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A Flexible LNG Market and Promotion of Investment

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A Flexible LNG Market and Promotion of Investment

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Foreword

While liquefied natural gas (LNG) has numerous advantages and can enhance the economic competitiveness, environment, and energy security (3Es) of Asia, several issues and challenges promote LNG in the region. The 2018 study conducted by the Economic Research Institute for ASEAN and East Asia, 'LNG Demand Development and Security in Asia', proposed the following policy recommendations:

1) a fast-track tool for project development;
2) assistance to private investment in the LNG value chain (including small-scale infrastructure) by public and private financial institutions;
3) robust project and risk management during development and implementation;
4) shipping optimisation; and
5) establishment of Asia's self-standing LNG market: acceleration of destination restriction removal, including removal from legacy existing LNG contracts; development of a reliable LNG price benchmark.

Referring to the outcome in 2019, the study in 2020/2021, 'A Flexible LNG Market and Promotion of Investment', aimed to provide more concrete and specific proposals and action plans to accelerate LNG use in Asia.

The authors hope that this study will provide new insights on LNG market development in the East Asia Summit region.

Hiroshi Hashimoto

Project Leader

Acknowledgements

This study was undertaken based on close discussions with LNG specialists and industry officials in ASEAN, Japan, and the United States (US). The authors thank all the participants of the online LNG workshop meeting on 20 April 2021 and the respondents to the written survey on destination flexibility issues.

The presentations at the workshop – from the region's industry players, government authorities, and stakeholders from the other regions that are also active in Southeast Asia – and ensuing discussions were very useful and inspiring to develop future strategies and policy measures to support development activities.

The authors also express sincere appreciation to Lucian Puglirearesi, president of the Energy Policy Research Foundation, Inc., and his team for their kind and generous support for this study. Without them, this report would not be possible. As a disclaimer, all errors and mistakes are the author's responsibility.

Hiroshi Hashimoto

Leader of the Working Group

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Table of Contents

List of Figures

List of Tables

Abbreviations and Acronyms

APS	alternative policy scenario
BAU	business-as-usual scenario
Bcf	billion cubic feet
Bcm	billion cubic metres
CCUS	carbon capture, utilisation, and storage
CNL	carbon-neutral LNG
COD	commercial operation date
ERIA	Economic Research Institute for ASEAN and East Asia
EU	European Union
FSU	floating storage unit
GDP	gross domestic product
GHG	greenhouse gas
IEEJ	The Institute of Energy Economics, Japan
ISO	the International Organization for Standardization
LNG	liquefied natural gas
m^3	cubic metre
MBtu	Million British thermal units
Mtoe	Million tonnes of oil equivalent
Mtpa	Million tonnes per annum
NTP	notice to proceed
OPGMP	Oil and Gas Methane Partnership
PDP	Power development plan
PPA	power purchase agreement
Tcf	trillion cubic feet
TFEC	total final energy consumption
TPA	Third-party access
TPES	total primary energy supply
UK	United Kingdom

UN	United Nations
US	United States
VPS	virtual pipeline system

Executive Summary and Key Findings

Key Findings

1) Gas complements renewables towards a cleaner energy system. The Association of Southeast Asian Nations (ASEAN) is a growing liquefied natural gas (LNG) and gas market. LNG imports in Southeast Asia grew by 32% in the past decade and are expected to continue growing as gas demand grows. Thus, the view that natural gas can be used as a transition fuel to a cleaner energy system in the region is optimistic.

2) Reducing greenhouse gas (GHG) emissions has become a common goal in the world. ASEAN countries also try to reduce fossil fuel consumption and invest more in renewable energy like solar and wind energy to achieve their GHG emission reduction goals. However, as coal is still the dominant fuel in the ASEAN region and the member economies prefer to utilise the existing infrastructure for stable energy supply, it will take time to phase out these coal-fired power plants. However, despite coal being the dominant fuel in the region, building a new coal-fired power plant has become increasingly difficult in the ASEAN region, even though no policy restricts coal consumption.

3) LNG-related investment is capital intensive and involves many challenges such as investment environment, regulatory framework, LNG market demand, and electricity tariff. It is even more challenging for a country that has no experience in LNG imports like Viet Nam and the Philippines. This report explores the LNG infrastructure development in Indonesia, Myanmar, the Philippines, and Viet Nam – countries that have just started or are about to start importing LNG.

4) Recently, more countries have become committed to tackling climate change by announcing decarbonisation or carbon neutrality targets, including China, the largest carbon emitter, and the US, the second-largest emitter, as well as Japan and the Republic of Korea (henceforth Korea). Following the decarbonisation and carbon neutrality targets declared worldwide, there is also a growing attention towards the decarbonisation and carbon neutrality for LNG.

5) Natural gas is considered to be a relatively clean fuel as its carbon dioxide (CO_2) emissions are half of coal's emissions when combusted in a power plant. However, it is still a fossil fuel. As more investors and customers challenge natural gas, the declining costs for renewable energy such as wind and solar also increase pressure on LNG producers and force them to look for ways to reduce or offset their carbon footprints. As a result, the market of carbon-neutral or decarbonised LNG is emerging. It is noteworthy that the GHG emissions of LNG cargoes include not only CO_2 emissions but also methane emissions. As more LNG buyers and consumers increasingly consider LNG's carbon footprints, decarbonising the LNG sector has become an imperative trend. This is ultimately expected to become an essential factor for investors when committing to invest in new LNG projects and even related infrastructure.

6) Investment in LNG projects greatly depends on demand potential. Natural gas might be 'dirty' for some countries looking to shift away from fossil fuels. However, it is still a cleaner alternative fuel to coal and oil in ASEAN countries as it provides stable power generation and

serves as a complementary fuel with renewables. The focus for ASEAN countries should be on how to help implement CCUS (carbon capture, utilisation, and storage) technologies and establish a reasonable and affordable pricing mechanism. So, energy transition could be facilitated and the region would not be left behind the global transition pathway.

7) It is important to identify (i) how LNG-consuming markets should be developed in the most promising region for worldwide economic growth, (ii) how LNG supply sources could be more flexible and competitive to be accepted in the ASEAN LNG market, and (iii) how technical and regulatory standards should be coordinated between individual economies so that future LNG cargoes could move freely between the markets in response to dynamic developments in those markets.

Summary of Policy Recommendations

The study, 'A Flexible LNG Market and Promotion of Investment', recommends that relevant stakeholders undertake the following initiatives to support a growing LNG market in Asia. Two items (#3 and #4) were also presented on 12 October 2020 at the 9th Annual LNG Producer–Consumer Conference held online.

1) Policy support needed to sustain infrastructure development

Governments should investigate the LNG infrastructure gap and place the right policy to promote the investment that will increase gas use demand. Leaving investment decisions in major infrastructure to market forces has been proven difficult because LNG-related infrastructure projects are capital intensive. Governments' concrete actions are required for developing infrastructure, such as LNG receiving terminals, regasification plants, storage tanks, gas networks, and pipelines or virtual pipelines.

