POLICY PAPER

Asia Roundtable Summary: The Importance of Natural Gas in Developed and Emerging Asia

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Executive Summary

On September 6, 2023, on the margins of the Gastech 2023 conference in Singapore, the EFI Foundation, together with the Institute of Energy Economics, Japan (IEEJ) and the Economic Research Institute for ASEAN and East Asia (ERIA), hosted a roundtable discussion on the role of natural gas in Asia's energy transition. Approximately 30 leaders from the natural gas industry, banking, and government participated. This roundtable was part of the EFI Foundation's *The Future of Natural Gas in a Deeply Decarbonized World, Phase II*. The project's overarching goal is to analyze natural gas markets through the lenses of energy security, decarbonization strategies, economics, and geopolitics. This roundtable aimed to gain perspectives from across Asia regarding the challenges and opportunities for natural gas in the context of national-level energy and decarbonization strategies.

Globally nations are tied to three basic energy needs that vary by region: security, reliability, and affordability. The ongoing European energy crisis – the result of Russia's invasion of Ukraine in early 2022 – has impacted the affordability and reliability of liquified natural gas (LNG) supply not only for Europe but also for Asia. Many countries in Asia are net liquefied natural gas (LNG) importers and are exposed to global market volatility, especially low- and middle-income countries that have not entered into long-term contracts (LTCs).

The approach to natural gas utilization by countries in Northeast Asia is largely driven by concerns about security and reliability of supply. Efforts to address these concerns have focused on LNG supply diversification and certainty through both LTCs and spot contracting strategies that ensure purchases from a robust variety of sources. Southeast Asian nations' natural gas demand is driven by the issues of affordability and reliability of supply. In contrast, India and China appear opportunistic in their use of natural gas and can adapt based on market conditions.

While long-term forecasts generally see natural gas growth in Asia, affordability remains a concern. Although global LNG prices have fallen from December 2022 highs, they could spike again in the coming winter should European demand compete with the post-pandemic reopening of manufacturing in Asia. Roundtable participants pointed out that there is an apparent disconnect in prices between suppliers and consumers in the region and that without a reduction in LNG prices, countries will most likely continue to utilize coal. It was acknowledged that emissions savings from coal-to-gas fuel switching could play an important role in Asia's decarbonization goals and provide reliable power to fuel industrialization, but affordability and reliability remain issues.

In the roundtable discussion, participants highlighted the region's energy poverty challenges. According to the Asian Development Bank, more than 350 million people in the region have only "limited access to electricity" and 150 million have "no access at all."[1] Many participants agreed that it may be difficult to address climate change goals if they can't first lift people out of energy poverty. While advanced economies are better equipped to afford high energy prices, it is much more challenging for developing economies, especially when natural gas is not always the most affordable option. Participants felt that it is important for advanced economies to understand that Southeast Asian nations are more concerned with economic development than climate change. While the war in Ukraine has destroyed energy relationships between the EU and Russia it has also forced countries globally to revise their energy security and decarbonization strategies. As a short-term solution, some countries have enacted crisis

policies to secure available LNG supplies to protect consumers and industries, while other governments have adopted incentive policies, and increased investments in energy efficiency and net zero-carbon technologies.

Key Takeaways

The following are key takeaways from the roundtable discussion and based on the feedback of participants:

1. Natural gas demand in Asia is expected to be the main driver for global LNG markets in the coming decades.
2. An affordable and reliable energy supply remains a top concern for many Asian countries.
3. Natural gas supply is a key energy security concern for many Asian countries.
4. It is critical to elevate the voices (in international forums) of low- and middle-income countries in Asia in the net-zero context.
5. Natural gas can play an important role in industrial decarbonization.
6. Coal-to-gas fuel switching lowers air pollution and decreases carbon emissions.
7. Large-scale deployment of carbon capture and sequestration (CCS) is critical for natural gas to be utilized while meeting decarbonization goals.
8. Methane leakage is a critical issue that needs to be addressed in the net-zero context.

(A more robust explanation of the key takeaways can be found in the conclusion.)

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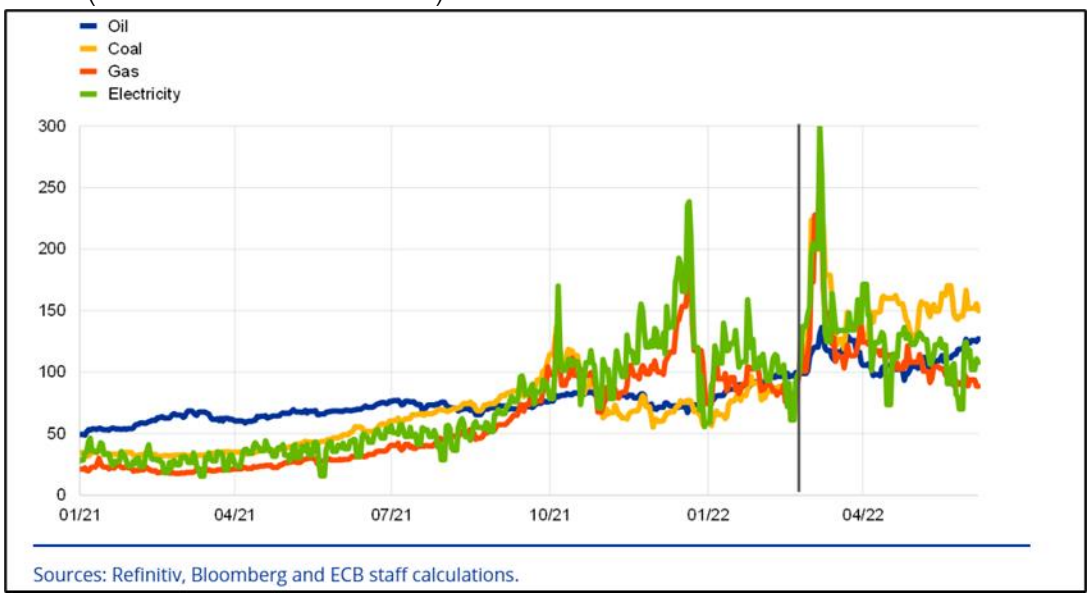
1. Introduction: Key Factors Affecting LNG in Asia

Russia's invasion of Ukraine and the ongoing conflict have sent shockwaves throughout the energy world, with significant impacts on natural gas and oil markets (Figure 1). The sanctions and high prices have either forced countries to find natural gas from new suppliers or explore the use of other sources of energy. The result of increased competition and higher prices for LNG has been increased coal usage in some developing countries, which may run counter to global emissions reduction goals.

Figure 1: Energy prices before and after the invasion of Ukraine
(Index: 23Feb2022 = 100)



Source: European Central Bank, ECB Economic Bulletin, Issue 4/2022
Notes: Oil prices are Brent crude oil prices, gas prices are the Dutch Title Transfer Facility (TTF) day-ahead prices. Coal prices are the nearby Rotterdam Coal Futures prices. Wholesale electricity prices for the euro area were calculated as a weighted average (applying net electricity generation as weights) of prices observed in the five biggest markets. The vertical line marks the start of the Russian invasion of Ukraine.[2]

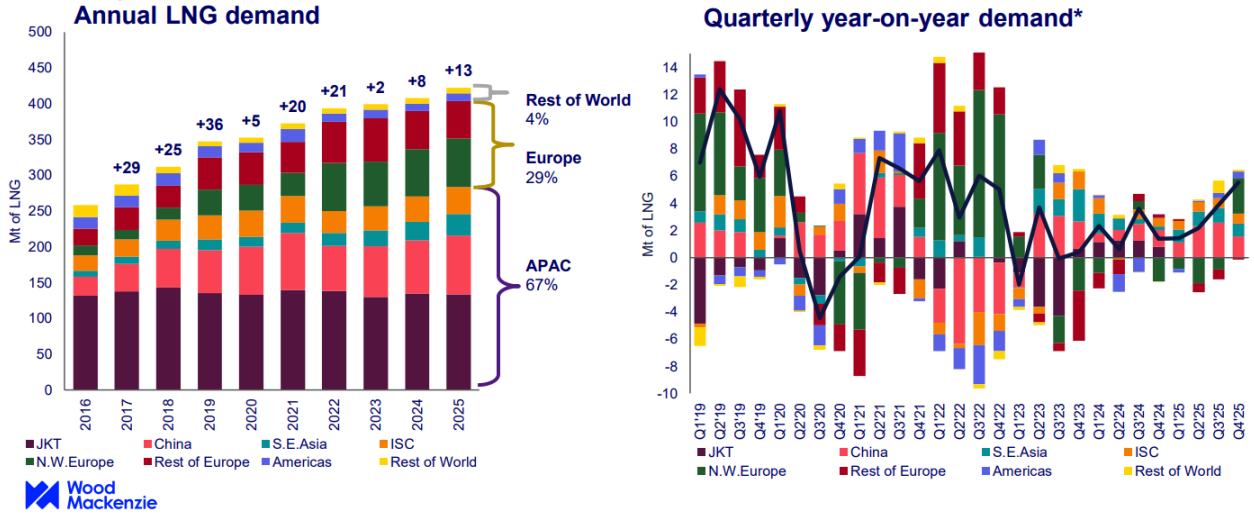
The Russian invasion has also altered traditional LNG trade routes. Countries worldwide quickly created new energy policies that not only prioritize long-term energy security but also meet short-term[a] demand.[3,4] Reliance on imported Russian gas via pipeline has been problematic for many European countries that lacked sufficient LNG import infrastructure; many countries have had to quickly permit and build onshore regasification terminals and floating storage regasification units. Importantly, the lack of destination clauses in U.S. LNG export contracts has enabled the redirection of gas supply to Europe; this has,

