Energy and LNG Trade Dynamics

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Abstract

The role of liquefied natural gas (LNG) in the global energy sector has grown significantly, as trade volumes have surged to new heights driven by higher demand and varied supply options. This article investigates the global LNG situation, drawing insights from recent academic and institutional analyses. The report investigates LNG supply and demand trends, geopolitical impacts, infrastructure developments, pricing approaches, environmental issues, and the long-term vision for the LNG industry. The literature reflects a common view that LNG demand is expected to increase in the near future, especially due to the needs of emerging Asian markets and its role in providing cleaner energy security. Major exporting countries are expanding their liquefaction operations, and many importing nations are enhancing their regasification setups, often with floating units, to meet rising demand. The crisis between Russia and Ukraine has prompted a realignment in gas flows, showcasing LNG's vital importance and exposing the market's sensitivity to supply disruptions and price changes. There is a gradual shift in LNG pricing and contract strategies towards more flexible, market-oriented frameworks, although oil indexation still holds considerable influence. Environmental aspects are central to LNG's future; seen as a more sustainable fuel, LNG is thought to facilitate the energy transition, but discussions continue regarding the duration of its growth in relation to climate goals. Various studies emphasize LNG's increasing importance and robust fundamentals, yet there are contrasting views on the risks of oversupply, long-term demand in a low-carbon future, and price stability. This study indicates that LNG is likely to remain essential in the global energy sector, yet stakeholders need to manage substantial uncertainties about market dynamics and climate issues.

Keywords: energy, lng, trade dynamics, supply and demand, policy, geopolitical factors.

Introduction

As nations pursue dependable and environmentally friendly fuel options for electricity production, industrial use, and heating, liquefied natural gas (LNG) has gained significant importance in the worldwide energy sector. The last ten years saw a steady rise in global natural gas usage, with LNG trade volumes reaching new peaks. The development of LNG has connected gas supplies to remote markets, helping importing countries reduce their dependence on pipelines and improve energy security (Adekoya et al., 2024). The modern LNG market has developed into a global entity, moving away from its previously regional focus. Traditionally, LNG trade was divided between the Asia-Pacific and Atlantic regions with minimal interaction, but since the 2000s, a more integrated global market has developed, merging previous regional boundaries (CLDP, 2017). East Asia's key consumers (Japan, South Korea, China, Taiwan) and Europe are tapping into shared supply pools, with new importers from other regions joining the LNG buyer network (Presley, 2023). Advances in technology and investment have opened the door for additional countries and companies to join LNG exports, expanding liquefaction capacity throughout the Atlantic, Middle East, and Asia-Pacific areas (Zou *et al*., 2022).

Expanding LNG trade presents complex dynamics, driven by a costly and geopolitically sensitive supply chain from gas extraction to distribution (Commodity Technology Advisory, 2021). LNG markets are impacted by supply-demand factors, global politics, infrastructure challenges, contracts, and environmental policies. The 2022 invasion of Ukraine by Russia exemplifies this, prompting Europe to shift from pipeline gas to LNG, which strained supply and caused price volatility (Presley, 2023). The climate commitments of governments and the global decarbonization movement cast doubt on LNG's future as a fossil fuel. While natural gas produces less carbon dioxide than coal or oil, its continued use must comply with mid-century carbon reduction goals, and methane leakage raises environmental concerns (Botão *et al*., 2023).

Methodology and Literature Selection

This paper utilizes a qualitative review methodology to gather key findings from contemporary scholarly research, institutional publications, and market assessments spanning from 2022 to 2025. The chosen references concentrate on the dynamics of LNG supply and

demand, contractual arrangements, and geopolitical factors. The review includes more than ten peer-reviewed studies and industry projections, particularly highlighting regions such as Asia, Europe, and developing markets. The findings are organized thematically into categories like market trends, geopolitical impacts, and pricing structures to enable a comparative evaluation of the global LNG industry.