2) Create more gas demand with innovative solutions to facilitate further investment: TPA, ssLNG, ISO tanks, LNG-to-powership, and VPS

A key element for a flexible LNG market is sufficient trade volumes. Third-party access (TPA) in some cases could allow more gas imports and, thus, a more competitive gas market. Small-scale LNG (ssLNG), LNG-to-powership, and virtual pipeline systems (VPSs) also provide innovative solutions to reach more users in remote areas unreachable by pipelines. Small-scale LNG offers smaller capacity and lower initial investments as opposed to traditional receiving terminal and regasification facilities. ISO (International Organization for Standardization) tank containers provide quick access to LNG for end users in locations far from main pipelines that require smaller volumes. The virtual pipeline system (VPS) refers to delivering LNG with trucks to off-grid users. These innovative solutions would encourage new players to join the natural gas business and promote a more flexible LNG market to gain access to competitive LNG supply for stable economic development. Ultimately, these will enhance energy security and send signals to the financial market accordingly.

3) Producers and consumers should make the best efforts to reduce the carbon footprint of LNG in the supply chain and at the consuming end, and eventually to zero.

Governments of LNG-consuming and -producing economies should make carbon footprint information visible and contribute to a sustainable society. Governments should help LNG consumers and producers reduce GHG by encouraging them to improve production, transportation, and power generation efficiency. Governments should also support research and development activities of industrial players to promote the carbon-neutral use of LNG, such as carbon-neutral hydrogen and ammonia eventually.

4) Pursue an LNG pricing mechanism that provides comfortable price levels for both consumers and producers

Comfortable prices should be affordable for LNG consumers worldwide, especially in emerging markets, while they should be profitable enough for producers. Producers should reduce the supply cost as much as possible, and consumers should appreciate the value of LNG from environmental contribution. Extreme gaps between spot and term-contract prices, extreme low or high levels of spot LNG prices, and extreme volatility are not sustainable. Governments of LNG-consuming and -producing countries should support pricing mechanisms that provide transparent and timely information of LNG markets in collaboration with key market players.

5) Pursue flexible terms and conditions in LNG contracts through constant monitoring of market activities and close communication with competition authorities

The increasing number of LNG suppliers and supply volumes, the emergence of portfolio players in the LNG business, and the growing pressure from LNG-purchasing companies have contributed to the relaxation of destination restrictions in recent years. Yet, more efforts are still needed to encourage the competition authority of importing countries to include relaxation of destination clauses to their agenda and pursue more transparency and harmonisation of trade information to achieve a more flexible LNG market.

Introduction

Since the establishment of the Economic Research Institute for ASEAN and East Asia (ERIA) in 2007, energy security in the East Asia region has always been one of the core policy research areas, where natural gas and LNG have played a significant role. Accordingly, LNG has been regarded as an essential focal point of ERIA's research activities since 2017, as it is a vital product and an important energy source in the region.

In support of the initiatives on expanding Asian LNG markets, the Institute of Energy Economics Japan (IEEJ) in Tokyo, in collaboration with the Energy Policy Research Foundation, Inc. in Washington, DC, has undertaken a series of workshops, research, and policy assessments since 2017. Joint recommendations were presented at the annual LNG Producer–Consumer Conference from 2017 to 2020.

Demand for natural gas in ASEAN countries is expected to grow faster than the total energy requirement in the region. In parallel with the expansion of renewables, the share of natural gas in ASEAN’s energy mix is expected to expand from 21% in 2018 to 24% in 2050, according to IEEJ’s Energy Outlook 2021 (IEEJ, 2021) . With modest domestic production growth in ASEAN, the import dependency of Asia (including non-ASEAN countries) could rise significantly from the current level of around 30% to nearly 50% by 2050. Therefore, ASEAN needs stable investment on the upstream and downstream infrastructure of natural gas and LNG – receiving terminals, pipelines, gas-fired power generation facilities – and LNG supply sources from within and outside the region.

Natural gas and LNG have been critical in the region, traditionally as the resource to export and now the driver to fuel the region's rapid economic growth. ASEAN region has some of the biggest LNG exporters globally – and now, some of the emerging LNG importers.

Globally, LNG liquefaction plants with significant capacity have started operations in recent years. The world is expected to see a further considerable expansion of LNG production in the next decade, after 130 million tonnes per year of capacity were sanctioned from 2017 to the first half of 2021. Notably, for those projects that got final investment decisions during the period, more than half of assumed volumes have not decided their final destinations. Those new projects will compete for LNG customers against each other and existing LNG production projects vying for contract renewals.

In other words, this creates additional opportunities for LNG players to make the LNG market more flexible. In the past, LNG used to be marketed and sold to ready LNG users. The value chain was constructed in a vertically integrated manner. Nowadays, those with LNG volumes to be supplied may take advantage of their expertise to develop emerging LNG markets and optimise LNG volumes between different international LNG markets. For example, Japanese LNG importers (city gas and electric power companies) with additional LNG volumes, trading houses, and upstream developers – in collaboration with Japanese commercial banks and governmental organisations – have already been active in ASEAN countries to create additional LNG demand. Sometimes they compete and collaborate with LNG players from other countries. Competition and collaboration could significantly increase LNG consumption points to make market activities more flexible. Increasing transactions between more players should make it less difficult for them to create Asia's LNG price indexes.

Many challenges exist, such as the balance between vertical integration of the LNG value chain and increasing flexibility of LNG transactions, credit ratings of diversified parties to be involved, and different technical standards in other countries. Yet, Japanese players are expected to continue contributing to the development of the LNG market in collaboration with national and private energy companies and regional organisations in the ASEAN region.

The LNG industry experienced a turbulent period in 2020–2021 due to the COVID-19 pandemic and its impact on the global economy. The industry saw extremely low spot LNG prices in the first half of 2020, stagnant project development activities with few investment decisions in the year, followed by the extreme volatility of spot LNG prices at the beginning of 2021. During this turbulent period, the world again learned that LNG is the most versatile energy source to respond to people’s energy needs. At the same time, the industry has noticed that global awareness of energy transition is growing. Therefore, the industry and governments must find ways to pursue the harmonised goals of economic prosperity and energy transition with cleaner energy sources.

The pandemic and the accelerating progress of the decarbonisation agenda have added extra complexity to developing a flexible LNG market. Although the situation has constantly evolved, the study cannot ignore those elements and updates them to the maximum extent.

The study aims to identify ways on (i) how to develop LNG-consuming markets in the most promising region for the world’s economic growth, (ii) how LNG supply sources could be more flexible and competitive to be accepted in the ASEAN LNG market, (iii) how technical and regulatory standards should be coordinated between individual economies so that future LNG cargoes could move freely between markets in response to dynamic developments in those markets. The study also looks into recent and expected developments of price formation in the Asian LNG markets to see what can be done to promote more suitable price benchmarks in the region. It also looks into financing and investment issues in each segment of the LNG value chain under the evolving LNG pricing developments.

Governmental policies will play a critical role in developing the Asian LNG markets by reducing investment risks in new LNG infrastructure in many emerging Asian countries. Financial support and export assistance measures will also play an essential role in Asia, particularly for countries that present high credit risks. Technical support will also help Asian countries with little experience in the LNG business as they embark on LNG imports. This research effort recognises that world LNG markets are heading towards more liquidity and transparency. Still, they have yet to mimic the open and extensive trading patterns prevalent in the global oil market and may never fully replicate.

For the Asian LNG market to flourish, new supply and demand centres need to grow. Also, the full range of market participants – from sellers and traders to final users such as power utilities – need to be confident that price discovery reflects supply and demand fundamentals. In this regard, the authors of this report, with great help from workshop session assistants and the ERIA secretariat, have continued their assessment of the role of destination restrictions as an impediment to arbitrage in the Asian LNG market.

