). Wholesale Gas Price Survey Report.

Middle East Price Formation (2005-2022):

In the Middle East, natural gas pricing has remained predominantly regulated. Mechanisms such as regulated sales price (RSP) and regulated below-cost (RBC) continue to account for most gas consumption. The region exhibits minimal adoption of gas-on-gas (GOG) competition mechanisms due to the absence of liberalised markets. Oil price escalation (OPE) is used sparingly for export contracts. Overall, gas pricing in the Middle East remains heavily influenced by subsidies and government controls, supporting domestic industries and social policies, with limited progress toward market-driven reforms (IGU, 2023).

Market and Regulated Pricing (2005-2022):

Over the past two decades, there has been a gradual global shift from regulated pricing mechanisms to market-based mechanisms such as gas-on-gas competition (GOG) and oil price escalation (OPE). This trend reflects the widespread liberalisation of gas markets and the expansion of LNG trade, especially in

Europe and Asia. Despite this shift, some countries still maintain regulated pricing frameworks to protect domestic consumers and ensure energy security, though these instances are becoming less frequent as competitive pricing gains traction (IGU, 2023).

World Price Formation– LNG Imports (2005-2022):

The evolution of the LNG trade has significantly influenced global gas pricing. Over time, the share of gas-on-gas (GOG) pricing in LNG imports has increased substantially, reflecting a move toward more flexible, hub-based, and spot-linked contracts. Conversely, reliance on oil price escalation (OPE) mechanisms for LNG has decreased, indicating a broader industry trend favouring transparency, flexibility, and market responsiveness (IGU, 2023).

2.10.2 IGU Global Voice of Gas Report

The IGU Global Voice of Gas Report (2024) provides a detailed examination of emerging trends within the natural gas sector, pointing to price volatility and the demand for agile policy structures. The report cites recent volatility in global gas prices as being fuelled mainly by geopolitical conflict, specifically Russia's continued war on Ukraine.

Although early 2024 has witnessed some market stabilisation, the report warns that the market continues to be exposed to sudden, data-driven shocks due to mild weather and robust storage levels. Even with enhanced supply reliability, global conditions are still tight, with new supply capacity years away from coming online. Such a backdrop underlines the value of forward-thinking pricing strategies that can mitigate shortages and limit the threat of price spikes.

The report further highlights the contribution of technology and innovation to creating more adaptive and precise pricing mechanisms. It demands policy support for market-based mechanisms, citing their challenges to government

agencies and gas consumers. Access to affordable gas continues to be central to economic stability, particularly for emerging regions.

To deal with price volatility, the IGU recommends balanced price mechanisms that insulate consumers from volatility and offer producers incentives to maintain supply constant and sufficient supply (IGU, 2024).

2.10.3 IGU Global Gas Report

IGU Global Gas Report (2023) captures a detailed exploration of the current global gas market, specifically emphasising pivotal issues and strategic imperative. The report documents the unprecedented surge in global gas prices witnessed in 2022 following supply disruptions and increasing demands, especially from the European continent. The price swing underscores the urgency of adopting dynamic pricing regimes that accurately reflect the market's direction. The report highlights the importance of ongoing constraints—especially those exacerbated by geopolitical tensions—necessitating a diversified supply portfolio that includes domestic production and liquefied natural gas (LNG) imports to enhance price stability.

Moreover, significant investment in gas infrastructure is perceived as requisite to allow a transition towards market-oriented pricing mechanisms, which involves expanding the LNG import capacity and domestic gas production. Additionally, regulatory frameworks encouraging competition and transparency are vital for establishing a healthy and effective gas market. The paper also points out that price instability disproportionately affects developing countries, especially those highly dependent on gas imports. It calls for governments to weigh the implications on stakeholders, such as public finances, industrial customers, and households. To avert energy poverty in poor areas, the report advocates establishing social protections to insulate poor people from severe price shocks.

Moreover, it promotes raising investments in low-carbon technologies, including hydrogen and carbon capture, to facilitate a sustainable energy system transition. The report further points out that Europe and Asia experienced record gas prices, fueled by supply chain disruption and shifting global trade flows, calling for robust and forward-thinking gas policy mechanisms (IGU, 2023).

2.10.4 World Gas Model Report

The World Gas Model Report (2024) projects global natural gas market trends through 2030 using scenario-based production, trade, and consumption simulations. It anticipates strong demand growth driven by population growth, economic growth, and the energy transition. Power generation and industry are the main drivers.

According to this report, global gas prices show three leading causes of volatility: geopolitical disruptions, imbalances between supply and demand, and increased LNG trade. The document suggests implementing market-based pricing changes to maintain accurate pricing while achieving climate targets. Natural gas is a short-term energy source that leads humanity toward lower-carbon alternatives.

Countries relying on gas exports face significant financial dangers from price instability, which demands stable prices for sound budget preparation and economic stability. Pricing instability leads to lower spending power for lower-income groups who purchase fuel.

Regulators and governments should collaborate with industry to develop this managerial strategy, which helps address these risks within energy systems. Energy pricing strategies must also include economic efficiency and social protection measures to ensure accessibility and affordability.

2.10.5 IGU World LNG Report

The IGU World LNG Report (2024) provides a complete picture of the worldwide LNG market by analysing existing patterns, new issues, and upcoming strategic choices. The document shows how the worldwide LNG distribution system continues to grow in complexity because it now links 20 exporting terminals with 51 different importing facilities across an expanded network.

The price of LNG reached $13.86 per MMBtu in 2023, while it experienced substantial market volatility from the previous year. The report shows that this price decrease came from modified seasonal demands, geopolitical restrictions and supply interruptions. The report suggests applicable pricing systems to safeguard customers' affordability and government income. Flexible pricing structures observed in the market embrace joint buying deals and Floating Storage and Regasification Units (FSRUS). Both solutions reduce reliance on traditional fixed infrastructure while offering improved logistical flexibility.

The document promotes financial backing for complementary carbon capture solutions and renewable energy integration programs to support sustainable development. The report calls for ongoing stakeholder involvement to develop market-responsive energy prices, enhancing economic durability and energy safety (IGU, 2024).

2.11 Gaps in the Literature

Despite substantial research on natural gas pricing mechanisms worldwide, critical gaps remain in the context of sustainability-linked pricing for small economies such as Bahrain. Existing studies primarily focus on liberalised markets in economically developed countries like the U.S., Germany, Japan, UK, etc. (Fulwood, 2024; Keller et al., 2022), with limited applicability to state-subsidised, resource-rich nations. In particular, the pricing transition from domestic to imported gas has been studied in contexts such as China and India

(Li, 2021; Tiantian et al., 2020), but these frameworks often fail to account for the economic and fiscal structures present in smaller economies.

Specifically, few studies attempt to construct pricing models tailored to countries facing dual challenges: energy security and fiscal sustainability. While regional reviews acknowledge pricing distortions (Hasan et al., 2022), the role of LNG importation in altering long-term pricing and government exposure remains under-examined. Most frameworks do not evaluate cost-recovery mechanisms, LNG pricing volatility, or budget impact assessments under supply diversification.

Further, sustainability-linked pricing strategies where natural gas pricing is aligned with climate targets and fiscal responsibility are increasingly discussed in the EU context (Knorr & Dobos, 2024; Rampazzo, 2024), but scarcely addressed in the Gulf. The GCC literature lacks empirically validated models addressing the economic risks of pricing reform while ensuring social protection for large domestic consumers such as power plants and strategic industries (e.g., Customer 2).

In addition, reports by international agencies such as IGU (2023) and GECF (2024) have raised the issue of price disparity and the need for reform, yet they stop short of offering country-specific solutions. Bahrain-specific research remains either descriptive or macroeconomic, often omitting sensitivity modelling, cost-recovery calculations, and policy reform pathways tailored to LNG-based supply structures.

This research fills the gap by developing a Bahrain-specific gas pricing framework that integrates the cost of imported LNG, assesses multiple reform scenarios, and models government revenue exposure. The framework also tests sustainability-linked pricing strategies and proposes a policy roadmap that is fiscally viable and economically efficient under specific constraints.

2.11.1 Identified Gaps in the Literature

Despite the growing body of research on natural gas pricing reforms globally, there remains a significant gap in studies specifically addressing Bahrain's unique market conditions. Most existing literature concentrates on large-scale energy markets such as the United States and Europe and emerging economies like India, where market structures, regulatory environments, and consumption patterns differ substantially from Bahrain's. Given Bahrain's high dependency on natural gas, the increasing reliance on LNG imports, and its distinct government-regulated pricing framework, there is a clear need for research that directly focuses on the Kingdom's specific economic and energy landscape.

Furthermore, while several studies analyse the economic and fiscal implications of gas pricing reforms, limited attention has been paid to their broader socioeconomic impacts, particularly in smaller economies like Bahrain. The potential consequences of rising gas prices on household expenditures, employment, industrial competitiveness, and inflation require deeper investigation, especially in the context of Bahrain's economic structure.

Additionally, the literature reveals a lack of integrated frameworks that connect natural gas pricing reforms with renewable energy development strategies. Although natural gas is often positioned as a transitional fuel toward cleaner energy, many studies fail to provide comprehensive approaches that align gas pricing mechanisms with long-term sustainability and renewable energy integration. This disconnect is particularly relevant for Bahrain, where the government is actively pursuing renewable energy initiatives alongside necessary reforms in gas pricing.

Another critical gap is the limited research on stakeholder behaviour, including the potential resistance from industrial users, policymakers, and the general public toward gas pricing changes. Successful implementation of pricing reforms

requires understanding these stakeholder dynamics and the challenges associated with policy acceptance and market liberalisation. Therefore, addressing these gaps is essential to ensure that any reform measures are economically viable, socially acceptable, and aligned with Bahrain's strategic energy objectives.

2.11.2 How This Thesis Fills These Gaps

This thesis aims to bridge the identified gaps in the literature by providing a focused and context-specific analysis of natural gas pricing reform in Bahrain. The study develops a Bahrain-specific pricing model by adapting international gas pricing methodologies to reflect the Kingdom's market conditions. It considers critical factors such as government subsidies, LNG importation costs, the role of small customers, and the sensitivity of key industrial sectors to price adjustments. Through this approach, the research offers a pricing framework tailored to Bahrain's economic realities and energy sector characteristics, ensuring relevance and applicability to the local context.

Moreover, the thesis extends beyond conventional economic analysis by assessing the macroeconomic and microeconomic impacts of gas pricing reforms in Bahrain. It examines fiscal stability, industrial competitiveness, and the financial burden on businesses and households to identify a pricing strategy that minimises adverse effects on the government, industries, and the general population. A distinctive contribution of this research is exploring the relationship between gas pricing reforms and Bahrain's renewable energy policy. The study investigates how adjustments in natural gas prices can act as a catalyst for enhancing energy efficiency and promoting investment in renewable energy projects, thus supporting the country's broader sustainability agenda.

In addition, the research incorporates a detailed stakeholder analysis to understand potential resistance and support the reforms. The study provides insights into stakeholder perspectives by engaging with major gas consumers,

policymakers, and energy sector experts through structured interviews and economic modelling. It identifies practical measures to facilitate a smoother policy transition. Through these contributions, the thesis addresses critical gaps in the existing literature. It offers a comprehensive framework for designing and implementing Bahrain's sustainable natural gas pricing policy, grounded in rigorous economic assessment and stakeholder engagement.

2.12 Summary

This chapter critically examined the theoretical, conceptual, and empirical foundations of natural gas pricing reform, with a particular focus on international best practices and economic frameworks applicable to Bahrain's context. The literature review began by outlining core principles such as cost-recovery pricing (Coady et al., 2019), energy subsidy reform (Rentschler & Bazilian, 2017), natural monopoly regulation (Farmer, 2022), and demand elasticity theory (Han et al., 2023), which collectively inform the pricing decisions adopted across varying national contexts. These frameworks are especially relevant to Bahrain as it confronts the dual challenge of fiscal exposure and growing reliance on imported LNG. The chapter also explored how countries adopt different models of gas market regulation depending on institutional capacity and economic structure (Putriastuti et al., 2021).

In addition, the chapter synthesized comparative experiences from several international case studies, including the United States and the European Union. Special attention was given to the volatility of global LNG prices and the unique implications this has for small economies such as Bahrain. Despite an expanding body of global literature on energy pricing, the chapter identified a critical gap: the absence of integrated models that account for the fiscal, social, and energy security dimensions of gas pricing in LNG-reliant countries (Hasan et al., 2022). This gap underscores the relevance and urgency of the present study, which seeks to construct a pricing framework tailored to Bahrain's unique market and policy

environment. Ultimately, this chapter provided the foundation for the study's methodological framework, economic modelling, scenario analysis, and the formulation of policy recommendations presented in the subsequent chapters.

Chapter Three: Research Methodology

3.1 Introduction

This chapter presents the research methodology adopted to examine the development of a sustainable natural gas pricing policy for the Kingdom of Bahrain. It outlines the analytical design used to assess the financial, economic, and policy dimensions of gas pricing reform in the context of declining domestic gas production and increasing dependence on imported LNG. The chapter draws from the conceptual and theoretical frameworks discussed in Chapter 2, transforming key concepts into practical research components. The methodology is structured to address the study's core research questions by combining data-driven analysis with policy-oriented evaluation.

Following a rationale-driven research approach, this chapter details the tools and techniques used for quantitative analysis, including pricing calculations, scenario development, and fiscal modelling. It also integrates qualitative assessments derived from the expert interviews. The adopted methodology reflects the interdisciplinary nature of the study, encompassing energy economics, public finance, and regulatory policy. The chapter is organized as follows: Section 3.2 describes the overall research approach and methodological rationale adopted in the study. Section 3.3 presents the data sources and collection methods. Section 3.4 provides a summary of the chapter. In summary, this chapter provides the foundation for the results and analysis discussed in Chapters 4 and 5.

3.2 Research Method

The research methodology adopted in this study was designed to comprehensively address the complexity of Bahrain's natural gas pricing landscape. The initial phase involved a review of Bahrain's economy, energy sector, and natural gas market. This included an examination of reform initiatives and strategies that have been proposed or implemented within the sector. These

insights were drawn primarily from data and reports provided by gas supplier, offering an in-depth understanding of the local context.

To complement this, international natural gas pricing policies were reviewed, with a focus on examining relevant case studies to derive valuable insights. The applicability of these global practices to Bahrain's context was assessed through literature analysis and reference to data from credible professional organizations. This ensured that the policy recommendations proposed in this study are informed by both local realities and international best practices.

In order to incorporate practical perspectives, structured interviews were conducted with key stakeholders associated with the natural gas value chain in the Kingdom of Bahrain. These interviews provided expert opinions that enriched the analysis and enhanced the contextual relevance of the findings.

Subsequent stages of the research included evaluating potential scenarios for the future balance of natural gas supply and demand, thereby identifying Bahrain's import requirements. Based on these projections, a series of natural gas pricing options were developed and assessed in relation to Bahrain's market dynamics. Their respective impacts on all major stakeholders were analyzed in detail.

Finally, the study concluded with a recommendation for the most suitable and sustainable pricing policy. An implementation plan for the proposed reform was also developed, ensuring that the transition from the current pricing structure to the recommended model is both feasible and aligned with Bahrain's long-term energy and economic objectives.

3.2.1 Research Method Process

The overall research framework for this study follows a structured methodology to ensure a comprehensive and systematic approach to addressing the research problem.

Figure 3.1 illustrates the research process, beginning with defining the research problem and objectives, followed by an in-depth literature review, data collection, and methodology development. The framework incorporates internal and external data sources. It utilises multiple price formation mechanisms, including oil price escalation, gas-on-gas competition, bilateral monopoly, netback from the final product, and various forms of regulated pricing.

This structured process ensures that the analysis is grounded in established pricing theories and global practices, supporting the development of well-informed conclusions and actionable recommendations for Bahrain's sustainable gas pricing policy.

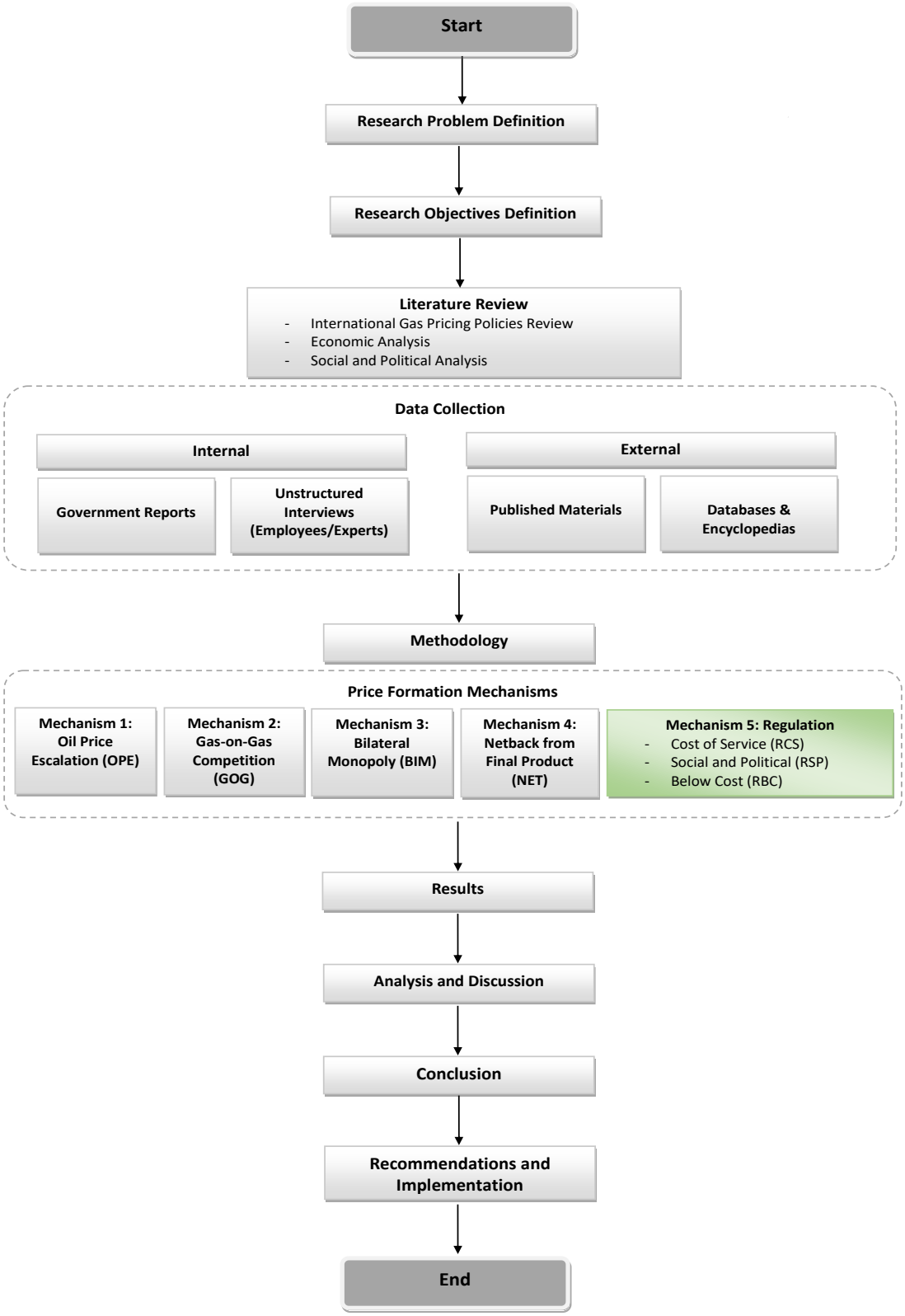


Figure 3.1: Research Method Flowchart

Source: Author's own construction (2025).

3.3 Data Collection

This study employed a structured data collection process to gather the necessary information from gas supplier and other relevant sources. The primary objective was to obtain reliable data for evaluating natural gas pricing options in Bahrain. This process began with securing internal data from gas supplier, encompassing both financial and operational metrics related to natural gas usage and supply.

To complement internal data, expert opinions were incorporated by engaging with key stakeholders across the natural gas value chain. These included professionals within the gas industry, regulatory authorities, and government agencies involved in energy planning and policy. Their insights provided qualitative depth to the study and ensured that sector-specific constraints and opportunities were appropriately captured.

In addition to local sources, the study incorporated international data to reflect best practices and provide benchmarking against global standards. This included open-source data, technical publications, industry reports, and publicly available information on natural gas and LNG markets. These inputs helped validate findings and contextualize Bahrain's gas pricing strategy within broader international trends.

3.3.1 Data Collection Process

The data collection process followed a staged and adaptive approach, as illustrated in Figure 3.2. The first stage involved obtaining formal approval from regulator. If approved, the researcher accessed internal financial and non-financial datasets for gas customers directly. In cases where initial approval was not granted, a secondary approval was sought from gas supplier. If both approvals were denied, the process redirected to sourcing published data.

Once access was secured, the study collected various categories of gas-related data. This included supply and demand figures, customer financial indicators, and macroeconomic data relevant to gas consumption and pricing. When internal datasets were incomplete, publicly available sources were consulted to fill the gaps. If financial data or customer-specific economic data were not available internally, direct requests were made to the customers themselves. Should the customers be unable to provide the data, the study relied on published estimates or approximations validated through literature sources.

The structured flow ensured that data acquisition was both systematic and responsive to availability constraints. This methodology was designed to maximize the accuracy and comprehensiveness of the dataset supporting the analysis, while also ensuring alignment with ethical and procedural protocols for accessing organizational and customer data. Figure 3.2 was developed to represent this approach and serves as a visual summary of the process used to collect and validate the study's core datasets.

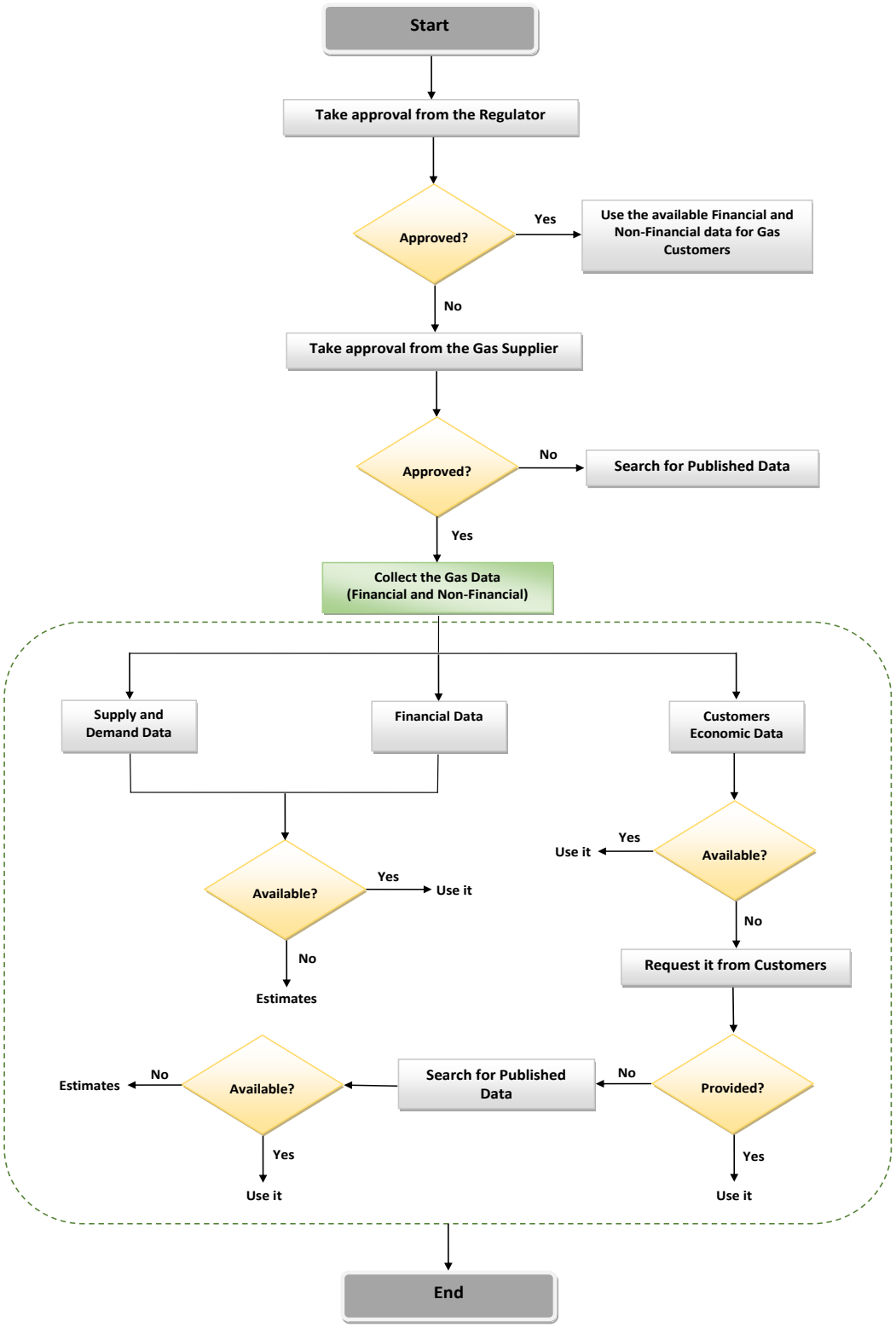


Figure 3.2: Data Collection Flowchart

Source: Author's own construction (2025).

3.3.2 Expert Interview Analysis: A Comprehensive Exploration of Industry Perspectives

To ensure that the research findings are grounded in practical and stakeholder-informed perspectives, a series of expert interviews were conducted with professionals across Bahrain's natural gas value chain. These interviews provided critical insights into the country's transition from domestically produced gas to imported LNG, with a particular focus on pricing reform, supply security, fiscal sustainability, and industrial resilience.

A total of ten experts were selected using purposive sampling, targeting individuals with a minimum of twenty years of experience in Bahrain's energy sector. Participants included senior policymakers involved in strategic planning, energy regulator, gas supplier, key gas consumers such as power plants, and international gas consultants with LNG expertise. This diversity was intended to ensure a holistic view of the challenges and policy options available to Bahrain. A demographic summary of participants, including their roles, affiliations, expertise, and experience, is presented in Appendix A.

Furthermore, each interview followed a structured protocol built around six key discussion themes: (1) Bahrain's natural gas supply strategy and energy security; (2) the necessity and timing of gas pricing reforms; (3) the relevance of international gas pricing models to Bahrain's context; (4) the economic impacts on stakeholders, especially power plants and industry; (5) the role of renewable energy in diversifying future energy sources; and (6) policy recommendations for a balanced and sustainable pricing transition. The interview guide used is provided in Appendix A, and each theme is explicitly aligned with the conceptual framework introduced in Chapter 2 and the research questions listed in Chapter 1.

Interview findings were directly mapped to the study's major and minor research questions. In response to the major research question, expert insights helped identify the critical components of a sustainable gas pricing policy by emphasizing the need for a phased reform strategy, targeted subsidies, long-term LNG contracts, and integration of renewables. These measures were consistently highlighted as essential to achieving long-term energy security while minimizing the economic impact on government, industry, and households.

With respect to Minor Research Question 1, experts confirmed that the depletion of domestic reserves necessitates LNG imports and emphasized that these imports will significantly increase the cost of supply unless pricing reform is implemented. With regard to Minor Research Question 2, interviewees consistently stressed that subsidies in their current form are unsustainable, and that a phased pricing transition supported by targeted subsidies would allow both gas consumers and government budgets to adjust gradually. On Minor Research Question 3, participants highlighted the importance of long-term LNG contracts, pooled pricing mechanisms, and risk-sharing frameworks to mitigate government fiscal exposure. In response to Minor Research Question 4, stakeholders emphasized the urgency of securing gas supply for critical users such as Customer 1 and Customer 2, while also supporting renewable energy investments to ease long-term pressure on imported LNG.

In terms of energy security, experts emphasized that Bahrain's domestic gas reserves are depleting rapidly, making LNG imports unavoidable to meet growing demand. Long-term LNG supply contracts were considered essential to ensure price stability and mitigate exposure to volatile spot markets. Policymakers highlighted the urgency of developing a comprehensive gas supply strategy that prioritizes critical sectors such as Customer 1 and Customer 2. Regulators supported the inclusion of strategic reserves and regional pipeline options as part

of a diversified energy supply plan, ensuring resilience in case of international market disruptions.

Regarding pricing reform, there was unanimous agreement that Bahrain's current gas pricing system is financially unsustainable in the face of rising LNG import costs. Experts strongly recommended a phased transition to cost-reflective pricing, supported by targeted subsidies for vulnerable customers. Regulator and gas supplier favored a pool pricing mechanism to spread import costs across the customer base and reduce price volatility. Industry representatives advocated for differentiated pricing based on customer priority, with essential industries receiving transitional support. The overall consensus was that a reform model must balance fiscal sustainability with affordability, especially during the transition period.

With respect to economic impact, stakeholders raised concerns about how pricing reforms would affect various segments of Bahrain's economy. Gas supplier cautioned that without reform, the government's gas sales revenue will continue to decline, exacerbating fiscal deficits. Gas consumers noted that increasing gas prices may reduce their global competitiveness, particularly for export-oriented manufacturers. Power producers highlighted the direct relationship between gas prices and electricity tariffs, raising potential socio-economic concerns for end-users. Regulator acknowledged these risks and advocated for a gradual price adjustment strategy that protects critical sectors while aligning tariffs with real costs over time.

Finally, in terms of energy transition, experts agreed that while natural gas will remain central to Bahrain's energy mix in the near term, renewable energy must play a growing role in reducing LNG dependency. Regulator indicated that Bahrain has already initiated some solar projects and renewable energy policies but acknowledged that further investment and incentives are required. Gas supplier proposed hybrid supply models in which renewables complement

imported LNG, while international consultants stressed that a sustainable long-term strategy must integrate renewables, carbon reduction goals, and flexible policy instruments to meet both energy and climate objectives.

Overall, the expert interviews validated the research assumptions and added significant depth to the scenario modelling and recommendations provided in Chapters 4 and 6. The findings emphasize the importance of a structured and inclusive transition strategy for Bahrain's natural gas pricing policy, informed by economic realities, sector-specific priorities, and stakeholder collaboration.

3.4 Summary

This chapter established the methodological foundation for assessing Bahrain's natural gas pricing reform by outlining the structured approach taken to collect and analyze relevant data. It detailed the analytical logic used to evaluate various pricing scenarios, incorporating both economic indicators and contextual considerations that shape energy policy in Bahrain. The chapter also addressed the operational steps followed to ensure methodological consistency, reliability, and relevance to the national context.

Through a combination of economic modelling and applied evaluation techniques, the chapter demonstrated how the research design supports a comprehensive understanding of the policy trade-offs involved in transitioning to a sustainable natural gas pricing system. The chosen methodology provided a framework for quantifying fiscal impacts, estimating customer implications, and linking those insights to policy objectives. This sets the stage for the results, analysis, and recommendations presented in the following chapters.

Chapter Four: Results

4.1 Introduction

The transition from a government-regulated gas pricing regime to a market-based framework carries significant implications for Bahrain's energy sector, fiscal position, and overall economic sustainability. Evaluating the outcomes of such a policy shift requires economic analysis and financial assessment across multiple reform scenarios, particularly given Bahrain's increasing reliance on imported LNG.

This chapter presents the development and findings of the Gas Pricing Model constructed for this study, which serves as the central tool for quantifying the economic and fiscal impacts of the pricing reforms. The model integrates key structural components including supply and demand, LNG prices and Supply costs to simulate outcomes under a range of scenarios. The analysis examines government revenue implications, subsidy requirements, and key customers profitability. Additionally, the chapter evaluates mitigation strategies such as energy diversification, fiscal planning, and efficiency enhancements, and conducts sensitivity analyses to assess the impact of LNG price volatility and demand fluctuations.

4.2 Pool Pricing Framework

As discussed in Literature Review chapter, there are different gas pricing mechanisms applied across global markets, including regulated social pricing, cost of service pricing, netback-based pricing, oil-indexed pricing, hub-based (market-based) pricing, bilateral negotiation, and hybrid pricing models.

After evaluating various pricing approaches, this study identified the Pool Pricing mechanism as the most suitable model for Bahrain's gas pricing reform. This approach enables the aggregation of costs from multiple supply sources, including domestic production, LNG imports, and potential future pipeline gas,

providing the flexibility required to manage price volatility and ensure financial sustainability.

The Pool Pricing model aligns with Bahrain's energy policy objectives, offering a structured and transparent framework that supports cost recovery, promotes energy security, and mitigates socioeconomic impacts. Its adaptability allows priority-based gas allocation across different customer segments, ensuring the country's economic development strategy supplies critical sectors. Furthermore, the model's design facilitates the precise definition of each component of the end-user price, enhancing pricing transparency and accountability.

The suitability of the Pool Pricing mechanism is further reinforced by its capacity to average costs across various supply sources, thereby reducing the financial burden associated with high-cost LNG imports. This framework also empowers the government to adjust the supply mix dynamically and assess the implications of these adjustments on end-user pricing.

In addition, the model identifies different levels of implementation complexity depending on the configuration selected, enabling policymakers to tailor the system to national priorities and operational capacities. These features collectively establish Pool Pricing as a pragmatic and practical solution for Bahrain's gas pricing reform.

4.2.1 Gas Chain Elements

The different elements of the gas chain which make up the end user price can be broken down into four categories:

1- Gas Commodity:

The cost of the molecule of gas, usually before it is delivered to the gas transportation infrastructure. Currently, the only source of gas supply in Bahrain is the existing domestic gas production and it is sold to the customers based on a

Natural Gas Supply Agreement (NGSA) with end user at the government set prices. Future sources of gas supply would be from new gas production in Bahrain (Deep Gas), imported LNG and Pipeline Gas.

For new gas production in Bahrain, again under a cost-based pool approach, the actual cost of gas as per the contract(s) will be used in the calculation. For imported LNG, this might be purchased under contract or on a spot basis, but in either case, the actual cost of the gas would be known and could be used in a cost-based pool calculation.

2- Gas Infrastructure:

A charge usually covers the costs of transmission and distribution to end users. This can be thought of as an infrastructure charge.

Gas infrastructure covers the Gas Distribution Network pipelines, Distribution Points, Valve Stations, and Metering Stations. There is a charge for using this infrastructure, which covers the operation, maintenance, etc. In addition, the Gas transmission network inside Bahrain Field, including the compression station and the LNG terminal, will be used for the imported LNG and if there is future pipeline gas with the required compression stations.

3- Supply Charges:

Charges added to cover marketing and customer service costs incurred by the gas supplier, including the billing and technical support.

4- Government Rent:

The Government rent is currently included in the difference between the gas sales price to the end users and the gas supply cost from the gas operator. Some of this difference is covering the gas infrastructure costs and supply charges, with the balance being taken by the government. The government rent and supply charges are usually regulated.

4.2.2 Cost Based v Market Based

Cost Based:

Under a cost-based approach, the actual cost of the gas (commodity) and/or the gas infrastructure is included in the calculation. The actual cost of gas in the case of Bahrain would currently be the gas supplier fee (or gas supply cost) for the existing Bahrain Field gas production capacity and in future, the contract price for new production (Deep gas) and the actual costs of imported LNG or Pipeline Gas.

In most countries, the actual charges for infrastructure are regulated and determined as part of the regulatory price control process, which is predominantly cost-based. Similarly, outside markets which are fully liberalised and opened to competition, the supply charges would also be regulated. The Government rent is effectively a regulated amount.

Market Based:

The market-based approach only applies to gas (commodity) element. In this case, rather than using the actual cost, a market the index is used, and if the gas supplier purchases gas (whether it is domestic gas or imported gas) at more or less than the index, the gas supplier takes the risk. This approach is typical for utilities in the USA, where they can pass through to customers the market index for gas, plus transportation costs, rather than their actual WACOG.

It is clearly easier to do this in a competitive market such as the USA than in a developing gas market like Bahrain; or indeed in most other markets outside North America and Europe that have no market index. It would theoretically be possible for Bahrain to link the gas commodity element to an external index like Henry Hub or NBP or an oil-indexed benchmark, especially for the imported LNG element. However, it would not reflect the Bahrain gas market conditions to be considered a market-based approach.

4.2.3 Pool Pricing Template

Table 4.1 is a template that summarises the application of the elements of the gas chain to Bahrain:

Table 4.1: Gas Pool Pricing Template

Gas Supply Source	A Commodity	B Infrastructure	C Supply Charges	D Government Rent	F End User Price
1. Existing Bahrain Field Production	A1	B1	C1	D1	**F1**
2. New Bahrain Field Production (Deep Gas)	A2	B2	C2	D2	**F2**
3. LNG Supply	A3	B3	C3	D3	**F3**
4. Gas Pipeline Supply	A4	B4	C4	D4	**F4**
Weighted Average	**A5**	**B5**	**C5**	**D5**	**F5**

The only gas supply source in Bahrain is the existing production of Associated and Non-associated gas from the Bahrain Field. Future sources of gas supply could include new Bahrain Field Production (Deep gas in pre-Khuff formation), Imported LNG and Pipeline Gas.

Under this template, the current gas price in Bahrain would be F1; the formula for which is as follows:

Formula (4.1): F1 = A1 + B1 + C1 + D1

In other words, the cost of existing gas production at the Bahrain Field (A1) plus the charge for the existing pipeline or overall gas infrastructure costs (B1), plus the existing supply charges (C1) and Government rent (D1).

In the circumstances where there would be differing supply sources for gas in Bahrain, then the weighted average or Weighted Average Cost of Gas (WACOG) could be calculated as an average price to charge to end users. The formula for this would be as follows:

Formula (4.2): F5 = A5 + B5 + C5 + D5

where all A4, B4, C4 and D4 are also weighted averages of their respective columns.

4.2.4 Pool Pricing Options

- **Option 1: Single Pool Weighted Average Cost of Gas:** One end-user price as the method averages commodity, infrastructure, transportation, and other costs in a single pool. (Simple to calculate & implement)
- **Option 2: Multiple Pools Structure with Averaging of Costs:** Different end user prices as method considers different commodity costs with averages infrastructure, transportation, and other costs. (Would likely to be a big different between end-user prices / Difficult to implement)
- **Option 3: Multiple Pools Structure with Attributable Costs:** Different end user prices as a method considers different commodity costs, infrastructure, transportation, and other costs. (There would be a significant difference between the end user prices / Very Difficult to implement)

1- Single Pool Weighted Average Cost of Gas

Table 4.2 presents the simplest pool mechanism, which involves a single pool. The resulting pool pricing would be the weighted average of all commodities,

infrastructure, Moreover, other costs are also called Weighted Average Cost of Gas (WACOG).

The end user price in this single pool would be the weighted average row where, for example, the average commodity cost, A5, would be the weighted average of A1, A2, A3, A4 and so on for the other elements of the gas chain, supply charges and Government rent. Under this pool structure, every end user would pay the same price F5.

Table 4.2: Gas Pool Pricing Template (Simple Weighted Average – Single Pool)

Gas Supply Source	A Commodity	B Infrastructure	C Supply Charges	D Government Rent	F End User Price
1. Existing Bahrain Field Production	A1	B1	C1	D1	**N/A**
2. New Bahrain Field Production (Deep Gas)	A2	B2	C2	D2	**N/A**
3. LNG Supply	A3	B3	C3	D3	**N/A**
4. Gas Pipeline Supply	A4	B4	C4	D4	**N/A**
Weighted Average	**A5**	**B5**	**C5**	**D5**	**F5**

This option is simple and easy to implement but not as fully cost reflective as the other options.

2- Multiple Pools Structure with Averaging of Costs

Table 4.3 presents the multiple pools with averaging costs approach, the infrastructure costs, supply charges and Government rent would be averaged, and

the same charge levied in all four pools. The only difference in the end-user prices in each pool would be the commodity costs.

Table 4.3: Gas Pool Pricing Template (Multiple Pools – Averaging Costs)

Gas Supply Source	A Commodity	B Infrastructure	C Supply Charges	D Government Rent	F End User Price
1. Existing Bahrain Field Production	A1	B5	C5	D5	**F1**
2. New Bahrain Field Production (Deep Gas)	A2	B5	C5	D5	**F2**
3. LNG Supply	A3	B5	C5	D5	**F3**
4. Gas Pipeline Supply	A4	B5	C5	D5	**F4**

This option provides some protection to the customers by maintaining at least the low commodity costs for some time while recognising that those customers will also benefit from the security of supply aspects of the LNG terminal, which they will, even if they do not actually use the degasified LNG.

3- Multiple Pools Structure with Attributable Costs:

Table 4.4 presents the multiple-pool structure, showing how each gas supply source is linked to a dedicated cost pool, with delivery costs directly attributed to the corresponding source.

The costs of the LNG terminal, for example, would only be charged to the LNG pool, while there would be separate charges for pipelines, supply charges and Government rent for each pool.

Table 4.4: Gas Pool Pricing Template (Multiple Pools – Attributable Costs)

Gas Supply Source	A Commodity	B Infrastructure	C Supply Charges	D Government Rent	F End User Price
1. Existing Bahrain Field Production	A1	B1	C1	D1	**F1**
2. New Bahrain Field Production (Deep Gas)	A2	B2	C2	D2	**F2**
3. LNG Supply	A3	B3	C3	D3	**F3**
4. Gas Pipeline Supply	A4	B4	C4	D4	**F4**

Clearly under this structure, there would be a big difference between the pool prices for end users, with the imported LNG price being very high, not only because of the higher commodity price, but also because of recovering the high LNG terminal costs.

In this different gas prices will be for customers depending on the pool that they are using, which gives the government the option to prioritise the customers and supply them based on their priority from the pricing pool, which is the domestic gas or the expensive one, LNG.