[a] The short-term is generally considered to be less than five years.

however, come at the expense of many U.S. LNG-consuming countries in Asia. This increase in European demand caused spot prices to jump nearly ten times the average, peaking in December 2022.[5] While European traders and holders of LTCs in Asia benefited from this arbitrage, this shift came at the expense of low- and middle-income countries that were priced out of the market.

Affordable energy supplies remain a top concern for Southeast Asian consumers. Even though the spot price of LNG in Asia has come down this year, the appetite for LNG in some developing markets remains soft with some viewing it as an unaffordable and unreliable fuel.[6] Other countries in South and Southeast Asia have, however, benefited from lower spot LNG prices in 2023. China's post pandemic recovery is falling short of expectations, however, if growth returns then the availability of LNG in the spot market will be reduced. On the other hand, European LNG imports will remain high but are expected to decline as Asia-Pacific demand is expected to outpace supply growth over the next two years (Figure 2).[7]

Figure 2: Global LNG Demand



Source: Wood Mackenzie, Short-Term trade and price outlook (Q3 2023)

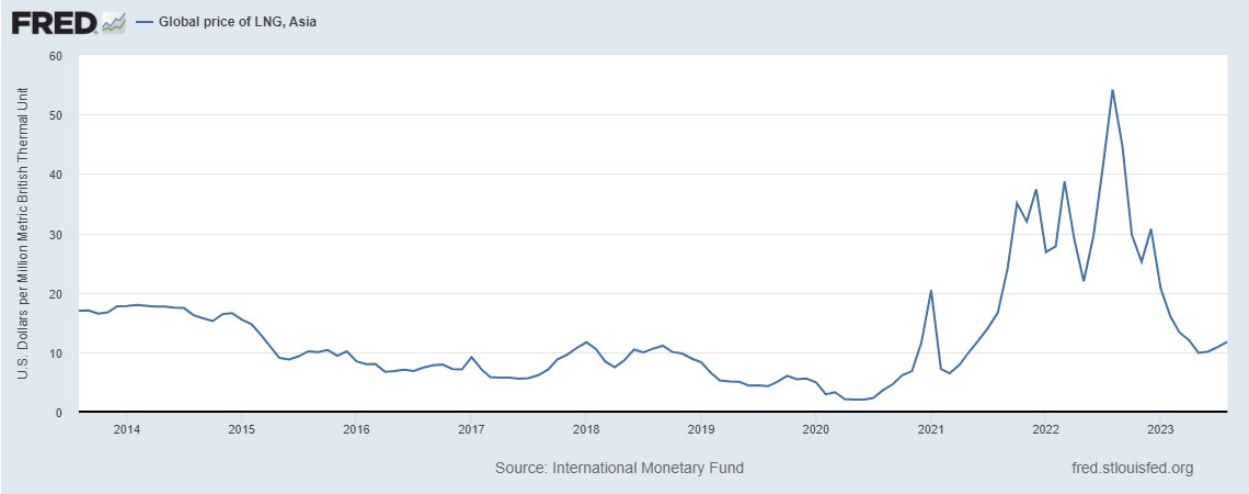
Asia's reliance on natural gas imports has increased the focus of many of its countries on the impacts of volatility in gas markets. Sanctions in Europe that forced nations to look for replacements of Russian piped gas with LNG caused price spikes in 2022 (Figure 3). LNG prices in Asian spot markets last year averaged US$34, more than double the annual average in 2021[8]. These high prices negatively affected demand for LNG in price-sensitive parts of Asia. Gas demand in Asia fell from 270 million tons (mt) in 2021 to 250 mt in 2022.[9]

Some LNG buyers in Asia have been protected from these price spikes by their preference for LTCs. However, it is estimated that 180 bcm of LNG contracts will expire between 2022 and 2025, followed by an additional 135 bcm between 2026 and 2030; Asia will account for 40% of the 2025 contracts.[10] Additionally, some current projections see LNG markets remaining tight until new supply comes online, which is unlikely before 2026. Also, long-term global LNG export project contracts starting before 2026 are already sold out.[11] How the countries that prefer long-term contracts and the producers of LNG come to an agreement on new contracts could have a dramatic impact on future LNG demand in Asia.

Natural gas is not as easily transportable as oil, an additional step that is reflected in the pricing of it and LNG. Natural gas needs to be either compressed for pipeline transport or liquefied for tanker transport. These differences in transportation costs mean that there is more variation in pricing between countries,

as natural gas is not as fungible as oil.[12] Natural gas procurement methods are evolving to account for market conditions and the contract environment is still recalibrating from the aftershocks of the Russian invasion of Ukraine. Most of the Russian natural gas supply to Europe went through pipelines and, lacking the same amount of infrastructure Russia does not have the ability to divert supplies to Asia easily or quickly.[13]

Figure 3: Global Price of LNG in Asia over the last 10 years



Source: Federal Reserve Bank of St. Louis and the International Monetary Fund

According to the IEA, "In emerging and developing markets in Asia, the gas import contracts with prices indexed to oil offer partial protection to consumers from high and volatile gas prices, and in some cases, this is buttressed by domestic subsidies."[14] High natural gas prices have, however, hurt prospects for coal-to-gas switching. Long-term trends, however, still point to increased demand for natural gas in Asia. More attention is being given to decarbonization which has forced countries to diversify supplies of hydrocarbons and consider CCS options, as well as increasing shares of renewables and other low-carbon fuels and technologies. In some instances, countries are looking at the possibility of moving directly from coal to renewables.

Much of Asia's natural gas supply is imported LNG, tying it to both global and regional markets. As noted, Northeast Asian nations' approach to natural gas utilization is driven by energy security and reliability of supply that diversifies supply sources accordingly. However, Southeast Asia's consumption of natural gas is dominated by affordability of supply. Finally, both India and China are opportunistic in their use of natural gas and will adapt based on needs and market conditions.

Overall, the energy crisis has changed trading relationships and strategies to address energy needs. Some countries have opted to revert to affordable yet carbon-intensive energy sources, while others are leveraging the lack of LNG to accelerate net-zero alternatives. Importantly, one hundred and fifty-one countries now have policies to meet net-zero targets by 2050.[15,16] These targets have mixed implications for natural gas usage in Asia. While some renewable energy technologies are forecast to have a better investment return and are less vulnerable to global oil and gas market price shocks, these technologies have their own challenges. One such challenge industry analysts have highlighted over the past year are forecasts of shortages of critical minerals and metals, and supply chain constraints, necessary for the manufacture of renewable technologies, which include necessary components for electrolyzers that produce green hydrogen. In Japan, switching from coal to renewables is expensive due to "discriminatory

regulations and land-use constraints", and in Southeast Asia, numerous countries subsidize coal and gas, complicating the economics of the switch to cleaner power.[17]