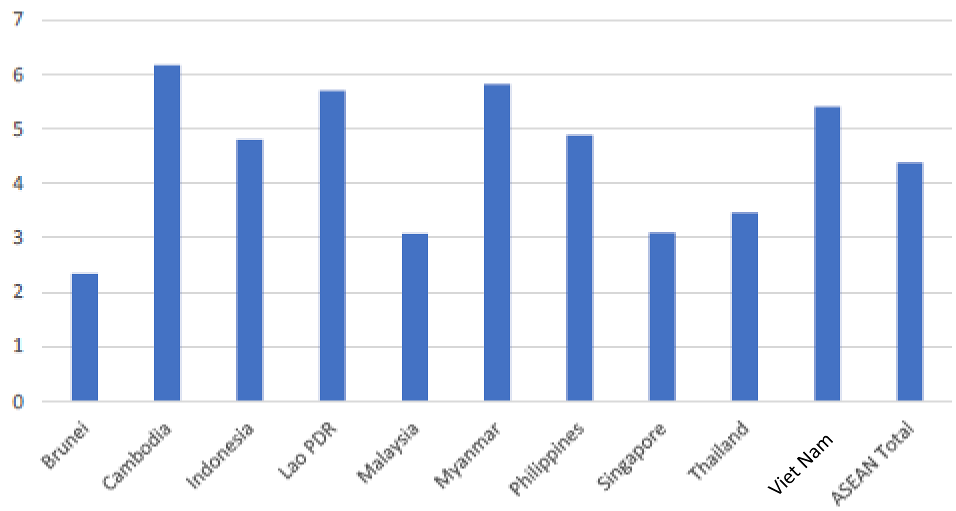
Chapter 1. Fast-growing LNG Market in the ASEAN Region

1.1. Natural Gas Outlook in the ASEAN Region

Macroeconomic outlook

The ASEAN Energy Outlook produced by ERIA forecasts the economy to continue to grow by 2050. Economic growth will increase by 4.3% from 2017 to 2050, with the gross domestic product (GDP) per capita increasing threefold – from US$4,880/person[1] to US$15,100/person in the same period. The population will also grow by 27%, from 636 million in 2017 to 809 million in 2050. ERIA classified GDP growth rates into three groups: low growth, middle growth, and high growth. The low-growth group comprises Brunei, Malaysia, Singapore, and Thailand; the middle-growth group, Indonesia and the Philippines; and the high-growth group consists of Cambodia, the Lao PDR, Myanmar, and Viet Nam.[2]

Figure 2.1. GDP Growth Rate Outlook, 2019–2050 (%)



Source: IEEJ–ERIA Workshop 'A Flexible LNG Market and Promotion of Investment in ASEAN-Under a New Era of Price Volatility and Energy Transition', ERIA's presentation material.

[1] Constant 2010 price and US dollars.

[2] IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', ERIA's presentation on the ASEAN Energy Outlook.

Table 1.1. ASEAN Countries, by GDP Growth Rate

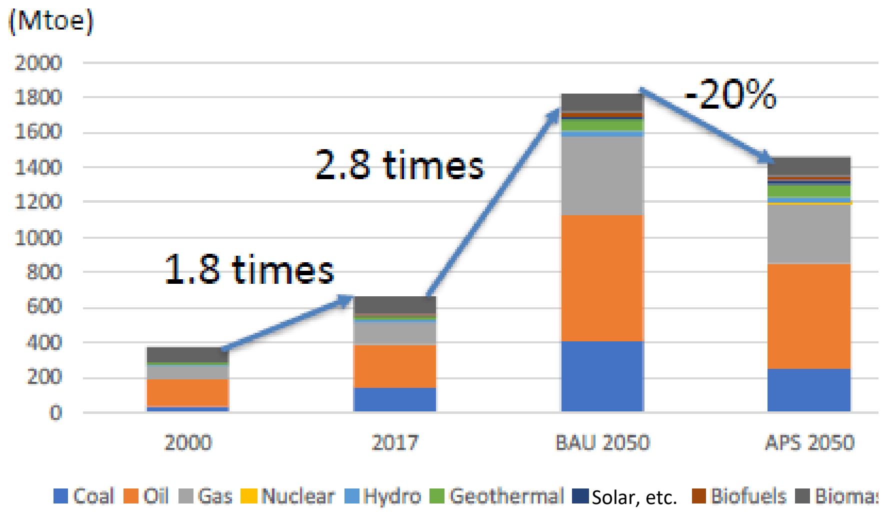
Low Growth	Middle Growth	High Growth
Brunei Malaysia Thailand Singapore	Indonesia Philippines	Cambodia Lao PDR Myanmar Viet Nam

Source: IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', ERIA's presentation on the ASEAN Energy Outlook.

Energy supply and demand outlook

Under the business-as-usual scenario (BAU), ERIA forecasted that ASEAN's total primary energy supply (TPES) would grow by 2.8 times, from 662 million tonnes of oil equivalent (Mtoe) in 2017 to 1,822 Mtoe in 2050, along with stable economic growth. Oil and gas would still be the dominant fuel with 3.3% and 3.8% growth. The share of coal would remain the same at 22%, while oil would increase from 37% to 40%, and gas from 20% to 25%. Fossil fuels would still play a dominant role, accounting for a significant share of 87% in 2050, but a lower figure of 82% under the alternative policy scenario (APS).[3] ASEAN would continuously rely on fossil fuels, especially coal and gas, for power generation and oil for transportation.

Figure 1.2. Total Primary Energy Supply Outlook in ASEAN, 2000–2050

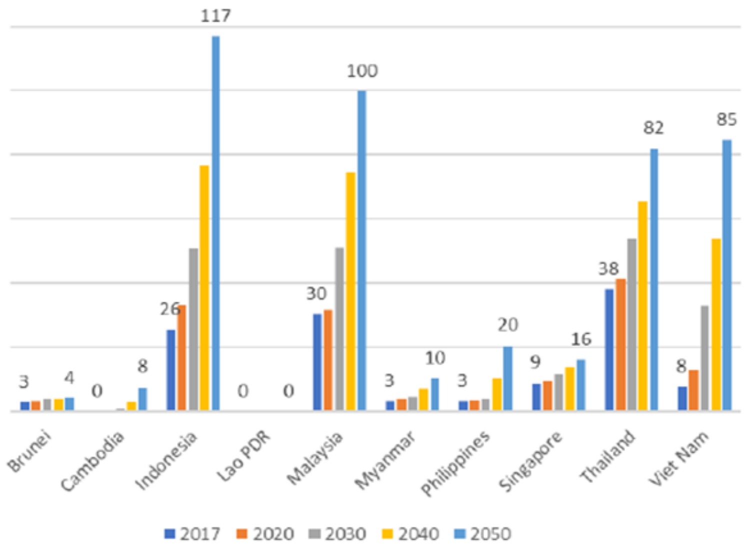


Source: IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', ERIA's presentation on ASEAN Energy Outlook.

[3] The APS includes more ambitious energy-saving targets and rapid advances in low-carbon energy technologies and renewable energy.