Gas Supply Allocation:

The calculation of Pricing Option 1 is straightforward to undertake, while Pricing Option 2 is based on an allocation process. This Option started by allocating the gas from the supply pools to different end users. Over time, the level of production in Pool 1 (Khuff Gas) will decline to be replaced by output from Pool

2 (Deep Gas) and from Pool 3 (Imported LNG or Pipeline Gas) and Pool 4 which is the LNG supply, including the expansion of the Terminal.

It should be stressed that under Pricing Option 2 and 3, the allocation of the priorities by user or category of users are determined based on a Policy Decision. Once these priorities have been set, then reflecting these priorities, the gas supply allocation or supply dispatch process from different supply pools is automatically carried out by the gas pricing model.

4.3 Future Gas Supply Scenarios

To assess the new gas pricing model under different circumstances, we need to develop a set of two scenarios to compare how gas prices would change over time. The scenarios take into consideration the likelihood of Natural Gas Pipeline opportunity on the overall gas supply balance. The two scenarios are:

- **Scenario 1:** Government to develop a new pipeline of Natural Gas supply from neighbouring country. In this case Pool 3 will be for the pipeline gas with lower cost than LNG. LNG will be moved to Pool 4 and there will be no need for the terminal expansion.
- **Scenario 2:** Natural Gas Pipeline opportunity is not an option. In this case, we will have only the LNG to cover the shortage of the supply from the domestic gas and terminal expansion will be required to cover the future shortage, which would result in high gas pricing for customers.

Scenario one is expected to yield the lowest set of gas; while Scenario 2 reflects the opposite, resulting in the highest customer prices. Some gas users would find future gas price levels challenging under certain circumstances, affecting their economic stability.

A common feature among the scenarios is that there will be an increase in the gas prices in all options, explained by the significant rise in high-cost LNG import

requirements. Thus, LNG supplies become more dominant in the overall gas supply mix. The share of LNG imports in the total supply would increase, highlighting the impact of the assumed depletion for the Bahrain Field during the same period. the difference between the two scenarios is the status of the pipeline gas option whether it will be available, or dependent on LNG after the domestic gas.

4.3.1 Model Assumptions

The following assumptions were made in developing the natural gas pricing model to ensure a comprehensive and accurate analysis of Bahrain's future gas supply, demand, pricing, and economic impact.

The assumptions used in this model are grounded in multiple sources to ensure their relevance and reliability. They were developed based on expert interviews with various stakeholders who possess specialized knowledge of Bahrain's natural gas market.

In addition, the assumptions draw upon findings and recommendations from relevant literature and prior studies. The development process also benefited from close collaboration with staff from gas supplier and regulator, whose technical input and domain expertise significantly contributed to the robustness of these assumptions.

- **Domestic Gas Production Decline:**
  - Domestic natural gas production is expected to decline over time, leading to an increased reliance on imported LNG.
  - The forecast for natural gas supply from the Bahrain Field includes Khuff gas and Deep gas, incorporating expected production decline trends.
  - The decline assumptions for Khuff from 2025 to 2040 are based on interviews and discussions with gas supplier and regulator.

- **Gas Demand Forecast:**
  - The gas demand forecast covers all gas consumers, including Customer 1 power plants and industrial customers, for 2025–2040.
  - A 2% annual increase in gas demand is assumed for Customer 1. In contrast, industrial gas demand is projected based on actual historical consumption and approved volumes for each customer based on the information available at gas supplier.
- **Customer Prioritization:**
  - Customer prioritisation is determined based on their criticality to the Kingdom's economy and overall energy security.
  - The priority ranking is as follows: Customer 1, Small Customers, Customer 3, Customer 2, Customer 4, Customer 5, Customer 6 and Customer 7.
  - This prioritisation is essential for determining the allocation of gas supply among different customer pools.
  - This assumption was discussed and agreed during the interview with gas supplier and regulator representatives.
- **Domestic Gas Production Costs:**
  - The production cost for domestic gas is assumed as follows: Khuff Gas: $1 per MMBtu and Deep Gas: $2 per MMBtu
  - These cost assumptions are based on interviews and discussions with gas supplier, the natural gas producer in Bahrain.
- **Domestic Gas Distribution Network Costs:**
  - Distribution and compression costs within the network are assumed to be included in production costs, based on discussions with gas supplier.
  - Therefore, the domestic gas model considers no additional charges for gas distribution and compression.
- **LNG Costs and Importation Risks:**
  - The cost structure for LNG imports includes Regasification Cost: $0.50 per MMBtu and Importation Risk-Associated Cost: $1.50 per MMBtu

- These assumptions are derived from market data, industry best practices, and discussions with global energy market experts.

- **LNG Price Forecast:**
  - Forecasts for Brent and Henry Hub gas prices from 2025 to 2040 are based on publicly available sources such as Platts and the EIA.
  - The pricing slope and intercept are determined based on market research, expert interviews, and global industry practices.
  - The model includes multiple pricing scenarios: Brent and Henry Hub price-based forecasts, An average of both forecasts and a fixed LNG price assumption of $8 per MMBtu (Long-term contract).
- **Future Pipeline Gas Supply Costs:**
  - Future pipeline gas supply costs are assumed as follows: Commodity price: $5 per MMBtu, Distribution cost: $0.50 per MMBtu and Compression cost: $0.50 per MMBtu.
  - These assumptions are based on interviews with industry stakeholders.
- **Government Rent and Supply Charge:**
  - Government rent is assumed to be $2.50 per MMBtu for all years to maintain stable revenue generation despite the transition to LNG imports.
  - A supply charge of $0.50 per MMBtu is included, consistent with current gas pricing structures.
- **Inflation and Cost Escalation:**
  - An annual inflation rate of 2% is assumed for supply costs based on historical inflation trends and industry expectations in Bahrain after consultation with industry stakeholders.
- **Future Supply Options:**
  - Two future supply options are considered to meet growing gas demand: Expansion of the LNG import terminal and development of a new gas supply pipeline.
  - The model evaluates both options across all worksheets.

- In scenarios where pipeline gas is available, the supply pools are assigned as follows: Pool 3: Pipeline gas, Pool 4: LNG.
- If pipeline gas is unavailable, the pools are allocated as follows: Pool 3: LNG from the existing terminal, Pool 4: LNG from the expanded terminal.

- **Volume-to-Energy Conversion:**
  - The conversion of natural gas volume to energy is based on the following heating values: Khuff Gas: 860 BTU/SCF and LNG: 1060 BTU/SCF.
  - These values are derived from actual data provided by gas supplier.
- **Project Analysis Assumptions:**
  - The capital cost of the LNG terminal expansion project is assumed to be $1 billion.
  - The assumed interest rate for financing is 5% and the project lifespan is set at 15 years.
- **GDP per Capita Forecast Assumptions:**
  - The model incorporates the historical GDP and GDP per capita in Bahrain, assuming that the Annual population growth rate is 2% and the GDP growth rate is 3% based on historical available data.

These assumptions form the foundation of the natural gas pricing model, ensuring a structured approach to forecasting gas supply, demand, pricing, and economic impact over the period 2025–2040.

4.4 Model Methodology

The natural gas pricing model follows a structured methodology to ensure accuracy and reliability. The model uses various data sources to forecast natural gas pricing, including:

- **Gas Supply and Demand Data:** Customers projected forecast data, Domestic production forecasts, LNG import quantities, and potential pipeline gas supply.

- **Costs Structures:** Gas supplier production costs for both Khuff and Deep gas, LNG importation cost, LNG regasification cost, Gas distribution cost and Gas compression cost. The distribution and compression costs are for both domestic supply and future pipeline gas options.
- **Financial Parameters:** LNG historical prices, LNG price forecasts based on Brent, Henry Hub and long-term contract, the inflation rate, government rents and supply charges, historical GDP and GDP per capita for Bahrain over the last five years are based on officially published sources and economic and financial data published by the gas consumers.

4.4.1 Pool Pricing Mechanism

The pool pricing framework categorises gas supply into distinct pools:

Pool 1: Domestic Gas (the cheapest supply source)

Pool 2: Deep Gas (higher extraction costs than conventional sources)

Pool 3: LNG from the existing terminal (higher cost imported gas)

Pool 4: Future Pipeline Gas (potential alternative to LNG) or LNG from the new terminal if the pipeline gas option is not available.

The model assigns each customer to a specific pool or combination of pools, depending on the priority of this customer in Bahrain and the quantity needed. The highest-priority customers will have priority access to the cheapest pool.

4.4.2 Gas Pricing Options

The model employs four key pricing options; each option is based on a pool pricing framework:

- **Option 1- Single Pool (Weighted Average Cost of Gas (WACOG)):**
  - All gas supply sources are combined into a single pricing pool and a weighted average cost is calculated based on the contribution of each source.

- This uniform price is then applied to all customers, ensuring simplicity but without differentiation based on the actual supply source used by each consumer.

- **Option 2 - Multiple Pools (Averaging Costs):**
  - The calculation in Excel segregates the gas supply into multiple pools, each representing a distinct set of supply sources.
  - The cost of each pool is determined by averaging the infrastructure charges, supply costs, and government rent, while the commodity price may vary depending on the pool.
  - The final price for each customer is determined based on the assigned pool, maintaining a balance between cost reflectivity and administrative efficiency.
- **Option 3 - Multiple Pools (Attributable Costs):**
  - The gas supply is segregated into multiple pools, each representing a distinct set of supply sources.
  - The model calculates the cost of gas individually for each customer based on the exact supply source it receives.
  - The commodity price, infrastructure charges, supply costs, and government rent are all assigned separately to each customer based on their specific supply allocation.
  - This ensures full cost reflectivity but results in varying prices across customer segments.
- **Option 4 - Hybrid Pricing Model:**
  - The model applies a combination of Option 1 (WACOG) and Option 3 (Attributable Cost) models.
  - This model differentiates between the high-priority and low-priority customers during the transition period. High-priority customers will follow Option 3, where their gas pricing is based on the lowest pool price to ensure price stability and prevent any increase in their gas costs. In

contrast, low-priority customers will follow Option 1, exposing them to a gradual increase in gas prices throughout the transition period.

- After the transition period, all customers are charged based on Option 3, considering the high priority customers will have access to the cheapest pool.

4.5 Model Design

The natural gas pricing model is built to estimate the natural gas prices and analyse the economic impact of various pricing options by integrating:

- Gas supply and demand forecasts
- Gas cost structures
- LNG projected prices
- Gas pricing scenarios analysis
- Different economic and financial analysis

The Model Sheets: The natural gas pricing model is structured as follows:

- **Assumptions:** Predefining all assumptions related to gas supply demand, Gas Supplier Production costs, LNG costs, LNG prices forecast, Pipelines gas cost, Inflations forecast, etc.
- **Calculations:** Gas supply, demand, and costs are determined to define the Pool Prices needed for the gas pricing options.
- **Pool Prices:** The pool prices are determined for each gas supply pool by combining the cost elements to calculate the end user price for each pool. Averaging costs are also calculated to define the Multiple Pool (Averaging Costs option).
- **Pool 1:** The existing Khuff gas from Bahrain field gas supply is allocated to the priority users first and then any remaining gas to other users, where

priority demand is over the Bahrain Field gas supply, the balance is then allocated to Pool 2 (Deep Gas).

- **Pool 2:** Pool 2, which Bahrain's Deep Gas supplies, takes the balance of gas demand not met by Pool 1 (Bahrain Field), with any further unmet demand passed to Pool 3 (imported LNG or pipeline gas if available).
- **Pool 3:** The balance of the remaining gas demand is allocated to Pool 3 for the imported LNG supply or pipeline gas if available. The balance is then allocated to Pool 4.
- **Pool 4:** The balance of the remaining gas demand is allocated to Pool 4 for the imported LNG supply using the new expansion terminal or existing terminal if pipeline gas option was available in Pool 3.
- **Option 1:** This worksheet "Option 1" calculates a simple weighted average or weighted average cost of gas (WACOG), as described previously in this report, assuming that all gas supply pools are combined and produce a single-weighted the average price for all the above-mentioned gas users. The final gas prices for all individual gas consumers throughout the Study period are also illustrated in this worksheet.
- **Option 2:** This is the summary of gas prices for all gas users over the Study period under Option 2, which is based on the calculation under the Multiple Pool option with averaging the costs. The figures are taken directly from the worksheets, which were built for individual gas users.
- **Gas Users worksheets for Option 2:** The derived gas prices for each gas user under Option 2 is calculated.
- **Option 3:** This is the summary of gas prices for all gas users over the Study period under Option 3, which is based on the calculation under the Multiple Pool option with attributable costs. The gas price figures for each gas user will be prepared separately, with a dedicated sheet that includes the corresponding supply and demand analysis and detailed pricing calculations.

- **Gas Users worksheets for Option 3:** The derived gas prices for each gas user under Option 3 is calculated.
- **Hybrid Option:** In the transition period (2025-2028), the gas prices for high-priority customers are based on Option 3 while the remaining customers are based on Option 1. From 2029 onwards all gas customers are based on Option 3.
- **Transition Period Subsidy:** The government subsidy required to support high-priority customers, including Customer 1, Customer 2, Customer 3, and small customers, during the transition period from year 2025 to year 2028. The subsidy ensures that these customers continue to receive gas at a fixed price of $4 per MMBtu during this period.
- **Gas Prices Analysis:** The impact of various gas pricing options on each gas customer from 2025 to 2040 is analysed for the impact of each pricing option on each customer.
- **Cost and Revenue Analysis:** The total costs and expected revenues under the four pricing options are compared for financial feasibility.
- **Reform Comparison:** multiple reform scenarios, including a no-reform case, individual pricing options, and the Hybrid reform are evaluated based on comparative analysis (revenue, cost and gross profit) to assess the economic and financial implications of implementing different pricing strategies.
- **Project Analysis:** An economic feasibility study for an LNG terminal expansion project. It evaluates the project's viability by comparing expected returns with the weighted average cost of capital (WACC) and incorporating assumptions related to its capital cost and interest rate.
- **Customer 2 Economic Analysis:** The economic impact of the projected gas prices on Customer 2. It examines Customer 2 affordability under the Hybrid

pricing scenario, evaluating the effect on its cash flow and overall economic sustainability.

- **GDP Per Capita & GDP Per Capita Forecast:** Historical GDP per capita trends in Bahrain and project future GDP per capita under different gas pricing options incorporating the renewable energy integration and LNG Export option. The forecasts provide insights into how various pricing strategies may influence economic growth and income levels.
- **LNG Prices Forecast:** Different LNG price forecasting methods, including Henry Hub, Brent, Long-Term Contracts, and a blended average of Henry Hub and Brent. It projects LNG price trends from years 2025 to 2040 to support strategic decision-making on gas procurement and pricing policies.

4.6 LNG Projected Gas Prices

LNG prices can be calculated using a variety of approaches depending on the benchmark and pricing structure. Two standard pricing methods are based on the Henry Hub and Brent.

1. **Henry Hub-Linked Pricing:** The formula for U.S. LNG pricing is based on 115% of the Henry Hub price, with an additional liquefaction fee of $2.25 to $3.50/MMBtu, depending on the contract terms. This approach accounts for procurement and liquefaction costs, with shipping added separately. This method has been increasingly adopted globally, especially by U.S. LNG exporters.

- Henry Hub Price: The spot price of natural gas at Henry Hub, quoted in $/MMBtu.
- 115% (Slope): This accounts for the cost of procurement and losses in the liquefaction process.

- Liquefaction fee (Constant): A fixed fee paid by the buyer, usually between $2.25 to $3.50/MMBtu, depending on the contract. (Assumed as $2.5/MMBtu)
- Shipping and re-gasification (Constant): Additional costs the buyer bears, which vary based on the distance to market and import terminal fees. (Assumed as $2.5/MMBtu)

2. **Brent Oil-Linked Pricing:** Brent-indexed LNG contracts typically use a percentage of the Brent price (around 10-14%) plus a constant fee. This model is more common in Asian markets and reflects the historical connection between oil and gas pricing.
    - Percentage (% Slope): A percentage that typically ranges from 10-14%, which reflects the correlation between oil and LNG prices. (Assumed as 12% based on international best practices and typical ranges observed in long-term LNG contracts)
    - Brent Price: The price of Brent crude oil per barrel, converted into $/MMBtu.
    - Constant: A fixed fee added to account for transportation or other fixed costs. (Assumed as $0.5/MMBtu based on international best practices and typical ranges observed in long-term LNG contracts).

The chart below shows the long-term forecast of expected LNG prices from 2025 to 2050, based on different Brent and Henry Hub price forecasts published by various reputable sources, including EIA, Platts, Bloomberg, and WM.

The projections indicate a gradual upward trend in Brent oil-linked LNG prices across all sources, reflecting anticipated market fundamentals and inflationary adjustments. In contrast, LNG prices indexed to Henry Hub exhibit a flatter trajectory with limited price escalation over the forecast horizon.

Chart 4.1 serves as a reference for long-term price expectations under different market scenarios, supporting the evaluation of pricing strategies and risk assessments in the context of Bahrain's gas pricing reform.

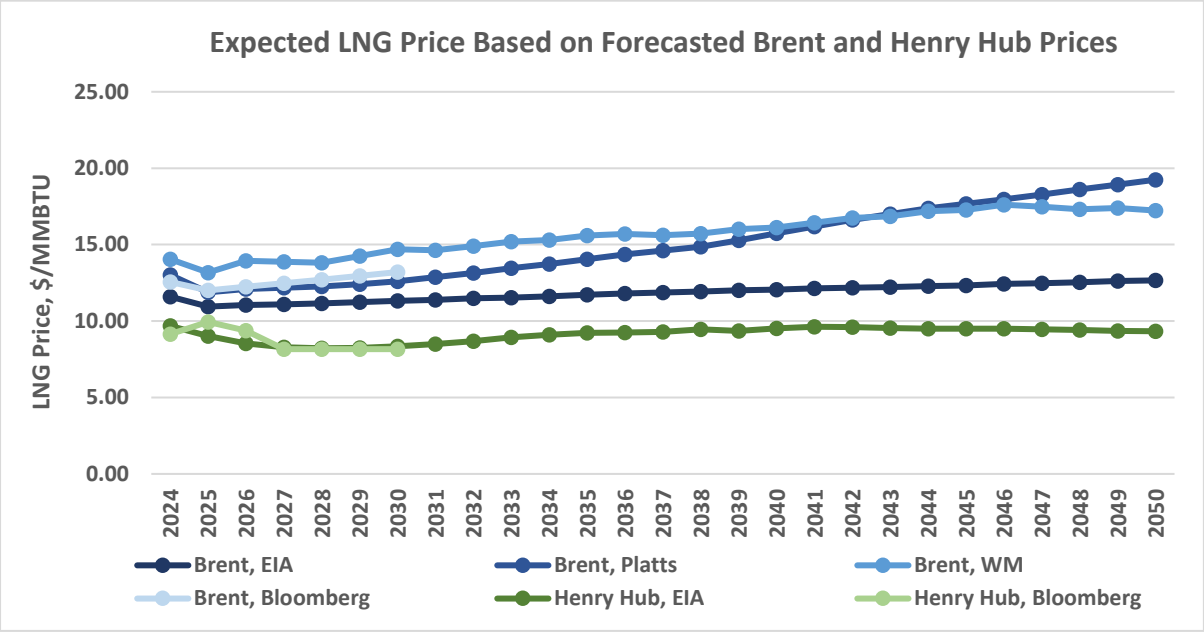


Chart 4.1: Expected LNG Price Based on Forecasted Brent and Henry Hub Prices

Source: Author's own construction based on data from EIA, Platts, Bloomberg, and WM (2025).

Calculating LNG prices based on Henry Hub and Brent prices:

Considering LNG prices, indexed to Henry Hub and Brent as 117% Henry Hub + 5 and 12% of Brent, from 2003, LNG prices have been calculated.

Chart 4.2 below presents the historical and near-term forecasted LNG prices based on Brent and Henry Hub gas price linkages from 2003 to 2024. The chart illustrates the fluctuations in LNG prices when indexed to Brent and Henry Hub prices, reflecting periods of volatility influenced by global energy market dynamics.

Notably, LNG prices linked to Brent showed significant increases during oil price spikes, particularly around 2008 and 2012–2014, while Henry Hub-based prices remained comparatively more stable but with some peaks. This figure highlights the historical relationship between LNG pricing and the underlying Brent and

Henry Hub indices, providing a basis for understanding price movements and potential risks during the transition period.

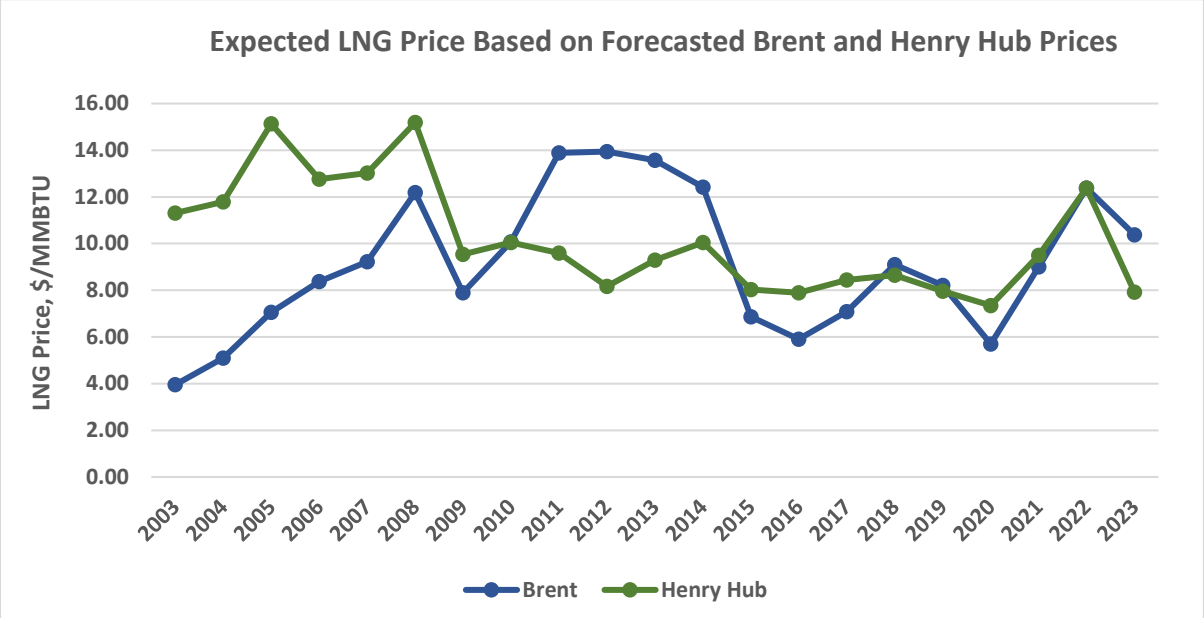


Chart 4.2: Expected LNG Price Based on Forecasted Brent and Henry Hub Prices

Source: Author's own construction based on data from EIA (2025)

4.7 Gas Prices Results

The following figures present the projected natural gas prices for all customers. From 2025 to 2040, these price projections are derived from the model's analysis, reflecting the expected trends and impacts of gas pricing options over time.

4.7.1 LNG Expected Prices

Since LNG is volatile, different scenarios that account for various price levels is considered for the coming years.

Chart 4.3 below presents the projected LNG prices under different pricing mechanisms, including Brent Oil-linked, Henry Hub-based, average of both and the Custom case which is based on the LNG long-term agreement fixed price. The data illustrates price trends over time across these different market options.

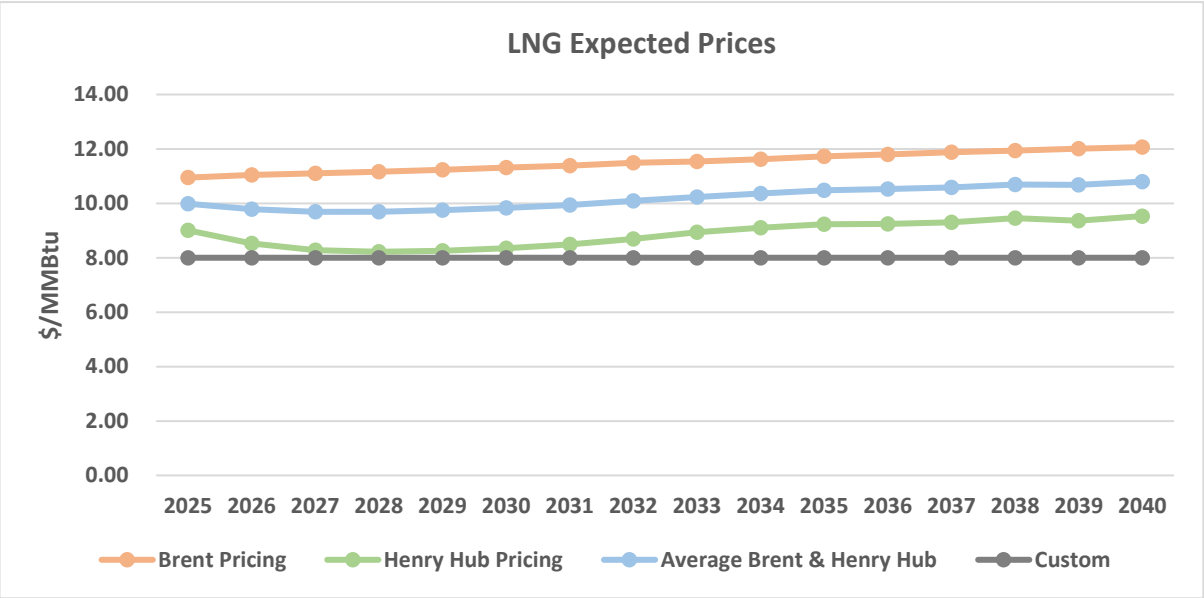


Chart 4.3: LNG Expected Prices (2025-2040)

Source: Author's own calculation from the developed gas pricing model (2025).

4.7.2 Gas Pricing Options Results

Option 1 - Single Pool Weighted Average Cost of Gas (WACOG):

Charts 4.4 and 4.5 below display the projected natural gas prices from 2025 to 2040 for gas customers under the pipeline gas and LNG terminal expansion scenarios using the WACOG pricing model.

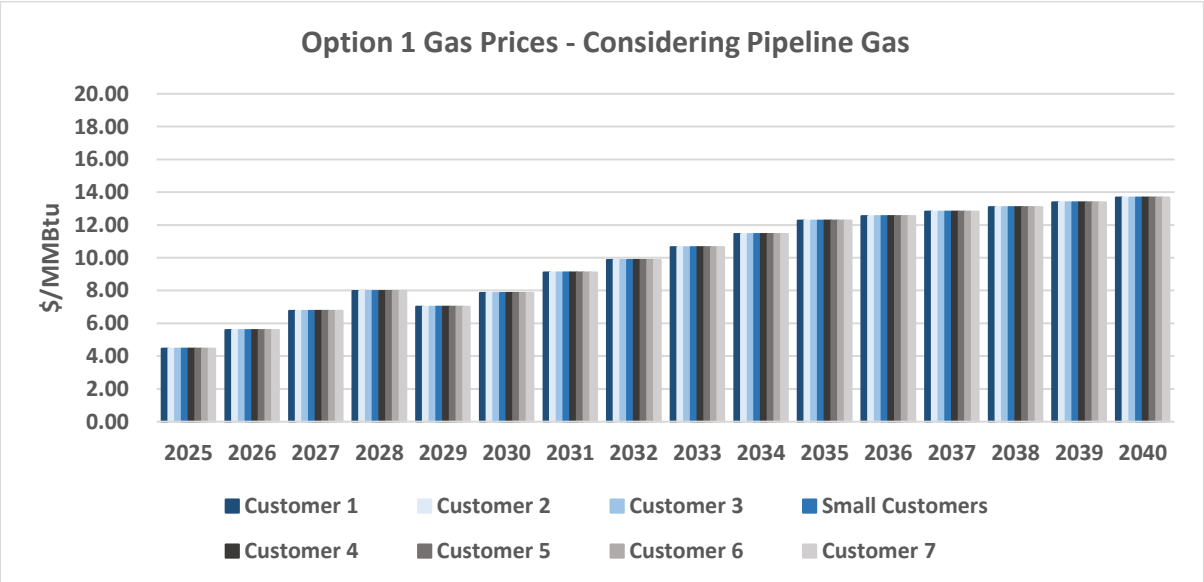


Chart 4.4: Projected Natural Gas Prices (2025–2040) based on Option 1 – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

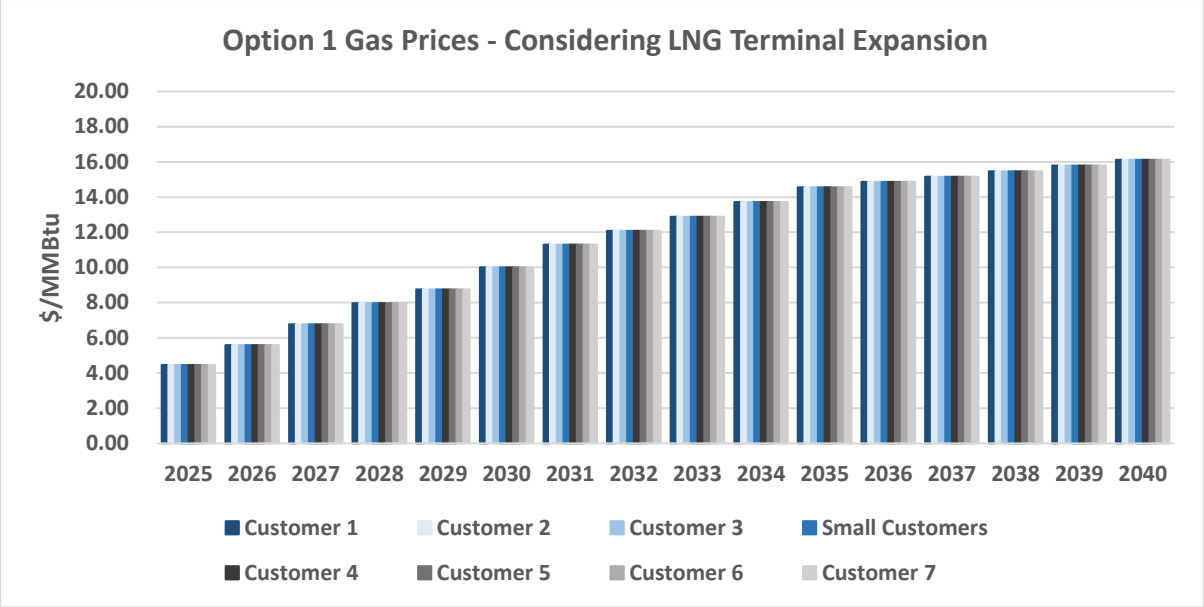


Chart 4.5: Projected Natural Gas Prices (2025–2040) based on Option 1 – Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Option 2 - Multiple Pools (Averaging Costs):

Charts 4.6 and 4.7 below show the projected gas prices under the multiple-pool pricing approach at average costs under the pipeline gas and LNG terminal expansion scenarios, where different gas customers are assigned average cost allocations while they depend on different pools for supply.

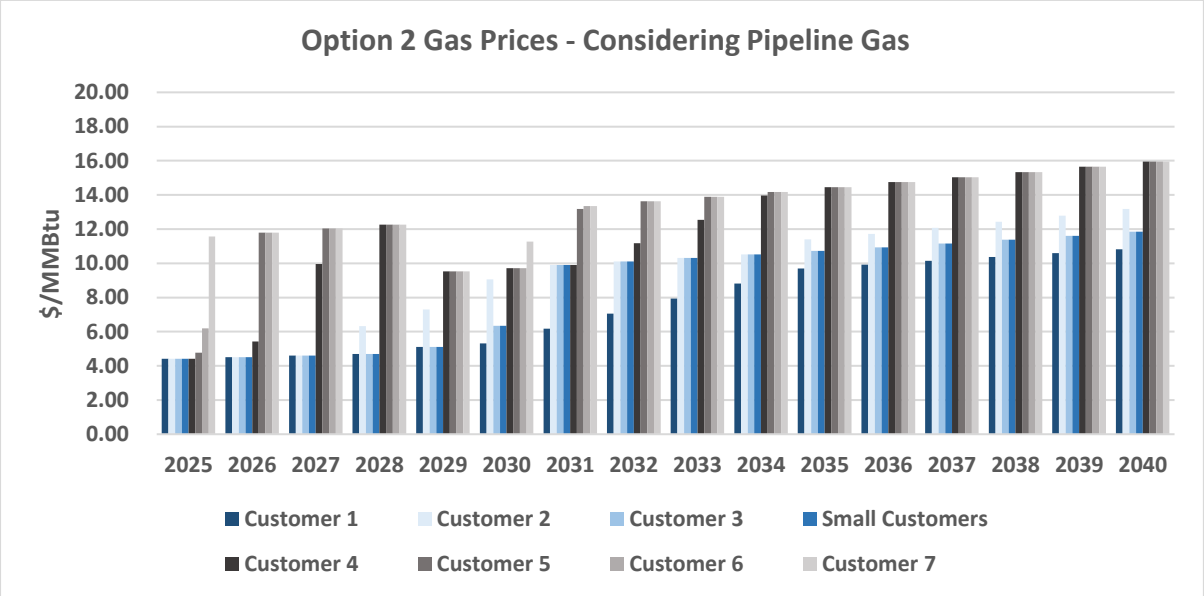


Chart 4.6: Projected Natural Gas Prices (2025–2040) based on Option 2 – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

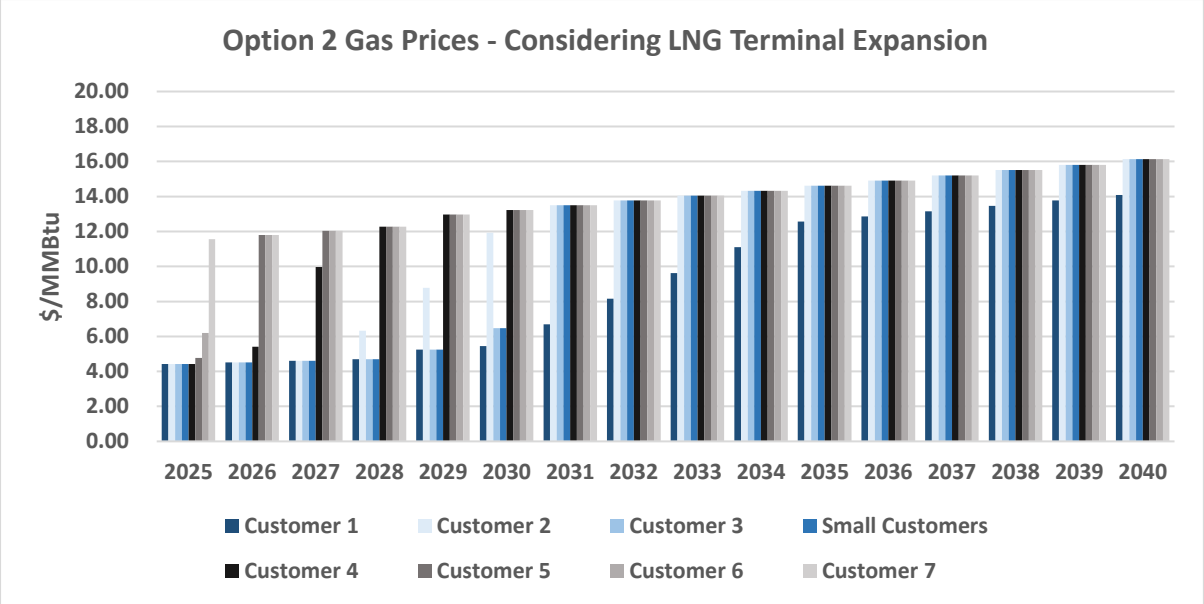


Chart 4.7: Projected Natural Gas Prices (2025–2040) based on Option 2 – Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Option 3 - Multiple Pools (Attributable Costs):

Charts 4.8 and 4.9 below depict the estimated gas prices under the attributable cost pricing approach under the pipeline gas and LNG terminal expansion scenarios, which assigns costs to gas customers based on their specific gas source.

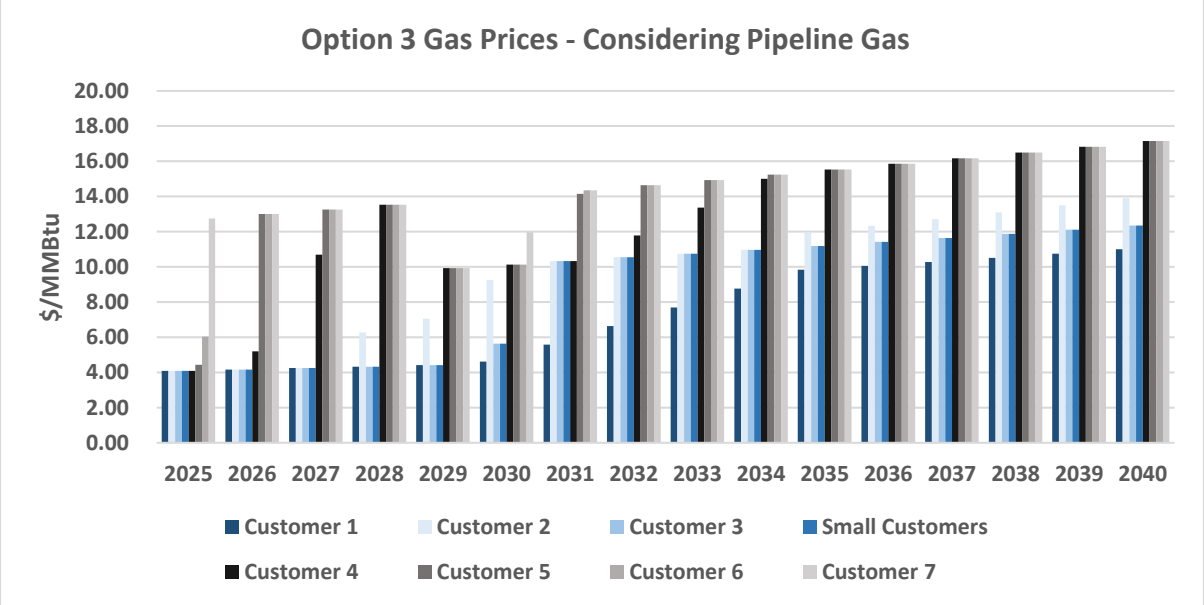


Chart 4.8: Projected Natural Gas Prices (2025–2040) based on Option 3 – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

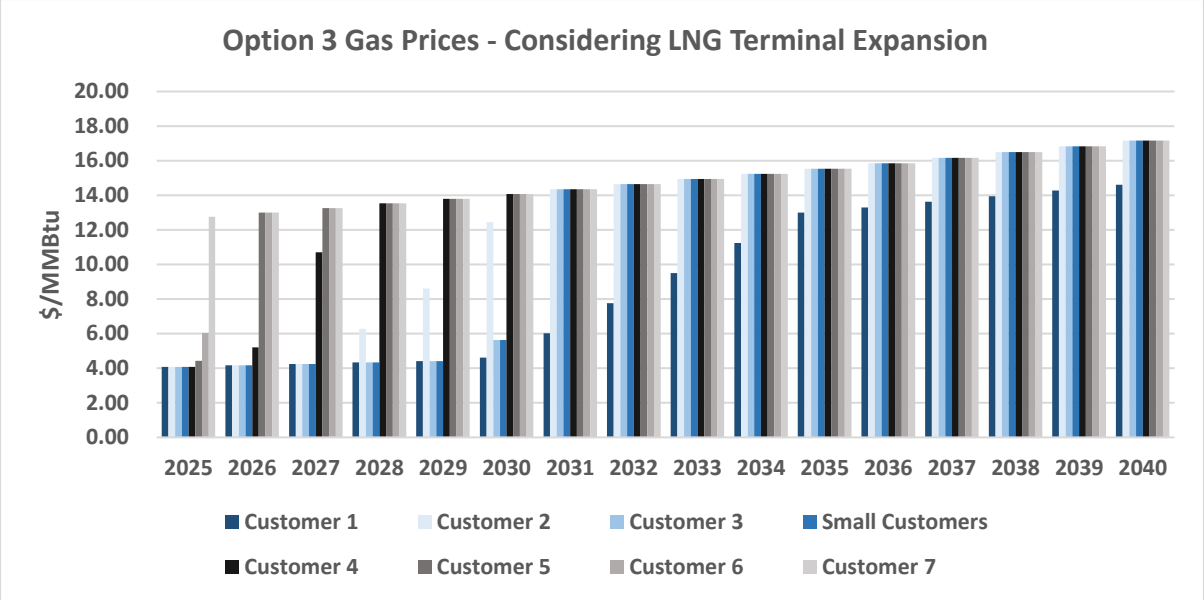


Chart 4.9: Projected Natural Gas Prices (2025–2040) based on Option 3 – Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Hybrid Option:

Charts 4.10 and 4.11 below present the estimated natural gas prices under the Hybrid pricing option where Option 3 is applied for the high-priority customers in the transition the period from 2025 to 2028, and Option 1 is applied to other major customers from 2029 onwards, Option 3 will be applied to all customers.