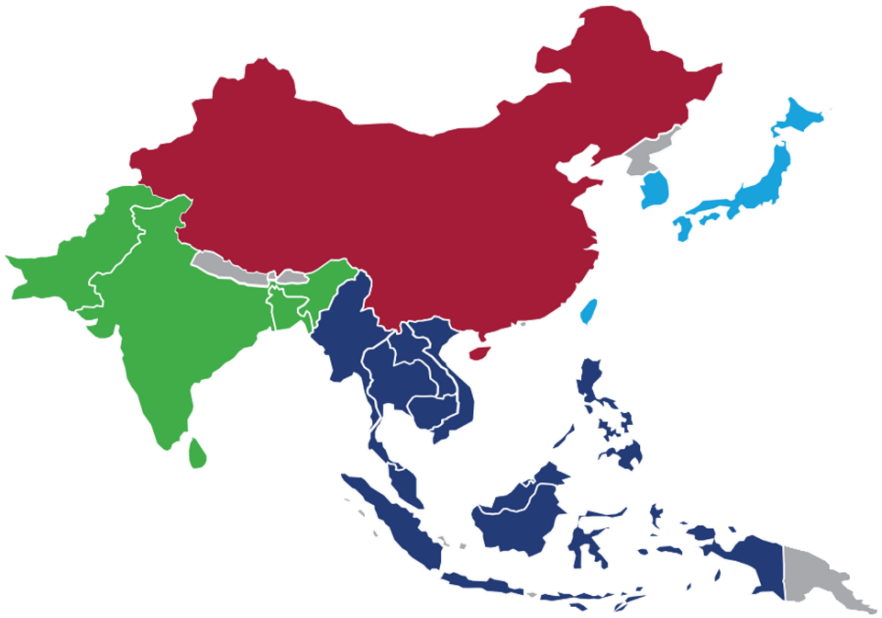
1.1 LNG Market Demand Outlook

Global gas demand between 2021 and 2030 is projected to grow by 400 bcm, about a 10% increase, with China and the Middle East accounting for over 80% of this growth.[18] National efforts to improve air quality will support gas demand growth in China, India, and Northeast Asia. Natural gas is driving incremental economic growth in Southeast Asia, but high spot LNG prices have slowed the transition from coal. Northeast Asian demand is significant but is forecast to plateau in the 2020s, with a long-term[b] decline in the 2030s, largely related to decarbonization efforts. Recent strikes in August 2023 at Australia's three LNG plants, that threatened to take out around 3.5 Mt of LNG or 10.5% of the global LNG supply, highlight the vulnerability to disruption of tight global LNG markets. If the strikes continue, Asian buyers will need to look for alternatives to meet commitments, resulting in more competition for spot LNG cargoes supplied by the United States and Qatar.

Asian gas growth is underpinned by expanding populations, strong economic growth, rising electrification, and fuel switching. However, high, near-term prices still present a critical challenge to growth in key markets, and risks of potential knock-on effects remain longer term, especially in South and Southeast Asia (Figure 4).

[b] The long-term is generally considered to be more than 10 years.

Figure 4: Factors impacting natural gas demand in Asia



- High price of LNG has forced governments/regulators to increase consumer gas tariffs by 50-100% depending on different sectors and their price sensitivity
- Risk to near-term LNG demand growth amid high prices and rising domestic production
- Growing urbanisation, industrialisation and rising income levels drive gas demand
- Stricter air quality and environmental control supports gas and LNG into power and industry in the longer term

- Across Asia, appetite for new LNG contracts remains strong as energy security and affordability concerns mount - gas demand rises rapidly, legacy contracts expire, domestic gas supply decline concerns intensify
- Risk to LNG demand growth in the early 2020s from high global prices, particularly in price sensitive South and Southeast Asia markets. Pace and scale of recovery is key risk into the mid term

- Gas demand to 2040 is upgraded to softening global gas prices and sufficient pipeline gas supply
- LNG demand returns to growth but faces comopetition from economically competitive piped gas from Russia and ramp-up of domestic gas in the long run
- Gas still fits into the strategic direction to diversify the coal-dominated energy mix and improve air quality but higher gas prices than coal and energy insecurity concerns risk near-term demand growth; more aggressive decarbonisation risks long-term demand levels

- Gas demand is resilient to high prices but faces downside pressures from growing pro-nuclear momentum in Japan and South Korea and long-term net zero targets across the region

- Near-term high prices risk LNG demand, especially in emerging markets of Vietnam and Philippines
- Declining domestic supply and rising demand increases LNG reliance across Southeast Asia
- Long-term gas demand under pressure as governments push for more renewables to meet energy security

Northeast Asia | (Mainland) China | Southeast Asia | South Asia

Source: Wood Mackenzie

Asia gas themes

1. Continued near-term risk to LNG demand amid high prices
2. Robust economic and population growth
3. Rising electrification
4. Coal-to-gas switching
5. Gas as a flexible transition fuel, particularly for the power sector
6. Falling domestic production and rising LNG reliance
7. Gradual market liberalisation
8. Governments refocus on energy security and affordability

Source: Wood Mackenzie

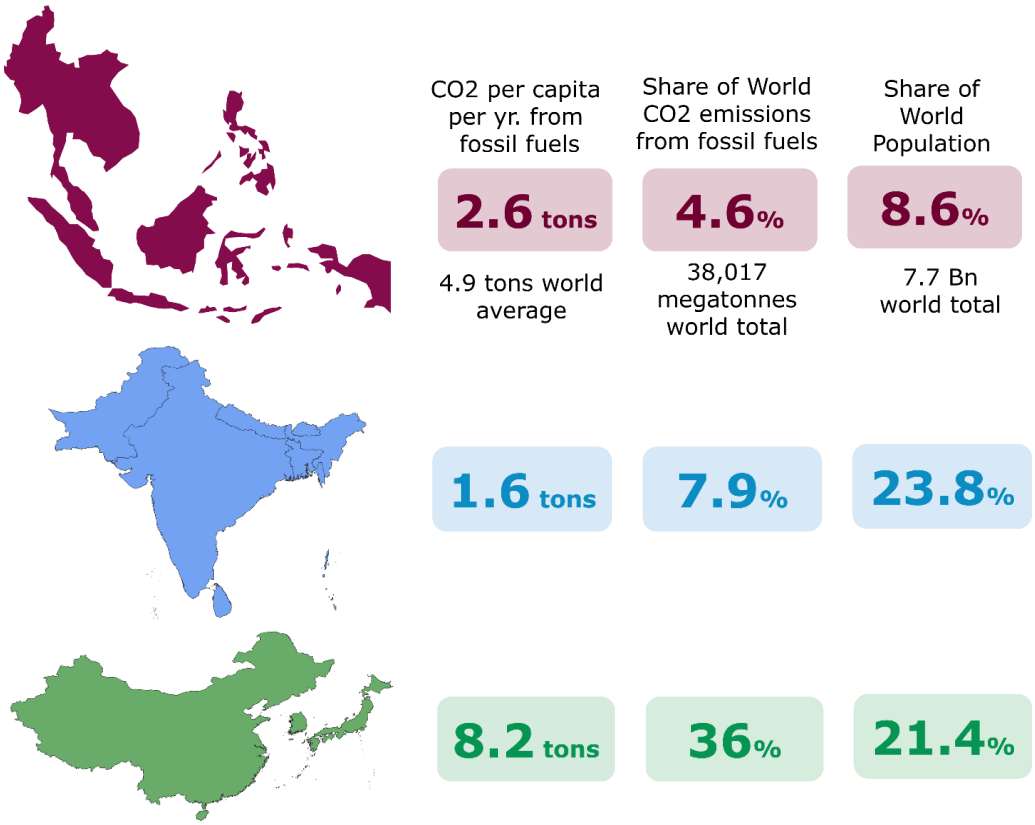
2. Presentations

The roundtable discussion began with two presentations, the first from Melanie Kenderdine, Principal and Vice President at the EFI Foundation, and the second presentation was delivered by Sakamoto Toshiyuki, Board Member, Director for Climate Change and Energy Efficiency Unit, and Yanagisawa Takafumi, Senior Analyst, from IEEJ.

2.1 Kenderdine, EFI Foundation

Ms. Kenderdine's presentation provided participants with baseline data related to climate and natural gas to level-set the discussion. She presented on the first phase of the workstream, *Global Gas Phase I: The Role of Natural Gas in Deep Decarbonization*, where the EFI Foundation held eight workshops with experts and stakeholders from key regions globally to explore the role of natural gas in the transition to low- and zero-carbon energy systems in those regions and globally. The study highlights the difference in regional emissions by population (Figure 5), with South and Southeast Asia having low emissions distributions for their populations and Northeast Asia having a much larger share of emissions per capita.