We will see a substantial jump in natural gas supply in some ASEAN countries: Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam. Especially in Indonesia, the gas supply will jump almost fivefold from 26 Mtoe in 2020 to 117 Mtoe in 2050. Cambodia and the Lao PDR, which have never consumed natural gas, are expected to use it for power generation and transportation.[4]

Figure 1.3. Natural Gas in TFES in ASEAN, by Country, 2000–2050 (Mtoe)

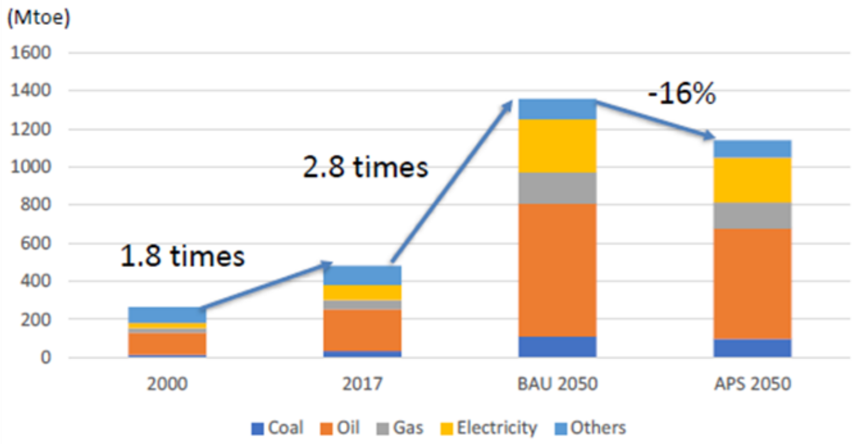


TFES = total final energy supply.
Source: IEEJ–IEF Workshop 'The Global Future of Natural Gas in a Low Carbon World – The future of natural gas in Southeast Asia', ERIA's presentation material.

ASEAN's total final energy consumption (TFEC) would grow by 2.8 times, from 480 Mtoe in 2017 to 1,138 Mtoe in 2050, along with stable economic growth. Oil and electricity would still be the dominant fuel, with electricity having the most significant increase of 3.8%, followed by gas 3.8%, and coal and oil 3.6%.[5]

[4] IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', ERIA's presentation on the ASEAN Energy Outlook.
[5] IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', ERIA's presentation on the ASEAN Energy Outlook.

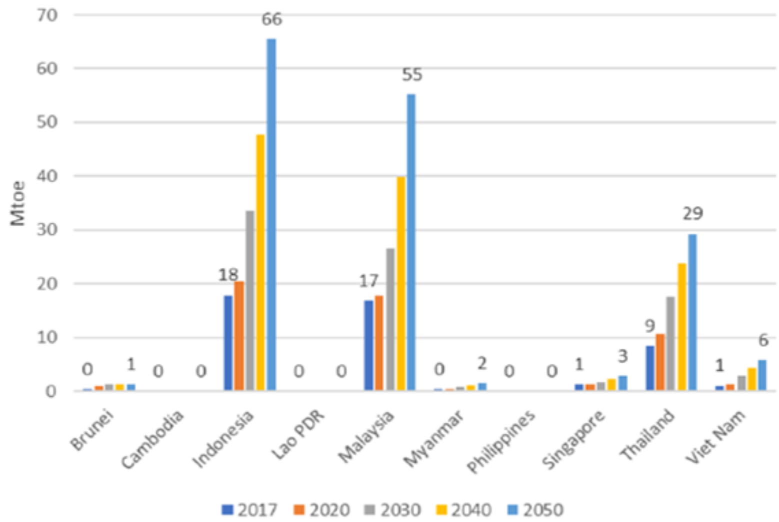
Figure 1.4. Total Final Energy Consumption in ASEAN, 2000–2050



Source: IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', ERIA's presentation on the ASEAN Energy Outlook.

The gas demand in the TFEC increases significantly in Indonesia, Malaysia, and Thailand due to the growing demand in the transport, industry, and commercial sectors. For example, the gas demand will grow 2.6-fold, from 18 Mtoe in 2017 to 66 Mtoe in 2050 in Indonesia. Viet Nam is also expected to introduce more gas use in the final energy consumption, which is mainly for the residential and commercial sectors.[6]

Figure 1.5. Natural Gas in TFEC in ASEAN, by Country, 2000–2050 (Mtoe)



TFEC = total final energy consumption.
Source: IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', ERIA's presentation on the ASEAN Energy Outlook.

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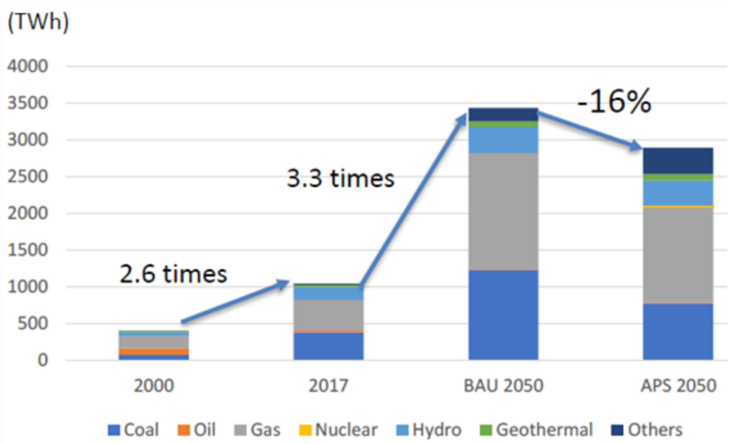
[6] IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', ERIA's presentation material.

Gas-to-power outlook

Power generation is forecasted to grow 3.3 times from 1,041 TWh in 2017 to 3,439 TWh in 2050, with gas being the dominant fuel. In 2050, the share of gas in power generation will grow to 46%, much higher than coal-fired power generation (36%).

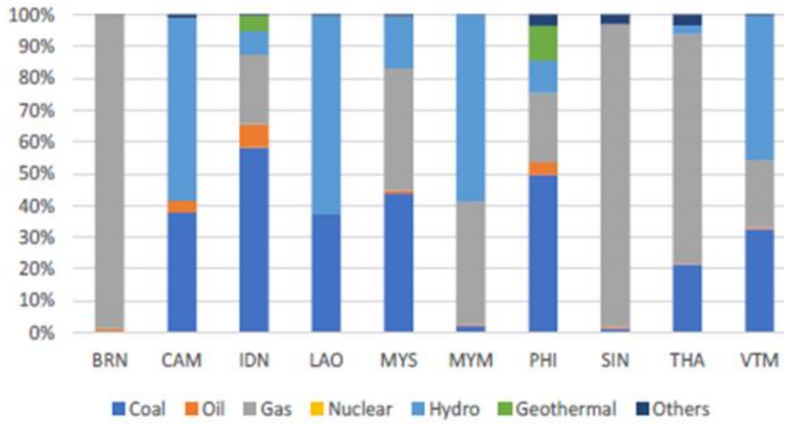
Figure 1.6. Power Generation Outlook in ASEAN Countries, 2000–2050 (Mtoe)



Source: IEEJ-ERIA Workshop ‘A Flexible LNG Market and Promotion of Investment in ASEAN-Under a New Era of Price Volatility and Energy Transition’, ERIA’s presentation material

Brunei, Singapore, and Thailand are gas-oriented countries, more than 80% of power generation relies on natural gas. Viet Nam is expected to also be gas-oriented in 2050 under the APS with almost 60% of gas-fired power generation.