LNG Supply and Demand Trends

In recent years, global demand for LNG has significantly increased, establishing it as a leading growth area in energy trade. Following a temporary dip during the COVID-19 pandemic, LNG consumption rebounded, reaching a record 400 million tonnes in global trade in 2022 (Presley, 2023). This indicated an approximate 6–7% increase in volume compared to the previous year, despite a slight decline in overall gas consumption in certain areas due to elevated prices (Botão *et al*., 2023). LNG trade is projected to grow steadily through the mid-2020s, with the International Energy Forum reporting a 25% increase in volumes by 2028, reaching around 500 million tonnes annually, supported by new liquefaction projects (Presley, 2023). The positive near-term forecast is reinforced by hide demand from Asia and Europe. While, China's LNG imports rising after a short pause, making it the leading LNG buyer in 2023. (Presley, 2023). China's gas use is projected to grow nearly 4% in 2023, reaching around 390 bcm, though at a slower rate than in the last ten years, with new long-term LNG contracts aiding ongoing imports (S&P Global, 2025). Emerging markets in Asia are enhancing LNG consumption. Countries including Pakistan, Bangladesh, Vietnam, and the Philippines are utilizing LNG for power and industry, anticipating a doubling of regional demand by the decade's close (Presley, 2023). Growth in these markets hinges on fuel costs and infrastructure, yet they are vital for new supply absorption. Moreover, ten new countries are set to start LNG imports in the next two years, highlighting LNG's expanding global presence (Presley, 2023).

The LNG industry is expanding significantly, with new export projects underway or recently finished, especially in the U.S., Qatar, and Africa, after years of under-investment in the mid-2010s. According to IEEFA (2024), it is expected that the world will see an addition of approximately 193 million tonnes per year in liquefaction capacity between 2024 and 2028, representing a 40% growth over existing capacity. If this is accomplished, the

overall LNG nameplate capacity across the globe would reach about 660 MTPA by 2028 (IEEFA, 2024). Key growth drivers are Qatar's North Field East and South projects, new Gulf Coast terminals in the U.S., and LNG facilities in Canada and Mozambique. The U.S. has quickly risen as a leading LNG supplier, leading global exports in 2022-2023, with additional terminals like Golden Pass and Calcasieu Pass planned for the mid-2020s (Hou *et al*., 2024). Qatar, known for its LNG dominance, is heavily investing to preserve its role and expand output into the 2030s (S&P Global, 2025). New LNG developments in Africa are underway, including a floating facility in Congo that shipped its first cargo in 2024 and the Tortue FLNG project off Mauritania/Senegal, projected for mid-2024 but running two years late (Energy Intelligence, 2023). Supply project progress is inconsistent. Many African initiatives are delayed by security and financial issues; especially, Mozambique's extensive LNG project (13 MTPA) has been on hold since 2021 due to insurgent violence, leaving its restart timeline uncertain (Energy Intelligence, 2023). Setbacks show that although liquefaction capacity is rising, geopolitical and operational challenges can slow new supply development.

Demand and supply trends lead to varied forecasts for the LNG market. Zou et al. (2022) present an "optimistic scenario" predicting a 2.7% annual growth in global LNG demand, potentially reaching 800 million tonnes by 2050, especially in Asia. This scenario suggests that strong demand from emerging economies will drive new LNG capacity utilization and increase LNG's share of global gas consumption (Zou *et al*., 2022). On the other hand, a "conservative scenario" suggests that annual LNG demand will grow at a rate of approximately 1.7%, resulting in around 600 million tonnes by the middle of the century, influenced by elements such as slower economic growth, increased competition from domestic gas and renewable sources, and lasting effects from occurrences like the COVID-19 pandemic (Zou *et al*., 2022). It is worth noting that in a scenario of decreased demand, the LNG market may face episodes of oversupply during the 2020s, as incremental projects are brought online quicker than the demand necessitates (Zou *et al*., 2022). Analysts have raised alarms regarding a possible oversupply, with the Institute for Energy Economics and Financial Analysis cautioning that the influx of new capacity expected by 2028 could surpass the demand projections set by the International Energy Agency, which may result in downward pressure on LNG prices if demand growth falls short (IEEFA, 2024). Alternatively, certain analysts highlight the necessity of continued investment to avert a

supply crisis in the 2030s, noting that a study warns of a potential LNG supply-demand gap if new projects are not initiated, given the long lead times for liquefaction (Botão *et al.*, 2023). To summarize, experts generally agree that LNG trade will increase in the near future, but perspectives vary on whether the mid-to-long-term market will favor excess capacity or tight supply conditions.