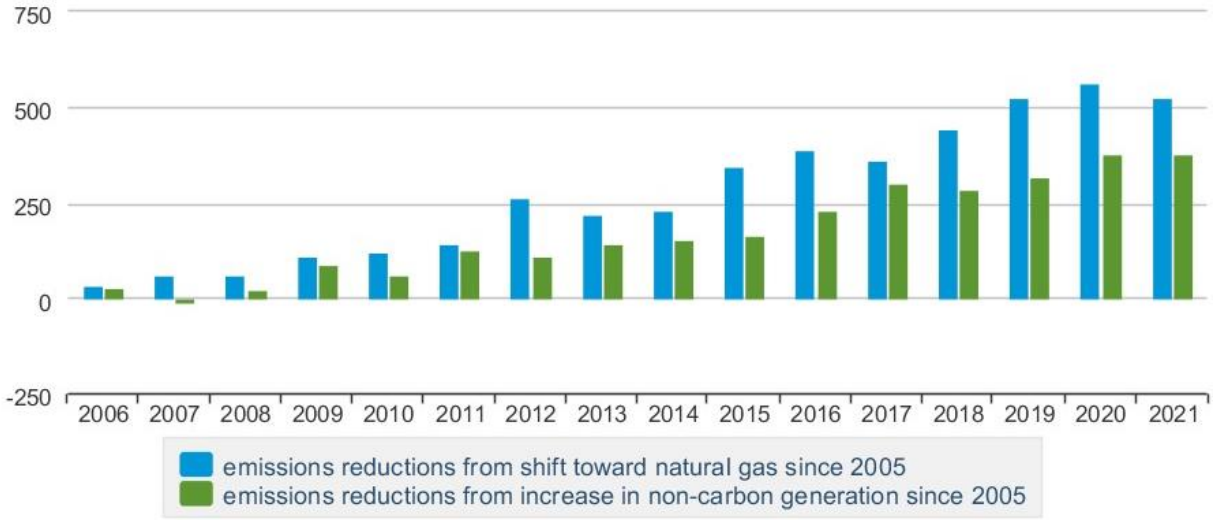
Figure 5: Asia Regional Emissions by Share of Population



Source: EFI, The future of natural gas in a deeply decarbonized world: Expert Workshop Summary Report (i.e., Phase I)

Kenderdine pointed out that the United States has made significant gains in CO_2 emissions reductions due to coal-to-gas fuel switching and renewables deployment. Between 2005 and 2021, the carbon intensity of electricity in the U.S. fell from 0.61 mt per megawatt-hour to 0.39 mt per megawatt-hour. Had carbon intensity remained the same as in 2005, an additional 905 million metric tons (MMmt) of CO_2 would have been emitted in 2021. Of these avoided emissions, 58% (526 MMmt) were due to a switch from higher-carbon fossil generation to natural gas generation, and 42% (379 MMmt) from growth in zero-carbon generation (Figure 6).[19]

Figure 6: CO_2 emissions reductions relative to 2005 caused by changes in U.S. electricity generation fuel mix (million metric tons of carbon dioxide)



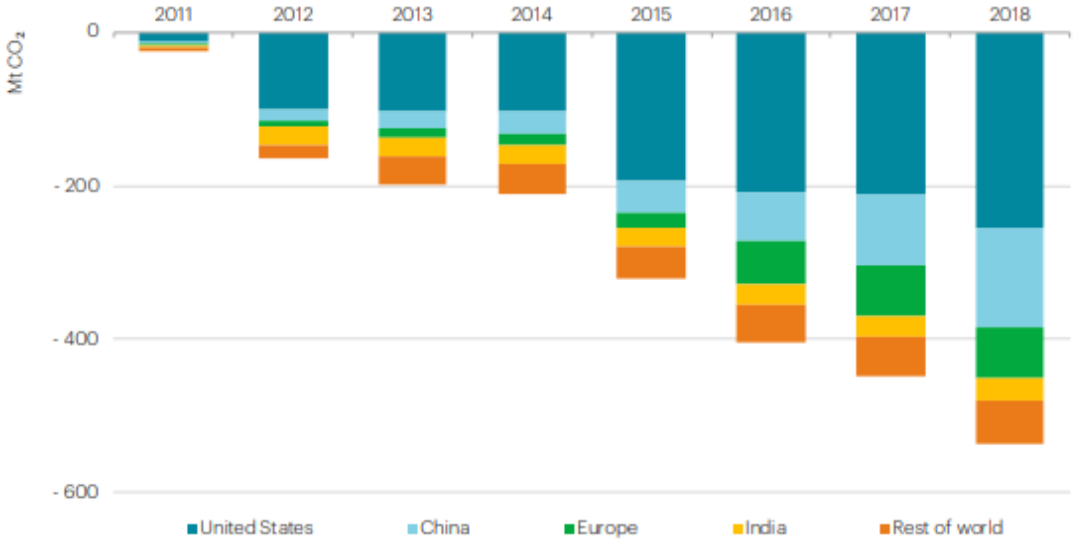
Source: U.S. Energy Information Agency (EIA), Monthly Energy Review, October 2022, Table 7.2a, Electricity Net Generation: Total (All Sectors) and Table 7.3c Consumption of Selected Combustible Fuels For Electricity Generation: Commercial and Industrial Sectors

Throughout the discussion, participants shared their viewpoints on LNG in the context of "natural gas as a decarbonization tool." Not only can switching from coal to natural gas power generation it can also play an important role in reducing GHG emissions, it can also help reduce key criteria pollutants while meeting energy demand in Asian countries. Between 2010 and 2018, coal-to-gas fuel switching abated emissions in the power sectors of major emitting countries; approximately 14% of total CO_2 emissions reductions in the U.S. power sector and 8% of CO_2 emissions reductions in China's power sector were associated with coal to natural gas fuel switching.[20] (Figure 7) In addition and as noted, fuel switching can improve air quality in the near term, especially by reducing coal-based sulfur dioxide (SO_2), and particulate matter (PM2.5) emissions.[21]

Kenderdine also highlighted the role of natural gas in industrial manufacturing processes that are essential for meeting the goals of the energy transition. Some high-heat industrial processes cannot be electrified and require a fuel feedstock to reach high temperatures. While McKinsey & Company estimates that 50% of industrial fuels used for energy in manufacturing could be replaced with electricity using technologies available today, electrification is not possible for processes that require more than 1,000° Celsius of heat.[22] Additionally, an increase in electrification requires upgrading the electrical grid infrastructure to handle greater capacities. Analysis suggests that the United States could require 72,000 miles of new high-voltage transmission lines and 360,000 towers by 2030. This infrastructure is made from steel, copper, aluminum, and other materials that require high heat for the associated processes.[23] These critical materials will be

in high demand as countries adopt greater electrification in various sectors, including transportation, i.e., electric vehicles (EVs). In addition, these materials are also used in other applications essential for energy transition, such as wind turbines and electric vehicles. Thus, natural gas with carbon capture and sequestration (CCS) could play an important role by providing lower-emission and cost-effective high-heat fuel for industrial applications.

Figure 7: Regional CO_2 savings from coal to gas fuel switching since 2010 ($MtCO_2$)



Source: IEA, The Role of Gas in Today's Energy Transitions
Note: Mt CO_2 = million metric tons carbon dioxide. Coal-to-gas switching includes emissions reductions in sectors where the market share of coal decreased, and the market share of gas increased within each region. The baseline increase in emissions assumes no improvement in the carbon intensity of energy or the energy intensity of gross domestic product (GDP) since 2010. Savings are calculated as those that occur compared to 2010.

2.2 Sakamoto and Yanagisawa, IEEJ

Mr. Sakamoto and Mr. Yanagisawa's presentation, "Consideration for the Role of IEA for Gas Security and Methane Management for Cleaner LNG Value Chains", highlighted the role of natural gas in developed countries' energy security and deep decarbonization goals.

As described in the presentation, the importance of natural gas in the Asian energy mix was recently discussed on a global scale at the LNG Producer-Consumer Conference 2023 (LNG-PCC 2023) hosted by Japan's Ministry of Economy, Trade, and Industry (METI), the International Energy Agency (IEA), and the Asia Pacific Energy Research Centre (APERC) in Tokyo on July 18, 2023. Discussions at the conference focused on specific measures to prevent the expansion and recurrence of an energy crisis through dialogues among IEA member countries, producers, and consumers.

It was noted in the roundtable discussion that the IEA tends to reflect "Western" voices, especially in the context of net zero. IEEJ underscored the importance of elevating voices from countries in Asia, which Japan sought to achieve through the LNG-PCC 2023. Yanagisawa also noted that the IEA should take advantage of COP28 to appeal to global stakeholders on the importance of natural gas for energy security and decarbonization, which could further elevate non-Western voices.