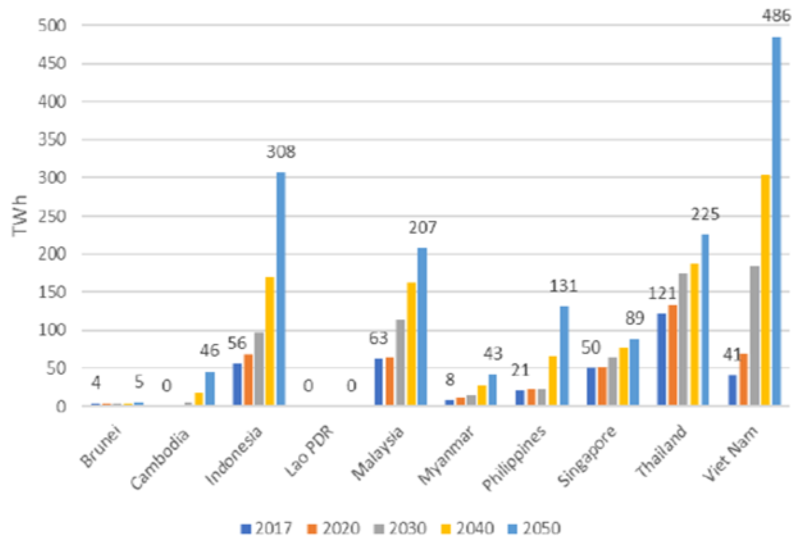
Figure 1.7. Power Generation Mix, by Country, 2017



Source: IEEJ–ERIA Workshop, ‘A Flexible LNG Market and Promotion of Investment in ASEAN-Under a New Era of Price Volatility and Energy Transition’, ERIA’s presentation on the ASEAN Energy Outlook.

Indonesia, Malaysia, the Philippines, Thailand and Viet Nam are expected to increase natural gas use in power generation in large amounts. Viet Nam's power sector is projected to shift drastically towards natural gas–fired generation. Gas-fired power generation is forecasted to grow by a hundredfold, from 41 TWh in 2020 to 486 TWh in 2050, due to the Viet Nam government's aggressive policy to promote gas in power generation. This trend is in line with ASEAN's transition to low-carbon economies.

Figure 1.8. Gas-Fired Power Generation in ASEAN, by Country, 2000–2050 (TWh)



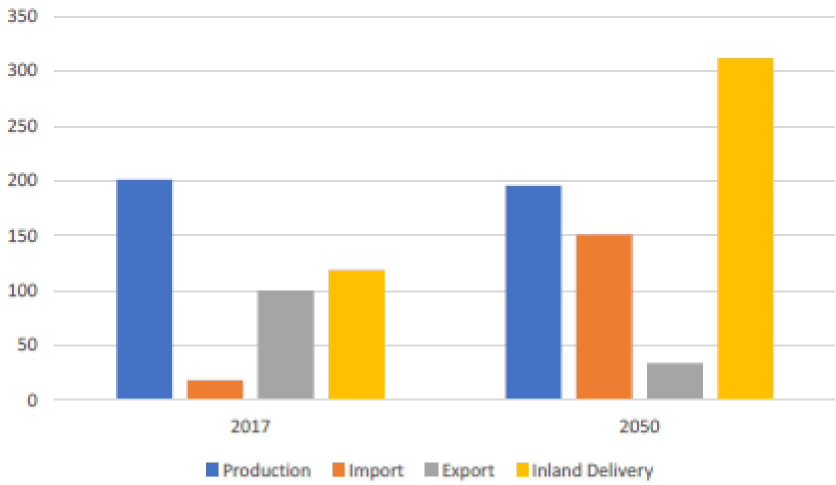
Source: IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', ERIA's presentation on the ASEAN Energy Outlook.

Natural gas trade outlook

Although the power generation mix entirely depends on the available energy resources of ASEAN countries, shifting to gas and renewable energy by 2050 has been a clear trend. As a result, gas and LNG imports will also increase remarkably to meet the growing demand for gas-fired power generation.

By 2050, most countries in the region will become net importers of LNG to meet the growing domestic gas demand in different locations. Some ASEAN gas-exporting countries, such as Malaysia and Indonesia, are also importing LNG at the same time.

Figure 1.9. Gas Trade Balance in ASEAN, 2017 and 2050 (Mtoe)



Source: IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', ERIA's presentation on the ASEAN Energy Outlook.

Furthermore, more countries will start importing LNG. In 2020, five ASEAN countries imported LNG: Thailand (5.6 million tonnes), Indonesia (2.8 million tonnes), Singapore (3.2 million tonnes), Malaysia (2.6 million tonnes), and Myanmar (0.18 million tonnes). These constituted 14.3 million tonnes of LNG imports in ASEAN, 4% of world LNG imports (GIIGNL, 2021). The Philippines and Viet Nam are also expected to start importing LNG soon, depending on the schedule of LNG-receiving terminals and associated infrastructure development.

To facilitate the growth of gas use in ASEAN, countries in the region will need to invest in the infrastructure, including LNG-receiving terminals, pipelines or virtual pipelines, regasification plants, transportation, and storage facilities because LNG cannot be imported and consumed without these unique facilities. The region has 13 cross-border pipelines, with a total length of 3,631 km connecting 6 countries and 9 LNG regasification terminals in 4 countries, with a combined total capacity of around 38.75 million tonnes per annum (mtpa).[7]

Natural gas investment outlook

According to the IEEJ *Outlook 2021* (IEEJ, 2021), the natural gas investment will maintain the expansion momentum, leading production, transport, and liquefaction capacity to increase at a stable pace. Resource development will account for US$9.7 trillion, or 80% of the total natural gas investment of US$12.2 trillion through 2050. In addition, US$1.8 trillion will be required in LNG-related equipment, including liquefaction facilities and tankers (IEEJ, 2021).

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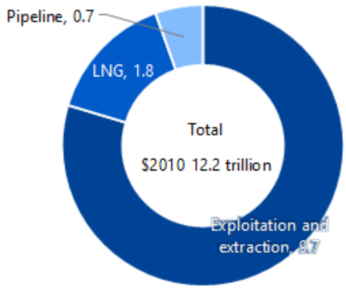
[7] IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', ASCOPE's presentation material.

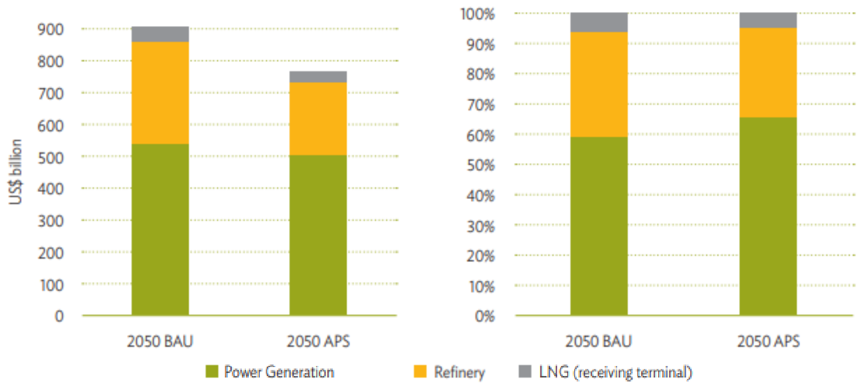
Figure 1.10. Global Natural Gas Investment in Reference Scenario, 2019–2050



Source: IEEJ (2021).

According to the ERIA energy outlook published in March 2021, the investment in LNG-receiving terminals in the ASEAN region under BAU is around US$52 billion and US$34 billion under the APS. Thus, the combined investments of LNG-receiving terminals, refinery, and power generation in the APS are 16% less than BAU. However, the investment in LNG-receiving terminals remains at around 5% of total investments, indicating that ASEAN will still need fossil fuel in the APS. Gas-fired power generation will be crucial.