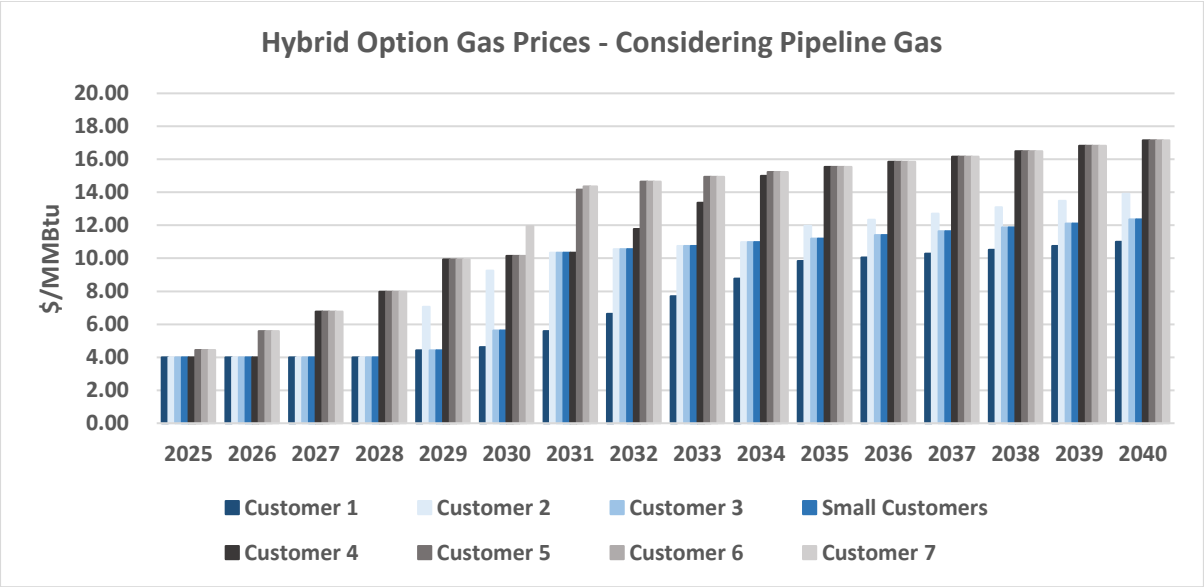


Chart 4.10: Projected Natural Gas Prices (2025–2040) based on Hybrid Option – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

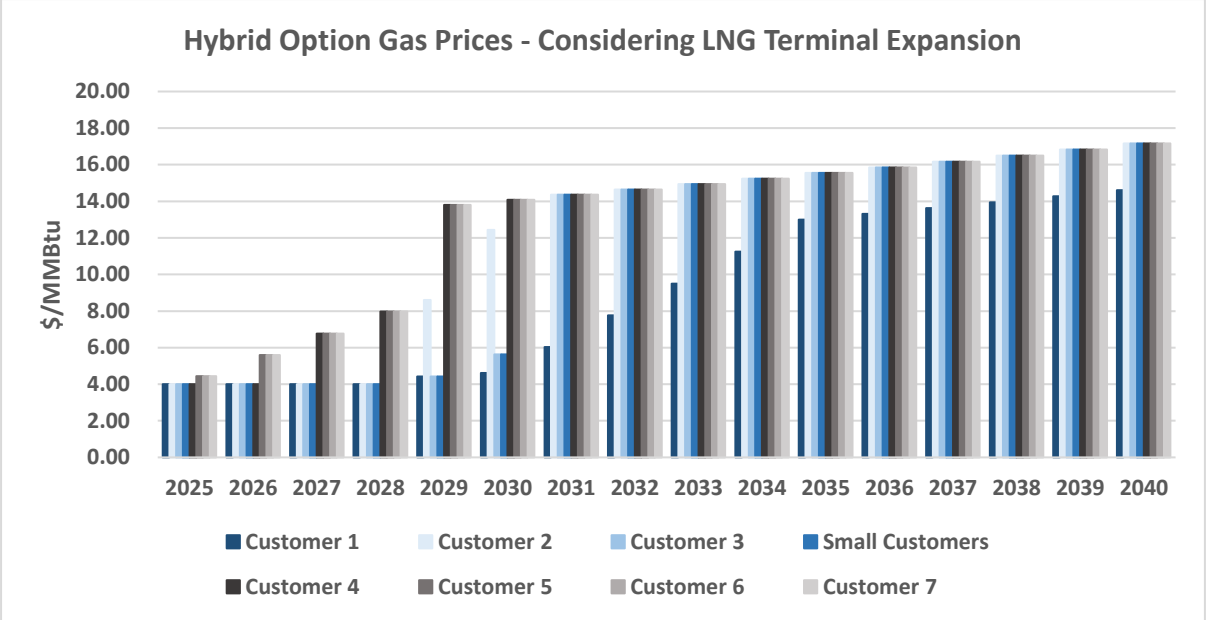


Chart 4.11: Projected Natural Gas Prices (2025–2040) based on Hybrid Option – Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

The projected gas price results across the reform options demonstrate that the proposed hybrid model achieves a gradual and controlled adjustment path. This structure reduces the risk of sudden price shocks, particularly for high-sensitivity and high-strategic consumers such as Customer 1 and Customer 2.

By implementing phased pricing reforms, the model minimizes the economic instability that could affect major gas consumers, ensuring that the cost burden is introduced progressively.

Additionally, the design helps to avoid sharp fiscal deficits for the government while balancing the financial impact on various customer segments. As a result, the overall disruption during the transition period is significantly reduced, maintaining stability across industrial operations and national energy planning.

4.8 Customers Gas Prices Analysis

The following charts 4.12–4.27 illustrate the projected gas price comparison for all individual customers across all possible gas pricing options: Option 1, Option 2, Option 3, and the Hybrid Option. Each customer's figure

presents a side-by-side comparison of these options, allowing for a precise evaluation of the pricing impact on this customer under different options.

Additionally, the analysis considers both cases, one where pipeline gas is available and another where the supply relies solely on the LNG terminal expansion.

- Considering Pool 4A: The pipeline gas option is available, and we will start with it before moving to the LNG.
- Considering Pool 4B: We only have the LNG option, and we will use the current terminal and the new existing terminal. The pipeline gas option is not available.

Price Behaviour for Gas Customers:

- **Customer 1:**

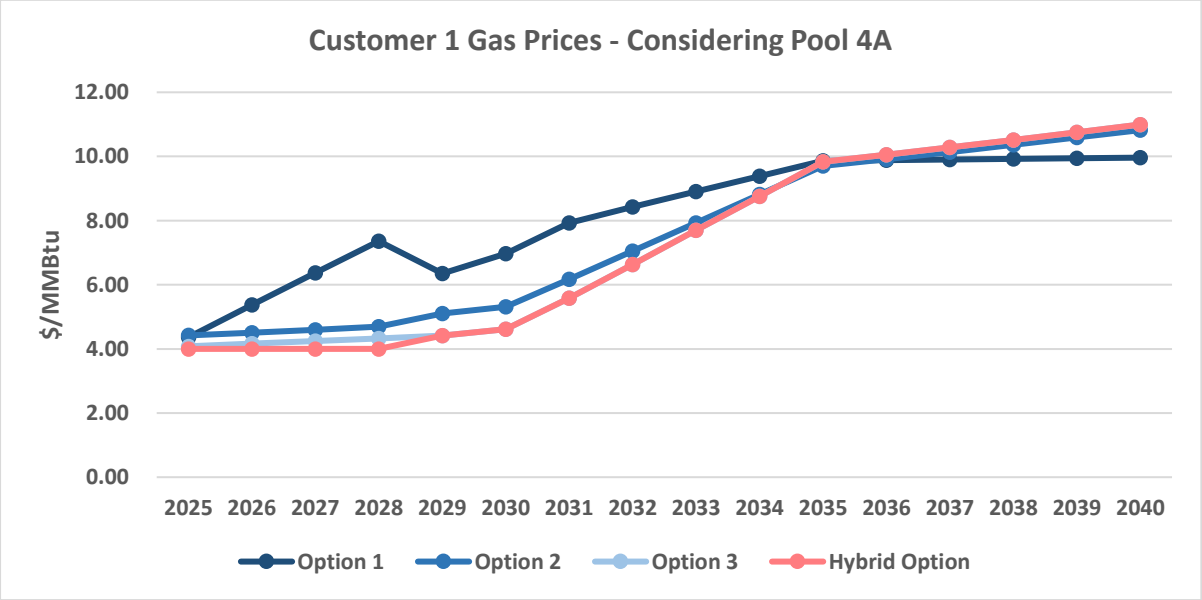


Chart 4.12: Customer 1 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

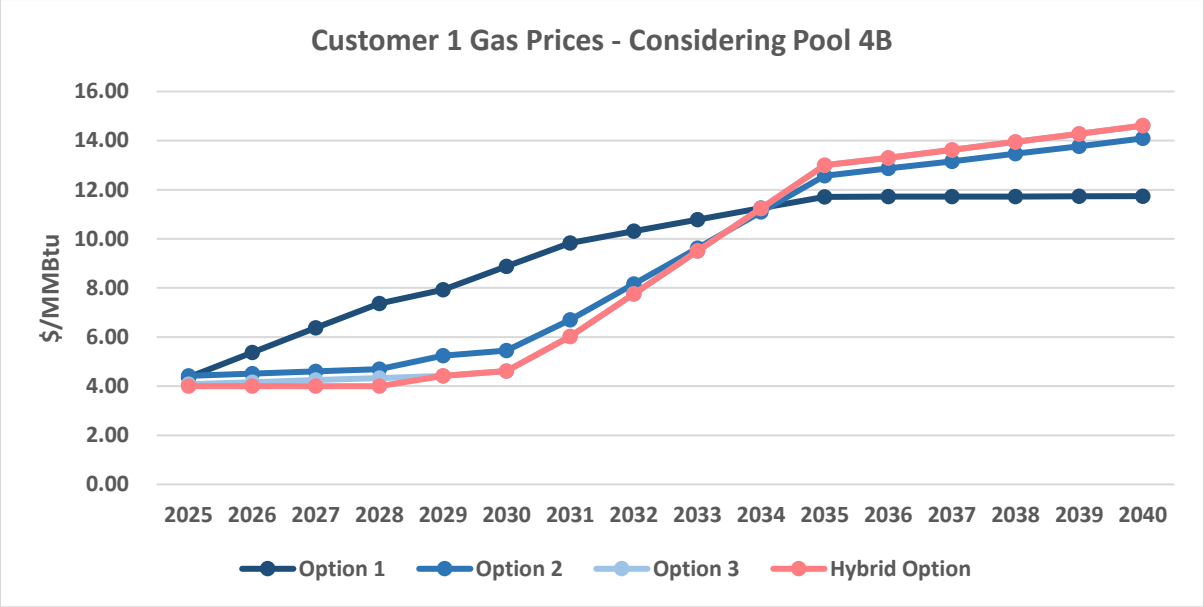


Chart 4.13: Customer 1 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Customer 2:**

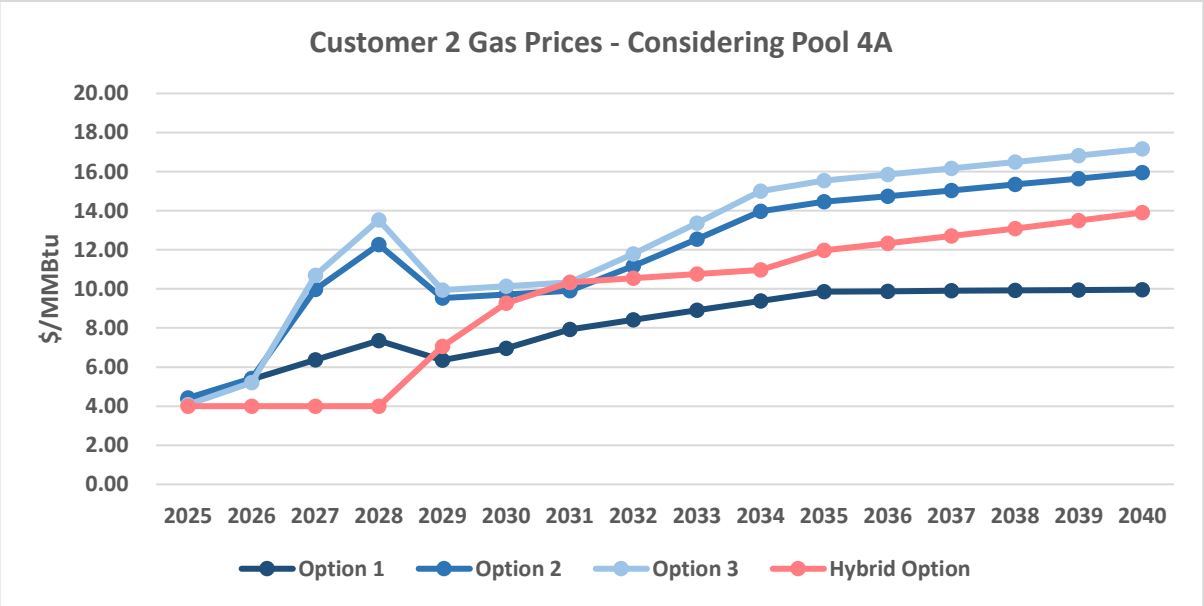


Chart 4.14: Customer 2 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

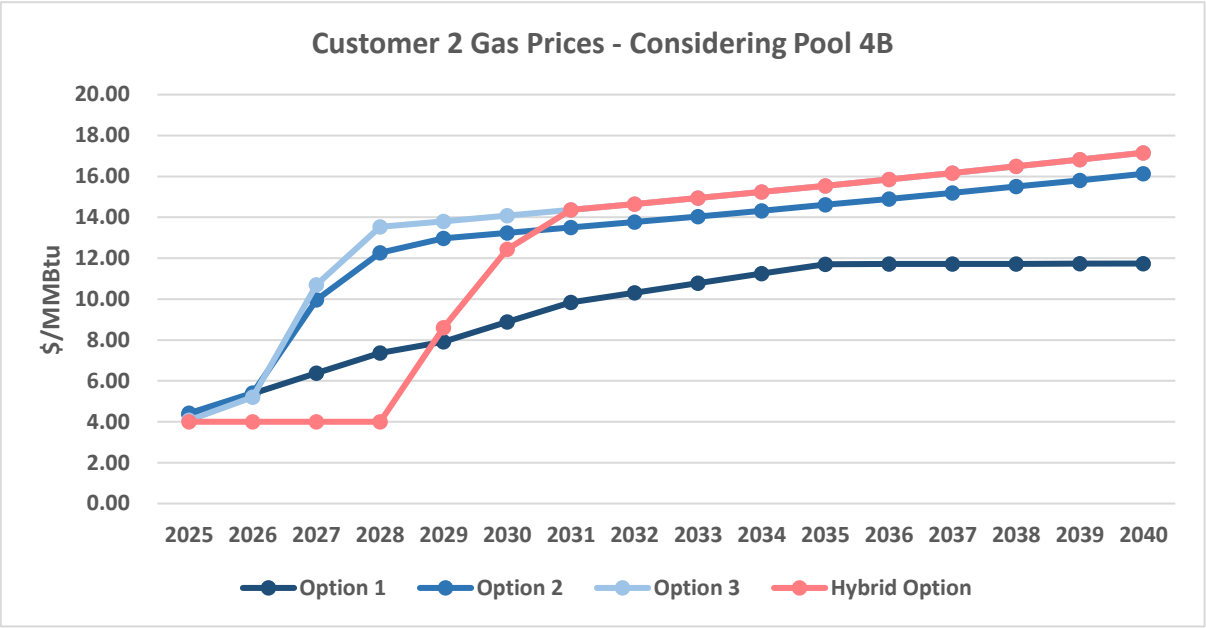


Chart 4.15: Customer 2 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Customer 3:**

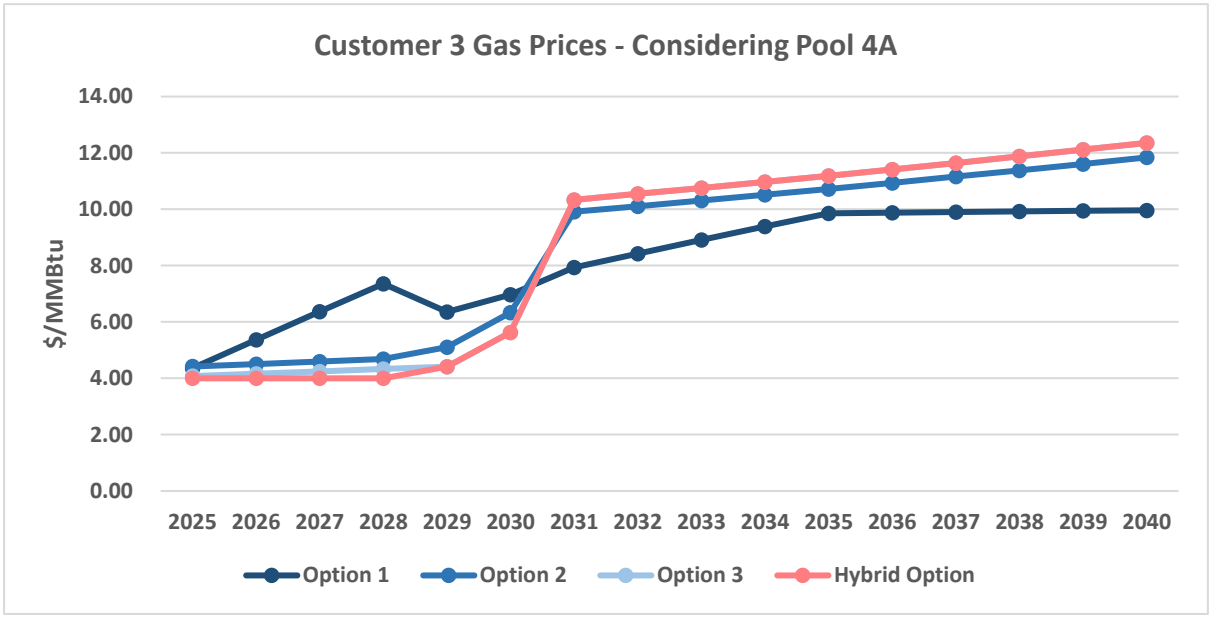


Chart 4.16: Customer 3 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

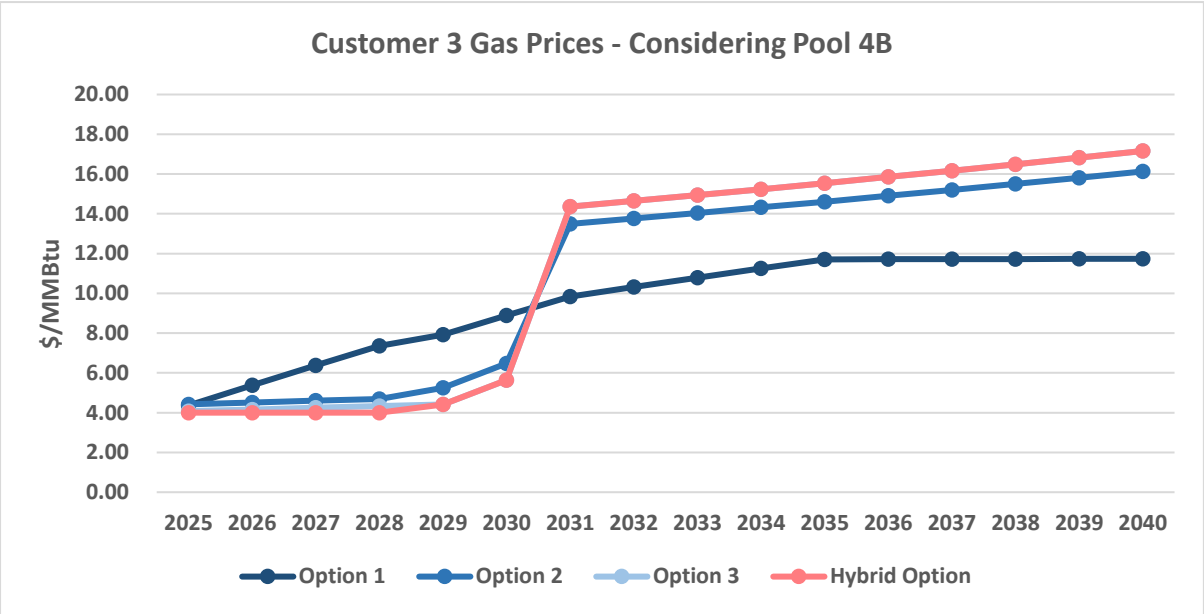


Chart 4.17: Customer 3 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Customer 4:**

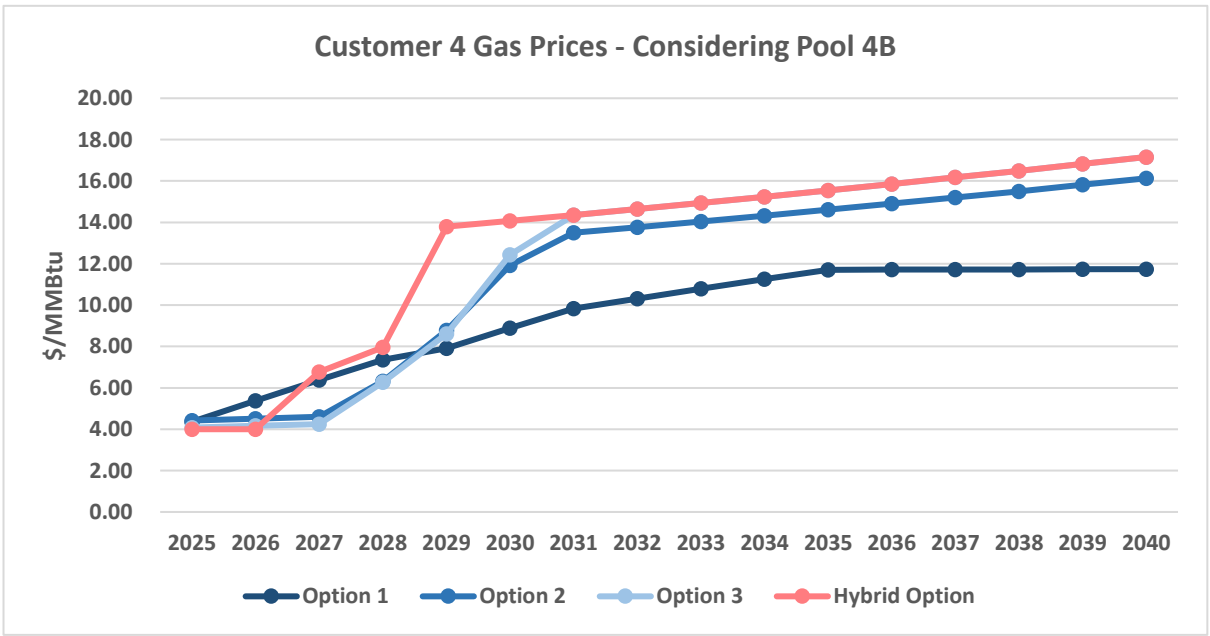


Chart 4.18: Customer 4 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

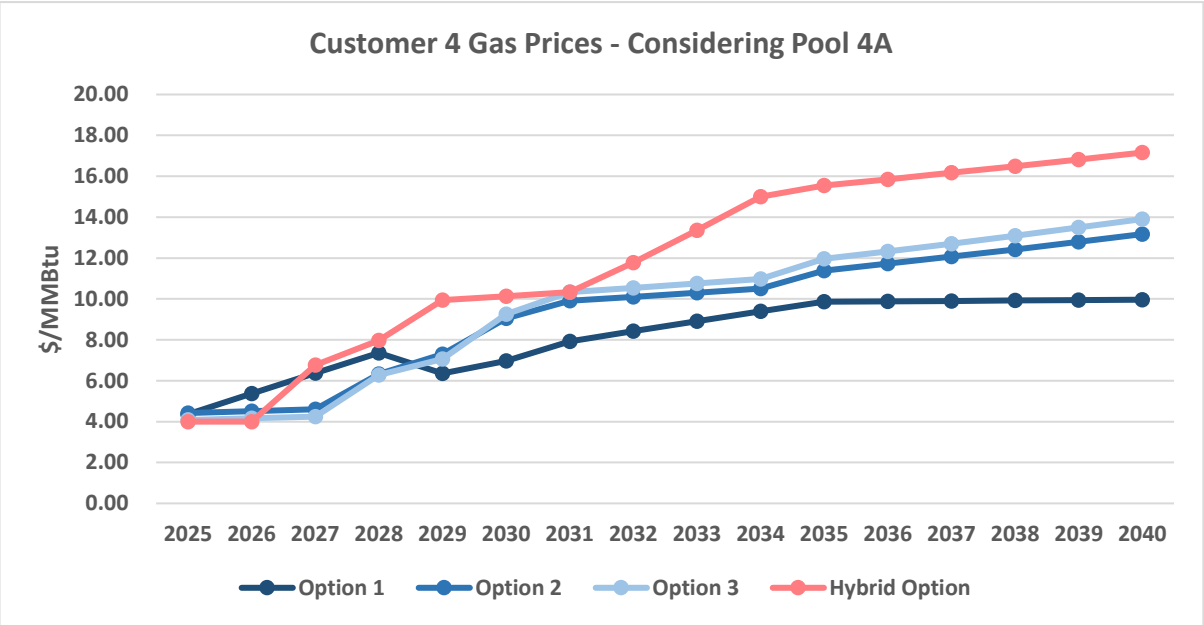


Chart 4.19: Customer 4 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Customer 5:

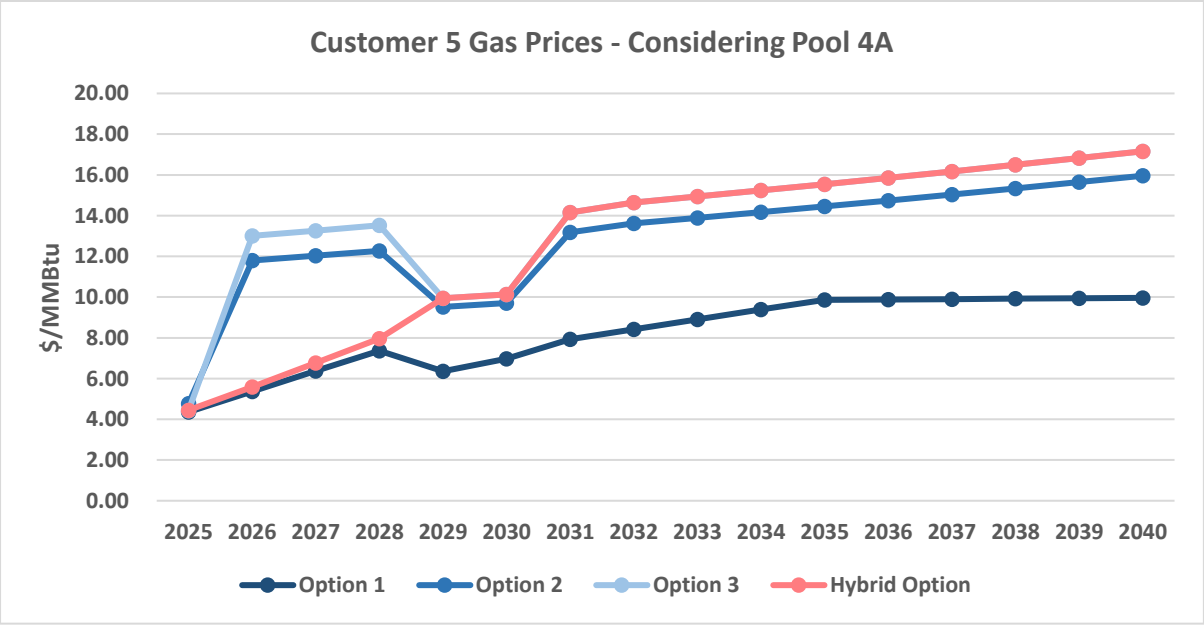


Chart 4.20: Customer 5 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

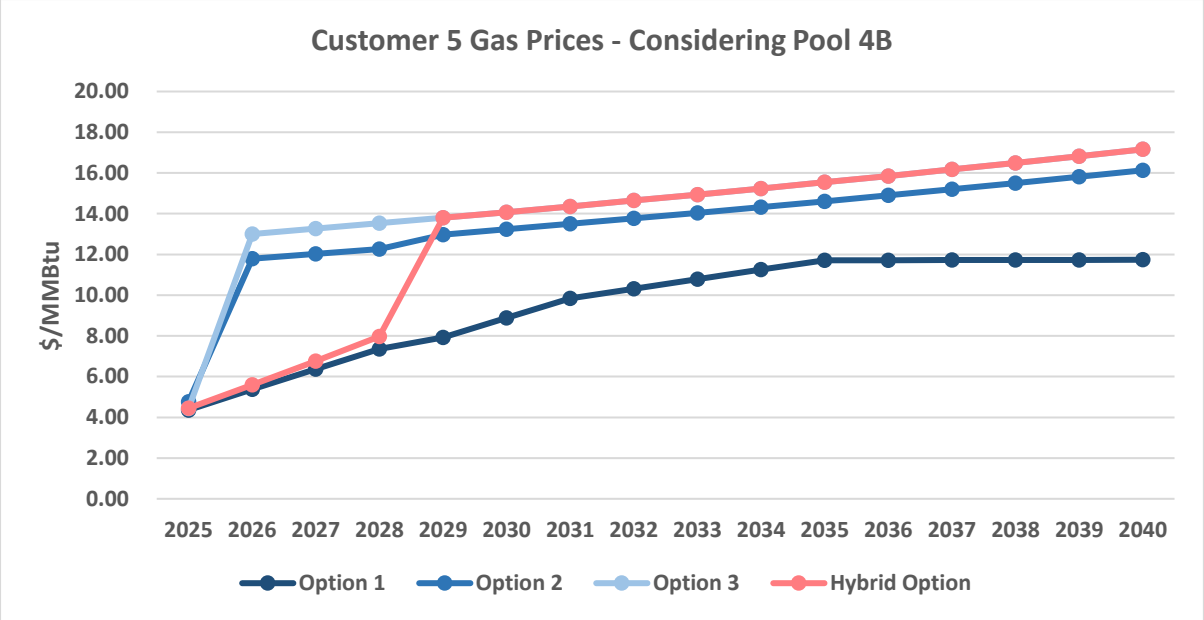


Chart 4.21: Customer 5 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Customer 6:

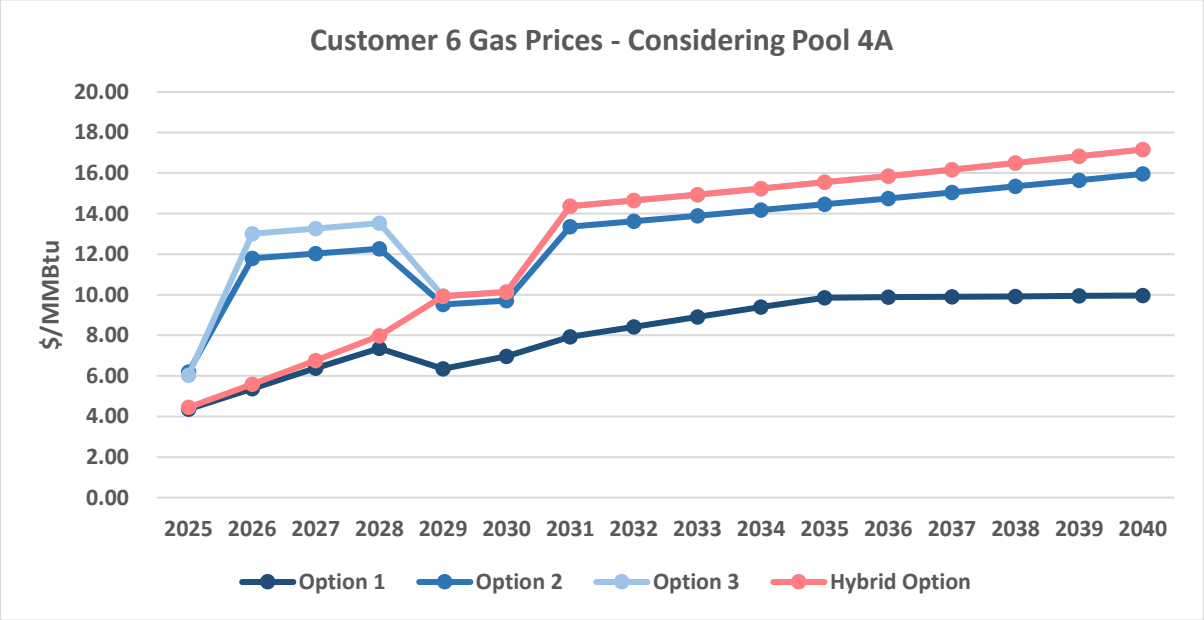


Chart 4.22: Customer 6 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

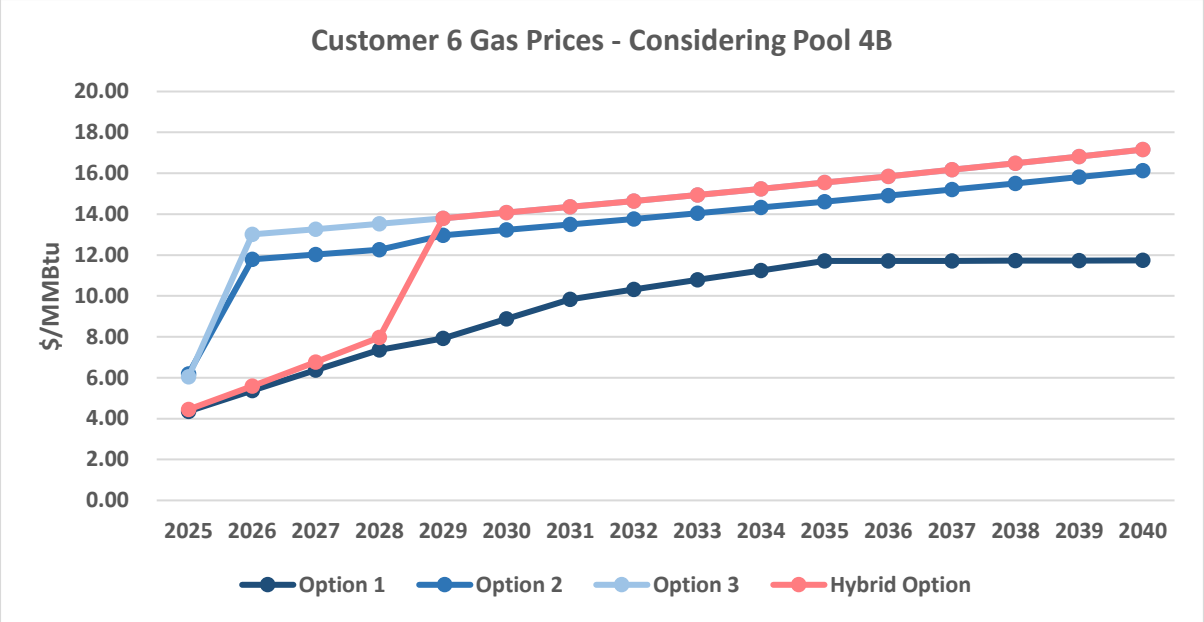


Chart 4.23: Customer 6 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Customer 7:

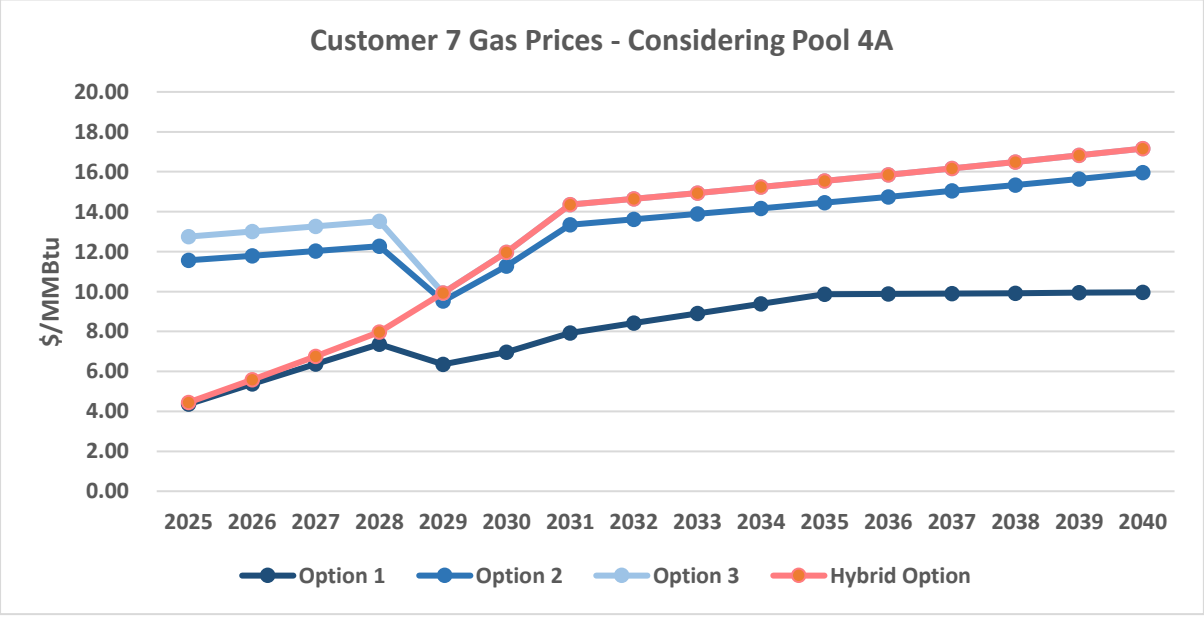


Chart 4.24: Customer 7 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

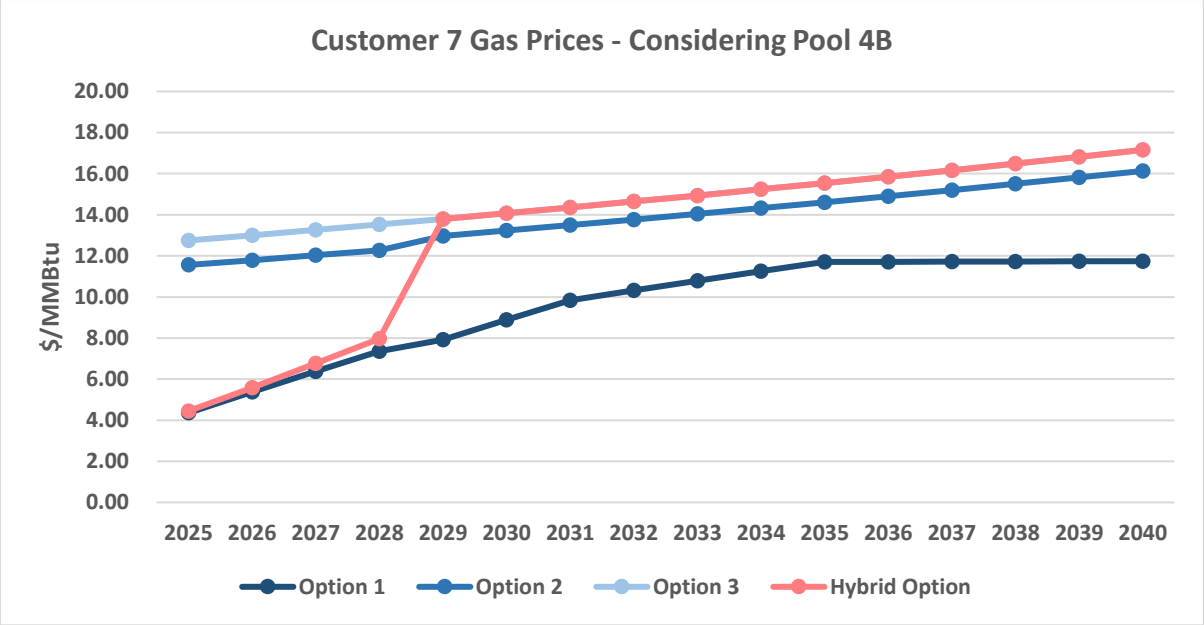


Chart 4.25: Customer 7 Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Small Customers:

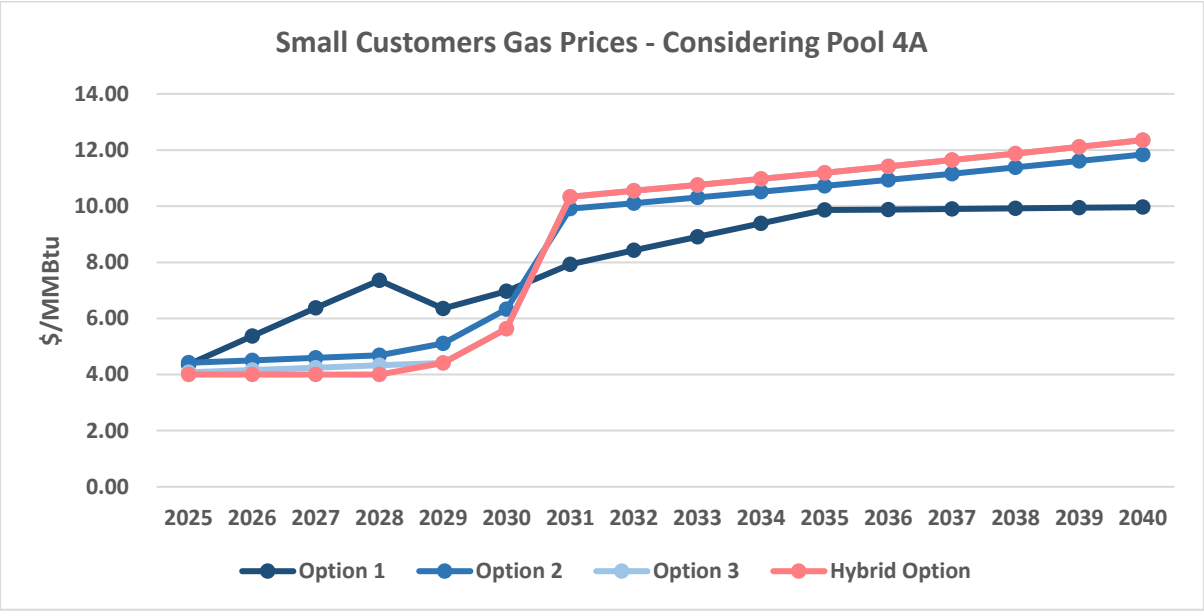


Chart 4.26: Small Customers Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

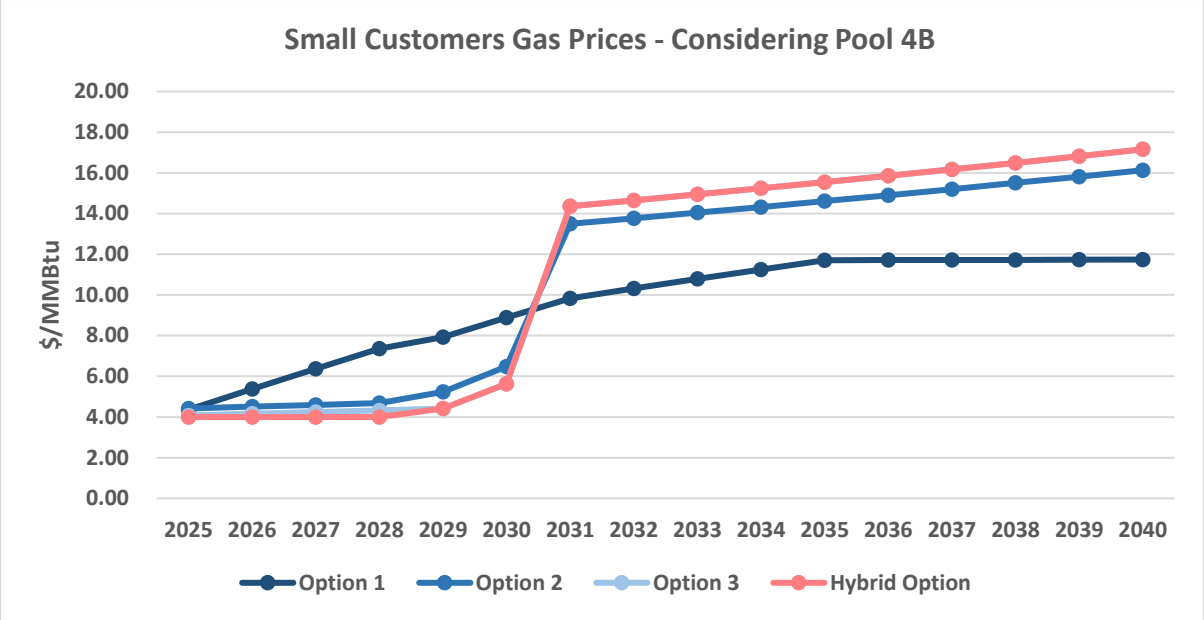


Chart 4.27: Small Customers Projected Natural Gas Prices (2025–2040) for all Gas Pricing Options – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

4.9 Cost and Revenue Analysis

The following charts 4.28-4.35 present the cost and revenue analysis for all gas sales across all options. This analysis highlights the financial implications of each option, assessing both the costs incurred and the revenue generated, along with the gross profit for the government (government margin).