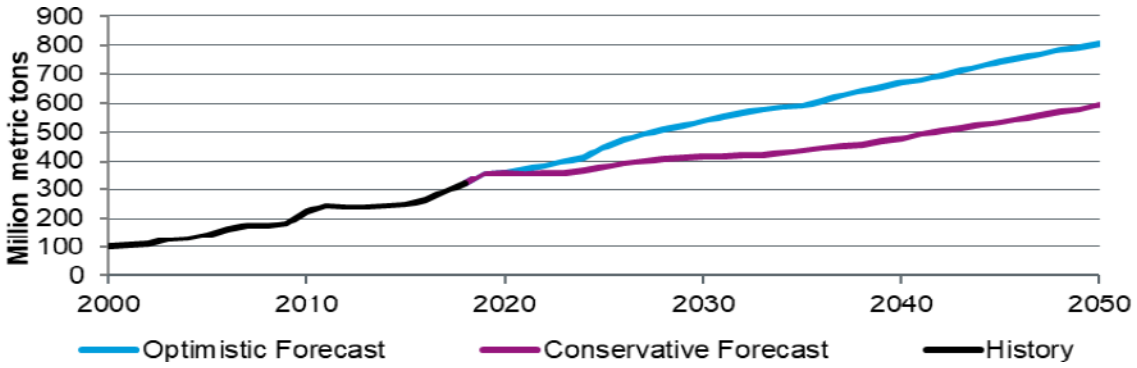

Figure 1: LNG Trend Forecasting (Zou et al., 2022)

LNG Trade and affect of Geopolitical Influences

Global LNG dynamics are heavily shaped by geopolitics, as international developments can quickly change gas trade. A recent example is Europe's gas supply adjustment following Russia's war in Ukraine, which historically relied on Russian pipeline gas, with LNG making up roughly 10-15% of EU supply in the 2010s (Presley, 2023). In response to the sharp decline of Russian pipeline flows in 2022, Europe turned to LNG like never before. LNG imports in the EU and UK rose nearly 60% from the previous year, reaching about 125 billion cubic meters (around 90 MTPA), which accounted for over 50% of Europe's gas consumption in 2023 (Presley, 2023). Almost overnight, the United States rose to become Europe's primary supplier, as by 2023, around half of the LNG imports for the EU and UK were sourced from U.S. export facilities, compared to just 17% in 2019 (Presley, 2023). This strategic change highlights LNG's role as a primary supply source for Europe, shifting its energy security approach. European buyers rushed to secure spot market cargoes and establish long-term LNG contracts to offset Russian supplies, driving global LNG prices to record highs in 2022. Consequently, geopolitical tensions hastened Europe's integration into

the global LNG market, linking European gas prices more closely to global supply- demand dynamics (Adekoya et al., 2024).