Figure 1.11. Global Natural Gas Investment in the Reference Scenario, 2019–2050



Source: ERIA (2021).

1.2. The Role of Natural Gas in ASEAN

Gas complements renewables towards a cleaner energy system

ASEAN is a growing LNG and gas market. The LNG import in Southeast Asia grew by 32% between 2010 and 2020 and is expected to continue growing as gas demand grows. The prospect of using natural gas in the region as a transition fuel to a cleaner energy system is optimistic.[8]

Reducing GHG emissions has become a common goal worldwide. ASEAN countries also try to reduce fossil fuel consumption and invest more in renewable energy like solar and wind to reduce their GHG emissions. However, as coal is currently still the dominant fuel in the ASEAN region and the member economies prefer to utilise the existing infrastructure for stable energy supply, it will take time to phase out these coal-fired power plants. However, despite coal being the dominant fuel in the region, building a new coal-fired power plant has become increasingly difficult even though no policy restricts coal consumption.

For example, in Thailand, a new coal-fired power plant approved by the government's power development plan (PDP) was forced to cancel the construction because of the protests by residents. Another case is that Japanese environmental organisations urged Mitsubishi Corporation to withdraw from a coal-fired power plant investment in Viet Nam.

On renewables, at the Energy Ministers Meeting of ASEAN countries, renewable energy in power generation and installed generation capacity was targeted at 23% and 35%, respectively, by 2025. However, the actual development of such renewable power generation takes time. Therefore, natural gas will play an essential role as a transition fuel and complement the intermittent renewables towards the energy transition to a low-carbon system for ASEAN countries.

For instance, Thailand's long-term PDP developed in 2018 already sees a bullish future of natural gas under three important concepts: security, economies, and environment. The plan forecasts that by 2037 natural gas will maintain a share of about 53% from 60% in 2018.

Infrastructure is the key to gas growth

Infrastructure development is the key underpinning potential LNG demand growth and promoting natural gas use in ASEAN. If sufficient infrastructure and related facilities are developed, the price volatility of natural gas can also be managed.

However, LNG-related investment is capital-intensive and involves many challenges such as investment environment, regulatory framework, LNG market demand, and electricity tariff. It is even more challenging for a country inexperienced in LNG imports like Viet Nam and the Philippines. This report explores the LNG infrastructure development in Indonesia, Myanmar, the Philippines, and Viet Nam that have just started or are about to start importing LNG.

Potential of small-scale LNG

In addition to LNG regasification terminals, some areas, such as remote islands, have no access to big infrastructure and natural gas pipeline networks. Therefore the ASEAN Council on Petroleum (ASCOPE) conducted a small-scale LNG and LNG bunkering study to explore

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[8] IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', Petronas's presentation material.

opportunities (ASCOPE, 2020). For example, Indonesia has a high potential of replacing the high cost of diesel generator sets in remote islands with limited connectivity.

One of Pertamina's assignments is to supply around 55 small-scale gas power plants across the country, especially in the eastern part. By 2030, ASCOPE forecasts that small-scale LNG demand in the ASEAN region will be around 10–16 mtpa: Indonesia 4.5 mtpa, the Philippines 2.3 mtpa, and Thailand 1.8 mtpa.

As for the potential of small-scale LNG for LNG bunkering in countries with many container ships to deliver cargoes, such as Indonesia, Malaysia, Singapore, and Thailand, ASCOPE forecasts demand to reach 3–5 mtpa in 2030.

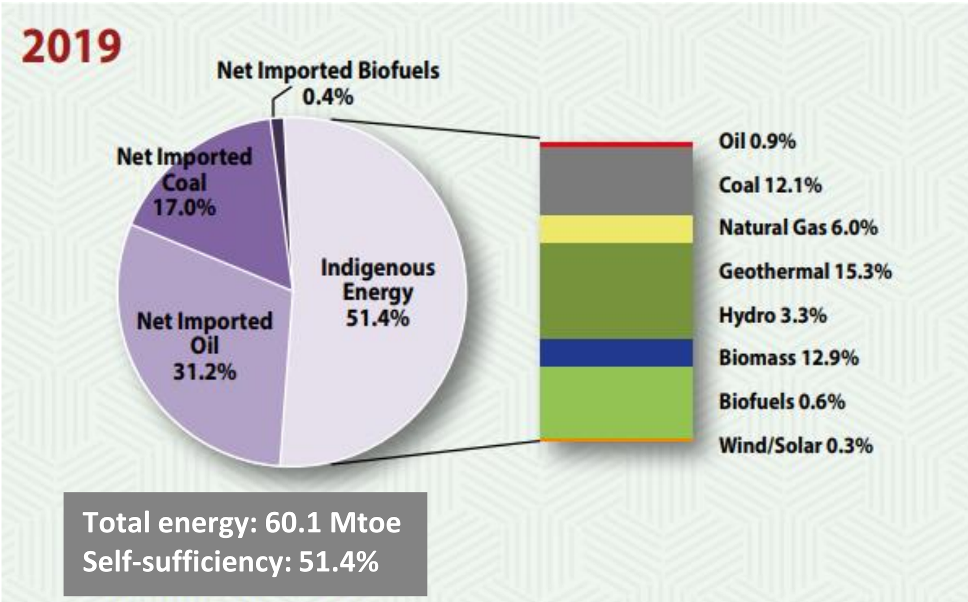
Chapter 2. LNG Infrastructure Development and Financing in Select ASEAN Countries: The Philippines, Viet Nam, Indonesia, and Myanmar

2.1. The Philippines

Background

The Philippines's TPES was 60.1 Mtoe in 2019 (DOE, 2019). Half of the supply is indigenous energy, of which geothermal (15.3%), biomass (12.9%), and natural gas (6.0%) accounted for the largest share of indigenous supply. Oil (31.2%), coal (17.0), and biofuels (0.4%) were the three imported energy, which made the country's self-sufficiency rate 51.4% in 2019.