- **Option 1:**

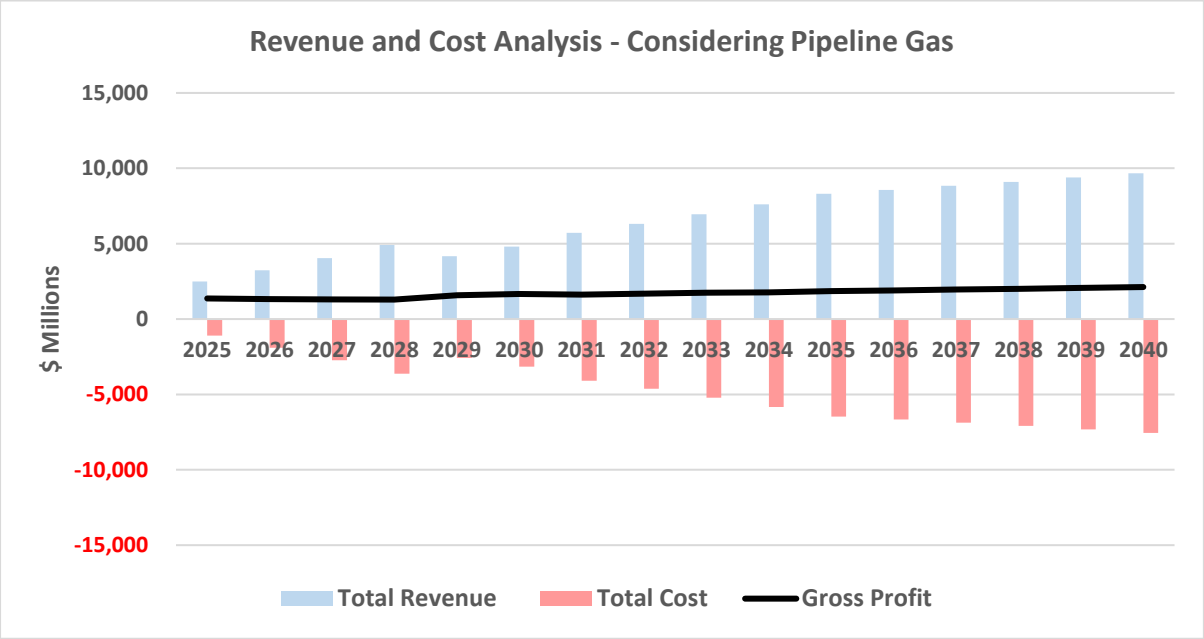


Chart 4.28: Cost and Revenue Analysis (2025–2040) for Option 1 – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

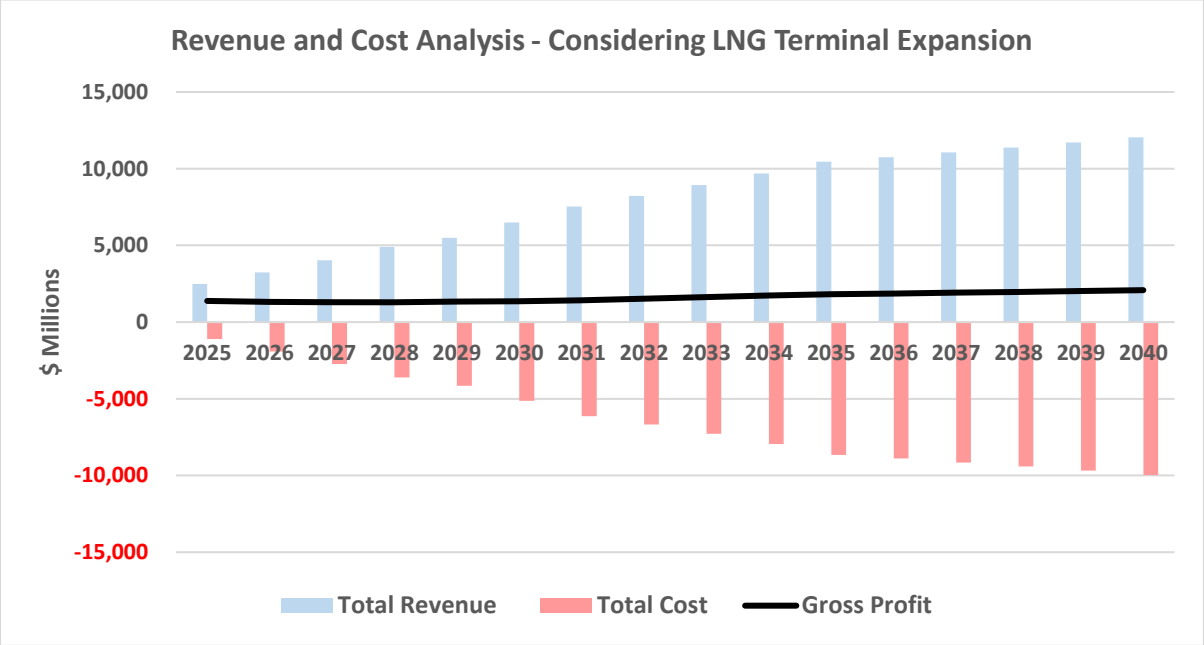


Chart 4.29: Cost and Revenue Analysis (2025–2040) for Option 1 – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Option 2:**

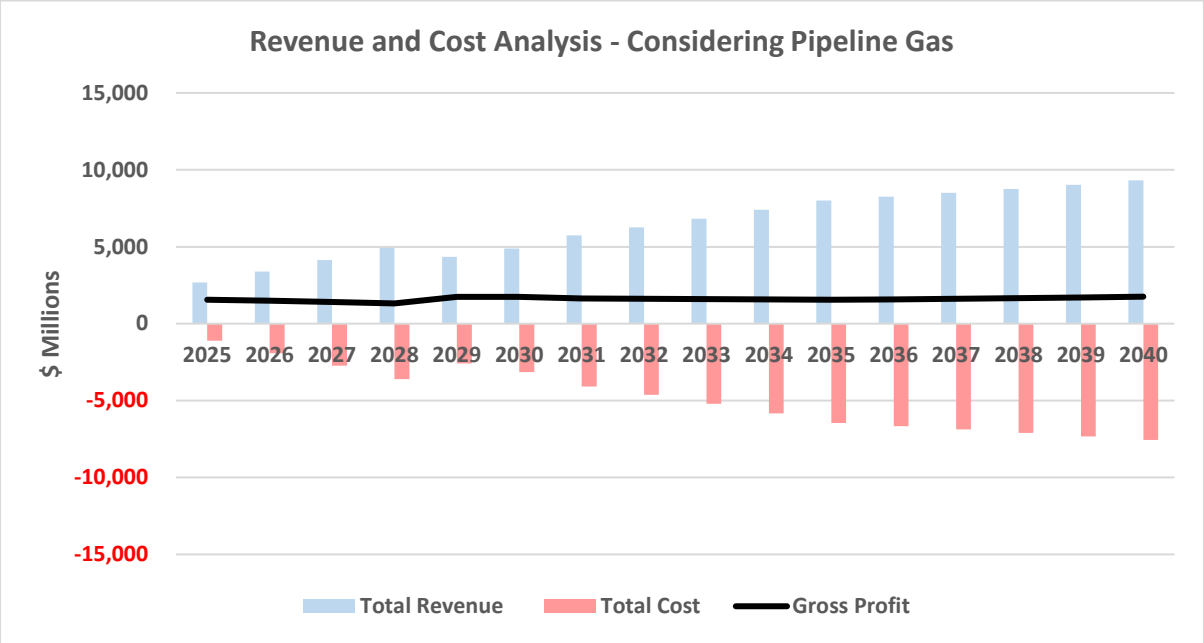


Chart 4.30: Cost and Revenue Analysis (2025–2040) for Option 2 – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

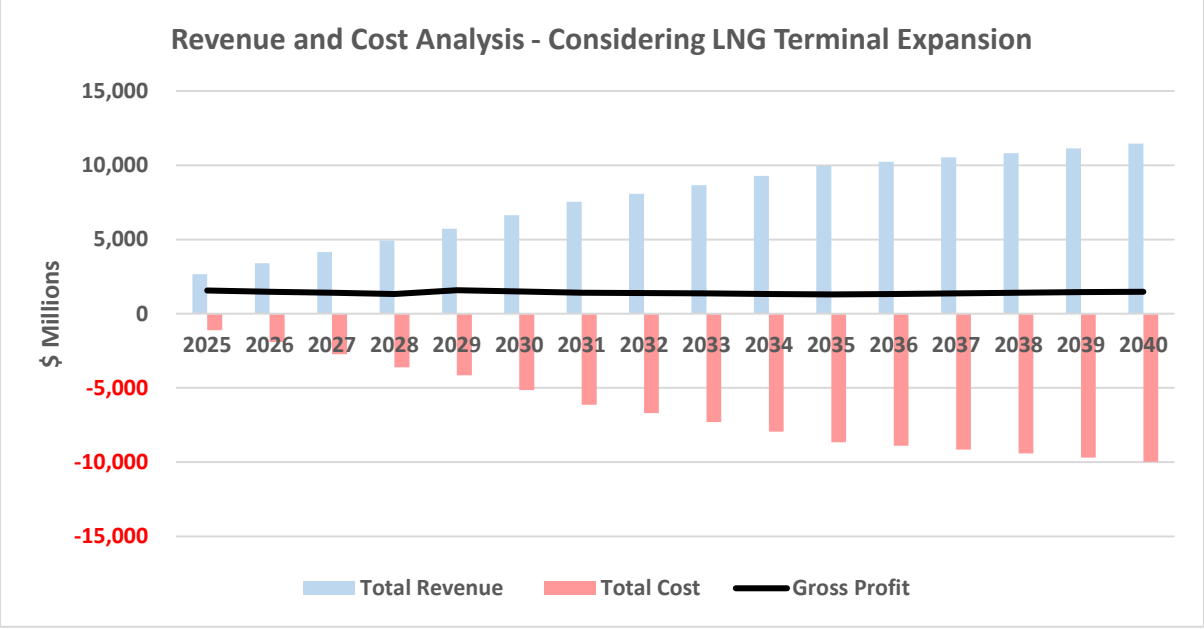


Chart 4.31: Cost and Revenue Analysis (2025–2040) for Option 2 – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Option 3:**

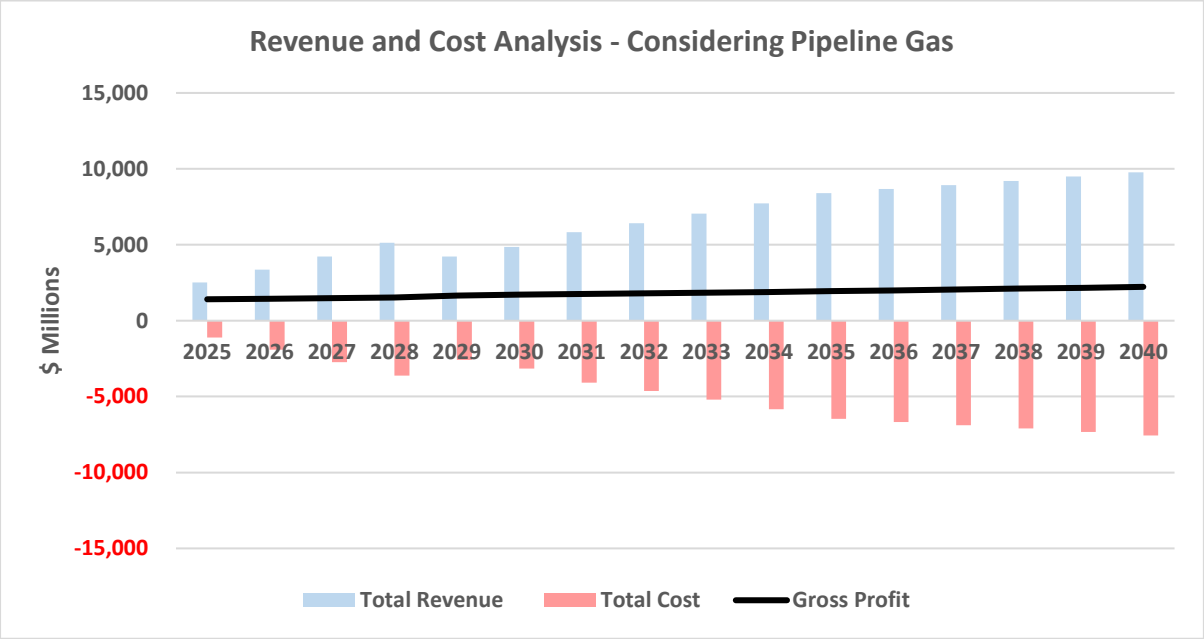


Chart 4.32: Cost and Revenue Analysis (2025–2040) for Option 3 – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

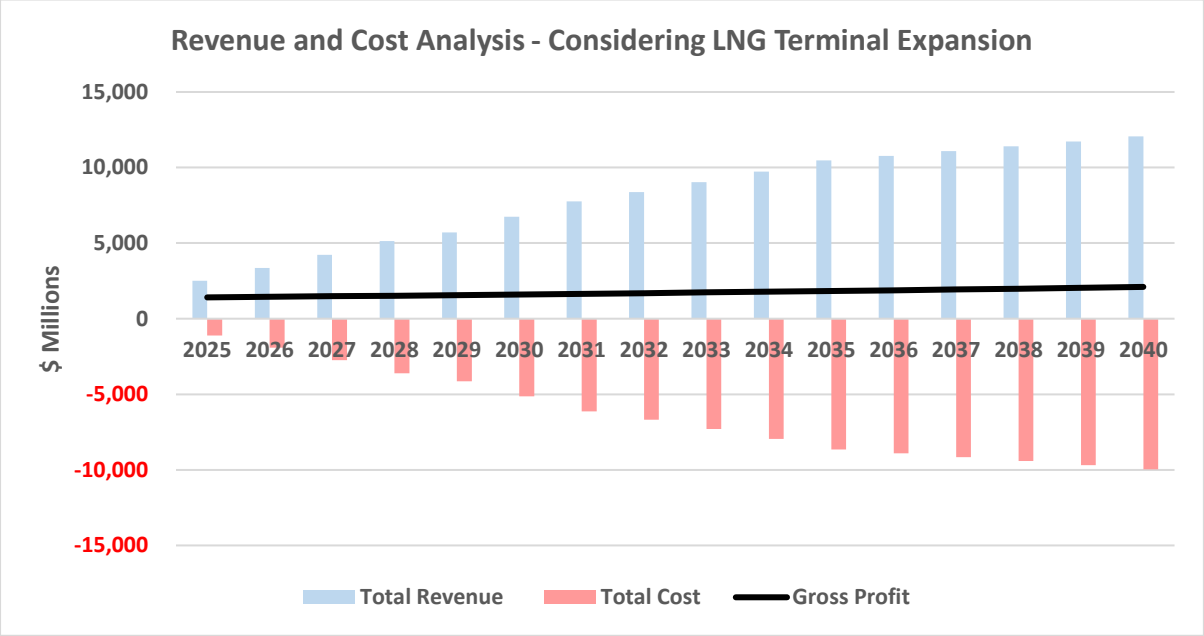


Chart 4.33: Cost and Revenue Analysis (2025–2040) for Option 3 – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Hybrid Option:**

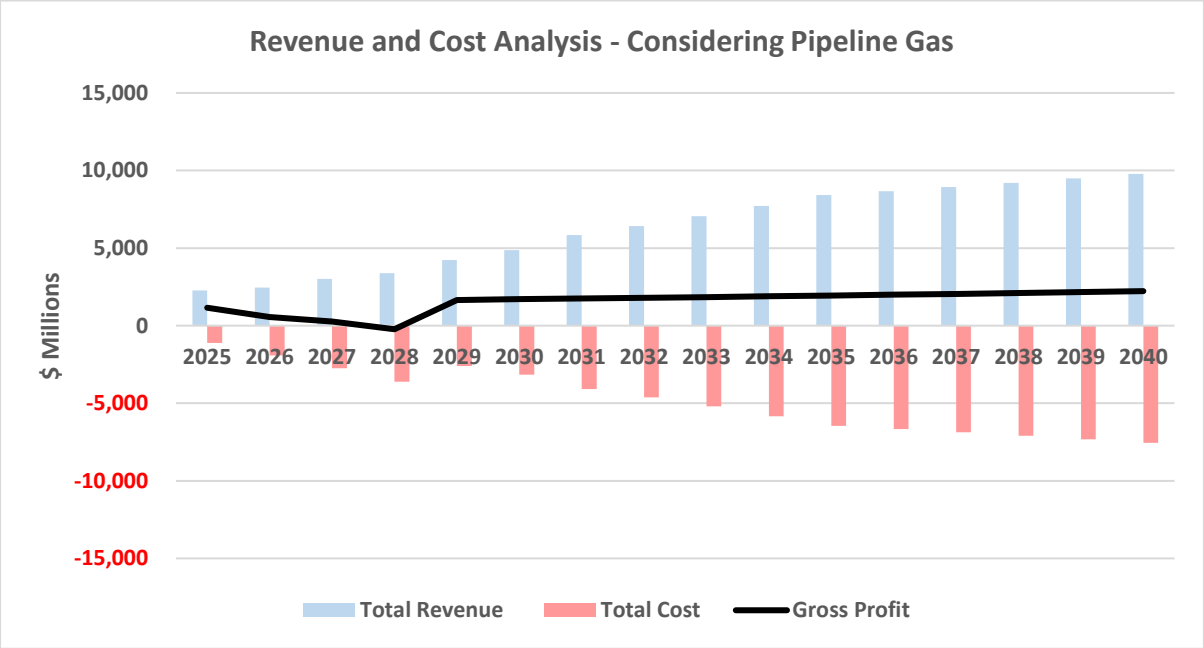


Chart 4.34: Cost and Revenue Analysis (2025–2040) for the Hybrid Option – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

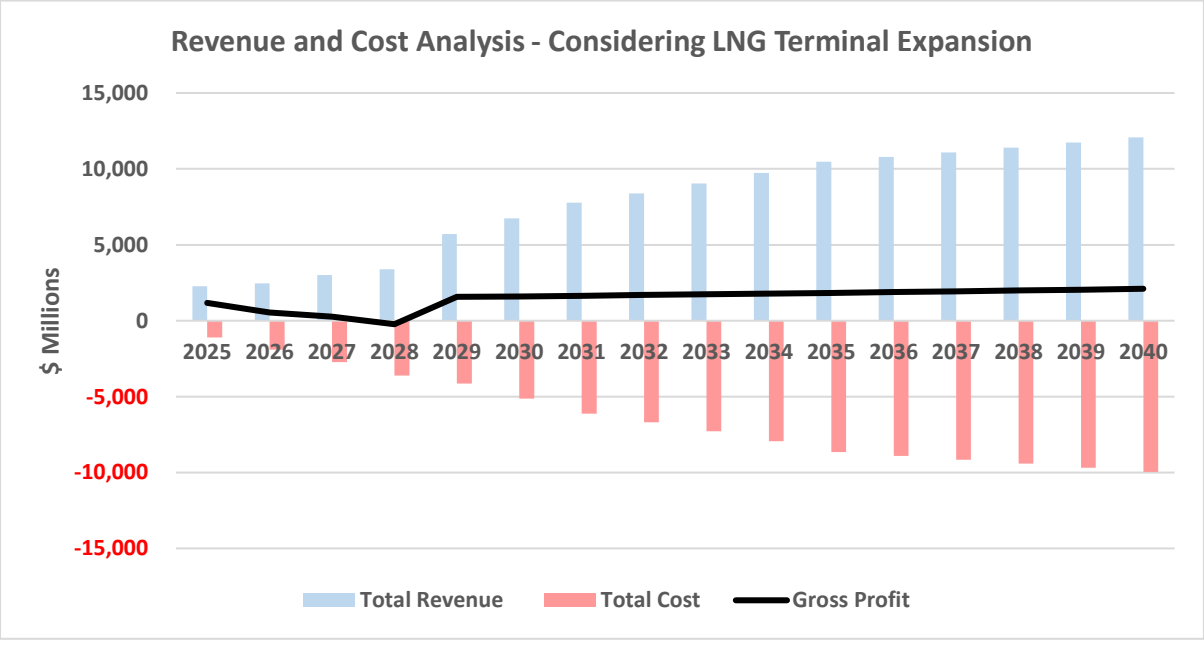


Chart 4.35: Cost and Revenue Analysis (2025–2040) for the Hybrid Option – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

4.10 Reform Scenarios Analysis

The charts below compare the possible reform scenarios for natural gas pricing. It evaluates the impact of maintaining the current pricing without any reform versus implementing reforms under Option 1, Option 2, and Option 3 each without subsidies.

Additionally, the charts include the Hybrid option, which incorporates a subsidy, providing a comprehensive view of each approach's financial and economic implications. This comparison highlights the potential outcomes of different pricing strategies and their effects on government gross profit.

Charts 4.36-4.45 below show gross profit projections under different gas pricing reform scenarios. The charts compare the financial outcomes of maintaining subsidies, implementing partial reforms, and transitioning to a fully market-based pricing structure.

- **Scenario 1: No Reform**

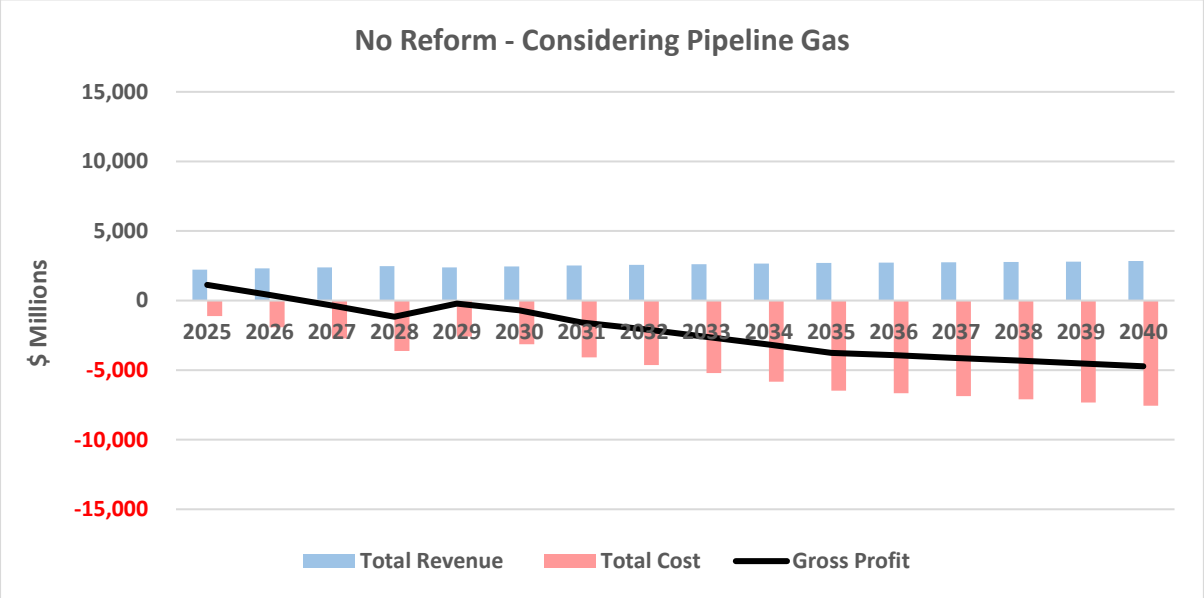


Chart 4.36: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the No Reform Scenario - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

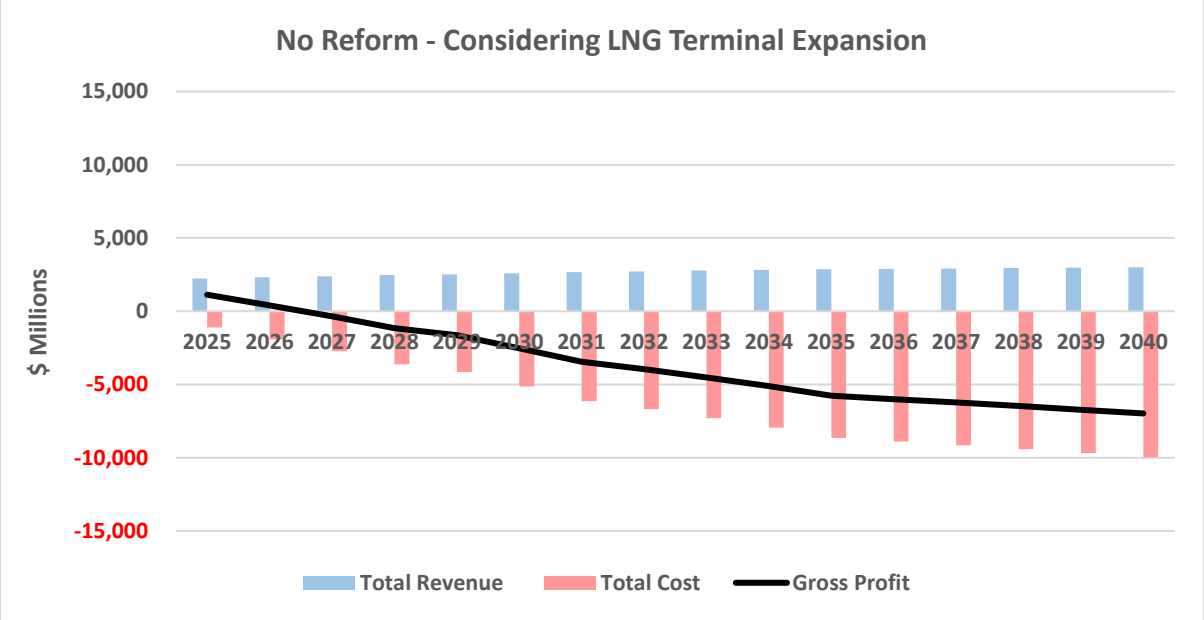


Chart 4.37: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the No Reform Scenario – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Scenario 2: Reform with No Subsidy (Option 1)**

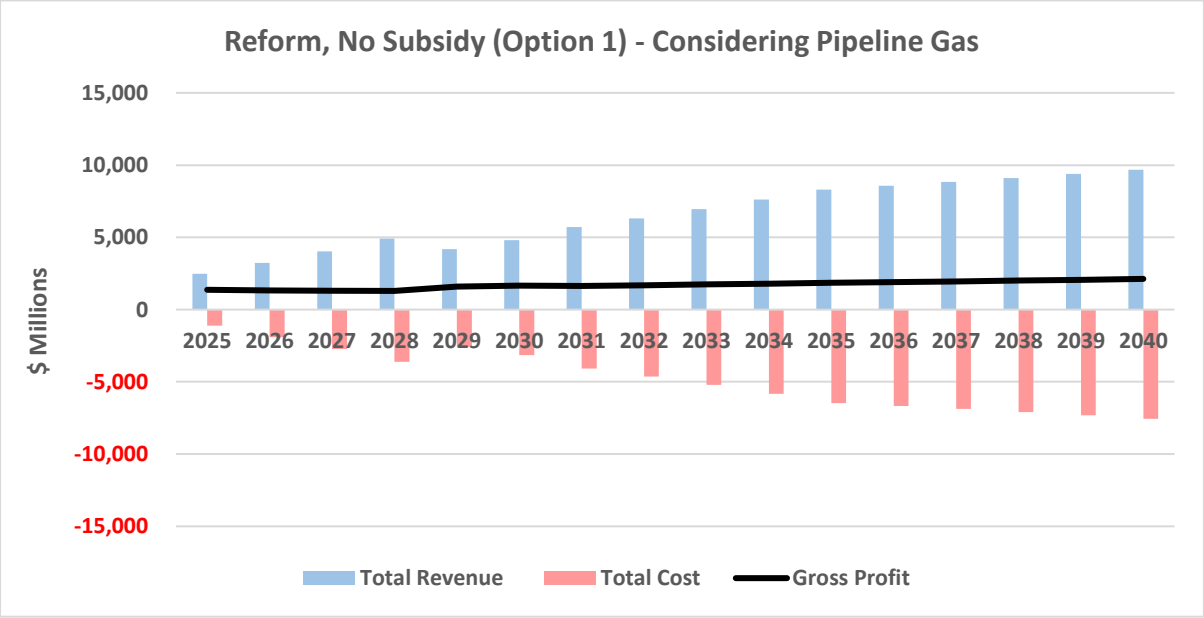


Chart 4.38: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the Option 1 Scenario - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

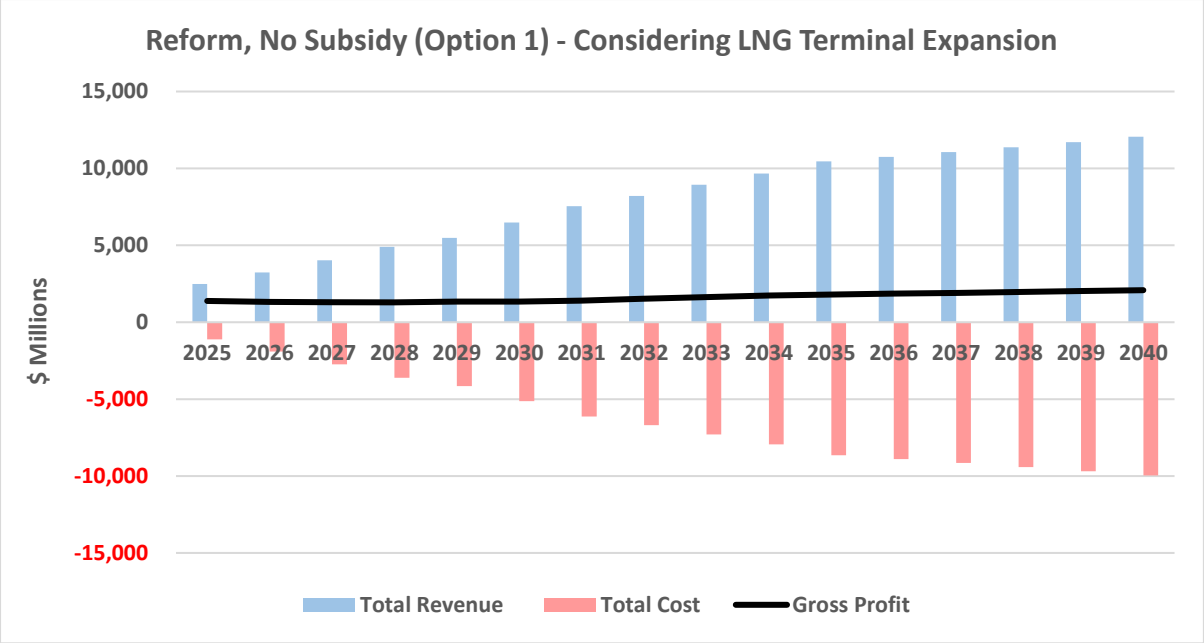


Chart 4.39: Cost and Revenue Analysis including the Gross Profit (2025–2040) for Option 1 Scenario – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Scenario 3: Reform with No Subsidy (Option 2)**

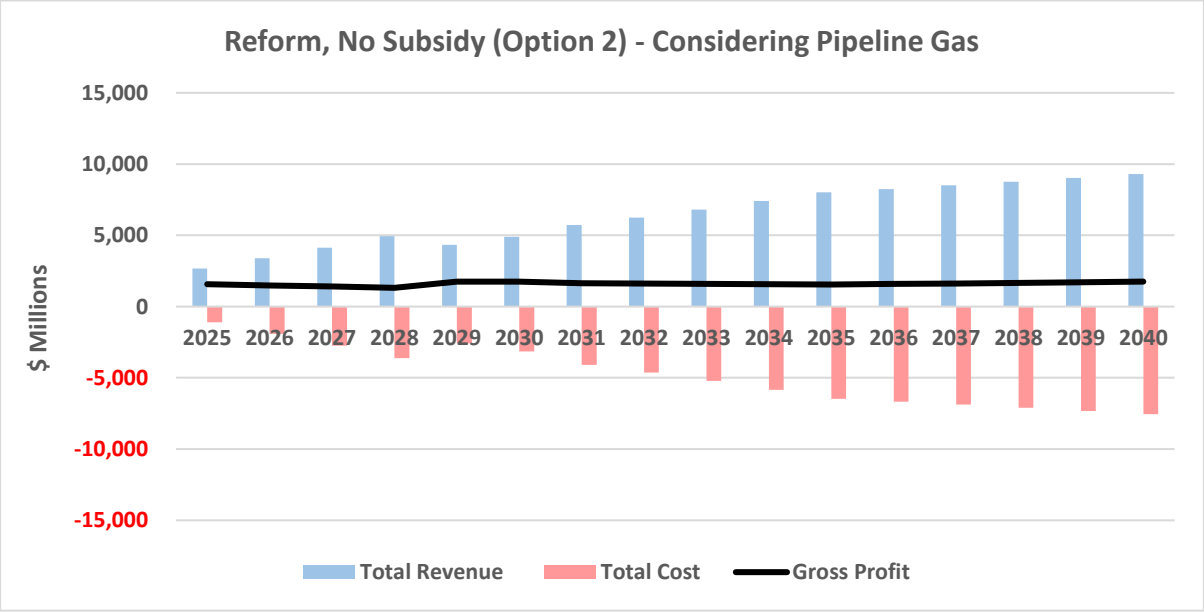


Chart 4.40: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the Option 2 Scenario - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

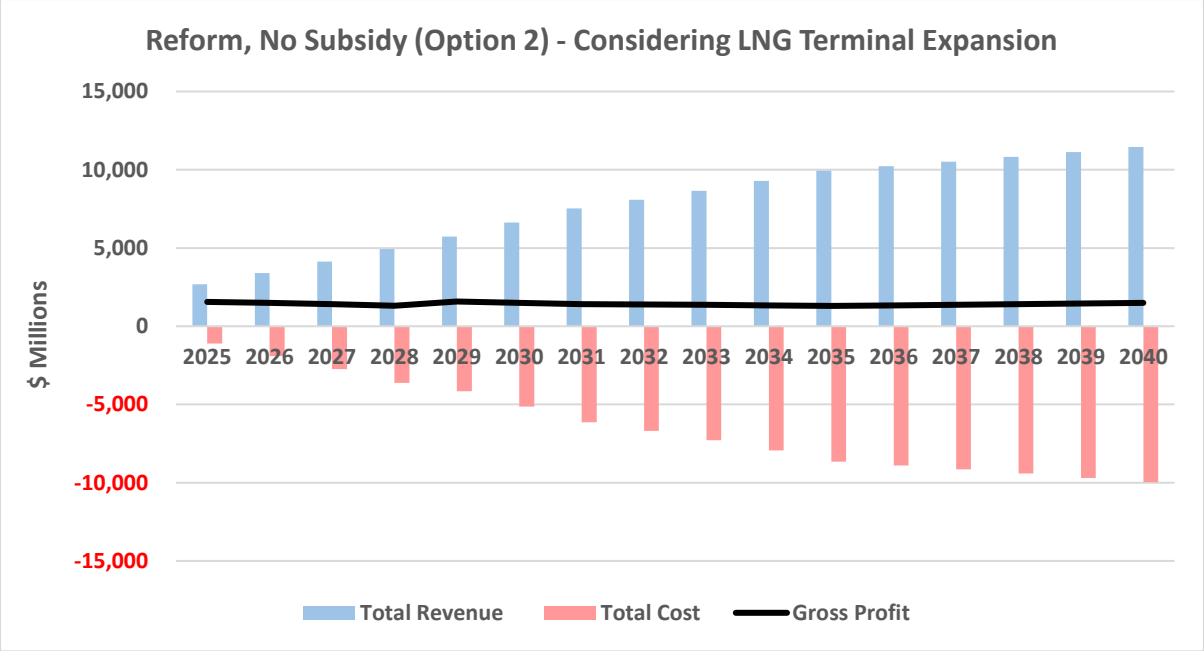


Chart 4.41: Cost and Revenue Analysis including the Gross Profit (2025–2040) for Option 2 Scenario – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Scenario 4: Reform with No Subsidy (Option 3)**

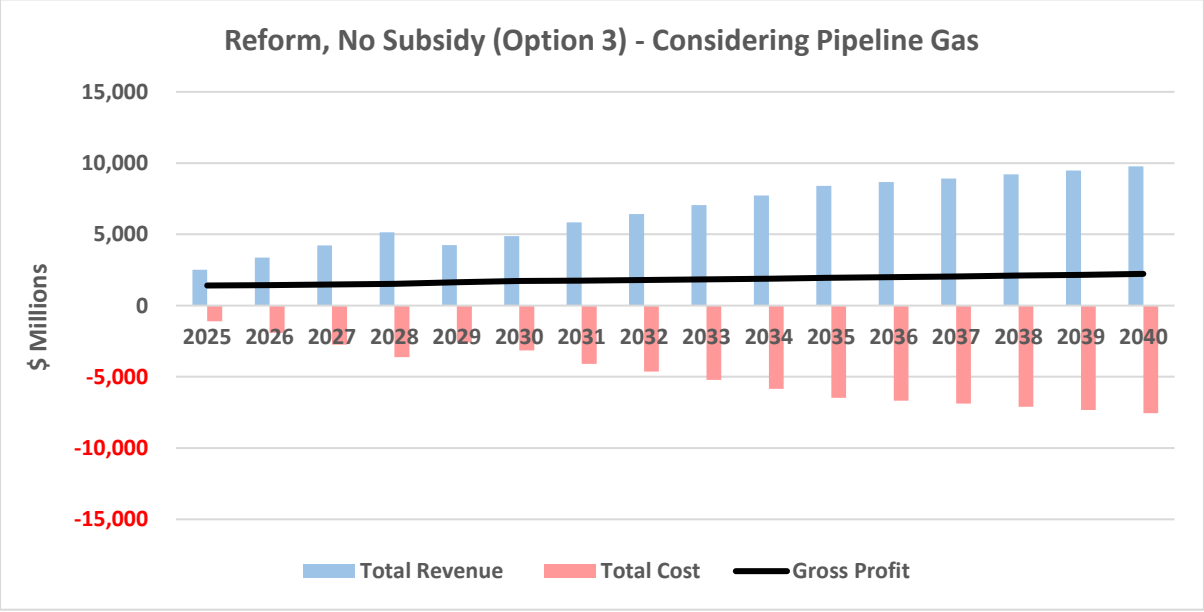


Chart 4.42: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the Option 3 Scenario - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