Throughout the roundtable discussion, participants echoed IEEJ's message of the disconnect between developed and emerging economies' perspectives on the role of natural gas, as well as the need to elevate non-Western voices and needs. One participant noted that there is a disconnect between reality and ideological policy, stating that "developed nations are not able to acknowledge the role of gas in other regions if it doesn't align with their ideological objectives." The West needs to acknowledge the role of gas in developing nations to mitigate energy security risks and energy poverty.

As part of the goal to enhance LNG security and develop a cleaner LNG value chain, METI released an "*LNG Strategy for the World – Chair's Summary for LNG-PCC 2023*." In the report, the Chair encouraged IEA members and the EU to focus on enhancing the information exchange needed to mitigate *security of supply* threats, explore cooperation on global flexibility options, and engage in further practices on methane abatement along the gas value chain in line with OGMP 2.0 protocols.[c] Increased sharing of information was supported by France, the European Commission, Italy, Japan, and the United States.[24]

> Consistent with the LNG-PCC 2023, IEEJ proposed two initiatives at this roundtable to strengthen IEA's role in global gas security. The first was for information sharing, related to gas security, to be expanded beyond non-IEA member countries. This could be achieved by enhancing information transparency and strengthening the advisory function. The second was for IEA to emphasize the importance of natural gas as an essential resource that ensures energy security in the energy transition to net-zero.

Methane abatement in LNG value chains was also a main point of discussion at the conference, which resulted in new coalitions. For example, the Japanese Company JERA, South Korean Company KOGAS, and Japan Organization for Metals and Energy Security (JOGMEC) released a joint statement that emphasized the "*Coalition for LNG Emission Abatement toward Net-zero (CLEAN)*" as a public-private joint effort for methane leak reductions. This statement was also signed by the United States, South Korea, Australia, and the European Commission.[25] Pathways to decarbonization, methane leakage reductions, the value of LNG in the clean energy transition, and overall energy security are specific to each country; each country has its own bottlenecks and challenges regarding LNG and decarbonization plans, and how this is harmonized with economic development and energy security is key question moving forward. Methane reduction measures, for example, are relatively cost-effective, but insufficient regulations and incentives, as well as the lack of a standardized framework, could undermine methane reduction efforts.

[c] The Oil and Gas Methane Partnership (OGMP) 2.0 is a methodology created by the Climate and Clean Air Coalition in 2014 as a voluntary initiative to help companies reduce methane emissions in the oil and gas sector. Through participation in the OGMP-associated reporting, companies are provided with a credible mechanism to address their methane emissions and demonstrate this systematic approach and results to stakeholders systematically and responsibly.

3. Roundtable Discussion

Throughout the roundtable discussion, participants agreed that Asia is currently the primary driver for global LNG demand. There was, however, a divergence of opinions regarding the longevity of the fuel source. Some participants expressed the view that natural gas is an important tool for energy security and economic development in the region and that demand will continue to grow through 2040. Other participants highlighted the emissions associated with LNG supply chains, which create tensions with 2050 net-zero goals. One participant opined that "natural gas is an interim mitigator on the journey to net-zero and not a solution in its own right." Overall, there was interest surrounding natural gas alternatives such as hydrogen and ammonia, but a recognition that these fuels are expensive and unlikely to penetrate Asia's price-sensitive market in the near term.

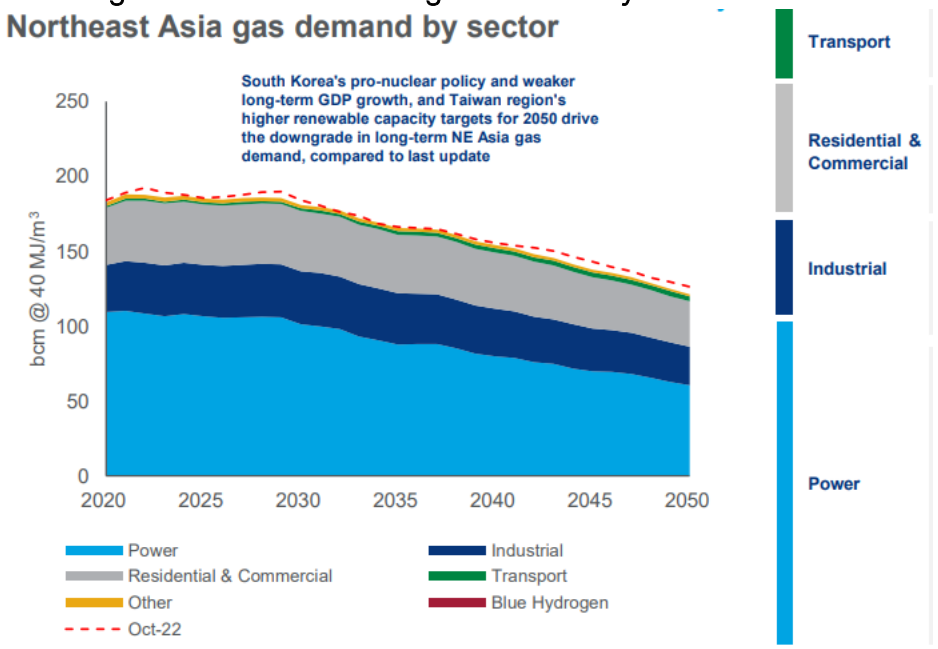
Through the roundtable dialogue, the EFI Foundation sought to investigate the primary challenges for regional Asian LNG markets. The following sections are divided by region and aim to capture roundtable participants' perspectives on challenges and opportunities in each geography for natural gas. The first is Northeast Asia (Japan, South Korea, and Taiwan). The second is Southeast Asia (Brunei, Indonesia, Malaysia, Philippines, Singapore, Thailand, Timor-Leste, Vietnam, and Burma). The third and final category is focused on India and China; while not purely a geographic focus like the other regions, these two countries are critical for understanding the role of natural gas in Asia.

3.1 Northeast Asia

Northeast Asian consumers have prioritized energy security, underpinned by certainty and diversity of supply. Natural gas is a large part of the energy mix in the region. In Japan and South Korea, natural gas demand has, however, decreased in response to high spot LNG prices, and both countries have instituted policies to reduce reliance on LNG in the wake of the Russian invasion of Ukraine. At the same time, both countries have expressed a renewed interest in nuclear energy as a primary energy source.

Gas is a key transition fuel for energy import-dependent countries in Northeast Asia and many forecasts suggest that demand will remain strong through the early 2030s. Post 2035, demand decline accelerates as GDP growth slows, population declines, and policies accelerate efforts to achieve net-zero emissions by 2050 (Figure 8). Population decline is the main source of demand destruction in the residential and commercial sectors. Industrial demand for natural gas is expected to decline as economic growth continues to slow in Northeast Asia's mature markets. In addition, electrification, improved efficiencies, and the adoption of low-carbon hydrogen in refining and chemical sectors contribute to decreasing demand for natural gas. In the transportation sector, Northeast Asia's natural gas vehicle fleet is small, and only minimal growth is expected out to 2050. Finally, the largest expected declines in demand are in the power sector as new coal and nuclear facilities compete with natural gas. Additionally, long-term decarbonization reduces demand post-2030 as renewables and battery storage technologies mature and scale, as well as low-carbon hydrogen, which could displace up to 35% of natural gas in the power sector by 2050.[26]

Figure 8: Northeast Asia gas demand by sector



Source: Wood Mackenzie, Global Gas: Asian Market Report, March 2023

In a move to diversify energy sources, in 2021 Japan initiated experimental coal power plant programs with a 20% ammonia fuel mix. Japan announced goals of using this approach for all its coal-fired power plants by 2035 and is developing the technology to use 100% ammonia in the 2040s.[27] During the roundtable discussion, participants disagreed on Japan's ammonia co-firing policies for coal plants. One participant commented that "with the right policy to alleviate stranded assets, Japan wouldn't need to co-fire ammonia in coal plants and could instead replace those coal plants with high-efficiency natural gas combined cycle plants." Another participant disagreed, stating that using existing infrastructure in the lowest carbon intensive way is better than stranding fossil fuel-based infrastructure and assets. The participant reminded the group that the transition is going to take time and it's still uncertain what zero- and low-carbon technologies will prevail.