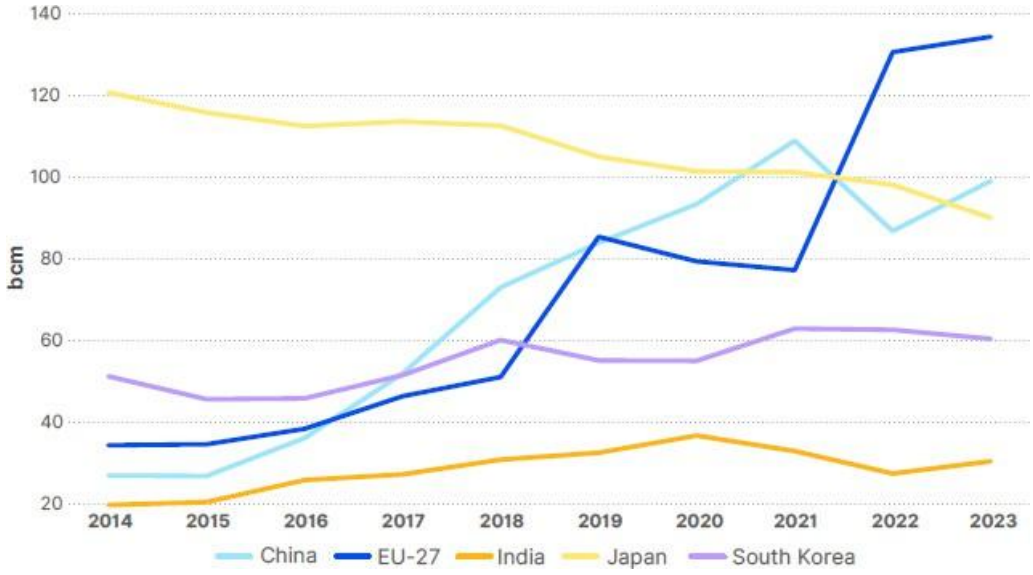

Figure 2: Biggest LNG Importers (ACER,2024)

Geopolitical influences are affecting LNG distribution globally. In Asia, China is using its expanding LNG resources to boost energy security and seize opportunities. In 2022, amid market constraints, some Chinese firms sold excess LNG to Europe at elevated prices, showcasing China's rising influence in LNG trading (Presley, 2023). Looking forward, China's impact will likely increase due to its expanding long-term contracts, with projections indicating that by 2030, Chinese buyers could command 25% of global LNG volumes, boosting their trading strength (Presley, 2023). Future LNG redirection by China to the spot market will depend on its own needs and policies, introducing uncertainty for the global market (Presley, 2023). Sanctions and diplomatic relations influence LNG transactions. For instance, Russia's LNG exports aren't as directly affected by sanctions as pipelines, but financing and developing new projects has become harder, potentially restricting future growth (Presley, 2023). At the same time, the United States has been evaluating the potential impact of sanctions or trade measures (such as tariffs) on LNG in its dealings with other nations – concerns have emerged regarding how the position of a U.S. administration (for instance, during a possible Trump term in 2025) on tariffs with China or sanctions against

specific LNG producers might influence global project development and trade dynamics (S&P Global, 2025). Consequently, actions taken by leading nations continue to be a significant unpredictable factor in the growth strategies for LNG.

Several pieces of research indicate that geopolitical risk translates into market risk concerning LNG. For instance, Michail and Melas (2022, reported in Adekoya et al., 2024) geopolitical risk indices elevate LNG carrier charter rates and transport costs, reflecting market unease in crises. An analysis reveals that LNG spot price fluctuations in recent years frequently result from geopolitical factors, as seen in early 2021 when Asian LNG prices exceeded to $30 per MMBtu due to storage shortages and changing import demands, illustrating the fragility of the LNG supply chain (Commodity Technology Advisory, 2021). Insufficient spare capacity or storage can make weather events highly influential in LNG geopolitics; a brutal winter in Northeast Asia, for instance, may lead to fierce competition for cargoes, triggering global price hikes (Commodity Technology Advisory, 2021). Furthermore, infrastructure decisions are driven by geopolitical concerns: the rapid deployment of floating import terminals (FSRUs) across European countries in 2022–2023 was a direct reaction to supply insecurities stemming from the conflict (ACER, 2024). At the same time, nations like Mozambique and Libya, which have the potential to export LNG but are plagued by internal strife, demonstrate how political instability can hinder global supply. In conclusion, the literature highlights geopolitics as a double-edged sword for LNG; while it has increased LNG's significance in energy security strategies, it also brings about volatility and risk. This situation calls for LNG suppliers and consumers to engage in meticulous risk management and contingency planning (Adekoya et al., 2024). The dynamic geopolitical landscape provides opportunities for new LNG entrants, like stable African and East Mediterranean countries, to fill supply gaps and for importers to diversify as emerging economies gain LNG access amid increased competition. Stakeholders should closely monitor international developments for LNG investment strategies.