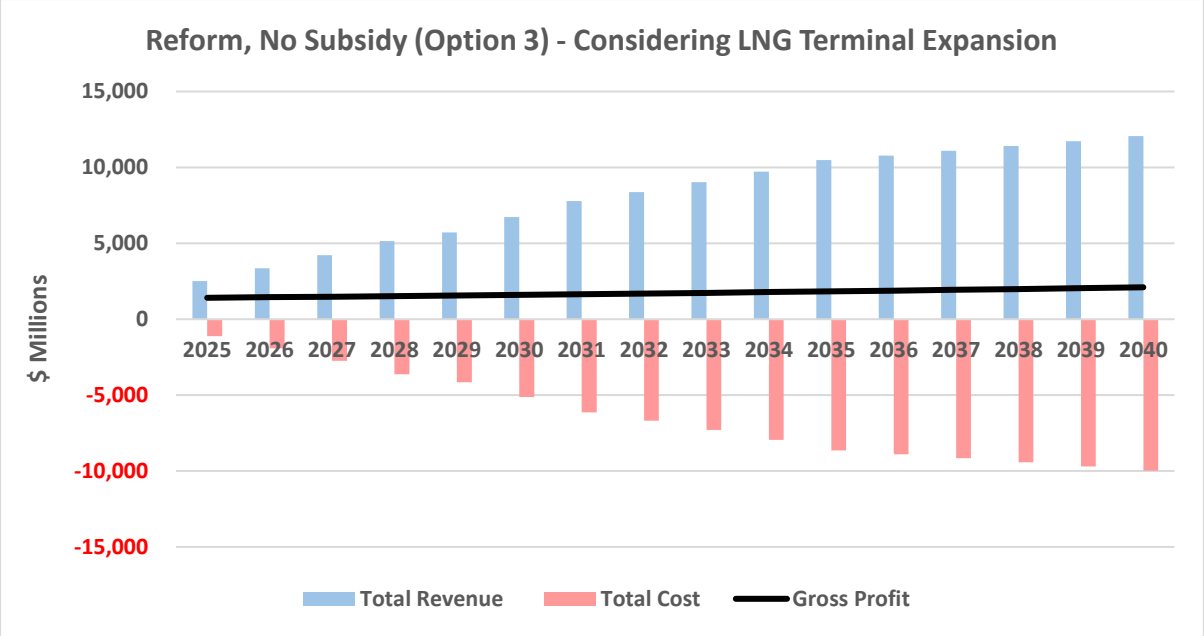


Chart 4.43: Cost and Revenue Analysis including the Gross Profit (2025–2040) for Option 3 Scenario – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Scenario 5: Reform with Subsidy (Hybrid Option)**

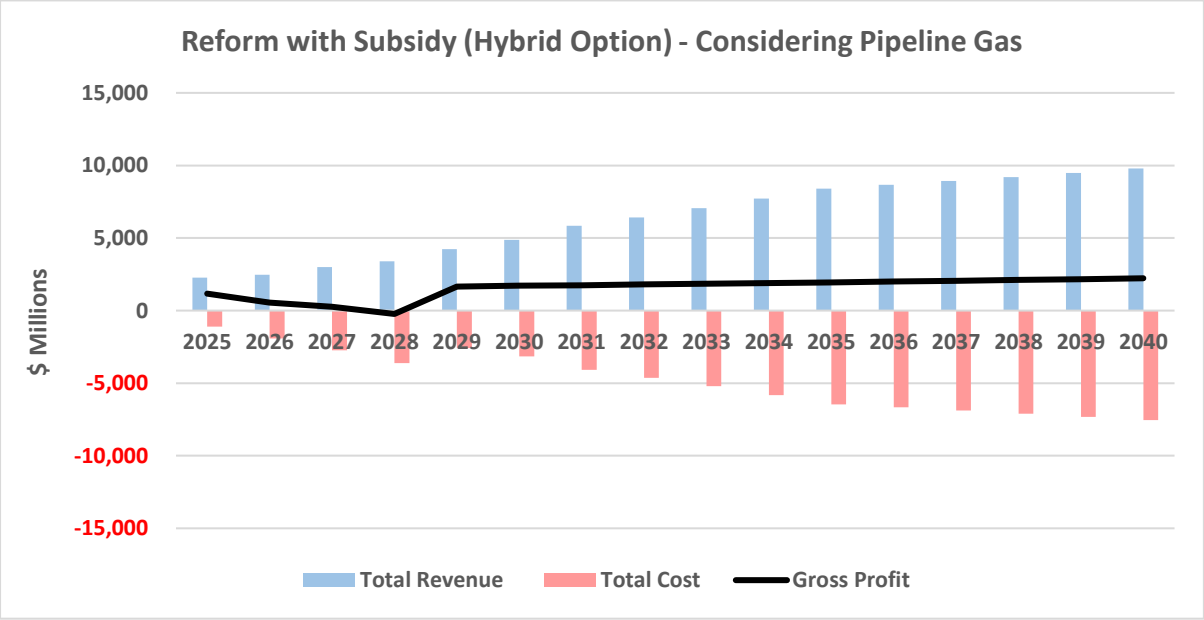


Chart 4.44: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the Hybrid Option Scenario - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

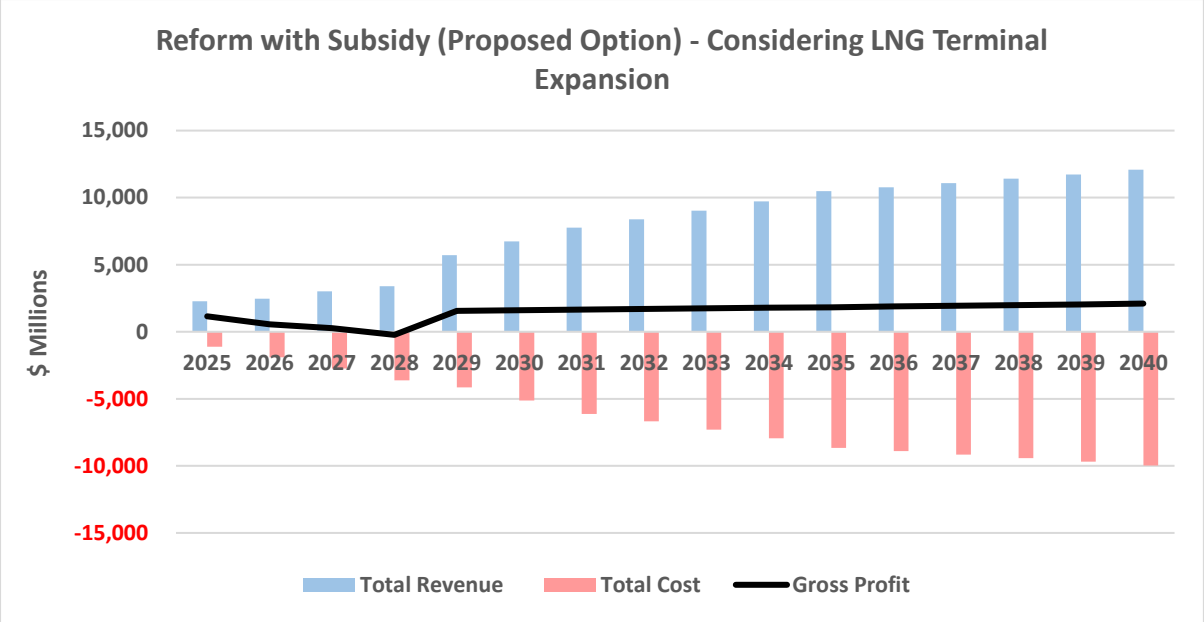


Chart 4.45: Cost and Revenue Analysis including the Gross Profit (2025–2040) for the Hybrid Option Scenario – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Revenue Summary for all the above scenarios:

Charts 4.46 and 4.47 below present projected government revenue from gas sales under different pricing options. The data reflects how policy changes along with the LNG imports influence national income generated from natural gas sales.

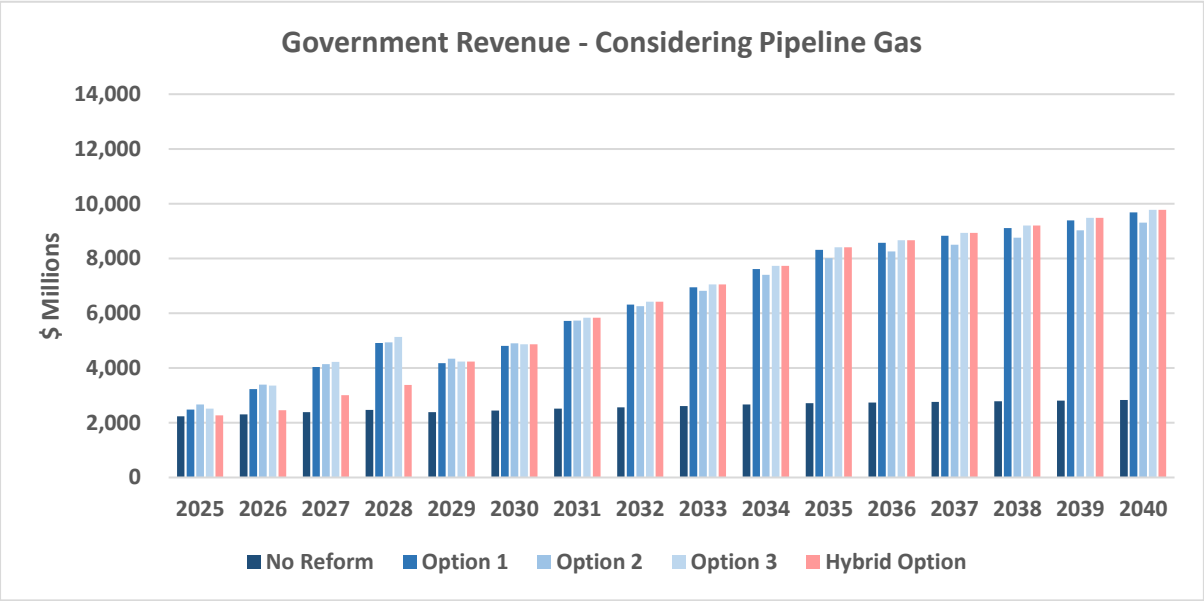


Chart 4.46: Revenue Summary (2025–2040) for all Gas Pricing Scenarios - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

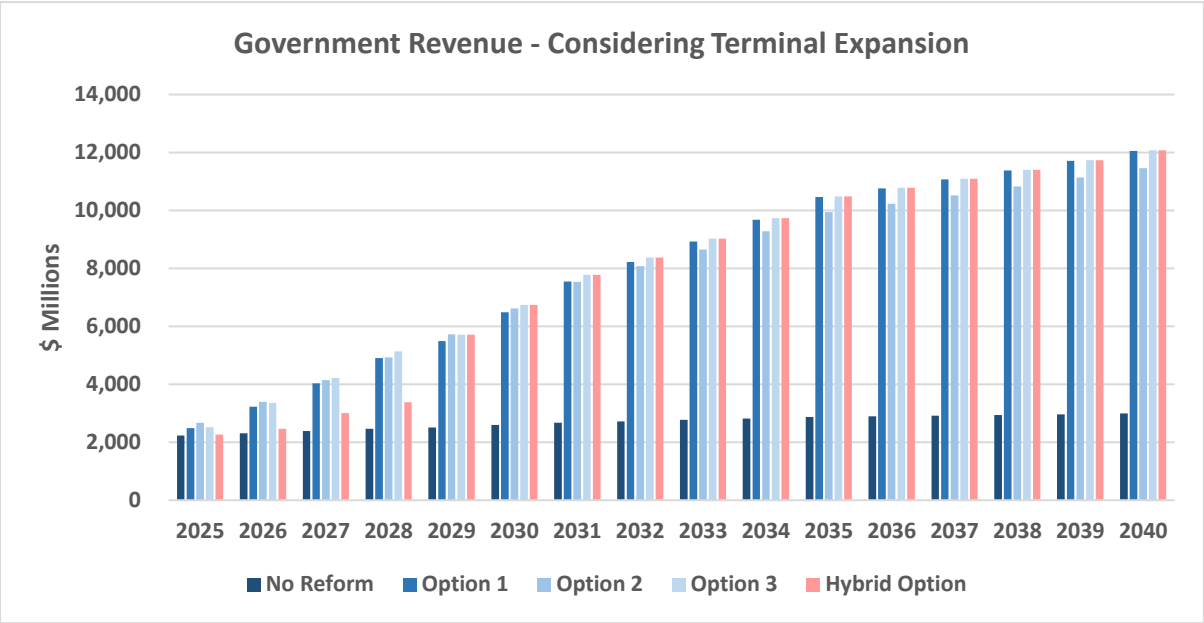


Chart 4.47: Revenue Summary (2025–2040) for all Gas Pricing Scenarios – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

- **Gross Profit Summary for all the above scenarios:**

Charts 4.48 and 4.49 below present gross profit estimates across different pricing options, including subsidy and non-subsidy cases. The data reflects the financial sustainability of new pricing approaches over time.

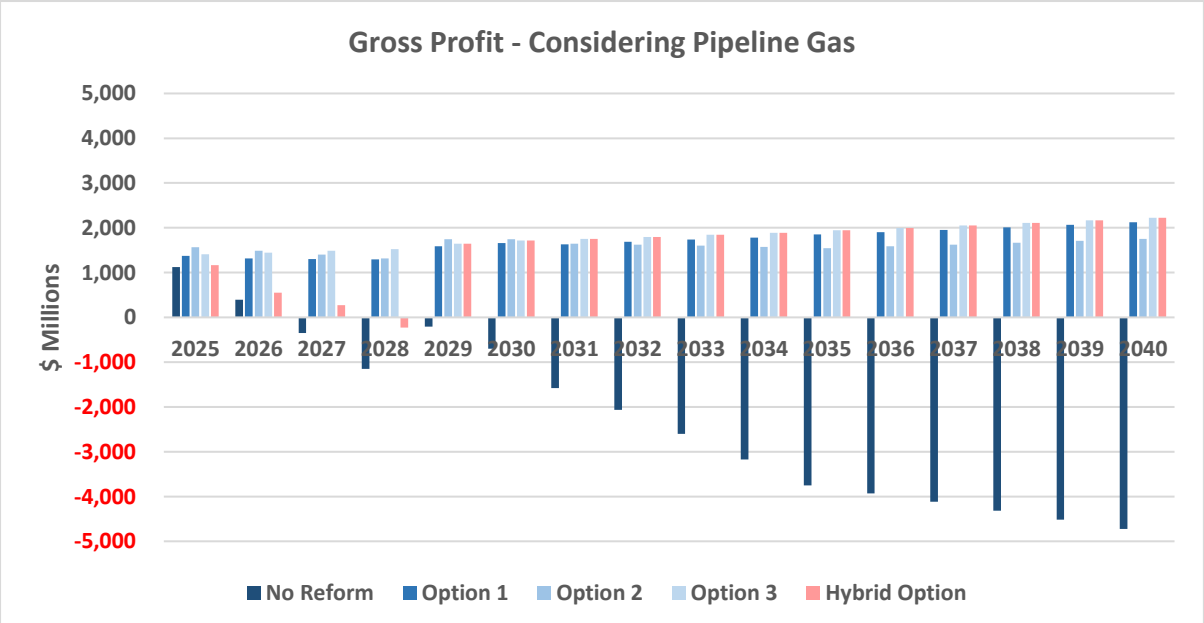


Chart 4.48: Gross Profit Summary (2025–2040) for all Gas Pricing Scenarios - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

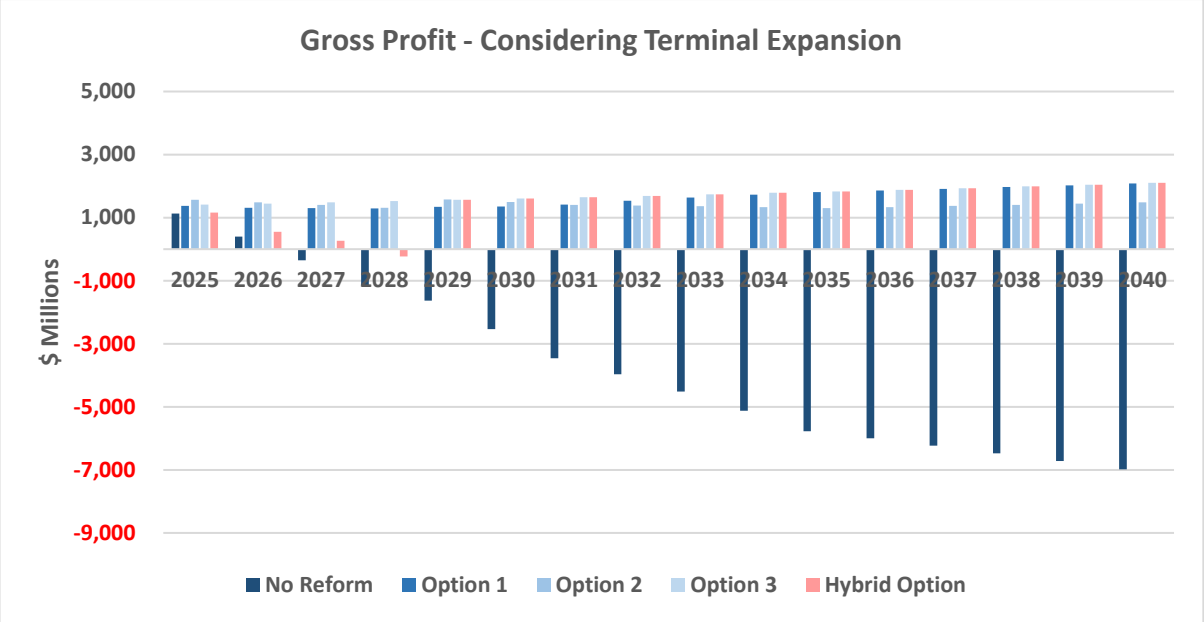


Chart 4.49: Gross Profit Summary (2025–2040) for all Gas Pricing Scenarios – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

Among the reform pathways assessed, the hybrid model demonstrates strong potential to support long-term fiscal sustainability. While it introduces gradual price adjustments, it also progressively reduces government subsidy obligations and improves cost recovery without creating immediate shocks for industrial customers.

This balanced structure allows for more stable government expenditure over time and better alignment with actual gas procurement costs. Compared to other reform options, the hybrid scenario offers a more fiscally resilient outcome under rising LNG dependency while maintaining industrial affordability.

4.11 Transition Period (2025–2028) Analysis

The tables below 4.5-4.8 present the projected gas prices during the transition period from 2025 to 2028, the phase in which a targeted subsidy will be applied for some customers. During this period, high-priority customers will be charged based on Option 3, granting them access to the cheapest available gas pool while maintaining a stable price to ensure their competitiveness and

operational sustainability. Meanwhile, all other customers will be priced based on the weighted average cost of gas (WACOG)- Option 1, which reflects the blend of domestic and imported gas costs.

The tables provide a detailed comparison of:

- Expected revenue without subsidies, assuming all customers adopt Option 1.
- Expected revenue with subsidies if high-priority customers adopt Option 3 and Other Customers Option 1.
- The total subsidy amount required to bridge the gap between the actual cost of supply and the subsidised rates provided to the gas customers.

Gas Prices:

Table 4.5: Summary of the Gas Prices in the Transition Period

Customer Name	Gas Price		Transition Period			
			2025	2026	2027	2028
Customer 1	Gas Price ($ per MMBtu)	Original Price (WACOG)	4.45	5.59	6.76	7.97
		Subsidized Price (Option 3)	4.00	4.00	4.00	4.00
Customer 2		Original Price (WACOG)	4.45	5.59	6.76	7.97
		Subsidized Price (Option 3)	4.00	4.00	4.00	4.00
Customer 3		Original Price (WACOG)	4.45	5.59	6.76	7.97
		Subsidized Price (Option 3)	4.00	4.00	4.00	4.00
Small Customers		Original Price (WACOG)	4.45	5.59	6.76	7.97
		Subsidized Price (Option 3)	4.00	4.00	4.00	4.00

Expected Revenue without Subsidy:

Table 4.6: Expected Revenue without Subsidy

Customer Name	Revenue	Units	Transition Period			
			2025	2026	2027	2028
Customer 1		$ Millions	838	1,074	1,325	1,592
Customer 2		$ Millions	737	927	1,121	1,378
Customer 3		$ Millions	14	18	21	25
Small Customers		$ Millions	35	44	53	63
Total		**$ Millions**	**1,624**	**2,062**	**2,521**	**3,058**

Expected Revenue with Subsidy:

Table 4.7: Expected Revenue with Subsidy

Customer Name	Revenue	Units	Transition Period			
			2025	2026	2027	2028
Customer 1		$ Millions	753	768	784	799
Customer 2		$ Millions	663	663	663	692
Customer 3		$ Millions	13	13	13	13
Small Customers		$ Millions	31	31	31	31
Total		**$ Millions**	**1,460**	**1,475**	**1,491**	**1,535**

Expected Subsidy:

Table 4.8: Expected Subsidy

Customer Name	Subsidy	Units	Transition Period			
			2025	2026	2027	2028
Customer 1		$ Millions	84	306	541	793
Customer 2		$ Millions	74	264	458	686
Customer 3		$ Millions	1	5	9	12

Small Customers		$ Millions	4	12	22	31
Total Subsidy		**$ Millions**	**163**	**587**	**1,030**	**1,523**
		%	7%	20%	26%	31%
Total Subsidy (With Inflation)		**$ Millions**	**167**	**610**	**1,093**	**1,648**

To further enhance the sustainability evaluation of the transition period pricing policy, a simple sustainability index is introduced using the Revenue Stability Index (RSI). This index reflects the ratio between revenue with subsidy and revenue without subsidy, indicating the extent to which revenues are stabilized despite subsidized prices.

A higher RSI denotes greater fiscal resilience. In 2025, the total RSI is approximately 0.90 (1,460/1,624), gradually declining to around 0.50 in 2028 (1,535/3,058), reflecting the increasing subsidy burden over time. These indices highlight the fiscal pressure resulting from prolonged subsidization and underline the urgency of gradual subsidy reform to maintain long-term budgetary sustainability.

4.12 Mitigation Strategy Analysis

While the scenario-based pricing analysis in this chapter highlights the fiscal pressures and subsidy burdens associated with Bahrain's transition toward greater LNG dependence, it also reveals the need for complementary strategies to mitigate these impacts. This section examines a range of mitigation approaches that, when integrated with pricing reform, can enhance long-term energy and fiscal sustainability.

1. **Diversifying Energy Streams:** Bahrain's current overreliance on natural gas particularly imported LNG presents strategic and financial vulnerabilities. Diversifying the national energy mix by accelerating

investments in alternative fuels can reduce long-term exposure to volatile LNG markets and buffer the economic impact of external supply shocks.

2. **Improving Energy Efficiency:** Enhancing gas-use efficiency across power generation and industrial operations can reduce total demand, slow the growth of import requirements, and ease pressure on the subsidy system. Energy audits and process optimization represent viable tools in achieving efficiency gains.
3. **Integrating Renewable Energy:** A gradual increase in the share of renewable energy can displace gas-fired power generation during peak hours. This shift would lower gas demand, reduce the need for costly LNG imports, and allow more domestic gas to be allocated to value-added industrial use.

These mitigation strategies are not substitutes for pricing reform but act as complementary measures that can reduce fiscal strain, support environmental commitments, and improve energy resilience. When coordinated with a phased pricing model, they provide a balanced framework for managing Bahrain's transition to a more sustainable and secure energy future.

4.13 Summary

This chapter has demonstrated the development and application of the Gas Pricing Model designed to evaluate the economic and fiscal implications of transitioning from Bahrain's regulated gas pricing system to a more sustainable, market-aligned framework. The model assessed multiple reform strategies. The analysis generated customer-level gas price forecasts for the period 2025 to 2040, quantifying the impacts on key gas consumers and government revenues. Scenario-based modelling provided insights into both the short-term transition period and the long-term pricing path associated with each reform option.

A key finding is that increased reliance on LNG significantly raises the cost of gas supply, with the LNG terminal expansion scenario resulting in sharp increases in subsidy obligations and a decline in the Revenue Stability Index (RSI) from 0.90 in 2025 to 0.50 by 2028 highlighting the growing fiscal risk. These results underscore the need for a phased pricing reform strategy that reflects the rising cost of imported gas while safeguarding economic stability.

Among the options assessed, the hybrid model demonstrated comparatively balanced outcomes across key indicators. The simulation showed that this approach allows for gradual pricing adjustments that reduce fiscal pressure while maintaining relative stability for major consumers. These results highlight the model's potential to mitigate subsidy burdens and support Bahrain's broader energy and fiscal policy objectives under rising LNG cost conditions.

Chapter Five: Analysis

5.1 Introduction

To develop an effective and sustainable natural gas pricing policy for Bahrain, it is essential to conduct a structured analysis of the model findings across the country's economic, energy, and affordability landscape. This chapter interprets the results by examining 24 charts derived from the Gas Pricing Model, drawing comparisons across scenarios and evaluating the feasibility of the reform options. The discussion highlights the implications of pricing reforms on energy security, economic stability, and socioeconomic impacts, offering strategic insights for decision-makers.

To ensure clarity and alignment with the study's objectives, the charts are organized into three core analytical dimensions: (i) economic impacts, (ii) macroeconomic and social impacts, and (iii) energy supply and security. These dimensions directly correspond to the research objectives and research questions.

Table 5.1 maps each group of charts to its associated research objective (RO), research question (RQ), and policy relevance. All charts are based on the author's original modelling and calculations, using data sources and methods described in Chapter 3.

Table 5.1: Key Charts

Chart No.	Topic	Research Objective	Research Question(s)	Policy Relevance
Charts 5.1–5.8	Industrial Gas Prices, LNG Costs, Revenues	RO1: Economic Impact	Major RQ, Minor RQ1&2	Justifies phased subsidy reform, cost-reflective pricing, and pooled pricing mechanisms
Charts 5.9–5.15	GDP Trends, Affordability Indicators, Economic Trade-offs	RO2: Macroeconomic and Social Impacts	Major RQ, Minor RQ2&4	Highlights need for pricing safeguards and gradual implementation pacing

Charts 5.16–5.24	LNG Imports, Supply-Demand Gap, Revenue Impact	RO3: Energy Security	Major RQ, Minor RQ1, 3&4	Supports diversification strategy and long-term planning for LNG and renewables

Each of the following sections presents and interprets the charts individually, emphasizing their policy significance and linking each finding to the broader reform strategy outlined in Chapter 6.

5.2 Gas Supply and Demand Analysis

As mentioned earlier in this study, an initial forecast of Bahrain's gas supply and demand has been developed using historical consumption patterns and assumptions regarding future gas supply decline. These assumptions serve as the foundation for the supply-demand analysis and provide a preliminary estimate of the anticipated gas shortfall in the coming years. This allows for an estimation of the volume of imported gas required to bridge the gap between domestic supply and projected demand.

Moreover, this analytical framework enables the identification of Bahrain's future gas supply profile, including the share of domestic production versus imported LNG, and helps link this with potential gas pricing structures. The outcomes of this analysis are essential for aligning future gas pricing reforms with the broader objective of achieving long-term economic sustainability.

It is important to note that the accuracy of this analysis is highly dependent on the gas supply and demand data. Therefore, the assumptions regarding production volumes, demand growth, and approved customer allocations must be regularly updated.

Chart 5.1 below presents the projected total gas demand in Bahrain from 2025 to 2040, including consumption by major industries, power generation, and other

sectors. The data reflects expected growth in gas demand based on historical trends and approved volume for the customers.

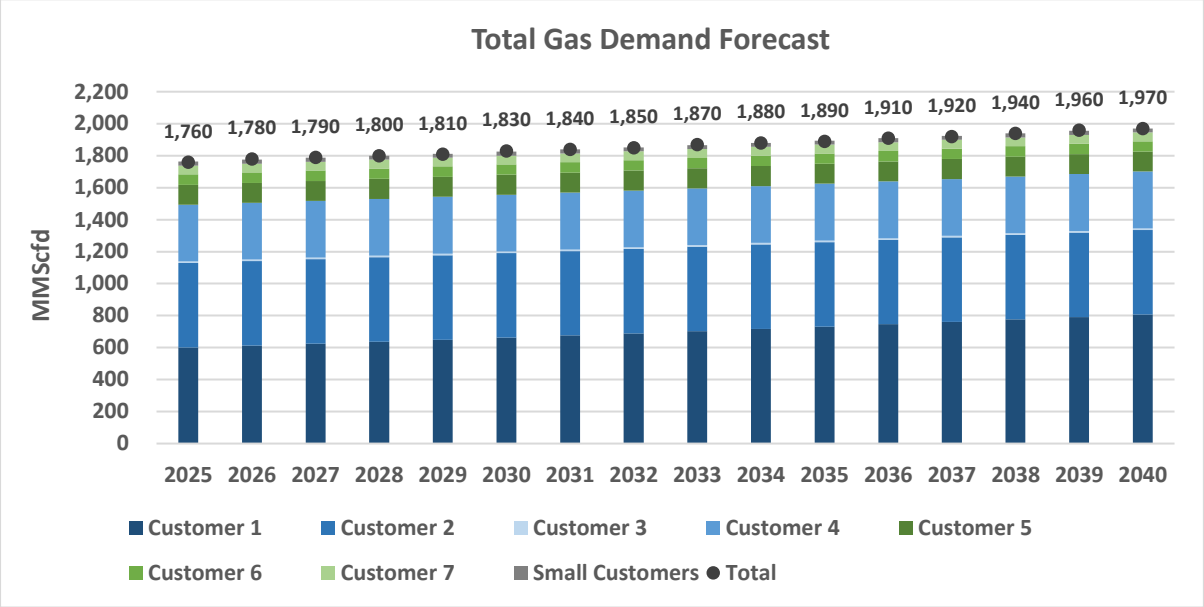


Chart 5.1: Total Gas Demand Forecast (2025-2040)

Source: Author's own calculation from the developed gas pricing model (2025).

Chart 5.2 below illustrates the expected availability of domestic natural gas over time based on the assumed production. The data highlights the gradual decline in domestic gas production and the anticipated supply gap.

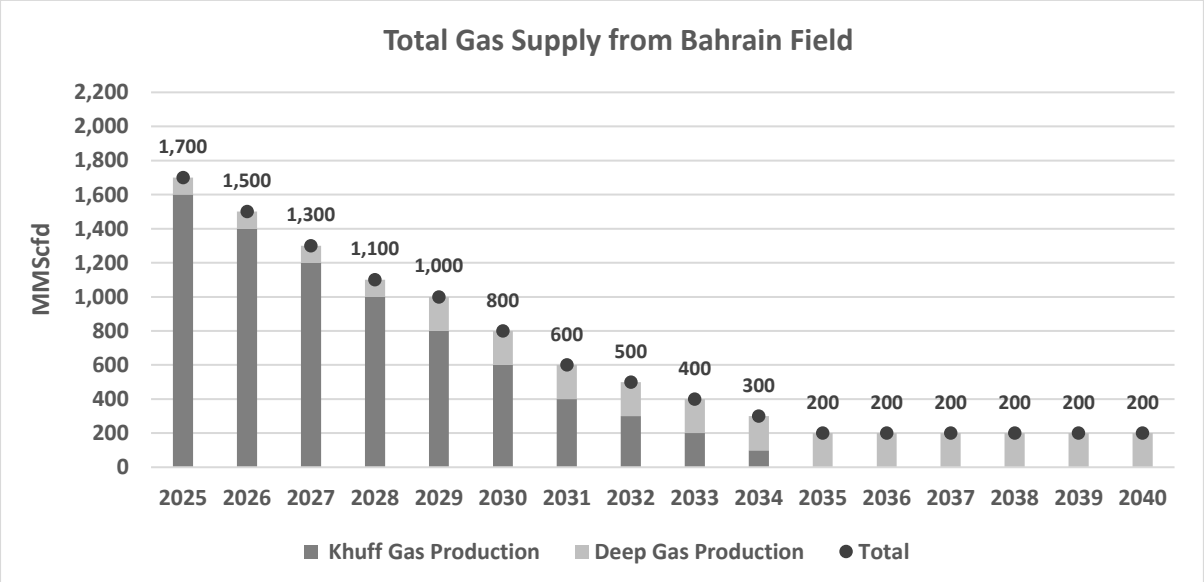


Chart 5.2: Total Gas Supply from Bahrain Field (2025-2040)

Source: Author's own calculation from the developed gas pricing model (2025).

Chart 5.3 below shows the projected gap between the domestic gas supply and the total demand.

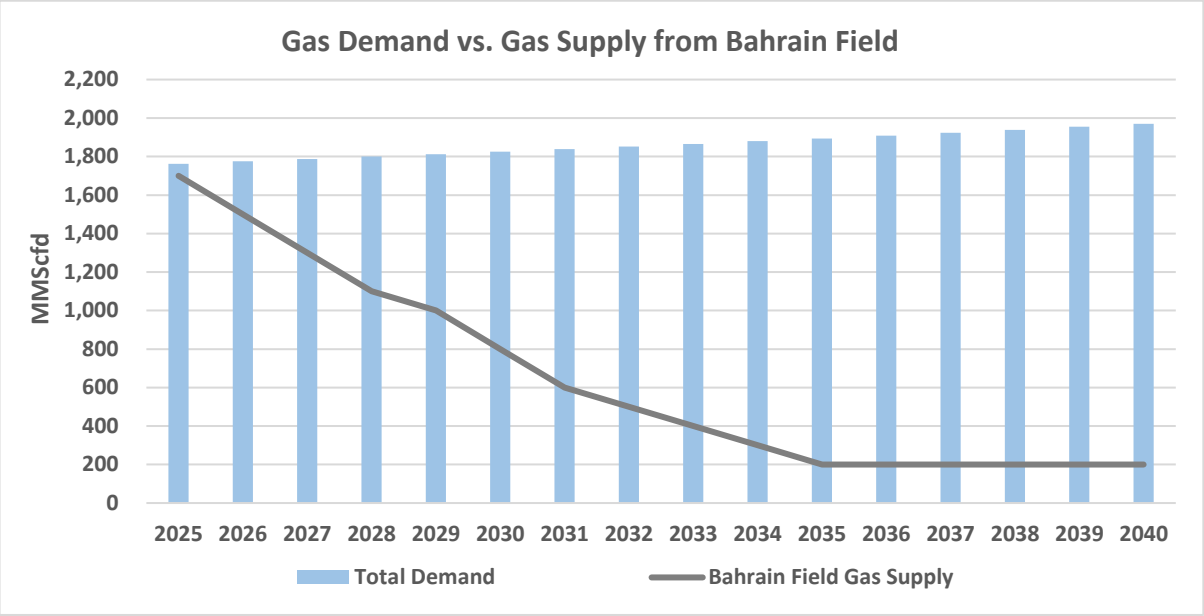


Chart 5.3: Gas Demand vs. Gas Supply from Bahrain Field (2025-2040)

Source: Author's own calculation from the developed gas pricing model (2025).

Chart 5.4 below shows the estimated LNG import requirements based on the projected gap between domestic gas supply and total demand. The data indicates the volumes of LNG needed to meet energy security requirements.

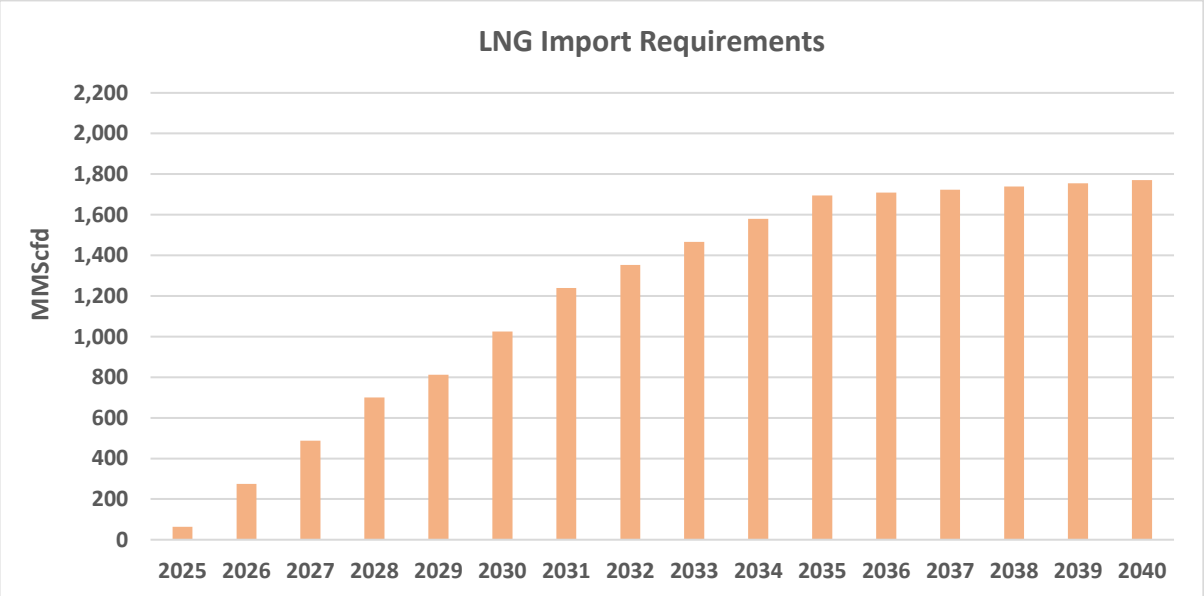


Chart 5.4: LNG Import Requirements (2025-2040)

Source: Author's own calculation from the developed gas pricing model (2025).

Based on the above supply and demand analysis, as well as the calculated shortage and importation requirements, the model has been developed and run using these assumptions as input parameters. The following sections present the results generated by the model, along with an analysis of these outcomes and their associated social and economic impacts on the Kingdom of Bahrain.

5.3 Model Analysis

5.3.1 Projected Natural Gas Prices (2025–2040) Across All Options

- **Option 1 (WACOG - Single Pool):**

  The steady increase in prices over time reflects the anticipated supply cost escalations and the gradual transition towards LNG importation. The impact on major customers, particularly power plants and Customer 2 is significant.

  The analysis underscores the importance of pipeline gas option utilisation once available to maintain industrial competitiveness and economic sustainability. The terminal expansion leads to higher gas prices due to the increased costs of LNG imports. The divergence in pricing between pipeline gas and terminal-based LNG supply highlights the economic trade-offs associated with commodity and infrastructure costs.

  The results suggest that while the terminal expansion provides supply security, it may necessitate subsidies to maintain affordability for high-priority customers.

- **Option 2 (Multiple Pools - Averaging Costs):**

  Option demonstrates a more varied pricing trend across customer segments, reflecting the flexibility in cost distribution. The tiered approach under this option enables cost-sharing mechanisms that provide relief to high-priority consumers while maintaining overall revenue stability.

  The findings highlight the critical need for efficient demand management strategies and the optimisation of domestic gas resources to minimise the

impact on high-priority customers by giving them access to the lowest-cost pool.

However, they will pay an average cost, including the LNG part. The differentiated pricing model under Option 2 provides some mitigation and minimise the impact on key gas consumers but does not fully shield customers from cost escalations.

- **Option 3 (Multiple Pools - Attributable Costs):**

  Option 3 adopts an attributable cost approach, where pricing is directly tied to the source of supply. The figure shows a more dynamic pricing structure, particularly affecting low-priority customers.

  The attributable cost method ensures that customers with low priority bear the brunt of cost increases as the lowest cost pool will be utilised by the high-priority customers.

  The findings suggest that while this approach maintains the economics for the high priority customers like Customer 1 and Customer 2 by maintaining the same current price for the coming 4 years and start increasing after that, it could lead to very difficult economic situation for the low-priority customers in export-oriented industries.

  The increased cost burden on low-priority customers suggests a need for complementary measures, such as long-term LNG procurement strategies or renewable energy integration projects.

- **Hybrid Option (Proposed Option):**

  The proposed option integrates elements of all previous pricing strategies to achieve an optimal balance between cost recovery and economic sustainability.

  The results underscore the importance of a transition period to save the economics of the high-priority customers by maintaining the same price as the current level (Option 3) and have a gradual increase in prices for the remaining customers (Option 1).

After the transition period, Option 3 will be applied to all customers, reflecting the actual use of gas will continue to supply high-priority customers from the lowest cost available pool.

At first glance, Option 1 may appear to be the most suitable choice for all customers, as it distributes costs evenly and seems economically fair across the board.

However, upon closer analysis, it becomes evident that applying this pricing approach to key strategic customers such as Customer 1 and Customer 2 present significant challenges. Both entities are susceptible to gas prices and carry substantial social and economic weight in Bahrain. Customer 1 is critical for delivering affordable electricity and water to the public, while Customer 2 significantly impacts Bahrain's Economy. Applying the weighted average cost model to these entities could have serious socioeconomic consequences.

The proposed option provides a well-structured transition period for customers in the early stages, during which gas prices remain relatively moderate. This gradual approach gives customers time to adapt and prepare for future price levels that align more closely with international market benchmarks. The proposed option supports industrial stability by allowing this adjustment period while laying the foundation for a more sustainable and market-driven gas pricing framework. This balance is essential for ensuring long-term economic resilience and energy sustainability in the Kingdom of Bahrain.

5.3.2 Cost and Revenue Analysis (2025–2040) Across All Options

The results indicate that government revenue from gas sales increases with price reforms, but the extent of the increase depends on the pricing structure and industrial response. Higher gas prices result in more significant government revenue, but they also risk reducing industrial consumption if companies seek alternative fuel sources or relocate operations. A phased pricing reform strategy

can mitigate sudden financial burdens while ensuring progressive revenue growth.

The revenue and cost structures results under different gas pricing options indicate that while revenue increases over time due to rising prices and demand, the corresponding cost of supply also escalates. Profitability varies significantly across options, with Option 1 providing the most stable revenue stream while Option 3 introduces higher revenue potential but with increased financial risk on low-priority industries.