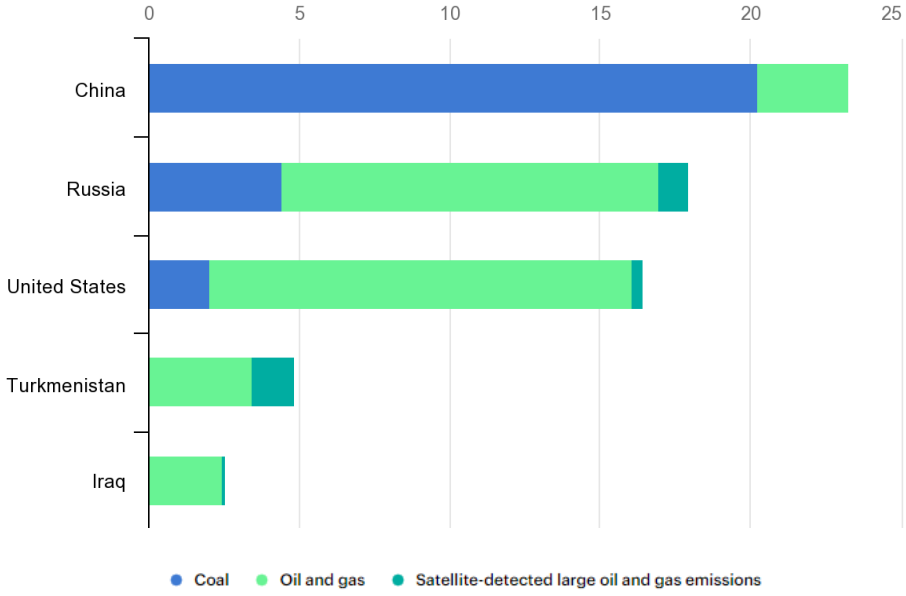
Although some forecasts are for natural gas demand to decline in Northeast Asia in the coming decades, the region is still expected to use more than 100 bcm per year in 2050. Additionally, South and Southeast Asian markets are expected to be major drivers of global gas demand as their populations grow and industrialization efforts expand. In this regard, several participants discussed the challenges and opportunities of continued gas use in the context of global decarbonization goals. One participant from a global research and consultancy group remarked that large-scale deployment of carbon capture and sequestration (CCS) is the only way natural gas can be utilized in accordance with climate objectives. This participant suggested that a global framework on CCS is needed to scale the technology and address emissions from power generation, industrial processes, and enable technologies such as direct air capture and low-carbon hydrogen, which are essential to many decarbonization strategies.

A participant from an independent not-for-profit organization agreed that CCS is an important consideration but argued that methane abatement is a more critical issue that needs to be addressed. While methane has much higher radiative forcing than CO_2, its residence in the atmosphere is 10-12 years compared to a

thousand years or more for CO_2. Methane's global warming effect is around 83 times stronger than CO_2 over a 20-year period, according to the UN Intergovernmental Panel on Climate Change.[28] Another participant added "It is more so the responsibility of upstream and midstream suppliers to mitigate their methane than for end-use consumers, who should be more focused on capturing the carbon from natural gas combustion."

One participant reminded the group that the technologies exist across the natural gas system to monitor and capture methane emissions. Oil and gas supermajors have been implementing these abatement technologies. The result: methane emissions from oil and gas production fell 28% between 2019 and 2021 among the industry's 100 biggest emitters. Although the industries' emissions have been declining, there are still significant emissions yet to be abated (Figure 9). Globally, normal oil and gas operations emit the equivalent of a Nord Stream size[d] event every single day on average. Efforts to stop very large leak events must therefore go together with measures to reduce emissions from normal operations, such as by replacing leaky equipment and installing emissions control devices.[29] A participant asked, "What can "advanced" Northeast Asian economies do to accelerate the deployment of CCS at scale in the Asia Pacific region to ensure natural gas consumption is aligned with decarbonization goals?"

Figure 9: Large (methane) leaks from fossil fuel operations, Million Metric Tons (2022)

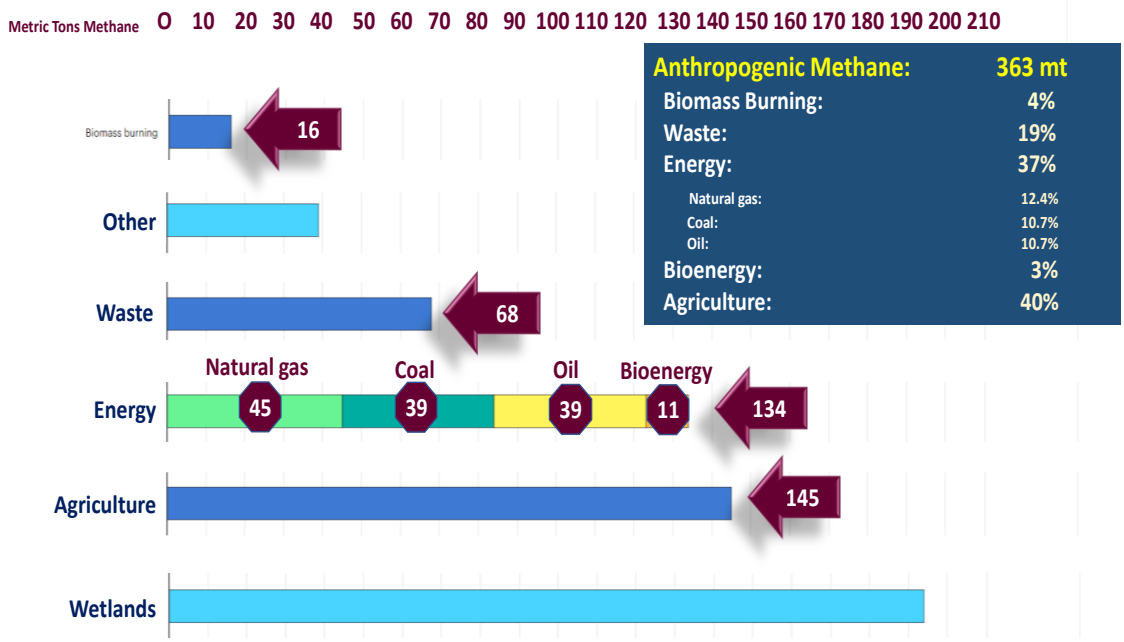


Source: IEA, Global Methane Tracker 2023 (updated February 2023)

However, as the participant pointed out, while the methane emissions issues from gas systems have not been fully addressed, natural gas systems are only 12% of global methane emissions, whereas agriculture accounts for 40% of anthropogenic methane emissions (Figure 10). A participant went on to add that if we want to get serious about methane, we need to also address emissions from agriculture emissions, such as rice paddies and dairy farms.

[d] According to Germany's federal environmental agency, the Nord Stream explosions in September 2022 released an emissions equivalent of 7.5m tons of CO_2 into the atmosphere.

Figure 10: Global methane emissions by source (March 2020)



Source: IEA, Global Methane Tracker 2020

3.2 Southeast Asia

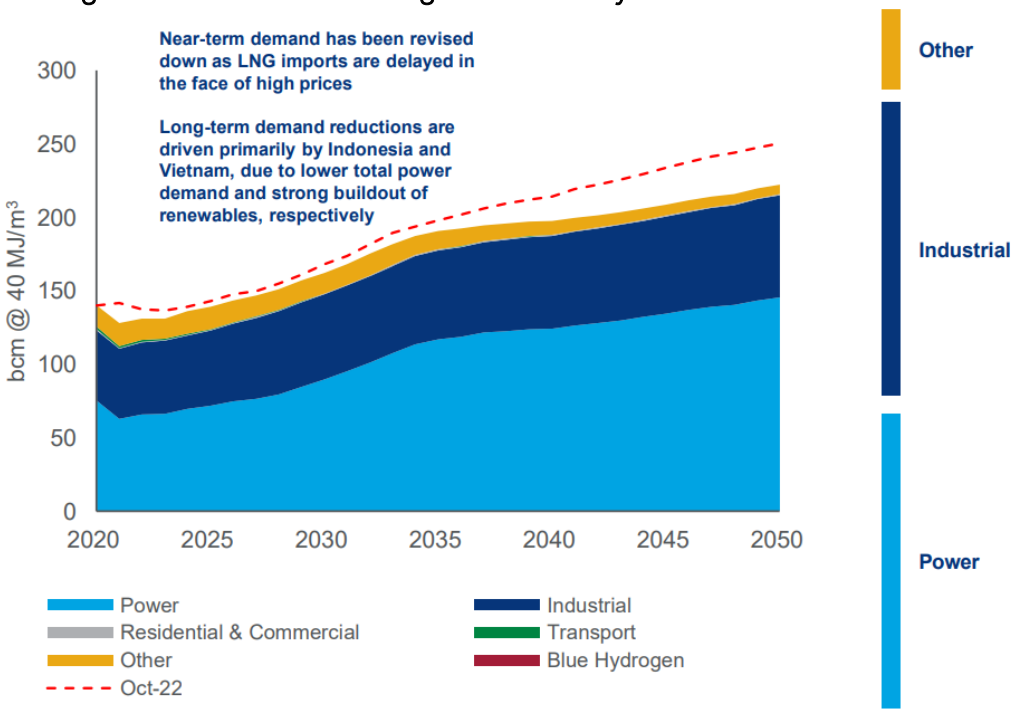
In contrast to Northeast Asian views, Southeast Asia appears to be more sensitive to affordability and reliability of supply, and how energy supplies will be affected by rapid economic and population growth in the region. Southeast Asia has seen rapid economic and population growth, which has, in turn, significantly increased energy demand in the region. From 2000 to 2020, energy demand almost doubled, natural gas consumption increased by over 80%, and it has maintained around a 20% share of the total energy mix since.