Türkiye’s Role in Global LNG Politics

Türkiye's strategic position and infrastructure improvements have made it an essential player in LNG geopolitics. The country has enhanced its ability to import and distribute LNG in Southeast Europe through the establishment of floating storage and regasification units in

İzmir and Dörtyol, as well as securing more long-term LNG contracts. In reaction to the Russia–Ukraine conflict, Türkiye has refined its energy diplomacy by entering into various gas agreements with the U.S., Algeria, and Qatar. The government aims to establish Türkiye as a regional hub for natural gas trading, bolstered by increased underground storage and interconnectors, which emphasizes its role in European energy security (S&P Global, 2025).

Pricing and Contractual Strategies

LNG pricing and contracts are slowly changing due to market globalization. Historically, LNG was sold through long-term contracts linked to oil prices, reflecting its roots in oil-indexed piped gas pricing. While these oil-indexed contracts (often tied to Brent or JCC) offered stability, they lacked flexibility and transparency, showing little connection to gas market fundamentals (CLDP, 2017). Some previous contracts in Asia incorporated S-curve pricing structures and ceilings to safeguard buyers against severe variations in oil prices (CLDP, 2017). Over the past ten years, spot LNG trading and gas hub pricing have begun to redefine LNG pricing. About 30% of LNG cargoes are now sold on a spot or short-term basis, typically connected to regional benchmarks such as the
U.S. Henry Hub, UK NBP, or the Asian JKM price (Botão et al., 2023). The trend has enhanced transparency and market-oriented pricing in LNG, lessening previous regional price differences. The integration of Atlantic and Pacific LNG markets shows that a shortage in one region raises prices worldwide, while excess supply decreases them, indicating a more cohesive pricing landscape (Hou et al., 2024).

Although the industry is shifting towards spot and hub-based pricing, long-term contracts continue to be essential, especially for financing new liquefaction projects. The contracts are changing, with increased flexibility in terms, including diverse pricing indices and destination flexibility for cargoes (Adekoya et al., 2024). The influx of U.S. LNG, typically priced on a Henry Hub plus fee model, has led legacy suppliers such as Qatar to introduce gas-based pricing in their contracts.

Concurrently, the extreme price fluctuations of 2021-2022 have unexpectedly sparked buyer interest in long-term agreements. Following record spot price surges, including Asian LNG hitting $70/MMBtu in 2022, many importers are now looking to secure stable long-term

supply contracts to shield against future price volatility (S&P Global, 2025). Reports indicate a resurgence in long- term contracts for 2022-2023, with Chinese and South Asian firms signing many 10-20 year deals with U.S. and Middle Eastern suppliers. European utilities, previously hesitant, are now exploring longer contracts for supply security (Presley, 2023). The literature raises the question of whether Japan and South Korea will return to major long-term contracts as their current agreements end (S&P Global, 2025). Some evidence points to a careful re-engagement in long-term procurement to offset volumes due to expire by the late 2020s, motivated by recent supply security lessons. Recent studies highlight the ongoing connection between LNG and oil prices. An analysis by Zhang et al. (2024) found that fluctuations in crude oil prices significantly impact China's LNG import costs (Zhang et al., 2024). A significant share of China's LNG contracts are oil-indexed, leading to price changes during oil market instability, even with steady gas supply-demand. Zhang et al. point out that exchange rates and energy policies link oil price risks to LNG, stressing that LNG is intertwined with crude oil dynamics in oil-linked markets (Zhang et al., 2024). As contracts increasingly rely on gas indexes or hybrid pricing, LNG prices are likely to diverge from oil. For instance, Europe's LNG imports now align with gas hub benchmarks, causing prices to surge in 2022–2023 due to regional gas shortages, regardless of oil price changes (Botão et al., 2023).