The proposed option strikes a balance, ensuring financial sustainability without excessively burdening consumers as the low-priority customers will benefit from Option 1 prices in the transition period before shifting to the actual LNG prices under Option 3.

The key insights from this analysis include:

- **Option 1 (WACOG - Single Pool):** Exhibits a relatively stable revenue growth trajectory with controlled cost escalations. However, profitability remains constrained due to the increasing cost of imported LNG.
- **Option 2 (Multiple Pools - Averaging Costs):** Shows a moderate increase in revenue, but cost fluctuations make profitability less predictable.
- **Option 3 (Multiple Pools - Attributable Costs):** Results in the highest revenue figures due to targeted cost allocation strategies. However, increased exposure to international LNG pricing leads to higher financial risks.
- **Proposed Option:** Ensures a balanced financial outcome by integrating domestic gas supply with controlled LNG procurement, maintaining a sustainable level of profitability while safeguarding industrial customers from price shocks.

Revenue and Cost Analysis for the Proposed Option Without Customer 2:

Charts 5.5 and 5.6 below presents revenue and cost projections under the proposed pricing model, assuming Customer 2 exits the market. The data highlights the financial impact of losing it on overall government gas sales revenue and government margin.

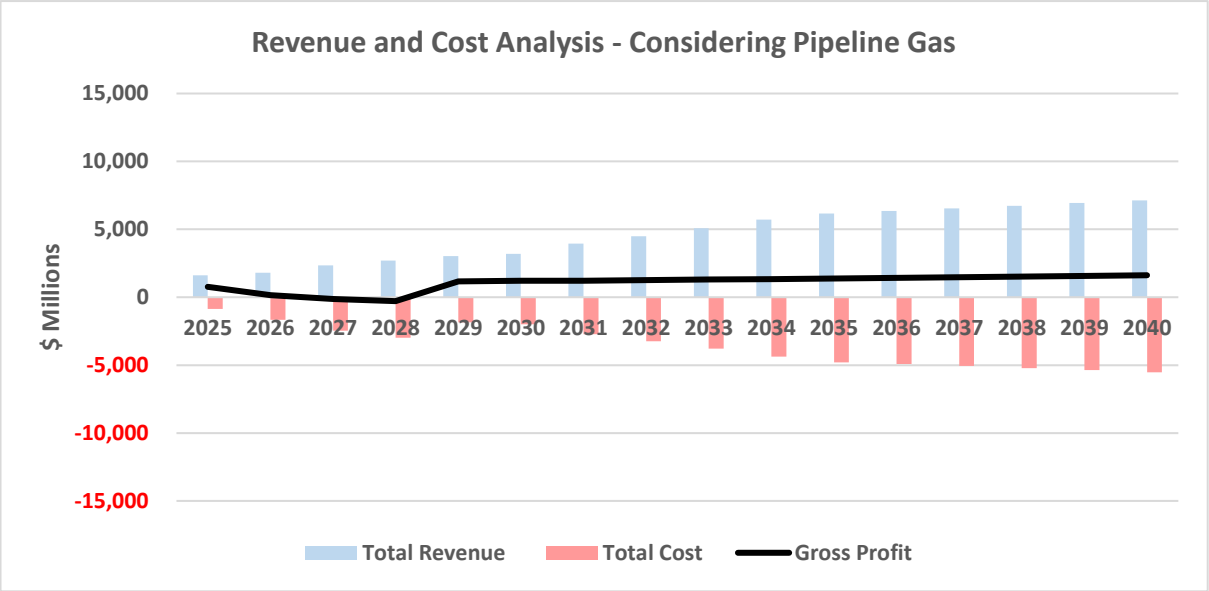


Chart 5.5: Cost and Revenue Analysis (2025–2040) for the Proposed Option without Customer 2– Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

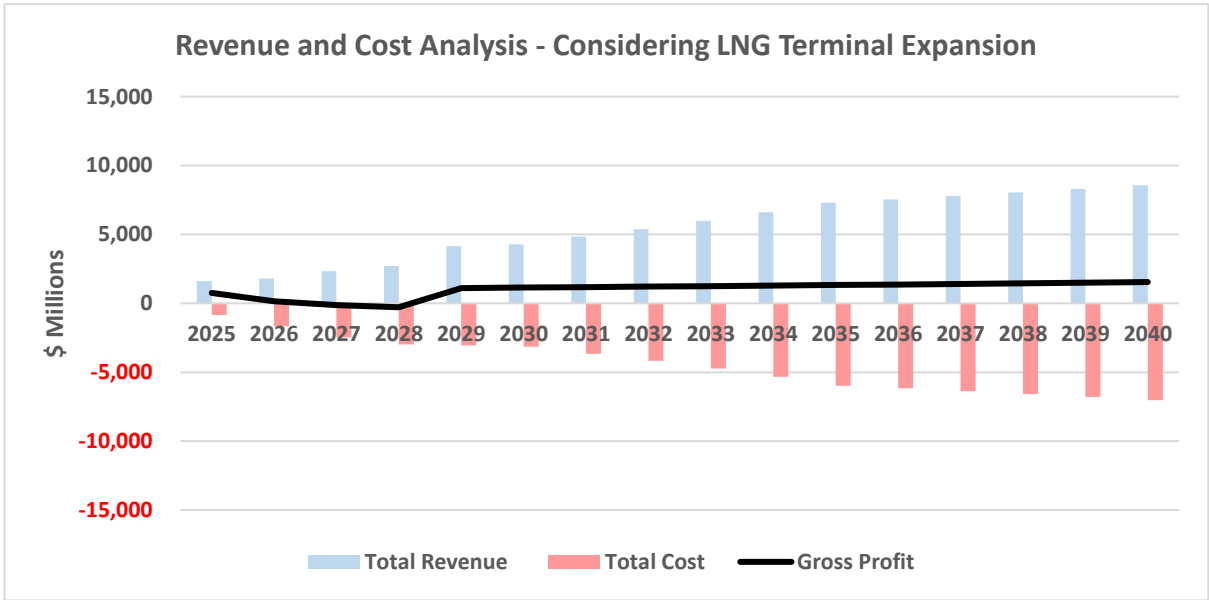


Chart 5.6: Cost and Revenue Analysis (2025–2040) for the Proposed Option without Customer 2– LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

The analysis reveals a sharp decline in government revenue, emphasising the critical role of Customer 2 Bahrain's Economy.

A reduction in Customer 2 contribution could lead to higher financial deficits for the government, emphasising the need for strategic gas pricing policies to retain major gas consumers.

In addition, without Customer 2 consumption, the cost burden of gas infrastructure (including LNG terminal expansion) is distributed among other customers, leading to increase prices for remaining industries.

The findings reinforce the need for a competitive and stable pricing structure that ensures critical industries such as Customer 2 remain operational while ensuring long- term economic stability.

5.3.3 Gas Pricing Analysis Across All Reform Scenarios

- **Scenario 1: No Reform**

Maintaining the current structure without any reform means that gas prices remain unchanged at $4/MMBtu, while the government takes on all importation and operational costs.

Impact:

- Initially, there was stable government revenue, but this model quickly became unsustainable as the annual costs of gas importation and sales continued to rise.
- Over time, Steep increases in costs place a significant financial burden on the government, which fully absorbs these expenses without recouping them from consumers.

This approach is not viable in the long run. Government revenue will be progressively eroded as costs rise, leading to negative financial returns. Without

reform, the government risks facing budget deficits, which would restrict funding for critical services and infrastructure projects.

This highlights the urgent need for reform to ensure sustainable finances, protect fiscal stability, and support essential government functions.

- **Scenario 2: Reform with No Subsidy (Option 1) - Single Pool (WACOG)**

Implements reform by aligning gas prices with actual market costs, removing subsidies, and using a single pool Weighted Average Cost of Gas (WACOG).

Impact:

- Government revenue increases significantly as the government no longer absorbs the cost of subsidies, and prices reflect the actual cost of gas.
- The cost to the government is reduced drastically as subsidy expenses are eliminated, allowing the government to maintain financial stability.
- While this approach reduces the fiscal burden on the government, the rise in gas prices will likely raise industry operating costs and reduce consumer affordability.

This scenario is fiscally beneficial for the government but presents risks to economic stability. Increasing gas prices for key gas consumers such as Customer 1 would raise electricity generation costs, potentially necessitating a rapid reform of electricity tariffs. Such a change could impact the population significantly.

In addition, this increase in the prices will significantly impact the key gas consumers who are very sensitive to gas prices, such as Customer 2, and will significantly impact Bahrain's Economy.

- **Scenario 3: Reform with No Subsidy (Option 2 and 3) - Multiple Pools**

This approach removes subsidies but uses multiple cost pools to average costs, distributing the supply pools based on customer priority. Some customers,

particularly those directly depending on LNG, will face higher costs sooner due to priority-based pool access.

Impact:

- Government revenue grows as subsidies are removed, though the use of multiple pools moderate the increase compared to Option 1.
- The cost to the government is reduced drastically as subsidy expenses are eliminated, allowing the government to maintain financial stability.
- Priority access means customers depending heavily on LNG will face steeper price increases from the beginning, impacting their economic stability while others benefit from gradual increases.

This scenario offers revenue but introduces economic strain for low-priority, LNG- dependent customers. With an immediate increase in gas prices, some low-priority customers may struggle to sustain operations and may exit the market. Implementing a transition period with a gradual gas price increase would provide these businesses the necessary time to adapt, helping them manage higher costs and remain viable.

Scenarios 2 and 3 (Gas Pricing Option 1, 2 and 3) will result in the same total revenue for the government, as they all maintain the government's margin and cover the full supply cost. The key difference among the options under these scenarios lies in their impact on customers, depending on whether the pricing mechanism is based on the weighted average cost of gas, a general cost averaging approach, or the exact cost for each supply pool. Each method distributes the financial burden differently across customer groups, affecting their cost structures and competitiveness.

- **Scenario 4: Reform with Subsidy (Proposed Option)**

This approach mitigates the immediate financial burden, ensuring a more stable and manageable shift towards sustainable gas pricing. This option includes a

phased subsidy specifically for the transition period from 2025 to 2028, allowing gradual price increases to align with market costs.

Impact:

- Government revenue is reduced during the transition period due to temporary subsidies but recovers afterwards as subsidies phase out and prices reflect full market costs.
- Subsidy costs are controlled within a limited period, allowing the government to provide necessary support without long-term fiscal strain. Such support will also help preserve the broader economic stability of Bahrain, sustaining key sectors and avoiding shocks to the overall economy.
- Gradual price increases during the transition prevent sudden shocks to low-priority customers, allowing them to adapt without immediate financial strain.
- It ensures a stable transition, helping to maintain current electricity prices for Customer 1 during the transition period and shielding the population from sudden increases in electricity tariffs.

In this study, we are calculating gross profit rather than net income, as our focus is on evaluating the efficiency of the gas and LNG pricing structure rather than the overall operational performance. By using gross profit, we align our analysis with the financial language of the government, ensuring that the presented figures are relevant to policy and economic decision-making.

Our objective is not to assess operations' profitability or efficiency but to measure the cost-effectiveness and sustainability of natural gas and LNG as commodities. This approach allows for a more precise evaluation of how pricing reforms impact government revenues and customer affordability while maintaining a transparent and consistent framework for policy discussions.

After analysing the gross profit outcomes across all scenarios for natural gas reform, it is evident that the recommended option allows for a sustainable path

forward. Initially, the government will absorb the associated costs to ensure a gradual and manageable adjustment in gas prices. This approach facilitates a smoother transition period, after which profitability will resume, reflecting a balanced economic stability and revenue generation strategy.

While it is true that during the transition period, the government may face some challenges due to reduced profits, this approach preserves the broader economic stability. By absorbing these initial costs, the government supports key industries and maintains stable electricity pricing, ensuring that both sectors remain strong through the transition.

This strategy ultimately safeguards the economy, positioning it for long-term resilience and a healthy recovery in profitability after the transition period.

5.3.4 The Advantages and Disadvantages of Pool Pricing Options

Table 5.2 below presents a comparison of the advantages and disadvantages of various pooled pricing mechanisms.

Table 5.2: Gas Pricing Pools Advantages and Disadvantages

Pool	Advantages	Disadvantages
Single Pool Simple Weighted Average (WACOG)	- Simple concept to understand. - Simple to administer. - Dampens effect of high LNG prices.	- Not cost reflective. - Could make end user price uneconomic for some sectors. - Some customers may not support the approach of including LNG in the average.
Multiple Pools Averaging Costs	- Partially cost reflective. - Security of supply benefits of LNG terminal paid for by all end users.	- Not fully cost reflective. - More complex to administer.

	- Partially dampen the impact of imported LNG prices.	- Political issues in determining which end users get access to which pools. - Some customers may not support the approach of including LNG in the average.
Multiple Pools Attributable Costs	- Cost reflective as new sources of supply will be fully costed to end users. - Protects the most critical end users and minimize the economic impact on government.	- More complex to administer. - Political issues in determining which end users get access to which pools. - Charging the full LNG cost to end users likely to result in extremely high uneconomic prices for some users.

5.4 Natural Gas Sales Analysis

The gas sales revenue is currently added to the government budget and is used for education, hospitals, etc. Gas sales revenue is expected to grow consistently over the years, assuming demand increases as forecasted and pricing reforms are implemented to protect the government's margins.

This study examines the projected gas sales revenue in Bahrain, incorporating revenue generated from the supply of domestic and imported gas to customers. The revenue estimation is based on the proposed pricing option and projected customer gas demand.

In addition, for comparative analysis and validation, this section presents actual revenue figures published in official government reports and annual financial statements.

5.4.1 Gas Sales Revenue in Bahrain

The consolidated final account report for the Kingdom of Bahrain for the fiscal year ending December 31, 2023, provides key insights into gas sales as part of the overall revenue structure.

Gas sales are recorded at net amounts collected from local companies and government entities, deducting the associated production costs. This approach ensures that the reported figures reflect the actual revenue received.

For 2023, the actual revenue from gas sales amounted to 366,732,410 BD, with a Budget of 675,767,000 BD. Gas sales contribute approximately 21.8% to the Kingdom's total revenue.

5.4.2 Impact of Losing Gas Revenue on Bahrain

Losing the gas sales revenue will have a significant impact across various sectors in Bahrain:

- The immediate effect would be reduced total government revenue, leading to potential budget deficits. The government may need to make difficult choices regarding spending priorities.
- Essential services such as education, healthcare, and social welfare programs could face cuts.
- The loss of revenue could impact economic growth and investment in infrastructure and development projects, leading to long-term economic challenges.

Customer Retention Risk:

The potential losses of key industrial customers such as Customer 2, which consumes approximately 40% of Bahrain's natural gas due to rising gas prices, will significantly impact gas sales revenue. This highlights the potential financial consequences if Customer 2 is not sustained and exits the market.

Given its sensitivity to gas pricing and the expected decline in government revenue under similar scenarios, it is important to maintain the operations and competitiveness of Customer 2 by maintaining similar gas prices during the transition period while working on a plan to integrate renewable and efficiency projects in the future.

5.4.3 Inflation and its Impact on Revenue

Inflation affects both operational costs and the real value of future revenues. If gas pricing is not indexed to inflation, future revenues may be worth less in real terms.

The natural gas prices increase with inflation. However, as LNG prices rise, the cost of imported LNG may begin to outpace revenue from gas sales. The government may need to consider indexing the gas prices to inflation to ensure that revenues keep pace with rising costs.

5.5 Economic Impact Analysis

5.5.1 Long-Term and Short-Term Economic Impact

It is important to distinguish between the short-term and long-term economic impacts of changes in gas prices, or energy prices in general.

In the short term, gas price increases will likely impact businesses immediately. However, in the long term, businesses tend to adjust their overall cost structure to address increasing energy costs, for example, by investing in energy-efficient

technologies and processes, or perhaps exit the business altogether if they cannot continue to compete.

Some countries may continue subsidising energy prices and increasing the government's financial burden. In several countries, this would accentuate their budget deficits and force governments to reduce investments in social infrastructures such as schools, hospitals, roads, etc., which would not likely attract private sector investments.

Other countries would make a choice (sometimes an unavoidable choice) to adjust upward energy prices and face short-term difficulties. This choice would lead to a more sustainable economic development path with lower budget deficits in the long term.

5.5.2 Economic Impact Analysis for Customer 2

Economic analysis covering the issue of natural gas price affordability for the large industrial customers in Bahrain require individual models for each of them to be developed to the appropriate level to enable the revenues, costs and profitability of each industry to be understood with particular reference to the sensitivity of the business to gas costs.

Unfortunately, most of the gas customers in Bahrain have not published this kind of information. However, Customer 2, representing around 40% of Bahrain's natural gas consumption, is a public company; this information is available and can be used in this section for economic analysis.

Charts 5.7 and 5.8 below present the expected net profit for Customer 2, considering both supply options, the Pipeline Gas and the LNG Terminal Expansion.

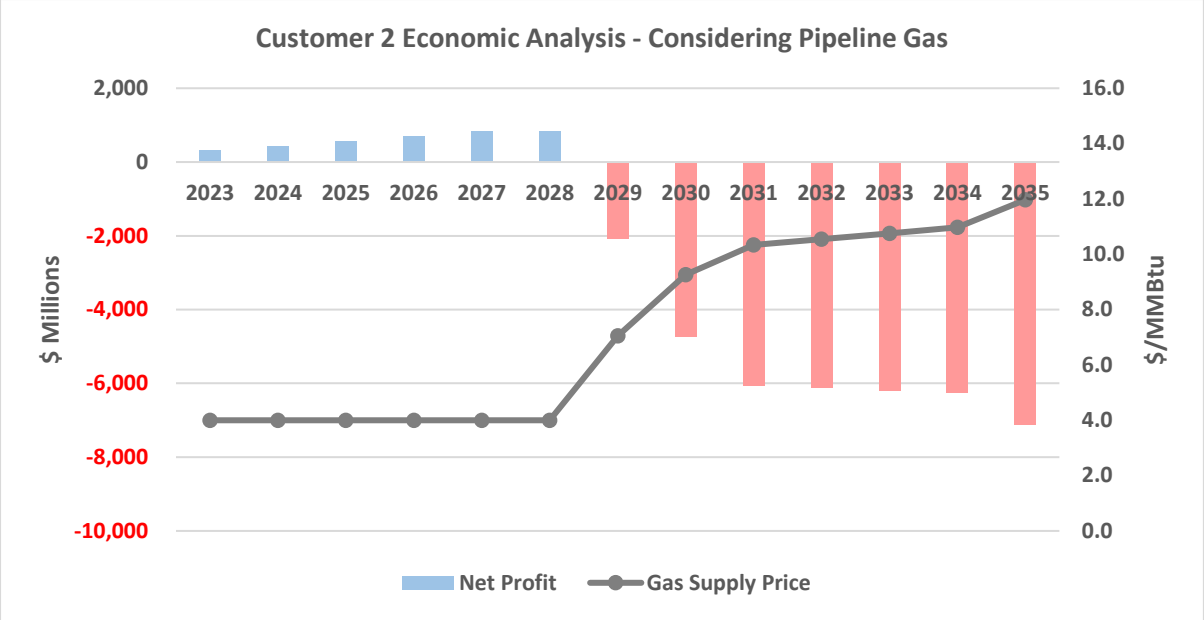


Chart 5.7: Customer 2 Economic Analysis – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

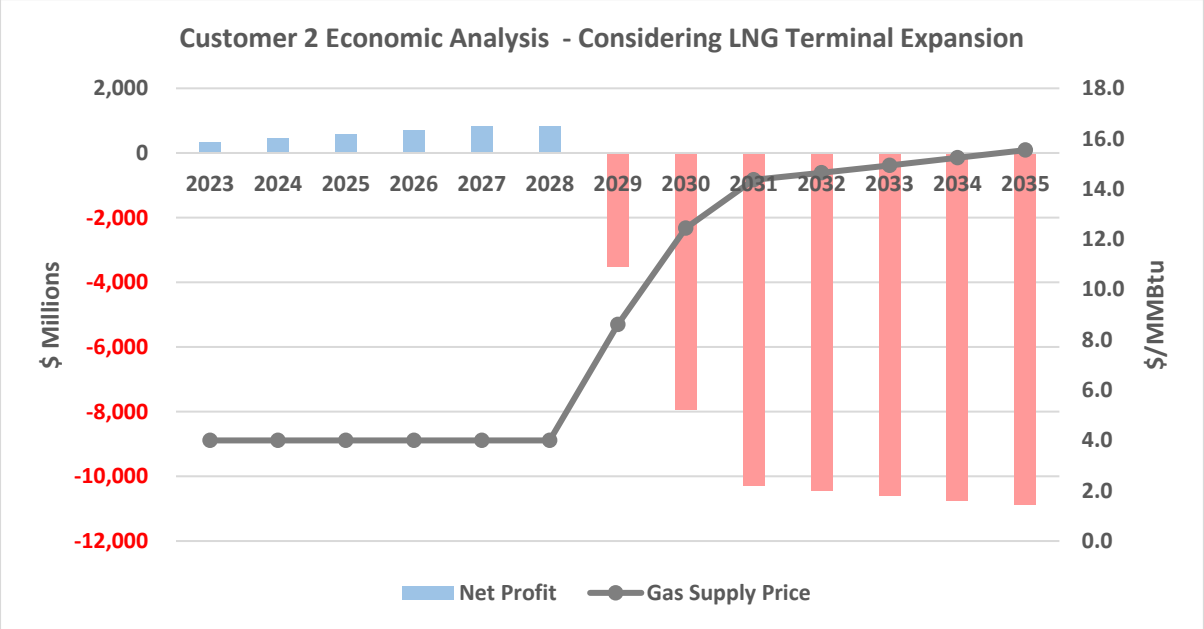


Chart 5.8: Customer 2 Economic Analysis – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

The economic analysis of Customer 2 profitability demonstrates that its net profit is entering a declining phase post the transition period immediately as natural Gas prices have increased due to the introduction of LNG into the supply mix for Customer 2.

The analysis model results indicate that Customer 2 financial performance is highly sensitive to changes in gas pricing, given its significant reliance on natural gas as a primary energy source. With LNG prices expected to be considerably higher than domestic gas, Customer 2 narrow profit margin making it challenging for the company to maintain its current level of operations and competitiveness.

Given the strategic importance of Customer 2 to Bahrain's economy, it is essential to ensure that gas pricing remains stable in the coming years to support its sustainability. A sudden increase in natural gas costs would impact Customer 2 profitability and have broader economic implications.

A long-term energy strategy must be developed for Customer 2, focusing on renewable energy integration and alternative fuel sources to reduce the dependency on natural gas. Without such measures, Customer 2 ability to operate efficiently and remain competitive in the global aluminium market will be significantly challenged under an LNG-driven pricing structure.

5.5.3 Economic Impact Analysis for Customer 1

The economic analysis of gas use in the power and water desalination sector is different in character from the foregoing analysis of petrochemicals, aluminium, steel and oil refining projects.

Demand for electricity generation plants increases gradually over time in line with electricity and water demand gave rise to a series of new investments over time rather than the one-off investment opportunities that arise in the other sectors.

Consequently, future demand for gas in the power sector is subject to more significant uncertainty than in the other industries, where for each customer, the main uncertainty is whether expansion projects will go ahead.

The economic analysis of Bahrain's power and water sector after reforming the natural gas pricing reveals significant economic and social implications. Moving power plants to higher gas prices will place substantial pressure on the government's budget, as it will have to cover the increased costs of gas procurement while continuing to subsidise electricity prices for both residential and commercial consumers.

This dual financial burden higher payments to power plants and ongoing subsidy obligations will create a significant fiscal challenge as the government cannot absorb these escalating costs indefinitely. The impact will extend beyond the government finances, potentially leading to higher electricity prices for consumers, increased inflationary pressures, and broader social concerns.

Given the critical role of the power and water sector in national stability and economic development, it is essential to categorise it as the most sensitive customer group, requiring sustained access to the lowest possible gas prices until the end of the lowest pricing pool. Maintaining affordable gas prices for power generation is necessary to avoid economic shocks and prevent disruption to essential services.

In parallel, Bahrain must accelerate the transition of power plants to renewable energy sources to mitigate the long-term impact of rising gas costs. This strategic shift will help stabilise electricity prices, reduce dependency on natural gas, and ensure long-term energy security, ultimately safeguarding both the economy and public welfare.

5.5.4 Economic Analysis for Small Industries

No quantitative model is needed for small industries due to the heterogeneous nature of businesses in this group of consumers and the fact that these users account for a tiny percentage of total gas consumption.

Natural gas consumed by small industries accounted for only around 2% of Bahrain's natural gas consumption and the impact on Bahrain's overall natural gas balance is expected to be limited or relatively minimal.

Many of these businesses are either insensitive to gas prices or only marginally affected, meaning that even if gas prices rise, the effect on Bahrain's overall inflation would be negligible. Additionally, if any sensitive industries were to relocate or cease operations due to gas price increases, their departure would not have a major impact on the economy, as their contribution to Bahrain's GDP is minimal.

However, according to the "Economic Vision 2030" published by the Economic Development Board (EDB) of Bahrain, the development of small industries, especially the clean industries is of paramount importance to Bahrain's future economic development. Hence, creating favourable conditions and environment for the targeted small industries to prosper in Bahrain is crucial in retaining and attracting these industries.

Based on the above, the small customers are considered as a high priority customers which will have access to the lowest price pools and maintain their gas price at the same level in the transition period before shifting to the higher price.

5.5.5 GDP Per Capita Analysis

The analysis discusses Bahrain's projected GDP per capita under various gas pricing scenarios, including the pipeline gas option and the LNG terminal expansion project.

The analysis considers multiple options, evaluating the economic impact of importing LNG with and without reform and different pricing mechanisms under Options 1, 2, 3 and the proposed option. Additionally, a no importation, no reform scenario is included to assess the consequences of failing to secure alternative gas supplies.

Furthermore, a long-term renewable energy scenario is considered, showing how increased reliance on renewable energy and efficiency measures could improve GDP per capita. Finally, the most optimistic scenario, in which Bahrain generates additional revenue from LNG exports, is included to illustrate the potential for returning to a strong and stable GDP per capita similar to historical levels. These comprehensive projections provide a clear view of the economic implications of Bahrain's energy policy choices.

The GDP per Capita figures are calculated based on the result of a study outlining that "A 1% increase in energy prices results in a GDP per capita decrease of 0.19% for high-income countries (e.g., Bahrain)."

Charts 5.9-5.16 below illustrate the projected GDP per capita under different gas pricing reform scenarios. The data highlights the expected economic impact of pricing reforms on national income levels, including adding renewable Energy to the supply system and adding a revenue stream through the LNG export option.

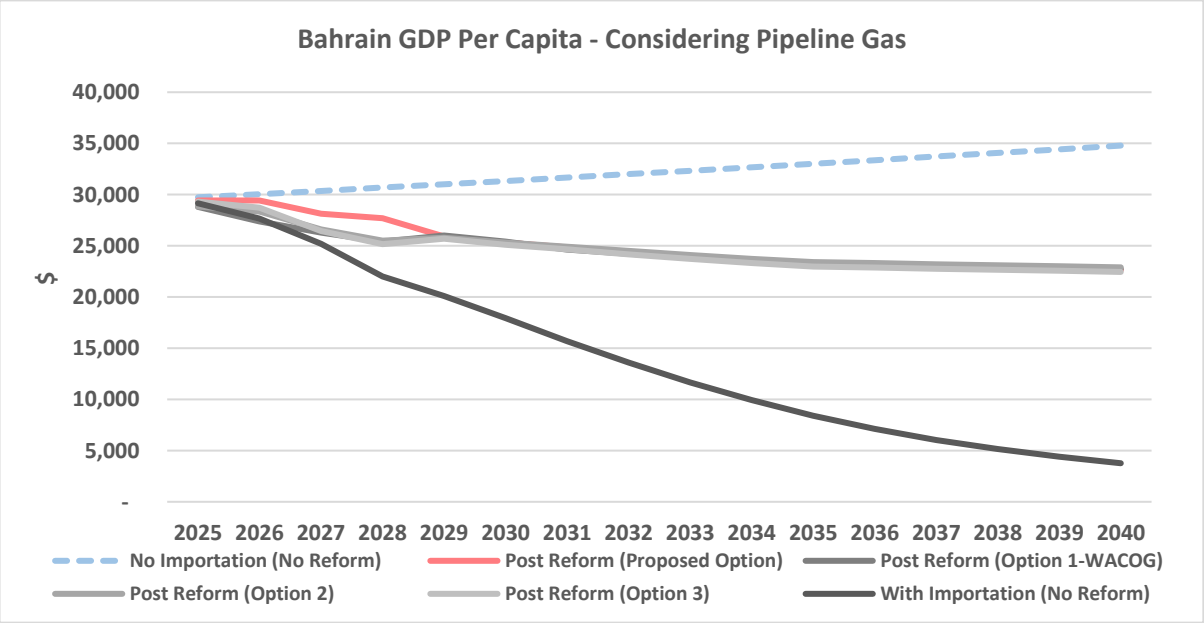


Chart 5.9: Bahrain Projected GDP per Capita (2025-2040) for All Reform Scenarios – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

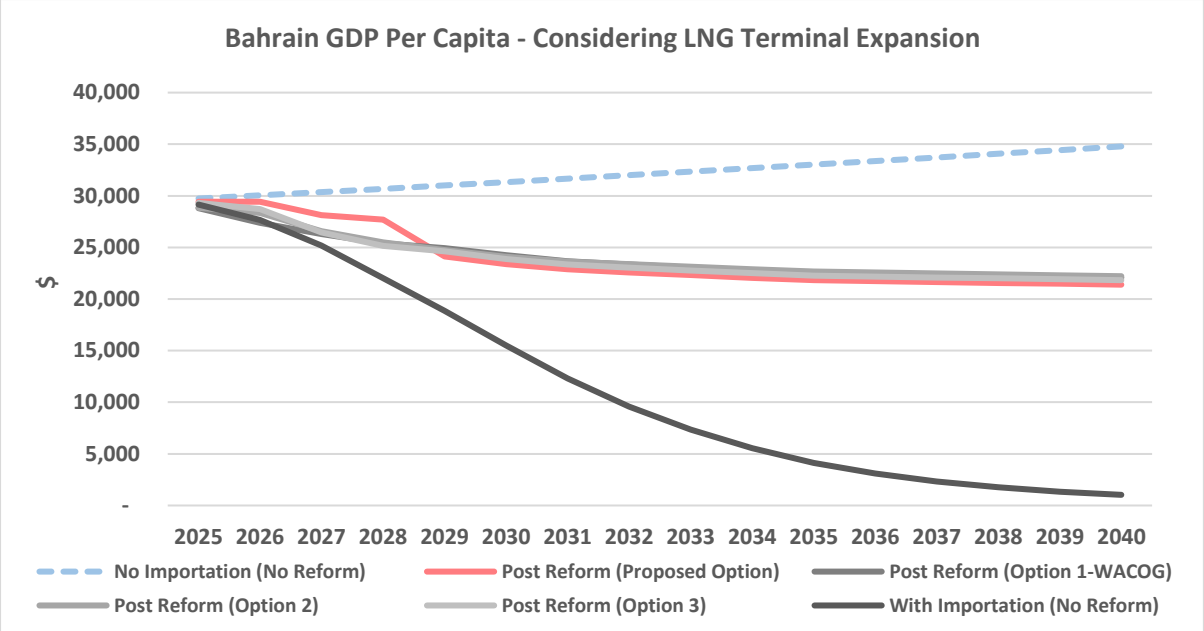


Chart 5.10: Bahrain Projected GDP per Capita (2025-2040) for All Reform Scenarios – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

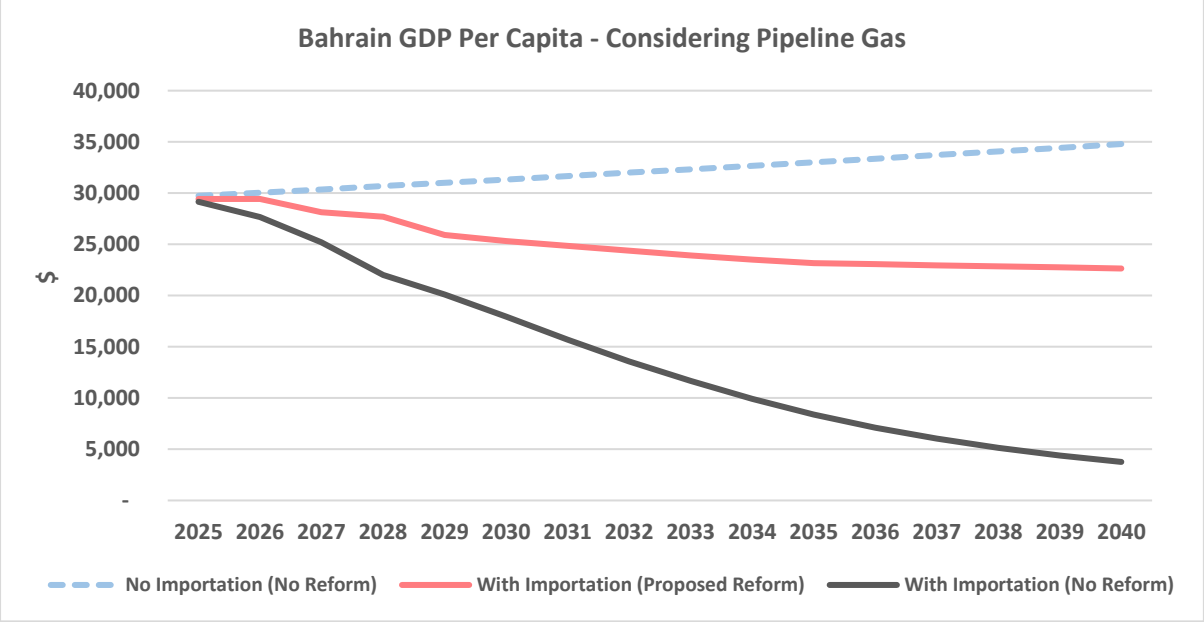


Chart 5.11: Bahrain Projected GDP per Capita (2025-2040) for the Proposed Reform Scenario – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

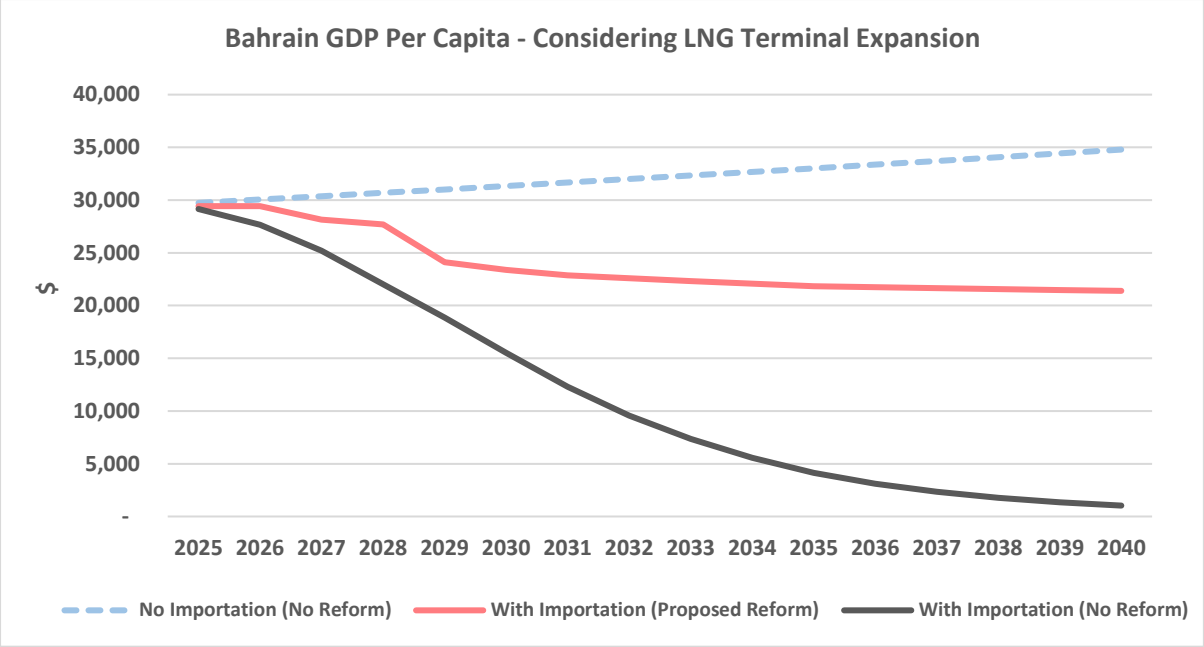


Chart 5.12: Bahrain Projected GDP per Capita (2025-2040) for the Proposed Reform Scenario – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

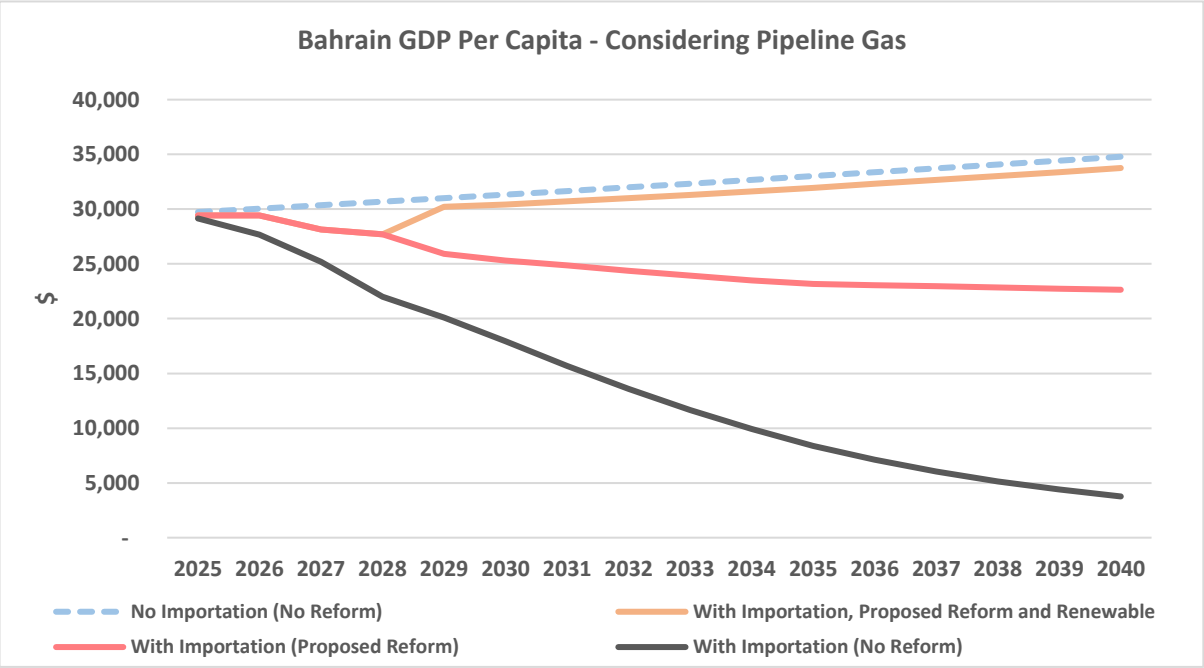


Chart 5.13: Bahrain Projected GDP per Capita (2025-2040) with Renewable – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

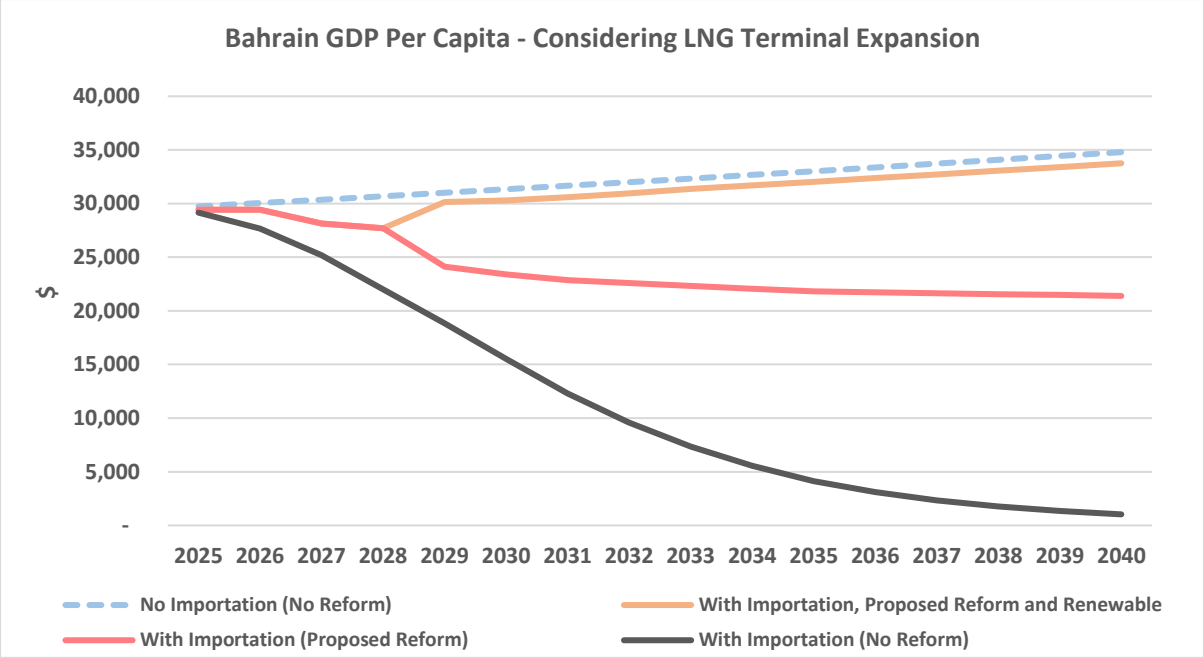


Chart 5.14: Bahrain Projected GDP per Capita (2025-2040) with Renewable – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

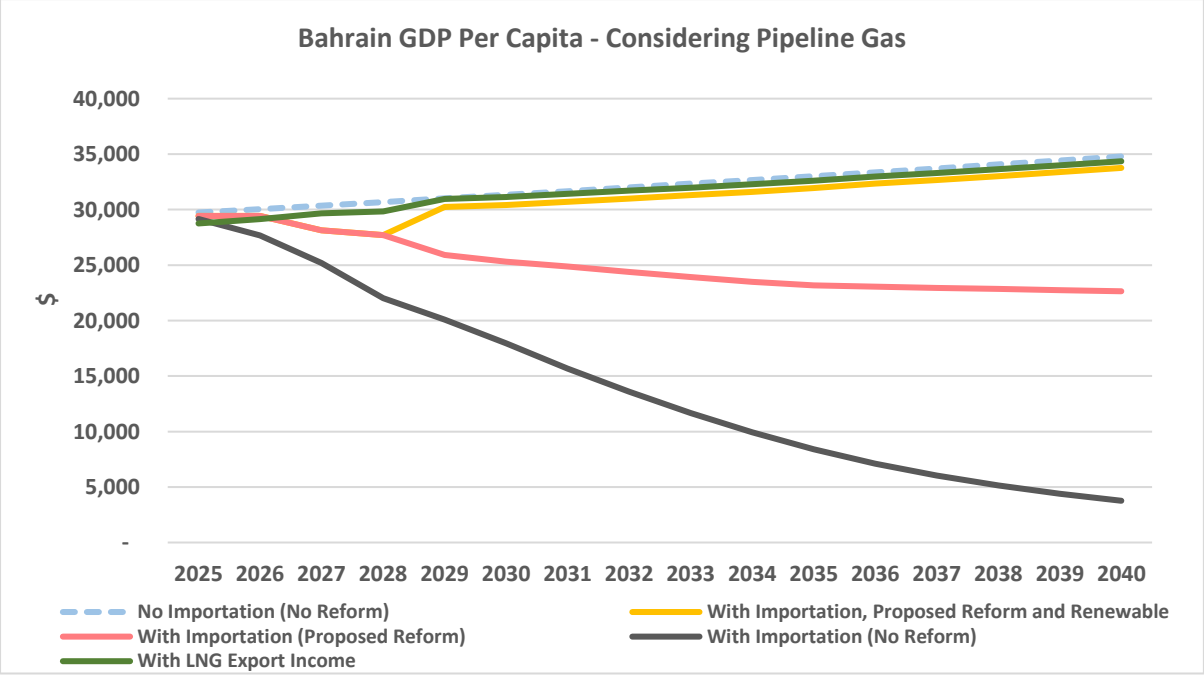


Chart 5.15: Bahrain Projected GDP per Capita (2025-2040) with LNG Export Option – Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

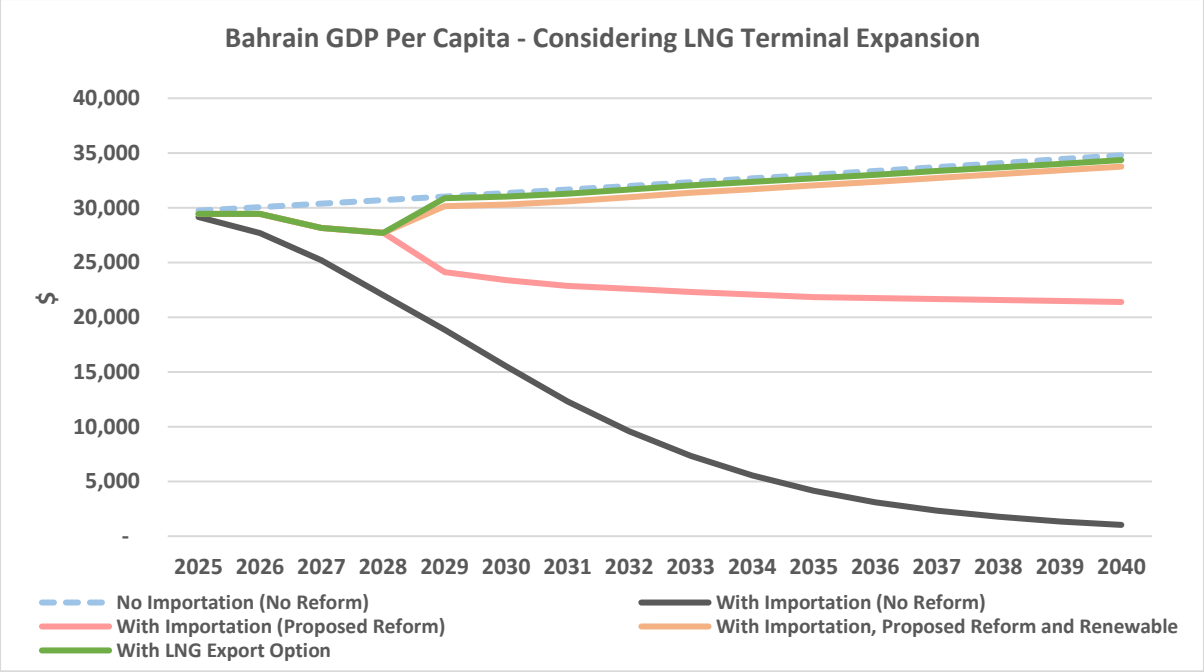


Chart 5.16: Bahrain Projected GDP per Capita (2025-2040) with LNG Export Option – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

The findings show that no importation/no reform Scenario will lead to economic stagnation and declining GDP per capita due to energy supply constraints and with the proposed gas pricing option, which is the best option to maintain the economic stability in Bahrain, there is still an expected decline in the GDP per capita, with moving to the importation.