Natural gas can play an important role in enabling decarbonization in Southeast Asian countries by switching from coal to natural gas, as well as in meeting energy demand for industrial and population growth. In countries like Indonesia and Vietnam, coal use for power generation is still much higher than natural gas generation. As the region's energy portfolio evolves, supporting economic growth of its respective industrial and manufacturing sectors, while also making the necessary infrastructure changes to support decarbonization, will be dependent on affordable and reliable sources of energy.

Gas demand in Southeast Asia is expected to grow in the coming decades (Figure 11). By 2050, Southeast Asia's gas power fleet could be around twice the size of Japan's current fleet, despite being a similar size today. Over the longer term, coal-to-gas fuel switching picks up in industrial sectors to meet energy transition goals, and demand is increased from new industrial complexes, refineries, and smelters.

Various forecasts suggest that growing electrification in the region will further contribute to gas demand as coal-to-gas fuel switching for power generation accelerates. Population growth is a major driver of increased gas demand in the power sector. Regional power demand is expected to double by 2050, with gas demand also doubling, and the strongest growth in population coming from Indonesia and Vietnam. Even with these large increases, the percentage share of natural gas in the region's power generation is expected to fall from 30% in 2022 to 24% by 2050.[30] It should be noted that, compared to the emerging economies in Southeast Asia, Singapore is an outlier and will increase carbon taxes five-fold, which will force companies to rethink energy efficiency and industrial operations.

Figure 11: Southeast Asia gas demand by sector



Source: Wood Mackenzie, Global Gas Asia Market Report, March 2023

Considering the limitations of renewables for providing reliable baseload power without significant storage infrastructure, fossil fuels will continue to play a significant role in Southeast Asia for the foreseeable future. It is expected that Southeast Asia will become a net natural gas importer by 2025, and volatile prices and geopolitical factors may have more significant long-term consequences for natural gas utilization in the region. Changing perceptions of resource affordability and policy attitudes towards investments in gas import infrastructure could follow. However, financing for any new coal projects in the future seems unlikely if climate pledges are to be met, so it could benefit countries in the region to initiate decarbonization of energy generation by replacing coal with natural gas. One participant, speaking on investing in energy in the region, said that financing of natural gas projects depends on the net-zero outlook of investors together with how countries are managing their plans to reach net zero. The contributor also mentioned that it is unclear yet whether lending to governments or directly to the private sector is best.

Affordability remains the largest constraint to LNG imports in Southeast Asia, particularly for emerging importers. A participant commented on the disconnect between producers and consumers on affordability. The participant stated that their producers can offer $12/MMBtu, but an affordable price point for consumers in emerging markets is closer to $8/MMBtu. The participant said that if those prices do not

come down, places like the Philippines, Vietnam, Indonesia, and Malaysia will continue to use coal-fired power generation. The participant went on to add that Australia and Qatar are not bringing on supplies sufficient to meet growing demand in Southeast Asia and that if the Asia Pacific is going to decarbonize with gas, it will have to come from North America. An increase in supply from North America could push prices down and create an affordable environment for Southeast Asian consumers to enter the LNG market.

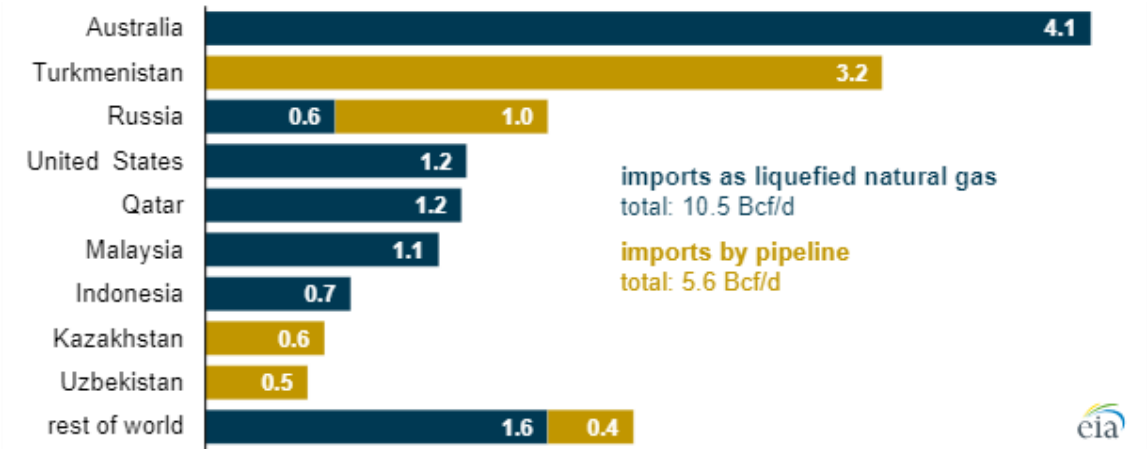
Throughout the roundtable discussion, participants discussed the challenge of energy poverty in the context of the energy transition. According to the Asian Development Bank, more than 350 million people in Asia and the Pacific have limited access to electricity, and 150 million people still have no access at all.[31] Many participants agreed with a comment made during the discussion that the world cannot solve climate change without lifting people out of energy poverty. While advanced economies are more equipped to afford the high price of low-carbon fuels such as hydrogen and ammonia, this is much more challenging for developing economies – especially when natural gas is not seen as an affordable solution. It is important for advanced economies to understand that Southeast Asia is more concerned with economic development than climate change, and it's the responsibility of the developed world to support low- and middle-income nations in industrializing in the lowest-carbon way possible.

3.3 India and China

China and India are among the world's largest economies with the world's largest populations. Both countries are also primed for expansive economic growth in the energy sector over the next two decades. How these countries increase their energy capacity for economic development, as well as how they decarbonize, will be felt throughout global energy markets.

China and India are both leveraging natural gas to diversify their coal-dominated energy mix to improve air quality and are also increasing their use of renewable energy. Both are opportunistic when it comes to the purchase and utilization of natural gas. Both countries produce around half of their natural gas supplies; the other half is imported. China's LNG imports averaged 10.5 billion cubic feet per day (Bcf/d) in 2021, a 19% increase compared with 2020. LNG imports accounted for more than half of China's overall natural gas imports and 30% of China's total natural gas supply in 2021 (Figure 12).[32] India and China are projected to drive LNG regasification capacity additions in Asia between 2022 and 2026, and both are projected to account for ~55% of Asia's total capacity additions by 2026.[33]

Figure 12: China's natural gas imports from selected countries, Bcf/d (2021)



Source: Graph by the U.S. Energy Information Administration, based on data from China's General Administration of Customs and the Global Trade Tracker

While many countries have used Russia's invasion of Ukraine, and the disruption in energy flows, as a rationale for moving away from Russian oil and gas imports, China and India are exceptions. Russia has long-standing trade and strategic relationships with both countries, offering steep price discounts while accepting payments in rupees and RMB while asking others to pay in rubles.[34] Without sanctions against Russia, China spent approximately $19 billion on Russian oil and gas in the months after the Ukraine invasion, from February to the end of May 2022. India paid Russia approximately $5 billion in the same period.[35]

Although coal is cheaper than natural gas, burning natural gas results in fewer emissions of nearly all types of air pollutants and CO_2 than burning coal or petroleum products to produce an equal amount of energy. About 117 pounds of CO_2 are produced per MMBtu equivalent of natural gas compared with more than 200 pounds of CO_2 per MMBtu of coal and more than 160 pounds per MMBtu of distillate fuel oil.[36] Natural gas also releases lower criteria air pollutants when combusted compared to coal, oil, and bioenergy (Figure 13). Criteria air pollutants, such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter ($PM_{2.5}$), pollute the air and cause smog as well as health risks. Some participants reminded the group that countries, like China and India, need natural gas for decarbonization purposes, but also for pollution mitigation in large urban centers.