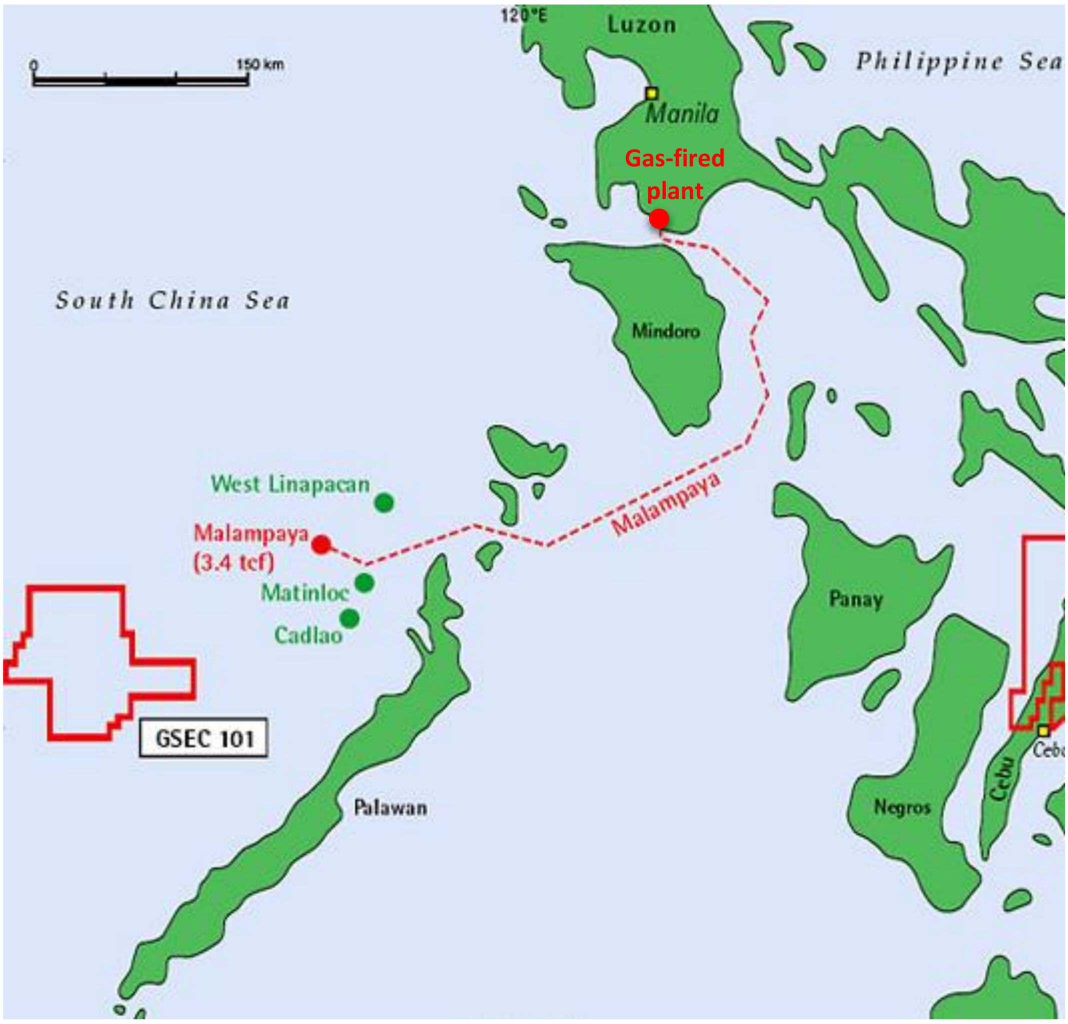
Figure 2.1. The Philippines's Primary Energy Supply Mix, 2019



Source: DOE (2019).

The Philippines has always been self-sufficient in natural gas since 1994. Its gas production increased significantly in 2001 when the offshore Malampaya gas field, the largest gas field in the country, started production. The field is located 80 km off the coast of Palawan Island, with proven reserves of about 2.7 trillion cubic feet (Tcf) of natural gas. The Malampaya gas field started commercial operation in June 2002 and began to supply gas to gas-fired power plants in Batangas. The field is scheduled to produce 146 billion cubic feet (Bcf) of gas per year (DOE, n.d.[a]). However, the DOE estimated that the known gas reserves would be depleted by 2024 (DOE, 2017a). The other two are San Antonio and Libertad gas fields. The San Antonio gas field was the first natural gas discovery in the country. It was located in Echague, Isabela, and was developed as a demonstration project of gas production with proven reserves of 2.7 Bcf. The field started commissioning in 1994 and ended in 2008 because of depletion (DOE, n.d.[b]). The Libertad gas field is southeast of Bogo town proper in northern Cebu, producing only less than 1% of the total gas supply in the country (DOE, n.d.[c]).

Figure 2.2. Malampaya Gas Pipeline Route to Gas-Fired Power Plant



Source: US Securities and Exchange Commission (2005).

The Philippines started producing natural gas in 1994. The production increased significantly in 2002 when the Malampaya gas field began commercial production. The power sector consumed 100% of the natural gas until 2004; the industry sector has consumed 0.5% to 2.4% of gas since 2005. The power sector is still the main consumer of natural gas in the country.

Table 2.1. The Philippines's Natural Gas Production and Consumption, by Sector, 1994–2020

Year	Production (Mmscf)	Consumption (Mmscf)			
		Power	Industrial	Transport	Total
1994	195	195	0	0	195
1995	188	188	0	0	188
1996	318	318	0	0	318
1997	193	193	0	0	193
1998	329	329	0	0	329
1999	253	253	0	0	253
2000	376	376	0	0	376
2001	4,951	4,951	0	0	4,951
2002	62,205	58,120	0	0	58,120
2003	94,807	87,423	0	0	87,423
2004	87,557	83,959	0	0	83,959
2005	115,966	110,217	525	0	110,742
2006	108,606	104,229	2,193	0	106,422
2007	130,211	124,103	3,316	0	127,419
2008	137,073	129,044	2,932	15	131,990
2009	138,030	131,433	3,019	18	134,470
2010	130,008	121,943	3,044	15	125,002
2011	140,368	133,732	3,288	47	137,066
2012	134,563	127,616	2,473	51	130,141
2013	123,944	116,549	2,665	35	119,250
2014	130,351	122,305	3,302	4	125,611
2015	122,541	115,788	2,138	0	117,926
2016	140,516	132,350	2,782	0	135,132
2017	139,209	132,256	2,255	0	134,511
2018	150,804	142,723	2,550	0	145,273
2019	155,495	146,365	2,642	0	149,007
2020	141,732	132,009	1,597	0	133,606

Source: DOE (2021a).

In terms of power generation, coal is the largest fuel source, accounting for more than half of total power generation in the country since 2017. Natural gas and geothermal are the second and third sources, with 21% and 10% shares in 2019. The gas share of total power generation peaked at 30% in 2011 and declined to 22% in 2016. It has remained stable ever since. The installed capacity of natural gas was 3,453 MW in 2019, accounting for 14% of the country's total installed capacity, of which 3,200 MW came from the Malampaya gas field.

Table 2.2. The Philippines's Power Generation, by Source, 2009–2019

Unit: GWh	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coal	16.476	23.301	25.342	28.265	32.081	33.054	36.686	43.303	46.847	51.932	57.890
Oil	5.381	7.101	3.398	4.254	4.491	5.708	5.886	5.661	3.787	3.173	3.752
Natural Gas	19.887	19.518	20.591	19.642	18.791	18.690	18.878	19.854	20.547	21.334	22.354
Renewable Energy	20.191	17.823	19.845	20.762	19.903	19.810	20.963	21.979	23.189	23.326	22.044
Geothermal	10.324	9.929	9.942	10.250	9.605	10.308	11.044	11.070	10.270	10.435	10.691
Hydro	9.788	7.803	9.698	10.252	10.019	9.137	8.665	8.111	9.611	9.384	8.025
Biomass	14	27	115	183	212	196	367	726	1.013	1.105	1.040
Solar	1	1	1	1	1	17	139	1.097	1.201	1.249	1.246
Wind	64	62	88	75	66	152	748	975	1.094	1.153	1.042
Total	61.934	67.743	69.176	72.922	75.266	77.261	82.413	90.798	94.370	99.765	106.041

Source: https://www.doe.gov.ph/sites/default/files/pdf/energy_statistics/2019-key-energy-statistics.pdf

Unit: GWh	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coal	27%	34%	37%	39%	43%	43%	45%	48%	50%	52%	55%
Oil	9%	10%	5%	6%	6%	7%	7%	6%	4%	3%	4%
Natural Gas	32%	29%	30%	27%	25%	24%	23%	22%	22%	21%	21%
Renewable Energy	33%	26%	29%	28%	26%	26%	25%	24%	25%	23%	21%
Geothermal	17%	15%	14%	14%	13%	13%	13%	12%	11%	10%	10%
Hydro	16%	12%	14%	14%	13%	12%	11%	9%	10%	9%	8%
Biomass	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%
Solar	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%
Wind	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: DOE (2019).