The inclusion of renewable energy and LNG export options in long-term scenarios is important to maintain the GDP per capita at the same level in future, considering that the change is only in natural gas sector.

This analysis underscores the importance of strategic energy planning, balancing natural gas pricing reforms with renewable energy investments to ensure long-term economic prosperity. In addition, it shows the importance of the diversification in Bahrain's GDP contribution from different sectors to improve the GDP per capita.

5.5.6 Inflation in Bahrain

The "size of the economy" typically refers to Gross Domestic Product (GDP), which measures the total value of goods and services produced within a country over a specific period (usually annually). GDP can be measured in "nominal" terms (using current prices) or "real" terms (adjusted for inflation), providing a clearer picture of growth excluding price level changes.

In 2023, Bahrain's GDP in real terms grew by 2.4%, driven primarily by a 3.4% the non-oil sector expanded, while the oil sector contracted by 2.4%. Bahrain's GDP is around USD 46 billion, with the non-oil sector accounting for approximately 83.9% of real GDP in 2023.

Natural gas pricing reform could promote Bahrain's fiscal stability and aid economic diversification, aligning with Vision 2030 goals. However, it poses short-term challenges, particularly for households and industries. Phased reforms with target subsidies for vulnerable groups would likely smooth the transition and mitigate the impact on growth.

Most of major industries relying on natural gas in Bahrain are Export-Oriented. When customers export most of their products outside the country, price changes in the domestic market, such as natural gas price increases, have a limited impact on inflation as they do not directly influence the prices paid by domestic consumers.

These industries can adjust their pricing strategies based on international markets where they sell their goods. If their production costs rise due to increased gas prices, they are more likely to reflect these cost changes in the prices they charge foreign buyers. This means that the price adjustments occur outside Bahrain, insulating the local economy from these fluctuations.

However, there are still potential ways in which higher gas prices could indirectly affect inflation in the broader economy:

- Even if most gas consumers are export-focused, natural gas is often a key input for generating power in Bahrain. Higher gas prices could raise the cost of electricity, which would affect households, businesses, and government services. This will potentially lead to inflation in sectors like housing, food, and services as businesses pass on their higher operating costs to consumers.
- The government plays a significant role in Bahrain's economy, and if it continues to subsidise natural gas or related services (like electricity) it may reduce spending in other areas or pass the cost to consumers by raising utility tariffs, which would contribute to inflation.

With export-oriented industries bearing the brunt of higher gas prices and minimal exposure to domestic consumers, inflationary risks are low. However, fast-tracking the adoption of renewable energy remains critical in ensuring price stability and energy sustainability for Bahrain's key industrial sectors.

5.5.7 Significance of Customer 1 and Customer 2 on Bahrain's Economy

Significance of Customer 1:

Customer 1 plays a crucial role in Bahrain's infrastructure and economic development. Customer 1 is essential in supporting both residential and industrial sectors across the Kingdom.

Customer 1 operations form the backbone of Bahrain's economic infrastructure, supporting many sectors, including manufacturing, services, and tourism. Reliable electricity access is critical for attracting foreign direct investment and local businesses' competitiveness.

While Customer 1 direct contribution to GDP may not be as visible as that of major industrial players like Customer 2, its role as an enabler of economic

activity is indispensable. The availability of utilities directly impacts productivity and operational viability across all sectors.

Customer 1 is particularly sensitive to natural gas prices, as natural gas is the primary fuel for electricity generation. As Bahrain moves toward natural gas pricing reform, Customer 1 may need to adjust its cost structure and pricing strategy, potentially affecting the overall cost of living and business operations throughout the Kingdom.

Customer 1 is central to creating the infrastructure needed for sustainable economic growth. Investments in energy efficiency and renewable energy integration enhance service delivery and support Bahrain's long-term vision for economic diversification and sustainability.

Customer 1 is integral to Bahrain's economic framework. Its role in providing essential services support the nation's industrial base and contribute to sustainable economic growth. As natural gas pricing and energy policies evolve, Customer 1 operations will remain a key factor in ensuring economic stability and development in Bahrain.

Significance of Customer 2:

Customer 2, one of the largest aluminium smelters globally, plays a crucial role in Bahrain's manufacturing sector contributes significantly to GDP. As the materials sector leader, Customer 2 accounts for a substantial share of Bahrain's exports and market value. Its energy-intensive operations make it highly sensitive to changes in natural gas pricing, given that energy costs directly impact its production expenses and global competitiveness.

The 2023 Bahrain Economic Report notes that the manufacturing sector accounted for 13.6% of Bahrain's GDP in 2023, and it mentions Customer 2 market prominence in Bahrain, which has a high market capitalisation and export impact. Furthermore, the report mentions that Customer 2 leads the materials

sector, which contributed 20.7% to the total market value on the Bahrain Bourse, indicating its economic significance within both the manufacturing sector and the national economy.

Customer 2 published a report outlining that Customer 2 was the first Aluminium smelter in the Middle East has been a major contributor to the social, industrial, and economic development of the Kingdom of Bahrain. Customer 2 sits at the heart of a thriving the aluminium downstream sector in Bahrain, which accounts for approximately 12% of the Kingdom's GDP.

Therefore, natural gas pricing reforms could have a pronounced effect on Customer 2 operational costs, potentially influencing both the manufacturing sector and overall GDP growth if these costs alter Customer 2 output or export pricing.

5.6 Major Project Economic Analysis

Economic analysis is carried out for the LNG terminal expansion project, which is expected to be the only way to maintain the demand in future as the current terminal is limited in capacity. Net Present Value (NPV), Internal Rate of Return (IRR) are calculated to check the feasibility of the project after comparing it with regulator accepted Weighted Average Cost of Capital (WACC).

5.6.1 Net Present Value (NPV), Internal Rate of Return (IRR) and Payback Period

- **Net Present Value (NPV):**

NPV allows us to calculate the present value of future cash flows (revenue) from the LNG terminal expansion is discounted at a chosen rate minus the initial investment (loan). This will help determine if the project will generate enough revenue to cover the loan cost and still deliver a profit after debt payments.

If the NPV is positive, the revenue will exceed the loan cost, indicating a profitable project. If negative, the project may not cover the loan costs.

- **Internal Rate of Return (IRR):**

IRR is the discount rate that makes the NPV of the project's cash flows equal to zero. This tells you the expected rate of return on the investment.

The project is financially viable if the IRR exceeds the loan interest rate. Otherwise, it may struggle to cover costs.

Using both methods can provide a thorough understanding of whether the project's revenue can fully cover loan payments and yield additional financial benefits.

5.6.2 The Weighted Average Cost of Capital (WACC)

The Weighted Average Cost of Capital (WACC) is a critical metric in corporate finance, especially in capital-intensive industries like oil and gas. It represents the average rate a company is expected to pay to finance its assets, combining the costs of equity and debt in proportion to each source's contribution to the company's capital structure.

WACC serves as a hurdle rate for investment decisions, helping determine if a project's return meets or exceeds the cost of funding it. WACC represents the average rate of return a company needs to pay to its capital providers, considering both debt and equity. WACC is commonly used in investment analysis to determine the minimum return required for a project to be viable.

Oil and gas projects are typically long-term, capital-intensive, and carry substantial risk, especially related to commodity prices, environmental regulations, and geopolitical factors.

WACC will help us determine the minimum rate of return that the LNG terminal expansion must be achieved to be financially viable and meet the expectations of both debt and equity investors.

Formula (5.1): WACC = (E/V x Cost of Equity) + (D/V x Cost of Debit x (1-Tax Rate))

Where:

- E = Market value of equity
- D = Market value of debt
- V = Total value of capital (equity + debt), so V = E + D
- Cost of Equity = Expected rate of return required by equity investors %
- Cost of Debt = Interest rate paid on debt %
- Tax Rate = Corporate tax rate (applies only to debt due to tax-deductible interest) %

Interpretation: The WACC is x%, meaning the company needs to achieve at least a x% return on its projects to satisfy both debt and equity providers.

Understanding and accurately calculating WACC helps us make financially sound decisions that align with government and shareholder interests, contributing to long-- term sector growth and resilience.

5.6.3 Minimum Attractive Rate of Return (MARR)

For any investment to be profitable, the investor expects to receive more money than the capital invested. In other words, a fair rate of return, or return on investment, must be realizable.

The MARR is established by financial managers and is used as a criterion against which an alternative's rate of return is measured when making the accept/reject investment decision. It will usually be equal to or higher than the WACC that the corporation must bear to obtain the necessary capital funds. So, the inequality

must be corrected for an accepted project. Exceptions may be government-regulated requirements (safety, security, environmental, legal, etc.), economically lucrative ventures expected to lead to other opportunities, etc.

5.6.4 LNG Terminal Expansion Project Evaluation

After consulting with regulator, the WACC is confirmed at 9.6% and the MARR is 10%. The MARR is the benchmark for evaluating project viability, with projects accepted if their IRR exceeds the MARR.

Calculating the NPV, IRR, and payback period will help assess the project's profitability and compare it with regulator MARR. However, the government should assess the project carefully, even if the IRR is below the MARR and if it is affecting the security of the energy supply.

We have to take into consideration that if LNG infrastructure is expanded, this could lock Bahrain into fossil fuel dependency, delaying the transition to renewable energy.

- **IRR and NPV Analysis:**

Different LNG Terminal Expansion Project capital cost is assumed, and IRR is calculated based on that, in order to compare it with the MARR for the regulator, table 5.3 below shows the results.

Table 5.3: Terminal Expansion Capital Cost, IRR and NPV Analysis

Assumed Terminal Expansion Capital Cost	Internal Rate of Return (IRR)	Net Present Value (NPV)
$1 Billion	22.7%	$3,772 Millions
$1.2 Billion	20.4%	$3,572 Millions
$1.5 Billion	17.6%	$3,272 Millions
$2.0 Billion	14.2%	$2,772 Millions

$2.5 Billion	11.7%	$2,272 Millions
$2.8 Billion	10.5%	$1,972 Millions

Our analysis indicates that once the capital cost reaches $2.8 billion, the IRR remains slightly above the MARR, suggesting that this is the threshold at which the project remains financially viable. Therefore, based on our calculations and assumed figures, we can conclude that the maximum acceptable capital cost for the terminal expansion is $2.8 billion, beyond which the financial feasibility of the project would be compromised.

- **Net Cash Flow Analysis:**

Charts 5.17 and 5.18 below present the Net Cash Flow for the LNG Terminal Expansion project and the proposed option scenario.

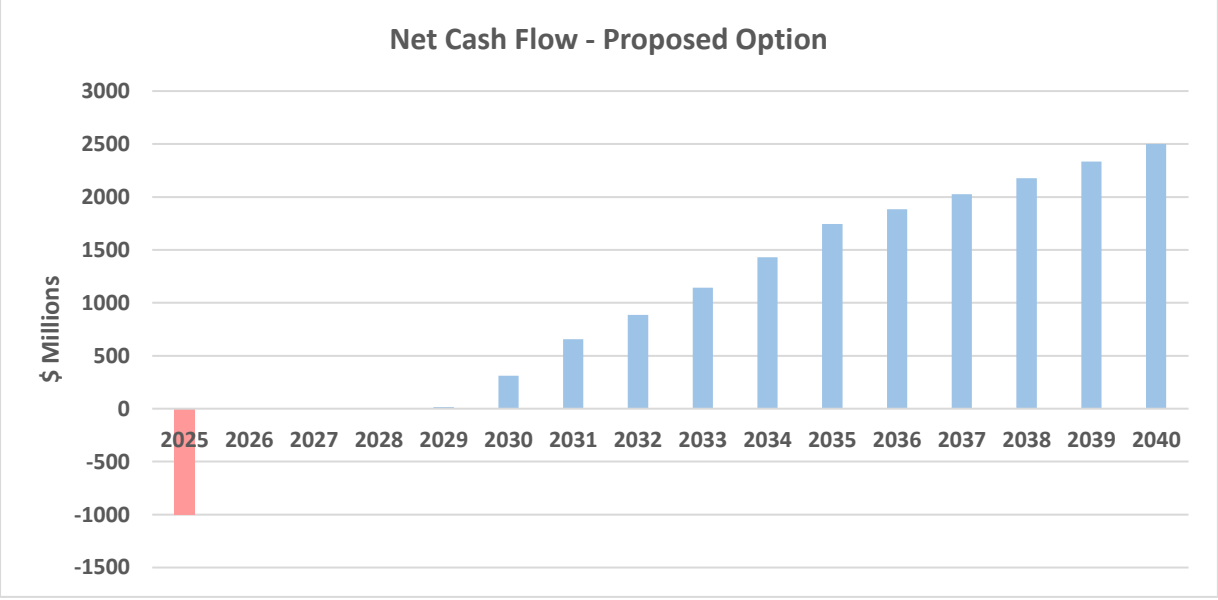


Chart 5.17: The Net Cash Flow for the LNG Terminal Expansion Project

Source: Author's own calculation from the developed gas pricing model (2025).

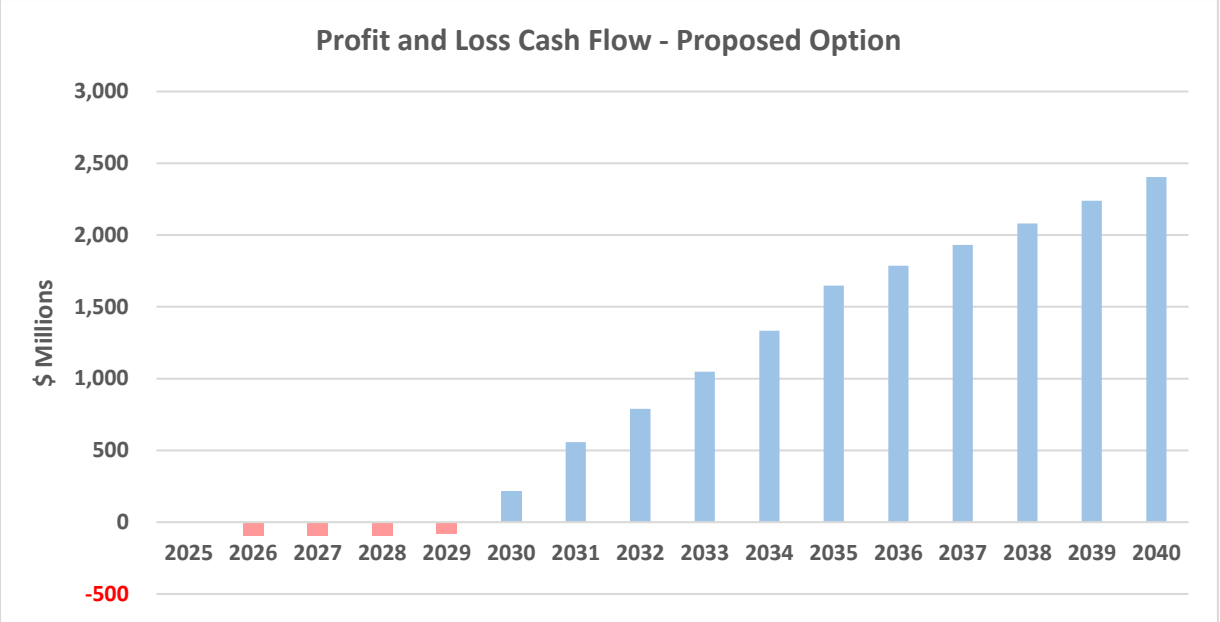


Chart 5.18: The Profit and Loss Cash Flow for the LNG Terminal Expansion Project

Source: Author's own calculation from the developed gas pricing model (2025).

Based on the analysis presented above, it is evident that the government will bear the financial burden of the LNG Terminal Expansion Project during the initial five years. However, starting from 2030, the cash flow is projected to improve significantly, generating increased revenue for the Kingdom.

While the project holds long-term economic benefits, it requires a substantial upfront capital investment. Therefore, the government needs to conduct a comprehensive financial and strategic analysis before proceeding, ensuring all economic implications and risks are thoroughly assessed.

5.7 Social and Political Impact Analysis

Introducing a new natural gas pricing policy in Bahrain will have significant social and political implications, particularly due to the country's reliance on subsidised energy prices and the potential economic impact of price reforms. The social and political impact that any new domestic energy pricing policy may have on a country is paramount and cannot be ignored or underestimated.

This section highlights a high-level identification of a new gas pricing policy's possible social and political implications. It includes the critical issue of "Energy Subsidies" and the potential impact of removing or not removing these subsidies.

The subsidy is "any government action that lowers the cost of energy production, raises the revenue of energy producers, or lowers the price paid by energy consumers". Energy subsidies would be theoretically justified if the subsidies improved social welfare.

The fuel subsidy scheme in the Kingdom of Bahrain was implemented owing to high revenue generation from the oil-gas sector with the intention that the people should benefit from the common resources and promote economic growth. These subsidies can, however, result in serious fiscal troubles in net-importing countries.

Gradual removal of subsidies and provision of investment incentives for renewables give businesses and industries a more extended timeframe to improve competitiveness in deal with higher input costs.

5.7.1 Issues of Subsidy

Energy price subsidies occur when consumers' domestic prices are below a benchmark price. Currently, gas prices in Bahrain are independent of the international market forces.

Considering the relatively high costs of gas imports, especially LNG supplies, current domestic gas prices are presently fixed at levels well below the opportunity costs. Continuing the policy of setting gas prices at these low levels will, at some stage results in much more significant government subsidies to customers, as gas import costs would undoubtedly be well above current gas price levels in Bahrain.

5.7.2 Potential Impact of Subsidy Removal

Removing gas subsidies would impact several social, political, economic, and environmental sectors.

- **Impact on Consumers and Cost of Living:**

The removal or reduction of gas subsidies could lead to an increase in electricity and water prices, as Bahrain's power and desalination plants rely on natural gas.

Low-income households may experience a disproportionate burden, necessitating compensation measures such as direct cash transfers or targeted subsidies.

The cost of essential goods and services may rise due to increased energy costs for businesses, potentially leading to higher inflation and economic hardship for lower- income groups.

- **Industrial Competitiveness and Employment:**

Industries that depend on low-price gas, such as Customer 2, Customer 5, and steel, may face higher operational costs, reducing their competitiveness in global markets.

Some industries may choose to relocate or scale down operations, leading to job losses and negative consequences for the labour market.

Mitigation mechanisms may include targeted financial support for the industrial customers that provide high levels of employment or have a significant multiplier effect on the economy.

- **Government Budget and Fiscal Policy:**

Removing subsidies would significantly improve government finances, reduce the fiscal burden, and free up infrastructure, healthcare, and education resources. However, the government must carefully balance the timing and scope of subsidy removal to avoid economic shocks and minimise the impact.

- **Environmental Impact:**

Subsidy generally drives excessive consumption and inefficient use of energy. Not only improving fuel gas consumption efficiencies, phasing out fuel gas subsidies also have profound environmental benefits.

The environmental benefit of reducing or removing fuel gas subsidies can be seen from two aspects. First, phasing out subsidies would cut emissions, benefiting air quality and, thus, human health. Second, phasing out fuel gas subsidies would level the playing field of renewable energy. A large discrepancy between fossil fuel and renewable energy prices creates disincentives for renewable energy.

Reducing or removing fuel gas subsidy would then allow for a rapid transition from fossil fuel to renewable energy, adding that funds from fuel subsidies could be redirected to clean energy subsidies and other environmental programs designed to mitigate environmental degradation.

- **Social Welfare:**

Removal of gas subsidies will undoubtedly improve the government budget, which will provide fiscal space for compensating vulnerable groups through welfare transfers.

Expenditure-wise, the government will have more room for various fiscal policies from subsidy removal. The government should reallocate this extra budget to each welfare sector accordingly.

5.7.3 Potential Benefits and Costs of Subsidy Removal

- **The Potential Benefits of Subsidy Removal:**
  - A significant improvement in the Government's budgetary position.
  - Increasing the financial viability of energy providers and potential energy investors.
  - Encouraging the efficient use of energy.

- Rationalising domestic energy consumption.
- Reducing carbon dioxide (CO2) emissions.
- Improving the quality of service provided.

- **The Potential Costs of Subsidy Removal:**
  - Short-run negative impacts on the economy as it adjusts to higher prices.
  - A fall in the output of energy-intensive industries.
  - A fall in household spending unless there are other compensating payments.
  - An increase in the inflation rate may require tightening fiscal and monetary policies, thereby reducing growth, production, and income.

The above-mentioned potential benefits and costs of removing subsidies and implementing a new gas pricing policy would need to be carefully weighed by policymakers. This would be done by considering the government's broader social and economic objectives, estimating the net trade-off between benefits and costs, and implementing adequate mitigation measures.

5.7.4 Subsidy System

The introduction of a new gas pricing system and the related unavoidable subsidy reform must successfully address social and economic considerations.

Several factors that should be considered in developing an effective and well-functioning subsidy system could be identified. Based on these factors, it is possible to develop a set of criteria which can be used to assess the relative attractiveness of alternative subsidy systems:

- Subsidies should be well targeted in that they should be directed only to those who are intended and deserve to receive them.
- Subsidies should, as far as possible, encourage efficiency. In effect, they should not undermine incentives for gas supplier or consumers to provide or use a service efficiently.

- Subsidy systems should be practical, reasonably straightforward, and cheap to administer. In addition, the resources allocated to subsidies should be affordable.
- Categorize customers based on their criticality to Bahrain's economic, social and political aspects.
- Allocate a fraction of the revenues from reforms to compensate small customers. Various support packages included subsidised loans for energy-efficiency technologies, new credit lines, reduced fees and taxes for exports, and limited quantities of gas at discount rates can be considered.
- The implementation of a subsidy system should be transparent in that information on the amount of government funds spent on the subsidy and on subsidy recipients should be disclosed.
- Subsidy systems should be transitory. They should be designed in such a way as to avoid consumers and producers becoming overly dependent on them.

5.7.4 Political Impact

General public government policies can help mitigate the negative impacts of inflation. These could include short-term social protection measures targeted at the public expenditure such as health, education and infrastructure; and the provision of industrial support, such as discounted loans for energy efficiency measures, temporary and targeted compensation.

On the other hand, gas price increases to customers like Customer 1 shall have a cascade effect on the price of electricity and water, which directly affects the general public and lead to people's anger towards the government. So, the government shall ensure the domino effect of subsidy removal on the general public at a minimum by adopting people-friendly policies.

The potential impact of removing subsidies and reforming energy prices will vary depending on the government's policy objectives and how it wants to achieve

them. However, continuing a policy of energy price subsidies is no longer sustainable in potentially gas-short countries like Bahrain and many other parts of the Middle East and North Africa region. It could pose a serious issue of gas supply security, which could affect the country's economy.

Therefore, there is a need to focus on the benefits and costs of removing these subsidies and reforming the country's gas pricing and the appropriate policies to adopt.

5.8 Hedging Strategies

There are various hedging strategies available to natural gas consumers, emphasising the need for risk mitigation and cost stability in volatile markets as Bahrain is moving to be an LNG importer.

5.8.1 Interest Rate Hedging

If the government decided to take loans for the financing of large infrastructure projects like the Terminal Expansion and Pipeline Gas, changes in interest rates could increase borrowing costs significantly, making the projects more expensive over time.

Hedging strategies can be an effective way for Bahrain to manage the financial risks associated with interest rate fluctuations. Including Interest Rate Swaps and Interest Rate Caps.

By using these tools, the government can avoid the financial burden of rising interest rates, ensuring the loan repayments remain within budget and reducing the risk of cost overruns.

Interest Rate Hedging helps stabilise the government's loan repayments, making financial planning is predictable and protects against market volatility.

5.8.2 Commodity Price Hedging

Given that Bahrain's natural gas sector is closely tied to the prices of gas and LNG, commodity price volatility is a significant risk. The government can use hedging strategies to stabilise the cost of importing gas or LNG, reducing the impact of price spikes.

Bahrain can enter into a long-term agreement to lock in current prices for LNG or natural gas deliveries in the future. This helps protect against price increases by securing a fixed price today. Similarly, options contracts give the government the right, but not the obligation, to buy LNG at a specified price, offering flexibility in managing price risks.

Bahrain could index LNG prices to oil prices to mitigate the risk of LNG prices. This ensures that any rise in LNG costs is balanced by increased oil revenue, providing financial stability for the energy sector.

Natural Hedging (Oil Price Indexing):

Some oil-exporting countries utilise natural hedging when importing LNG to mitigate the financial impact of losing domestic gas revenues.

As Bahrain transitions to imported LNG, the revenue generated from domestic natural gas declines, creating a potential economic gap. However, a natural hedge is established by linking LNG prices to Brent crude oil. When oil prices rise, the cost of LNG imports also increases, but higher revenues from crude oil exports offset this. Conversely, when oil prices decline, the cost of LNG imports decreases accordingly, reducing the financial burden on the economy. This dynamic creates a balanced approach, allowing Bahrain to manage price volatility and sustain economic stability while transitioning from domestic gas to imported LNG.

Chart 5.19 below illustrates the concept of natural hedging in Bahrain's LNG imports by comparing oil production revenues and LNG costs at different crude oil prices ($60, $75, and $100 per barrel). As Bahrain transitions from domestic gas to imported LNG, rising oil prices increase both LNG costs and crude oil revenues, offsetting financial impacts.

Conversely, lower oil prices reduce both, minimising economic burdens. The analysis assumes a 10% annual decline in oil production and uses a Brent oil-linked LNG pricing formula. LNG Cost is calculated and compared with the oil revenue to estimate the net amount, demonstrating how this strategy can help balance Bahrain's economic stability during the transition.

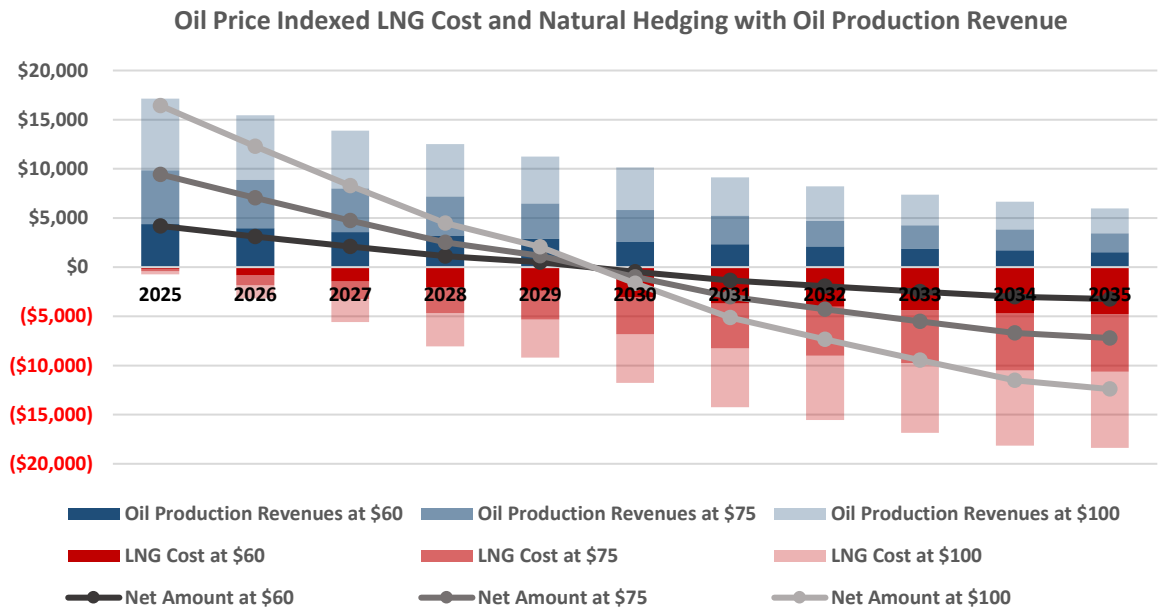


Chart 5.19: Example of Oil Price Indexed LNG Cost and Natural Hedging with Oil Production Revenue

Source: Author's own calculation from the developed gas pricing model (2025).

5.9 Managing LNG Price Risks for Bahrain

As Bahrain transitions to becoming an LNG importer, the country faces significant exposure to global LNG price volatility. Events like the Russia-Ukraine war has demonstrated the vulnerability of energy markets to geopolitical

risks, leading to price surges and supply disruptions. To safeguard Bahrain's economic interests and ensure energy security, a robust LNG procurement strategy must be adopted.

5.9.1 The Impact of LNG Price Volatility

The sensitivity analysis of LNG price fluctuations is a crucial aspect of Bahrain's gas pricing reform, given the inherent volatility of LNG prices. These fluctuations are driven by global market dynamics, supply chain disruptions, geopolitical factors, and seasonal demand variations, directly impacting government and gas customers.

The core objective of the new gas pricing policy is to ensure a stable transition from domestic gas to LNG imports. If LNG prices are highly volatile, it is difficult to predict long-term economic impacts. The gas pricing model assumes that LNG prices follow a predictable trend, but real-world fluctuations can undermine the strategy.

The analysis aims to understand how fluctuations in these benchmark prices can impact Bahrain's natural gas pricing policy. This includes assessing the impact on government revenues and the cost of gas to customers.

The underlying assumption is that the historical pattern of ups and downs in prices may repeat in the future, and this modelling will help evaluate how much volatility affects strategic decisions.

The primary objective is to generate projected Brent and Henry Hub prices for 2025–2040 by using the historical prices from 2003–2023. Instead of relying on standard market forecasts, future projections are developed by replicating historical volatility patterns, which are assumed to continue under similar market conditions.

Charts 5.20-5.24 below show the historical-based sensitivity, built on Brent and Henry Hub price trends from 2003 to 2023 reveal substantial year-on-year volatility when projected from 2025 to 2040. Brent oil-based prices exhibit pronounced swings, often tied to global geopolitical events and supply chain disruptions. Henry Hub's projections, while more moderate, reflect cyclical shifts based on the supply and demand in the gas market.

This volatility significantly affects the predictability of government revenues and customer pricing. In years of peak prices, gas sales could generate windfall revenues for the government yet impose unexpected financial burdens on industrial users. During downturns, the opposite occurs: customer costs fall, but so do state earnings, potentially leading to budget shortfalls.

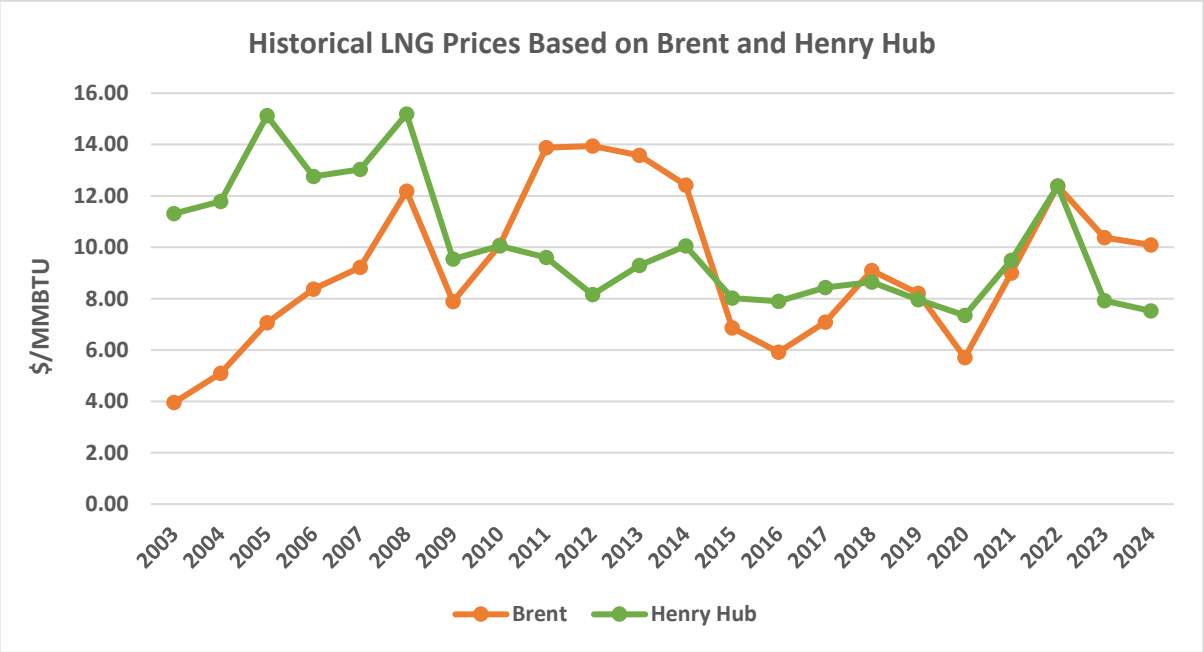


Chart 5.20: Historical LNG Prices Based on Brent and Henry Hub

Source: Author's own calculation from the developed gas pricing model (2025).