Figure 13: Criteria pollutant emissions, % of global total, 2019

	SO_2	NO_x	$PM_{2.5}$
Coal	58%	14%	16%
Oil	37%	72%	20%
Natural Gas	0.7%	10%	4%
Bioenergy	5%	4%	63%

Source: IEA, The role of gas in the energy transition

China's outlook for gas consumption, industrial needs, and power generation has been consistently increasing, and meeting its climate targets without natural gas appears unrealistic. Natural gas is seen as a viable and reliable fuel to power China through 2050. At the same time, reaching China's target of net-zero emissions by 2060 will require increasing the integration of low-carbon or renewable energy sources.[37] China will increasingly use more gas to move away from coal, but it will simultaneously increase emissions with the mining and processing of critical minerals. The use of natural gas in China will, however, be affected by these net zero goals, which may limit the scope of gas deployment and infrastructure as it moves closer to 2060.[38] It may also increase CCS as an option.

Participants disagreed on China's LNG demand outlook, although agreed that China benefited from LNG arbitrage during the war in Ukraine. While some participants hypothesized that China will be the first 100 MMBtu market, others highlighted China's aggressive renewables and coal deployment which could move the country away from natural gas. Coal is critical to China's power mix and one participant noted that Xi Jinping, President of the People's Republic of China, views coal as a central pillar of China's energy security. Another participant noted that China's strong LNG contracting strategy also adds to an energy security approach.

One participant representing a financial institution was bearish on the LNG demand outlook in Asia, especially in China. In 2023, China is expected to add 170 GW of solar capacity, in addition to large expansions in wind and coal. They expect that China's LNG imports have already peaked and could even

possibly decline in the coming decades. If Chinese and European demand declines, Southeast Asia remains the key driver for growth in global LNG markets. However, this participant thought that it's unrealistic to think that Southeast Asia's demand would increase above current Chinese demand, which could result in a massive oversupply.

Although global gas markets move from boom to bust cycles, a huge oversupply could be possible if China's LNG import capacity is a false signal of demand and large demand increases are expected in Southeast Asia. Alternatively, the market could experience an oversupply if Russian natural gas returns to global markets. Not all LNG imports into China are necessarily used for domestic consumption, and importers will often trade LNG for a profit on the spot market. For example, U.S. LNG contract holders in Asia, namely China, benefited from arbitrage gains by reselling cargoes to Europe during the European energy crisis in 2022. The participant pointed out that if producers are overestimating demand in Asia, a large oversupply event could cripple global markets as it would become uneconomical for producers.

Compared to China, participants viewed growing LNG demand in India as more viable. India's government continues to face several challenges to meet the country's growing energy demand, including securing affordable energy supplies and attracting investment for upstream projects and transmission infrastructure. The government has made considerable headway with energy reforms and continues to focus on greater energy security, infrastructure development, and market liberalization.[39]

With the spike in LNG prices, India utilized more coal and oil in 2022 than in previous years. India's natural gas demand is, however, forecast to increase in the longer-term; these supplies will come both from imported LNG as well as from increased domestic production. India is price sensitive and natural gas prices could be volatile in the next decade, but India can source LNG from most large producers, in Russia, Qatar, and the United States.

India's natural gas demand grew in 2021, despite pandemic-related disruptions and the effects of increased costs of LNG. Much of this growth can be attributed to the expansion of natural gas distribution infrastructure. Furthermore, the government plans to invest an additional $60 billion this LNG expansion and aims to connect 70% of the country's population to the natural gas grid.[40]

While India's decarbonization strategy has been praised as ambitious,[41] India's economic development plan to integrate an estimated 300 million people into urban economies is equally ambitious. This plan will likely drive-up energy demand, as well as the associated emissions from conventional energy sources. Roundtable participants questioned India's ability to meet its aspirational decarbonization targets with the increase in natural gas use. How India handles this increase in energy demand with low-carbon energy sources will be key to how it accomplishes its climate milestones.

4. Conclusion

The 2022 European energy crisis, spurred by Russia's invasion of Ukraine, impacted the affordability and reliability of LNG supply in Asian nations. In turn, the sub-regions of Asia discussed in this summary have prioritized different needs following the shift of LNG trade flows from Asia to Europe.

Northeast Asian consumers have prioritized energy security, underpinned by certainty and diversity of supply. In Japan and South Korea, natural gas demand decreased in response to high spot LNG prices, and both countries have instituted policies to reduce reliance on LNG in the wake of the Russian invasion of Ukraine. Both countries have also expressed renewed interest in nuclear energy as a primary energy source for power generation. Japan is experimenting with the use of ammonia co-firing in coal-burning power plants to lower CO_2 output and avoid stranding assets.

In contrast to Northeast Asian views, Southeast Asia is more sensitive to price but also has its own concerns about the reliability of supply. The region is undergoing rapid economic and population growth, which has increased energy demand. Many participants felt that natural gas could play an important role in enabling decarbonization in Southeast Asian countries by switching from coal to natural gas, as well as complementing renewables. South and Southeast Asia also suffer from high levels of energy poverty. Affordable and low-carbon energy solutions are essential to lifting disadvantaged populations out of energy poverty and enabling economic expansion in line with decarbonization goals.

China and India are among the world's largest economies with the world's largest populations, and both are primed for expansive economic growth and the associated energy demand over the next two decades. How these countries increase their energy capacity for economic development, as well as how they decarbonize, will reverberate throughout global energy markets. Both are leveraging natural gas and renewable energy to diversify their coal-dominated energy mix and improve air quality. Both are opportunistic when it comes to the purchase and utilization of natural gas and will respond to global markets accordingly.

Decarbonization, methane leak reductions, and how important LNG is to the energy transition, and overall energy security are specific to each country. Each country has its own bottlenecks and challenges regarding LNG and decarbonization plans, and how this is harmonized with economic development and energy security is the key question moving forward.

This Roundtable Summary provides an overview of the discussions that took place between EFIF and stakeholders in Asia during Gastech 2023 in Singapore on September 6, 2023. The roundtable discussion focused on the role of natural gas in a future global energy economy moving towards deep decarbonization considering a range of energy security issues raised by recent geopolitical events. A list of key takeaways from the roundtable discussions is described below.

4.1 Key Takeaways

Asia's strong gas demand:

1. **Natural gas demand in Asia is expected to be the main driver of global LNG markets in the coming decades**. Natural gas growth in Asia is underpinned by expanding populations, strong economic growth, rising electrification, and fuel switching. However, high, near-term prices still present a critical challenge to growth in key markets, and risks of potential knock-on effects remain long-term, especially in South and Southeast Asia.

Affordability:

2. **Affordable and reliable energy supply remains a top concern for Asian consumers**. Developing economies in South and Southeast Asia were priced out of the LNG market during the 2022 European energy crisis and continue to find LNG supplies unaffordable.

Energy Security:

3. **Natural gas supplies are a key energy security concern for many Asian countries**. Northeast Asian nation's approach to natural gas utilization is driven by energy security, which is achieved by a diversity of sources and certainty of supply through contracting strategies.

Energy Poverty and Equity:

4. **It is critical to elevate the voices of low- and middle-income countries in Asia in the net-zero context.** Developed nations, especially in the West, need to acknowledge the critical role of natural gas in developing nations for mitigating energy security risks, addressing energy poverty, enabling industrialization, and meeting decarbonization goals.

Reaching Net-Zero:

5. **Natural gas can play an important role in industrial decarbonization**. High heat requirements make it difficult to electrify some industrial processes. Natural gas is a lower-carbon alternative to coal and fuel oils, which make up a large share of industrial feedstock today.
6. **Coal-to-gas fuel switching lowers air pollution and decreases carbon emissions**. Although coal is more affordable than natural gas, burning natural gas results in fewer emissions of nearly all types of air pollutants and carbon dioxide (CO_2) than burning coal or petroleum products to produce an equal amount of energy.
7. **Large-scale deployment of carbon capture and sequestration (CCS) is critical for the consumption of natural gas while also meeting climate objectives.** A global framework for CCS is needed to scale the technology and address emissions from power generation, industrial processes, and to enable technologies such as direct air capture and low-carbon hydrogen, which are essential to many decarbonization strategies.
8. **Methane leakage is a critical issue that needs to be addressed.** While the residence of methane in the atmosphere is 10-12 years compared to 1000 or more for carbon dioxide, its radiative forcing levels are very high.[42] Capturing methane enables early gains for meeting climate mitigation goals. The technologies exist to abate methane across the LNG value chain and strides have been made in capturing and accounting for it.

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