Long-term LNG contracts often include price review clauses that allow for renegotiation if market conditions change significantly (CLDP, 2017). In the 2010s, these clauses became contentious as many Asian buyers sought price reductions due to the disparity between oil-indexed LNG prices and lower spot prices. While flexibility in contracts is now standard, executing price reviews can be difficult and may lead to arbitration (Sakmar, 2013; CLDP, 2017). The current high-price environment may prompt buyers to request price reviews, but sellers facing increased costs may resist. This highlights the evolving nature of contract terms and enforcement in LNG commerce.

The LNG pricing and contractual landscape is gradually shifting from traditional oil-indexed long- term contracts to a more flexible system that includes increased spot trading and hub indexation. Research indicates that this shift has enhanced market efficiency through greater flexibility and transparency (Botão et al., 2023; Hou et al., 2024). However, the demand for security and stability keeps long-term contracts important, especially amid recent

market volatility (S&P Global, 2025). The balance between these opposing forces will influence future LNG pricing. As the market evolves, major LNG buyers, particularly in Asia, are adopting a portfolio approach, combining long-term, short-term, and spot purchases to optimize costs and security. Sellers are also diversifying their contract structures to reach a broader customer base, reflecting the cyclical nature of LNG markets.

Long-Term Outlook for LNG

The long-term outlook for global LNG is influenced by supply, demand, policy, and technology. Analysts agree that LNG will grow through the 2020s and early 2030s, with increasing capacity and imports solidifying its role in the energy system (Zou et al., 2022; IEEFA, 2024). The mid- 2020s are crucial, as a surge of new LNG supply is expected around 2025-2026, potentially shifting the market from tight conditions to a looser balance (IEEFA, 2024). If major projects proceed, the 2025-2027 period may see excess supply and lower spot prices, benefiting price-sensitive buyers in regions like South Asia and Latin America. This could unlock previously untapped demand (IEEFA, 2024). Reports suggest that lower LNG prices might increase short-term procurement and develop new markets. In response, major players are investing in infrastructure, such as regasification terminals and gas-fired power plants, to ensure demand for the anticipated supply glut (IEEFA, 2024). This reflects confidence that oversupply can be managed by stimulating demand in new areas.

If demand growth exceeds expectations or project delays limit supply, the market may remain tight longer. Global LNG demand heavily relies on developments in Asia, particularly in India, which has significant potential for LNG import growth. However, this potential hinges on expanding pipeline networks, reforming gas price subsidies, and keeping LNG affordable (S&P Global, 2025). India's recent LNG import growth may be unsustainable due to price sensitivity; high prices in 2021-2022 led to a decline in imports, but lower prices could boost imports and help balance the market (S&P Global, 2025).

European demand flexibility also affects the outlook. In 2022-2023, Europe reduced gas consumption by over 10% through demand response and fuel switching during high prices (Botão et al., 2023). Future demand-side reactions, like industries shifting or consumers conserving energy during price spikes, could reduce LNG demand volatility. A long-term uncertainty is the decline in structural gas demand in Europe and other mature markets due to

efficiency and decarbonization efforts. The Paris Agreement suggests a significant reduction in global fossil gas use post-2035 under a 2 °C or 1.5 °C scenario (Hou et al., 2024). However, stated policies (IEA STEPS) indicate moderate gas demand growth through 2030, particularly outside Europe. Many expect LNG demand in the Asia-Pacific to continue rising into the 2030s, even as Europe's demand stabilizes or declines (Zou et al., 2022; IEEFA, 2024).

The globalization of LNG trade is expected to deepen, as shown by Hou et al. (2024) through network analysis. They reveal a shift from a regionalized system to a more integrated global network with increased connectivity. The LNG trade network is expanding in size and density, forming a core of key exporters (U.S., Qatar, Australia) and importers (China, Japan, South Korea, India). This trend indicates greater resilience and liquidity, allowing for more flexible cargo reallocation in response to regional demand changes. However, the network still exhibits a core- periphery pattern, which may lead to imbalances, such as smaller buyers relying on a few suppliers. The top ten countries by volume continue to dominate trade flows, and their policy changes will significantly influence the network's evolution. This suggests that the policy decisions of China, India, Europe's climate strategy, and U.S./Qatar exports will shape the LNG market's future in the 2030s and beyond.