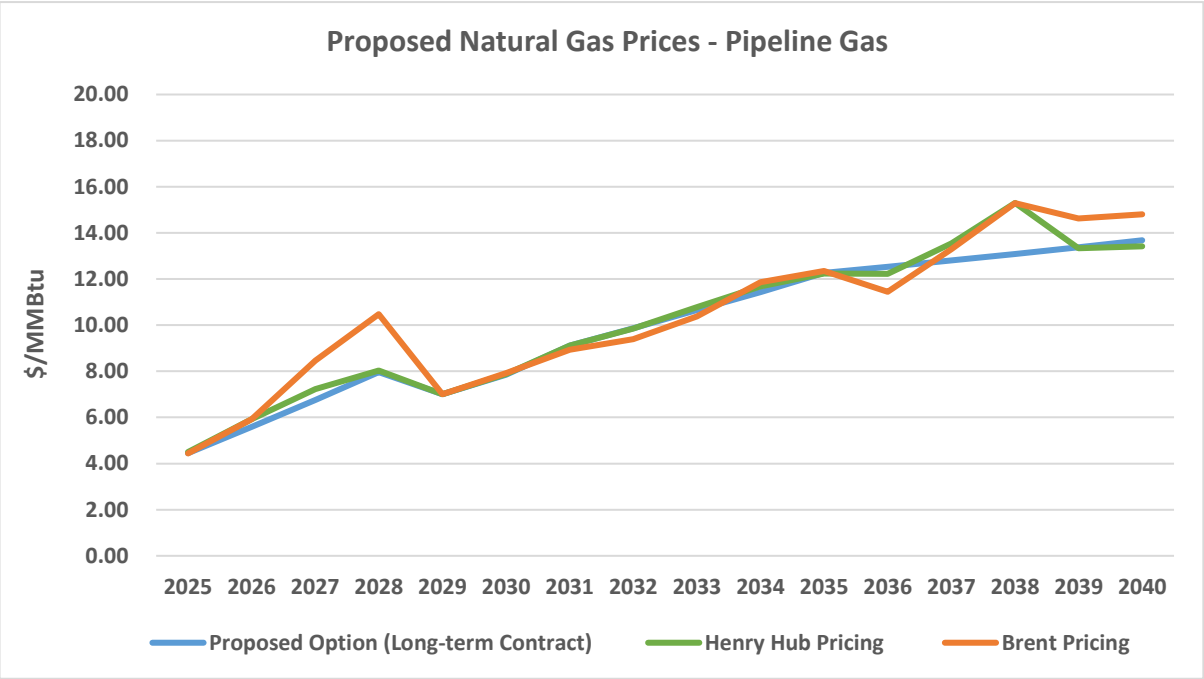


Chart 5.21: Proposed Natural Gas Prices - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

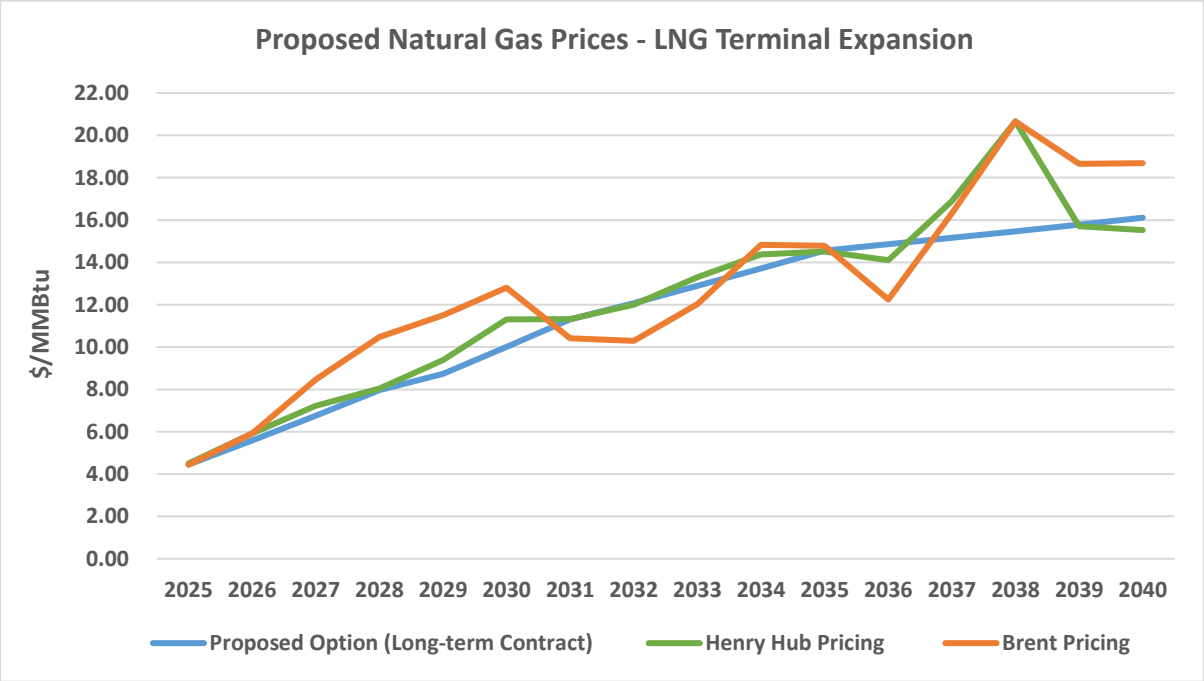


Chart 5.22: Proposed Natural Gas Prices – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

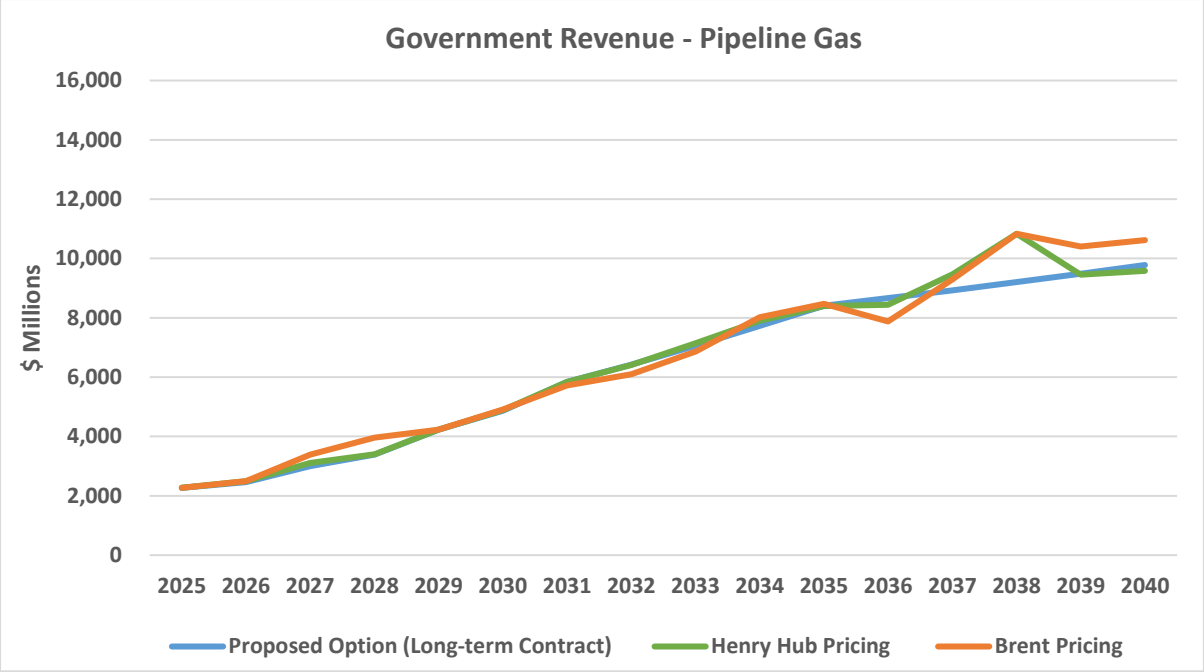


Chart 5.23: Government Revenue - Pipeline Gas

Source: Author's own calculation from the developed gas pricing model (2025).

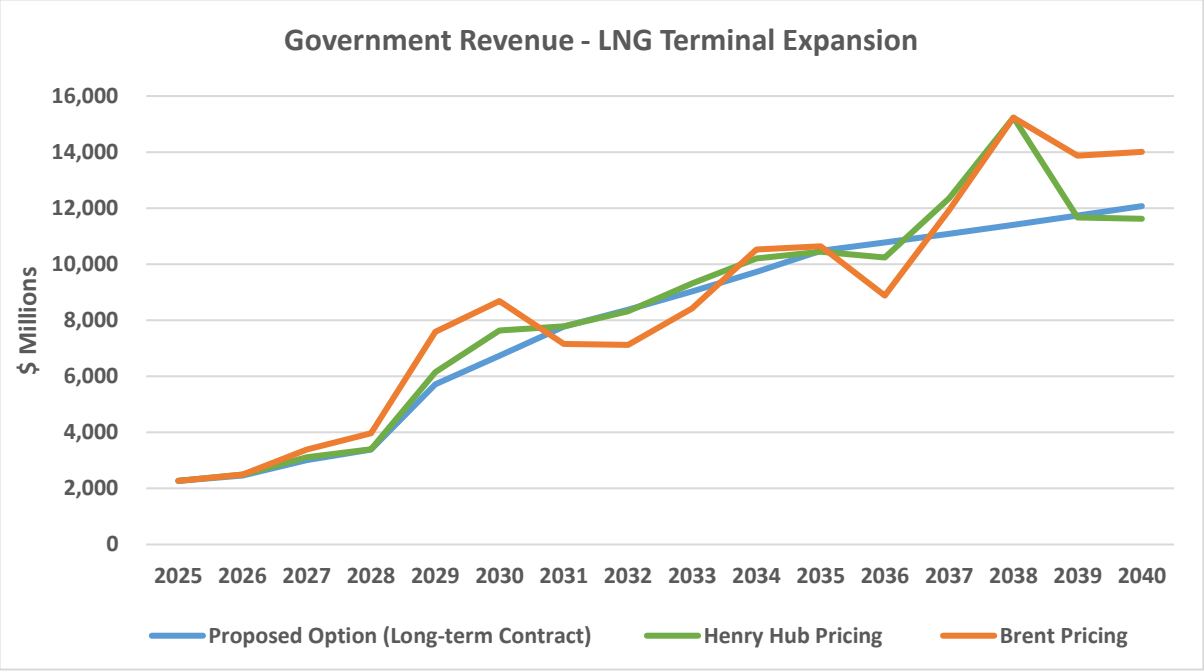


Chart 5.24: Government Revenue – LNG Terminal Expansion

Source: Author's own calculation from the developed gas pricing model (2025).

This scenario stresses the importance of adopting a pricing framework that incorporates risk buffers and minimising the impact of this volatility.

5.9.2 Optimal Procurement Strategy for Bahrain

Given the high price volatility and geopolitical risks, Bahrain should adopt a hybrid procurement model, leveraging the strengths of both long-term contracts and spot market purchases.

A. Long-Term Contracts:

Long-term contracts form the backbone of a stable LNG supply strategy. These agreements provide:

- **Price Stability:**
  - Fixed or indexed prices protect Bahrain from sudden price surges, enabling better financial planning.
  - Indexing to benchmarks like Brent crude ensures prices reflect broader energy market trends.
- **Supply Security:** Guarantees uninterrupted supply, reducing dependency on volatile spot markets.
- **Strategic Relationships:** Building long-term partnerships with key suppliers (e.g., Qatar, U.S., Australia) fosters reliability and potential renegotiation opportunities during crises.

Key considerations for Bahrain's long-term contracts:

- **Volume Commitment:** Secure 70-80% of LNG needs through long-term agreements to minimise exposure to spot market volatility.
- **Flexible Terms:**
  - Include clauses for destination flexibility, allowing redirection of LNG cargoes to other buyers when domestic demand is lower.
  - Negotiate risk-sharing provisions, such as price caps or renegotiation clauses, during extreme market conditions.

B. Spot Market Engagement:

The spot market provides flexibility to adjust procurement volumes based on demand fluctuations and market conditions:

- **Flexibility:** Utilize the spot market for 20-30% of LNG needs to capitalise on lower prices during periods of oversupply.
- **Opportunistic Procurement:** Monitor global LNG price trends and secure competitive deals during market downturns.
- **Diversification:** Engage with multiple suppliers in the spot market to reduce dependency on long-term partners.

5.9.3 Infrastructure and Storage Investments

To enhance Bahrain's ability to navigate market volatility, investments in infrastructure and storage are critical:

- **LNG Storage Capacity:** Build storage facilities to stockpile LNG during low-price periods. This buffer can mitigate supply disruptions during geopolitical crises.
- **Import Terminals:** Strengthen LNG import infrastructure to ensure seamless handling of long-term and spot cargoes.
- **Strategic Reserves:** Establish reserves that can be deployed during emergencies, reducing the reliance on spot purchases during price spikes.

5.10 Policy Synthesis

This section presents a strategic policy framework that consolidates the results of the analysis into a practical, phased reform approach. In line with the study’s objectives and the roadmap outlined in the Abstract, the framework is structured around three core components: a pricing model, an implementation roadmap, and a long-term sustainability strategy.

Phase I: Gas Pricing Model (2025–2027)

During this period, a phased transition is implemented through a dual pricing mechanism. High-priority customers receive targeted support to ensure continued industrial competitiveness, while other segments gradually shift to a cost-reflective pricing model. This approach allows the government to contain the fiscal burden while preparing stakeholders for the upcoming market-aligned structure.

Phase II: Reform Implementation Roadmap (2028–2030)

With the foundational pricing adjustments in place, this phase focuses on consolidating reform through structured implementation. Measures include policy alignment, regulatory refinement, and enhanced energy efficiency across major consumption sectors. Fiscal exposure from subsidies is reduced, and natural gas consumption becomes increasingly optimized through clearer market signals.

Phase III: Long-Term Sustainability and Diversification (2031 and beyond)

This final phase envisions a fully restructured gas pricing framework aligned with Bahrain's broader economic and energy transformation goals. It includes a shift toward energy diversification, integration of renewables, and reduced dependency on imported LNG. Structural reforms during this phase are supported by sustainable pricing mechanisms that ensure affordability, competitiveness, and fiscal resilience.

The proposed phased framework aims to provide policymakers with a structured, evidence-based roadmap for reform. The sequencing of each phase is directly supported by scenario modelling results, particularly the trends observed in the projected subsidy burdens. The hybrid pricing approach at the initial phase enables the government to maintain revenue stability while minimizing disruption for strategic customers. As fiscal risks escalate, the framework

supports a progressive reduction in subsidies to safeguard long-term budgetary sustainability. By linking quantitative outputs to defined policy stages, this strategy offers a coherent transition pathway toward sustainable, market-aligned gas pricing in Bahrain.

5.11 Summary

This chapter analyzed the economic, social, and energy-related implications of natural gas pricing reform in Bahrain, drawing on the results of the Gas Pricing Model and policy scenario evaluation. Among the evaluated options, the hybrid pricing strategy was identified as the most balanced approach. It offers a pathway to fiscal stability while minimizing economic disruption for key gas consumers such as Customer 1 and Customer 2.

The economic and social dimensions of reform reveal significant trade-offs. While pricing adjustments enhance government revenue and reduce long-term fiscal exposure, they also introduce cost pressures on energy-intensive industries. These effects can ripple across the economy. As such, the chapter highlights the need for a carefully managed transition supported by targeted subsidies, energy efficiency investments, and the gradual integration of renewable energy to ensure equity and affordability.

Furthermore, the analysis emphasizes the importance of complementary measures, such as hedging strategies, infrastructure development, and diversification of energy sources to mitigate the risks of LNG price volatility. Without timely and well-sequenced reform, Bahrain faces heightened fiscal vulnerability, rising energy insecurity, and a deterioration of long-term economic resilience. These findings form the analytical foundation for the policy framework and phased implementation roadmap proposed in the next chapter.

Chapter Six: Conclusions and Recommendations

6.1 Introduction

This chapter concludes the study by synthesizing its key findings, evaluating the extent to which the research objectives and expected outcomes have been achieved, and identifying the study's main limitations. It reflects on the strategic implications of Bahrain's shift from domestic natural gas production to increasing reliance on imported LNG, reinforcing the urgency of implementing a sustainable pricing policy that supports fiscal stability, energy security, and economic resilience.

Building on the economic modelling and policy analysis presented in earlier chapters, the chapter proposes a phased, data-driven gas pricing reform strategy tailored to Bahrain's institutional and energy landscape. It outlines a structured set of policy recommendations supported by a practical implementation roadmap, aimed at balancing cost recovery with affordability and industrial competitiveness.

6.2 Evaluation of Research Objectives and Expected Outcomes

6.2.1 Evaluation of Research Objectives

The study successfully addressed the five interrelated research objectives forming the foundation of the proposed gas pricing reform. In relation to Objective 1, a dynamic and flexible pool pricing model was developed to simulate various gas supply scenarios and assess their implications on government revenue and end-user pricing. This model aligns with international practices while remaining adaptable to Bahrain's unique market structure. Objective 2 was addressed through a carefully designed four-year phased transition plan (2025–2028), which incorporates customer segmentation and fiscal buffers to support stakeholder adaptation. However, this objective faced a key limitation due to the lack of

disaggregated financial data at the customer level, which constrained the ability to tailor the transition strategy to individual consumer profiles, particularly in assessing affordability and potential resistance.

Objective 3 was partially achieved through scenario-based analysis of the effects of gas source variability and LNG price volatility on both government revenue and major consumers. While this analysis provided meaningful insights, the absence of detailed data from several large gas users limited the comprehensiveness of the stakeholder impact assessment. Objectives 4 and 5 were fully met through the development of actionable policy recommendations and a comprehensive implementation roadmap. These include strategies for pricing reform, energy diversification, and efficiency improvements, as well as a structured implementation plan.

6.2.2 Evaluation of Expected Outcomes

The study successfully achieved its intended outcomes by developing a sustainable natural gas pricing policy that balances fiscal discipline, energy security, and economic competitiveness amid increasing LNG dependency. A flexible pool pricing framework was established, capable of responding to supply variability and market volatility. The study conducted a comprehensive quantitative analysis of the reform's impacts on government revenue, affordability, and broader macroeconomic indicators such as GDP. It also identified key risk mitigation measures, including supply diversification, storage infrastructure, and financial hedging instruments to reduce exposure to global LNG market fluctuations. In addition, the study delivered evidence-based policy recommendations and a structured implementation plan to support effective and enduring reform.

6.3 Reflections on the Research Questions

The study addressed its core research questions by developing a phased gas pricing model that integrates domestic and imported LNG costs through a pool-based framework. The model, supported by scenario and sensitivity analyses, provides a structured transition plan. It ensures fiscal sustainability and energy security while minimizing the impact on key consumers during the transition phase.

The research explored appropriate pricing mechanisms and transition strategies, confirming that a differentiated approach can manage the shift toward cost-reflective pricing with minimal disruption. Fluctuations in domestic gas production and LNG prices were shown to significantly affect government revenues and affordability, reinforcing the need for a phased and flexible reform strategy.

To mitigate volatility and fiscal risk, the study proposed tools such as long-term LNG contracts, supply diversification, and financial hedging. It also highlighted the importance of integrating renewables and improving energy efficiency to reduce reliance on imported gas and support Bahrain's long-term sustainability goals.

6.4 Key Contributions of the Study

This study proposes an integrated gas pricing model tailored to Bahrain's gas supply challenges. While various regional pricing models exist, this model is specifically designed for the structural dynamics of Bahrain's gas market, incorporating LNG price volatility, fiscal constraints, and economic and social impact considerations, validated through different scenario analysis. It offers a practical and sustainable solution aligned with Bahrain's long-term energy and economic goals.

The model contributes meaningfully to Bahrain's energy planning by offering a comprehensive, data-driven approach to support the country's transition from domestic gas to LNG importation, while preserving energy security and fiscal stability. It provides policymakers with a strategic framework for pricing reform, investment planning, and subsidy management. By simulating phased implementation, the study shows how pricing reforms can be achieved without disrupting industrial productivity or imposing excessive fiscal burdens.

6.5 Limitations of the Study

While the study offers a robust, data-driven gas pricing policy for Bahrain, several limitations should be acknowledged. The absence of detailed customer-level financial data limited the analysis of affordability and demand elasticity, leading to reliance on aggregated assumptions. Supply forecasts, based on historical trends and expert input, remain uncertain due to unknown depletion rates from the Bahrain Field and the timing of future developments. As such, the domestic supply gap projections were based on indicative figures rather than official data, which may impact the accuracy of estimating LNG importation requirements under the reform scenarios.

The model also assumes macroeconomic and geopolitical stability, though global disruptions can cause LNG price volatility and affect policy predictability. Technical and data-related constraints further limit the model's accuracy; assumptions on supply, costs, and consumption were derived from general benchmarks, and behavioral responses to pricing changes especially post-subsidy could not be fully captured.

6.6 Policy Recommendations and Implementation Plan

To ensure a successful transition toward a sustainable gas pricing regime, Bahrain must adopt a multi-pronged reform agenda that addresses pricing frameworks, supply strategies, subsidy adjustments, and energy diversification.

The following consolidated recommendations are structured and aligned with a phased implementation plan. This plan includes implementation plan phases, monitoring areas, and way forward, detailed in Appendix E.

1. **Gas Pricing Model Framework:** Develop and operationalize a robust, data-driven natural gas pricing model capable of simulating diverse pricing scenarios and market conditions. The model should account for pool pricing mechanisms, LNG importation costs, domestic gas allocations, and customer priority classifications. This tool must remain dynamic and updated periodically to reflect new cost data, geopolitical shifts, and demand variations.
2. **Gas Supply Strategy and LNG Procurement:** Formulate a comprehensive national gas supply strategy. This should include:

- Diversification of LNG contracts across short-, medium-, and long-term terms to hedge price and volume risks.
- Development of gas storage solutions, including the repurposing of depleted domestic fields, to support supply flexibility and enable trading strategies.
- Exploration of regional pipeline imports as a complementary supply option.
- Improved nominations and forecasting processes across the supply chain, reducing **the** risk of shortages.

These strategies aim to enhance energy security, reduce over-reliance on volatile markets, and ensure supply cost optimization.

3. **Renewable Energy and Energy Efficiency:** Accelerate Bahrain's energy diversification by:

- Integrating renewable energy into the national grid with clear targets and investment incentives for both public and private stakeholders.
- Promoting energy efficiency through regulatory incentives, conservation programs, and industrial benchmarks to reduce gas consumption intensity.

- Establishing a hybrid supply framework, where renewables and LNG jointly contribute to power generation and industrial demand.

These efforts contribute to long-term resilience and environment goals.

4. **Subsidy Reform:** Implement a targeted subsidy mechanism that protects economically vulnerable sectors and critical industries (e.g., Customer 1, Customer 2) during the transition period. This mechanism must gradually shift from broad subsidies to means-tested or sector-prioritized support, ensuring fiscal efficiency while minimizing socio-economic shocks.
5. **Electricity Pricing Reform:** Align electricity pricing reforms with gas price restructuring to eliminate cross-sectoral market distortions. In particular:

- Gradually adjust tariffs for industrial and commercial users to reflect true gas costs.
- Maintain affordable residential tariffs during the initial reform phase, while considering long-term alignment with cost-recovery goals.

This ensures coherence in pricing policy and economic competitiveness.

6. **Phased Implementation Roadmap:** The transition to a sustainable gas pricing regime will follow a three-phase implementation plan, detailed in Appendix E – Table AE.1:

- Phase 1 (2025–2028): Introduce transitional pricing, where high-priority users access lower-cost domestic gas, and others begin paying a weighted average cost of gas.
- Phase 2 (2029–2035): Shift all customers to a multiple-pool pricing mechanism, reflecting attributable costs and increasing LNG dependence.
- Phase 3 (Beyond 2035): Embed renewable energy sources into the pricing pools and continue efficiency enhancements.

Table 6.1 below outlines the policy recommendation matrix, presenting key problems, corresponding policy solutions, and the supporting evidence drawn from the study's findings.

Table 6.1: Policy Recommendation Matrix

Problem	Policy Recommendation	Supporting Evidence
1. Rising LNG import costs are creating unsustainable subsidy pressures on government finances.	Implement a phased hybrid pricing model to gradually align prices with true gas supply costs.	Scenario results show that the hybrid model reduces fiscal stress while maintaining affordability.
2. Lack of long-term financial planning for pricing reform may lead to policy instability.	Integrate pricing reform into national fiscal planning and energy policy frameworks.	Analysis shows LNG pricing volatility requires policy embedding for stability.
3. High reliance on subsidies for all consumers undermines fiscal sustainability.	Introduce targeted subsidies only for strategic customers during the transition phase.	Customer impact assessments show selective support reduces pressure while preserving competitiveness.
4. Strategic industries (e.g. Customer 1, Customer 2) are vulnerable to sudden pricing shifts.	Apply transitional support and cost-sharing mechanisms for key industrial customers.	Sector-specific modelling demonstrates need for gradual burden-sharing to avoid industrial disruption.
5. Overdependence on gas in power sector increases exposure to LNG risk and fiscal stress.	Diversify energy supply through renewable energy integration.	Mitigation strategy shows that the renewables can reduce gas demand and LNG dependence
6. Inefficiency in gas usage leads to excessive demand and unnecessary import reliance.	Promote demand-side efficiency through industrial audits, incentives, and regulatory standards.	The study demonstrates that efficiency measures reduce import requirements and supports long-term stability.

6.7 Future Work

To build on the findings of this study and support the sustainability, several key areas are recommended for future research:

- Conduct detailed financial modelling for major gas consumers to assess cost structures, pricing sensitivity, and resilience, enabling more targeted and equitable pricing reforms.
- Quantify the impact of renewable energy integration and energy efficiency technologies on reducing LNG dependency and improving fiscal and environmental performance.
- Develop a comprehensive technical roadmap for the transition to LNG, assessing infrastructure readiness, equipment compatibility, regulatory requirements, and investment needs to ensure a smooth implementation.
- Investigate electricity pricing reform to align tariffs with actual generation costs, incorporating international benchmarks, subsidy phase-out modelling, and socio-economic impact assessments to ensure fiscal and social balance.
- Formulate a long-term LNG procurement strategy addressing supply diversification, pricing indexation, contractual flexibility, and infrastructure readiness to enhance Bahrain's energy security and adaptability.

6.8 Summary

This chapter consolidated the findings of the study into a strategic framework for gas pricing reform, presenting a phased approach designed to support Bahrain's transition to a more sustainable, market-aligned structure. Without reform, the country faces rising fiscal pressures due to its growing reliance on imported LNG. In contrast, the phased strategy enables gradual adjustments that minimize disruption while improving cost recovery and enhancing revenue stability.

The chapter also outlined key policy enablers such as regulatory readiness, institutional coordination, and investment in renewables and efficiency that are essential for successful implementation. The recommended roadmap supports a realistic and data-driven transition, tailored to Bahrain's evolving energy and economic context. In addition, the chapter identified future research directions to support ongoing policy refinement, including the development of dynamic pricing tools, improved subsidy targeting, and integrated planning with long-term energy diversification goals. Together, these elements form a coherent policy agenda that aligns with the Kingdom's national development priorities.

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Appendices

Appendix A: Expert Interview

Interview Discussion Topics:

1. Bahrain's natural gas supply strategy and energy security
2. The necessity and timing of gas pricing reforms
3. The relevance of international gas pricing policies to Bahrain's context
4. The economic impacts on stakeholders, especially power plants and industry
5. The role of renewable energy in diversifying future energy sources
6. Policy recommendations for a balanced and sustainable pricing transition

Feedback Focus Table:

Table AA.1: Experts Interview Discussion Topic Focus Table

Discussion Topic	Senior Experts	Regulator	Gas Supplier	Key Customers	3rd Opinion
1	x	x	x		
2		x	x	x	
3		x			x
4	x	x	x	x	
5		x			x
6	x	x	x		x

Participants:

Table AA.2: Demographic Profile of Expert Interview Participants

Role	Organization	Participants
Senior Experts	Formerly Customer 3 and Customer 4 - Retired	2
Regulator	Regulator Company	2
Gas Supplier	Gas Supplier Company	3
Key Customers	Customer 1 - Power Plants no. 3 & 4	2
Third Opinion (Consultant)	International Agency	1

1. **Senior Experts:**
    - Manager of Petroleum Engineering in Customer 4/General Manager of Exploration and Development Division in Customer 4/Member in Board of Directors at Customer 3 (Customer 3 and Customer 4)
    - Manager of Gas Distribution and Sales (Customer 3 and Customer 4)
2. **Regulator:**
    - VP Portfolio Management & Corporate Development – Investments
    - VP Performance Management – Strategy
3. **Gas Supplier:**
    - Chief Business Officer-Business Excellence and Performance Management
    - Chief Legal Officer
    - Chief Financial Officer-Finance and Supply Chain
4. **Key Customers: Customer 1 Power Plants**
    - Commercial and Performance Manager (Power Plant no. 3)
    - Commercial and Performance Manager (Power Plant no. 4)
5. **Third Opinion (International): Gas Consultant**

Appendix B: Customer 2 - 2023 Financial Statement

CONSOLIDATED STATEMENT OF PROFIT OR LOSS

For the year ended 31 December 2023

	Note	2023 BD'000	2022 BD'000
Revenue from contracts with customers	19	1,543,908	1,840,924
Cost of revenue	21	(1,290,417)	(1,295,314)
GROSS PROFIT		253,491	545,610
Other income	20	7,054	5,030
Gain on foreign exchange		2,954	9,378
General and administrative expenses	21	(39,064)	(38,555)
Selling and distribution expenses	21	(55,778)	(83,788)
Finance costs	22	(62,230)	(33,003)
Realised gain on settlement of cash flow hedge for interest rate swap (IRS)	17	13,299	12,227
Directors' remuneration	25	(420)	(412)
Changes in fair value of derivative financial instruments	17	(1,114)	85
PROFIT FOR THE YEAR BEFORE TAX		118,192	416,572
Tax	18	(167)	(405)
PROFIT FOR THE YEAR		118,025	416,167
Basic and diluted earnings per share (fils)	23	83	294

Khalid Al Rumaihi
Chairman

Isa Bin Khalid Bin Abdulla Al Khalifa
Director

Ali Al Baqali
Chief Executive Officer

Figure AB.1: Customer 2 - 2023 Financial Statement

Source: Customer 2. (2024). Financial Statement.

Appendix C: Bahrain 2023 Consolidated Final Account Report

- **Bahrain Gas Sales Revenue:**

Kingdom of Bahrain
Consolidated Final Account
For The Year Ended 31 December 2023

4- Revenue By Chapter, Section, And Item

BD

Code				Description	2023			Actual 2022
Itm	Ch	Sec	Ac		Budget	Actual	Difference	
4	1	1	40011	Oil Sales - Bahrain Field	128,112,000	149,448,593	21,336,593	166,624,658
4	1	1	40012	Oil Sales - Abu-Sa'afa Field	1,125,473,000	1,545,755,835	420,282,835	1,959,671,140
4	1	1	40014	Future Generations Reserve- Abu-Sa'afa Field	(20,590,000)	(34,734,133)	(14,144,133)	(20,501,772)
4	1	2	40054	Gas Sales - Other Companies	675,767,000	366,732,410	(309,034,590)	305,873,604
4	1	3	42011	Gas Income Tax	352,000	1,470,213	1,118,213	4,103,586
4	1	3	42013	Petrol Tax	6,856,000	6,026,892	(829,108)	5,507,328

Figure AC.1: Bahrain Gas Sales Revenue for 2022 and 2023

Source: Ministry of Finance and National Economy. (2023). Bahrain Consolidated Final Account Report

- **Government Entities Actual Expenditures:**

Kingdom of Bahrain
Consolidated Final Account
For The Year Ended 31 December 2023

9- Transferred Budget Expenditures

BD

Government Entity	Budget	Actual	% Of Spend	Actual 2022
Government Entities with Attached & Independent budgets	343,889,414	393,044,826	114	154,433,315
Contributions in Regional & International Organizations	14,966,013	13,305,216	89	14,523,968
Support for Low-Income Families	128,000,000	141,787,974	111	139,273,379
Food Support	35,904,000	48,677,744	136	46,333,816
Social Insurance Organization	21,000,000	20,562,088	98	20,643,624
Government's Share and Contribution in the Social System	-	678,885	-	1,442,518
Government's Share in the Unemployment Insurance Program	21,000,000	22,093,086	105	21,129,256
Social Security Fund	21,500,000	23,785,116	111	23,023,325
Allowance for Improvement of Standard of Living for Retirees	177,500,000	228,894,107	129	169,353,605
Housing Program Support (Rent Allowance-Reduce of Instalments)	61,000,000	58,617,762	96	57,978,015
Government Aids	900,000	672,637	75	1,484,073
Interest on Loans and Securities	766,000,000	834,976,341	109	736,385,050
Retentions, Forwarded budgets, and Other Commitments	83,768,900	79,489,114	95	132,868,161
Total	**1,675,428,327**	**1,866,584,896**	**111**	**1,518,872,105**

FigureAC.2: Government Entities Actual Expenditures for 2022 and 2023

Source: Ministry of Finance and National Economy. (2023). Bahrain Consolidated Final Account Report

- **Consolidated Revenue/Expenditure Statement:**

Kingdom Of Bahrain
Consolidated Revenue/Expenditure Statement
For The Year Ended 31 December 2023

BD

Description	Notes	Budget 2023	Actual 2023	Actual 2022
Revenue				
Oil & Gas	4،3	1,915,970,000	2,034,699,810	2,421,278,544
Revenues & Fees	4،3	885,890,960	920,775,284	872,946,027
Gov. Goods & Services	4،3	80,246,500	76,529,614	71,741,335
Investments & Gov. Properties	4،3	180,523,300	131,278,396	137,422,757
Sale of Capital Assets	4،3	724,234	723,808	1,135,316
Fines, Penalties & Mis.	4،3	40,031,006	31,964,389	39,329,204
Total Revenue	**4،3،2**	**3,103,386,000**	**3,195,971,300**	**3,543,853,183**
Recurrent Expenditures				
Manpower	8،7،5	1,342,040,202	1,403,849,201	1,478,009,134
Services	8،7،5	228,255,241	237,556,132	243,021,221
Consumables	8،7،5	55,936,097	84,234,155	150,757,811
Assets	8،7،5	17,388,998	14,941,960	17,965,777
Maintenance	8،7،5	39,462,914	36,277,562	41,689,286
Transfers	8،7،5	589,303,281	621,275,331	444,871,275
Grants & Repayment of Loan Interests	8،7،5	1,133,326,218	1,294,545,861	1,119,886,096
Total Recurrent Expenditure	**8،7،6،5،2**	**3,405,712,951**	**3,692,680,201**	**3,496,200,600**
Projects	**10،5،2**	325,000,000	277,223,271	233,313,342
Total Expenditure	**5**	**3,730,712,951**	**3,969,903,472**	**3,729,513,942**
Surplus / (Deficit)		**(627,326,951)**	**(773,932,171)**	**(185,660,759)**

Carried Forward Budget			
		2023	2022
Recurrent Expenditure Budget	13،5	7,109,185	7,283,951
Projects Budget	13،5	47,000,000	100,000,000
Total Carried Forward Budget		**54,109,185**	**107,283,951**

H.E. Shaikh Salman bin Khalifa Al-Khalifa
Minister of Finance and National Economy

Figure AC.3: Consolidated Revenue/Expenditure Statement

Source: Ministry of Finance and National Economy. (2023). Bahrain Consolidated Final Account Report

Appendix D: World Bank Income Groups

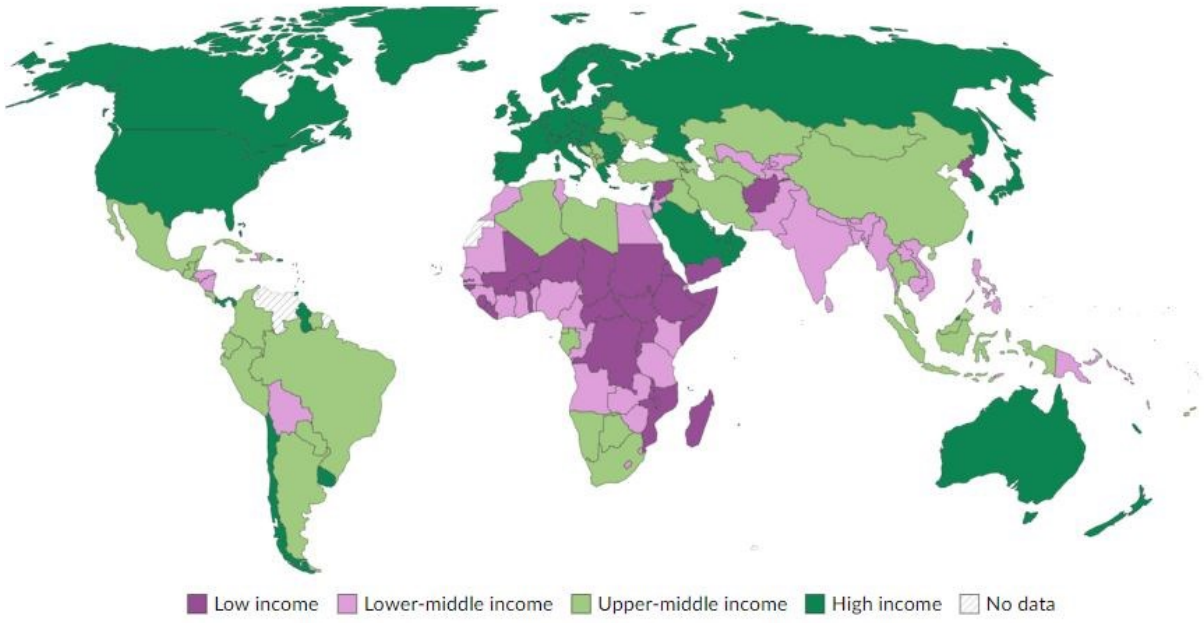


Figure AD.1: World Bank Income Groups

Source: World Bank (2024)

- **Low-income countries** are those with a gross national income (GNI) per capita of **$1,145 or less** in 2023.
- **Lower-middle-income countries** are those with a GNI per capita **between $1,146 and $4,515** in 2023.
- **Upper-middle-income countries** are those with a GNI per capita **between $4,516 and $14,005** in 2023.
- **High-income countries** are those with a GNI per capita of **more than $14,005** in 2023.

Appendix E: Implementation Plan

Implementation Plan Phases:

Table AE.1: Gas Pricing Policy Implementation Plan

Phase	Timeframe	Key Actions & Deliverables
Phase 1: Transitional Pricing Model	2025-2028	**Key Actions:** Apply Option 3 (Attributable Cost) for high-priority customers, Apply Option 1 (WACOG) for other customers and Maintain stable gas prices for strategic sectors. **Deliverables:** Implement hybrid pricing model, Establish pool access framework prioritizing strategic customers, Revenue tracking matrices and Issuance of transitional pricing guidelines and subsidy policy.
Phase 2: Full Market-Based Pricing Model	2029-2035	**Key Actions:** Transition all customers to Option 3 (Multiple Pools – Attributable Costs) and Ensure LNG importation or pipeline supply coverage. **Deliverables:** Complete migration to pool-based pricing for all customers, LNG or pipeline contracts in place to meet projected demand, Stakeholder communication on pricing updates and Updated fiscal reports reflecting cost recovery impacts.
Phase 3: Efficiency Gains	Beyond 2035	**Key Actions:** Sustain pool-based pricing, Integrate renewables into supply pools and Encourage efficiency and innovation in gas use. **Deliverables:** Renewable integration milestones, Performance benchmarking reports for customer sectors and Updated gas policy framework incorporating sustainability targets.

Implementation Plan Monitoring Areas:

Table AE.2: Monitoring Areas of the Gas Pricing Policy Implementation

Monitoring Area	Key Performance Indicator (KPI)	Review Frequency
Gas Price Stability	Price deviation remains within ±10% of regional LNG benchmark index.	Quarterly
Economic Impact	Government revenue from gas sales covers ≥90% of LNG cost.	Annually
Energy Security	Domestic Production + Renewable share ≥50% of total gas supply mix.	Annually
Customer Satisfaction	≥80% of industrial users report satisfaction with price transition and support mechanisms.	Annually

Implementation Plan Way Forward:

Table AE.3: The Way Forward for the Implementation of the Gas Pricing Policy

Implementation Stages	Details	Expected Outcomes
Present the Study	Discuss the results of the study with gas supplier and regulator	Agree on the proposed gas pricing policy.
Communicate the Gas Pricing Policy	Present the proposed natural gas pricing policy to MoOE and MOFNE.	Accept the study and advise to engage with a third-party consultant to review the study.
Stakeholders Engagement	Conduct consultative process to obtain feedback from All Stakeholders.	Issue consultative document considering stakeholders feedback.
Issue Gas Price Change Resolution	Endorse and issue resolution to concerned stakeholders.	Adopt resolution in coordination with gas supplier and regulator.

الملخص

يمثل ضمان استدامة سياسة تسعير الغاز الطبيعي وتحقيق الجدوى الاقتصادية تحديًا بالغ الأهمية لمملكة البحرين، لا سيما في ظل تراجع الإنتاج المحلي من الغاز وزيادة الاعتماد على واردات الغاز الطبيعي المسال. و على الرغم من أن الغاز الطبيعي قد شكل ركيزة أساسية للنمو الاقتصادي في البحرين على مدار العقود الماضية، إلا أن هيكل التسعير الحالي لم يعد قابلاً للاستمرار، الأمر الذي يستدعي إصلاحاً عاجلاً. ومع ذلك، لا تزال الأبحاث المتعلقة بالتأثيرات طويلة الأمد لإصلاحات تسعير الغاز الطبيعي على أمن الطاقة والاستقرار الاقتصادي والقدرة التنافسية الصناعية في البحرين محدودة.

تهدف هذه الدراسة إلى إنشاء سياسة لتسعير الغاز الطبيعي تكون مستدامة وتحقق توازناً بين الجدوى الاقتصادية، وأمن الطاقة، والتنافسية الصناعية، مع تقليل العبء المالي على الحكومة. وقد تم في هذه الدراسة تقييم نماذج تسعير مختلفة لاختيار النهج الأمثل بناءً على التحليل الاقتصادي ومراعاة أصحاب المصلحة.

اعتمدت الدراسة على محاكاة اقتصادية كلية، وتحليل سيناريوهات متعددة لتقييم آثار سياسات التسعير تحت ظروف مختلفة. بالإضافة إلى ذلك، أُجريت مقابلات منظمة مع أصحاب المصلحة الرئيسيين في قطاع الطاقة مع التركيز بشكل خاص على سوق الغاز الطبيعي. وقد وفرت هذه المقابلات رؤى قيمة حول الآثار المترتبة والمرتبطة بمقترحات الإصلاح.

تشير النتائج إلى أن الإصلاح في هيكل تسعير الغاز الطبيعي ستكون له تبعات اقتصادية، إلا أن النموذج المقترح يعد الأكثر قدرة على الحد من الاضطرابات وضمان الاستدامة المالية على المدى الطويل. كما تبرز النتائج أن عدم تنفيذ الاصلاح سيؤدي إلى أعباء مالية متزايدة نتيجة الاعتماد المتزايد على واردات الغاز الطبيعي المسال، ما يشكل تهديداً لأمن الطاقة والنمو الصناعي في البلاد. وتؤكد الدراسة كذلك على أهمية تنويع مصادرالطاقة، وتعزيز كفاءة استخدامها، وتعزيز دمج مصادر الطاقة المتجددة للحد من المخاطر الاقتصادية. تحمل هذه النتائج دلالات مهمة على سياسات الطاقة والتخطيط الإقتصادي. اذ أن إصلاحاً مدروساً في تسعير الغاز، مقترناً باستثمارات استراتيجية في الطاقة البديلة وتحسين الكفاءة، من شأنه أن يعزز قدرة البحرين الاقتصادية.

تقدم هذه الدراسة إطارًا استراتيجيًا لصانعي القرار لتنفيذ عملية انتقال مرحلية ومتوازنة نحو اقتصاد أكثر استدامة.

الكلمات المفتاحية: سوق الغاز الطبيعي في البحرين، الاستدامة الاقتصادية، أمن الطاقة، واردات الغاز الطبيعي المسال، تسعير الغاز الطبيعي، إصلاح السياسات، الإطار التنظيمي، الطاقة المتجددة.

جامعة البحرين

كلية الهندسة **قسم الهندسة الميكانيكية**

سياسة تسعير مستدامة للغاز الطبيعي في مملكة البحرين

أطروحة مقدمة كجزء من متطلبات الحصول على درجة الماجستير في الإدارة الهندسية

اعداد

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(أستاذ مساعد)

جامعة البحرين

يونيو 2025