The long-term outlook for LNG is divided. Some industry experts believe LNG will thrive into mid-century, supporting economic growth in developing areas, complementing renewable energy, and potentially contributing to zero-carbon fuels through hydrogen production with CCS (Adekoya et al., 2024). Conversely, other scenarios predict that global LNG demand will peak in the 2030s and decline as electrification and renewables grow (Botão et al., 2023). There may be a 10–20 year window for LNG expansion, after which its future will depend on global climate alignment. In the near to medium term, LNG is seen as essential for energy security and reducing emissions

compared to coal. However, opinions differ on its long-term role: whether it will diminish or adapt by integrating with cleaner technologies.

Conclusion

Liquefied Natural Gas (LNG) has emerged as a crucial element in the worldwide energy landscape, demonstrating notable increases in its production, trade, and usage. Recent studies emphasize the evolving supply-demand relationship of LNG, the diversification of trade, and its rising geopolitical significance. Research shows a robust LNG industry, driven by new liquefaction initiatives that increase supply, numerous nations expanding their import capabilities, and a reliable global shipping network linking providers and buyers. The adaptability of LNG has been vital during recent emergencies, especially in Europe, where it has compensated for the absence of pipeline gas, highlighting its importance for energy security. In the short to medium future, LNG demand is projected to grow, particularly in Asia, as it supports economic development and energy transitions by substituting more polluting fuels such as coal.

Significant alterations are occurring within the LNG marketplace. The shift from traditional long- term, oil-linked contracts to more versatile options like spot trading and gas-indexed pricing is creating a mix of opportunities and obstacles. Enhanced market efficiency has resulted from increased liquidity and globalization, but these factors have simultaneously led to heightened volatility and more competitive landscapes. To counter unexpected disruptions, stakeholders are modifying their procurement approaches and putting resources into adaptable infrastructure, such as floating storage and regasification units (FSRUs) and storage facilities. This evolution signifies a market that is gaining maturity, learning to navigate risks while simultaneously broadening its scope.

The future of LNG is characterized by both hopeful prospects and unpredictable challenges in the long run. A significant number of people think that LNG will continue to be an important resource for many years, serving as a transitional fuel that helps decrease coal consumption and promotes renewable energy sources. This implies a considerable appetite for gas in the 2030s, particularly if gas consumption grows in emerging economies and infrastructure continues to develop. On the other hand, certain specialists caution that elements such as stringent climate regulations, progress

in renewable energy technologies, and enhanced energy efficiency may impede the growth of LNG demand in the future. Furthermore, there is a risk of an excess supply emerging in the middle of the 2020s if new developments are initiated without sufficient demand, which could result in decreased prices and financial difficulties for certain producers. However, this situation might not last long, as lower prices could invigorate demand and push out higher-priced suppliers, which would help in reestablishing market equilibrium.

One important lesson derived from contrasting opinions is the necessity of adaptability and resilience in the planning processes of the LNG industry. It is widely accepted among analysts that adaptability—achieved through modular approaches, versatile contracts, and responsive regulations—is vital for effectively dealing with uncertainties. Additionally, ensuring that LNG expansion is compatible with sustainable environmental goals is critical. The sustainability of the industry will rely on its ability to merge with a decarbonizing economy, which could entail cutting emissions, managing methane leaks, and possibly incorporating hydrogen into LNG, while also showcasing its alignment with enduring climate targets to decision-makers and the public.

In summary, the worldwide LNG landscape brings forth both prospects and difficulties. LNG facilitates energy security and emission reductions, driving considerable investment in infrastructure and supply. The future prosperity of the organization depends on its ability to adeptly handle market fluctuations, adapt contracts, and address environmental consequences. The present body of literature conveys a cautiously encouraging viewpoint: LNG is anticipated to remain a crucial player in the energy landscape, contingent upon the active risk management by both the industry and governmental bodies. The global LNG industry can effectively manage market changes and align with wider economic and climate objectives by fostering innovation, encouraging international collaboration, and adopting adaptable strategies.

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