Table 2.3. The Philippines's Installed Capacity, by Source, 2009–2019

Unit: MW	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Coal	4,277	4,867	4,917	5,568	5,568	5,708	5,963	7,419	8,049	8,844	10,417
Oil	3,193	3,193	2,994	3,074	3,353	3,476	3,610	3,616	4,153	4,292	4,262
Natural gas	2,831	2,861	2,861	2,862	2,862	2,862	2,862	3,431	3,447	3,453	3,453
Renewable energy	5,309	5,437	5,391	5,521	5,541	5,898	6,330	6,958	7,079	7,227	7,399
Geothermal	1,953	1,966	1,783	1,848	1,868	1,918	1,917	1,916	1,916	1,944	1,928
Hydro	3,291	3,400	3,491	3,521	3,521	3,543	3,600	3,618	3,627	3,701	3,760
Wind	33	33	33	33	33	283	427	427	427	427	427
Solar	1	1	1	1	1	23	165	765	885	896	921
Biomass	30	38	83	119	119	131	221	233	224	258	363
Total	15,610	16,358	16,162	17,025	17,325	17,944	18,765	21,423	22,728	23,815	25,531

Source: DOE (2019).

Drivers of LNG Imports

The Malampaya gas field currently supplies 3,200 MW gas-fired power plants. However, the gas supply is depleting and becoming less reliable. The industry has revealed that there is always insufficient gas supply to the existing power plants, which puts the 3,200 MW of installed capacity in the Luzon grid at risk.

While no other domestic natural gas resources are enough to replace Malampaya's gas supply, the government promotes natural gas as an environment-friendly, secure, stable, and economically efficient energy source. There is an urgent need to attract more investments in the downstream LNG industry and import LNG for the existing gas-fired power plants in the Luzon grid. The country cannot yet access the international LNG market as there are no existing or operational LNG import facilities.

Regulatory framework support for LNG infrastructure development and investment

The government has already prepared the necessary policies as indigenous gas supply from Malampaya approaches depletion by 2024. DOE has stated that it is a priority to ensure a secure and stable energy supply by diversifying the energy mix through LNG (DOE, 2017a). The regulatory framework for LNG investment and development is as follows:

Philippine National Standard, 2016

The Philippine National Standard was promulgated on 20 June 2016. It provides the quality specifications for natural gas. The standards specify the requirements for all the natural gas commercially sold in the country (DOE, 2016).

Downstream Natural Gas Regulation, 2017
DOE issued the Downstream Natural Gas Regulation in 2017 to provide a regulatory framework (DOE, 2017b) for the downstream natural gas industry and transparent guidelines for investors in the Philippines, including:

- industry compliance to policies, rules, standards, and best practices on siting, design, construction, expansion, modification, and operation and maintenance of any gas-related projects;
- industry compliance on importation of LNG, supply, and transport of natural gas;
- providing for the legal, technical, and financial documentary requirements, application procedure, evaluation process, criteria, and permits.

Executive Order No. 30 - Creating the Energy Investment Coordinating Council to Streamline the Regulatory Procedures Affecting Energy Projects, 2017
This executive order provides for energy projects amounting to at least US$70 million to be classified as Energy Projects of National Significance (EPNS). Also, it mandates the streamlining of the permitting process of all government agencies under the Energy Investment Coordinating Council to act on proposals within 30 days if the project is considered an EPNS; otherwise, the proposal is deemed approved (DOE, 2017c).

Republic Act 11032 - Ease of Doing Business and Efficient Service Delivery Act, 2018
To further facilitate the LNG investment, the Ease of Doing Business and Efficient Service Delivery Act set a standardised deadline for government transactions:[9]

- 3 days – simple transactions of business entities
- 7 days – more substantial transactions
- 20 days – highly technical transactions

Infrastructure development of LNG imports

The permitting process comprises three stages: (i) notice to proceed (NTP); (ii) permit to construct, expand, rehabilitate, and modify; and (iii) permit to operate and maintain. There are currently seven proposed LNG receiving terminal projects.

[9] IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', Philippines' presentation material, 2021.

Table 2.4. Status of Proposed LNG Terminal Projects in the Philippines

Proponent	Partner Company	Project	Location	Capacity	Estimated COD[a]	Target Market	Application Status
FGEN LNG Corporation (80%)	Tokyo Gas (20%)	FSRU and LNG Terminal	Barangays Sta. Clara, Sta. Rita Aplaya, and Bolbokin Batangas City	5.26 mtpa	Q3 2022	1) Existing gas-fired power plants, namely, 1,000 MW Sta. Rita; 500 MW San Lorenzo; 414 MW San Gabriel; and 97 MW Avion. 2) Proposed 600 MW Sta. Maria and 600 MW St. Joseph power plants.	Permit to Construct on 23 September 2020
Excelerate Energy L.P.	Topline Energy & Power Dev Corporation (Filipino) (currently planned for 30%)	FSRU and LNG Terminal	About 9.5 km offshore in Bay of Batangas	4.4 mtpa	Q3 2022	EGCO Group (small-scale LNG break bulk capacity) and Third Party Access model (transparent and non-discriminatory open access model)	1) Notice to Proceed (NTP) issued on 20 September 2019 2) NTP extension letter (6 months) issued on 27 May 2020 3) NTP extension (3 months) due to force majeure

Batangas Clean Energy, Inc (51%)	LCT Energy and Resources Inc. (Filipino) (49%)	LNG Storage and Regasification Terminal	Barangay Pinamucan-Ibaba, Batangas City	3 mtpa	Q4 2025	Self-owned gas-fired power plant (1,100 MW) and anticipated gas demand from potential users located near the project site: 1) JG Summit Petrochemical Plant 2) Tanduay Distillers	1) NTP issued on 20 March 2020 2) NTP extension of 9 months (6 months plus 3 months due to force majeure or COVID-19 quarantine)
Energy World Gas Operations Philippines Inc. (100%)	None	LNG Storage and Regasification Terminal	Barangay Ibabang Polo, Pagbilao Grande Island, Quezon Province	3 mtpa	Q4 2022	Self-owned gas-fired power plant (650 MW) in Quezon province in 2021	Permit to Construct issued on 21 December 2018, valid for 2 years
Atlantic Gulf & Pacific Company of Manila, Inc. (AG&P)	Osaka Gas	FSU and Onshore Regasification	Barangay Ilijan and Dela Paz, Batangas City	3 mtpa	Q2 2022	1,200 MW Ilijan Power Plant in Barangay Ilijan, Batangas City	NTP issued on 24 February 2021

Shell Energy Philippines, Inc. (SEP) (100%)	None	FSRU	Tabangao, Batangas City	3 mtpa	Q3 2022	1) AC Energy proposed gas-fired power projects in Mariveles and Subic 2) JG Summit Petrochemical Corp for 81 MW existing power plant and 30–40 MW expansion	NTP issued on 16 Mar 2021
Vires Energy Corporation (VEC)	None	FSRU and LNG storage and regasification terminal	1.6 kilometres from the south-eastern coastline of Batangas Bay in Barangay Simlong, Batangas City	3 mtpa	Q1 2023	a 500 MW floating power plant	Notice to Proceed (NTP) issued on 22 April 2021

[a] Commercial operation date.
FSU = floating storage unit, FSRU = floating storage regasification unit.
Source: IEEJ–ERIA Workshop, ‘A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition’, Philippines’s DOE presentation material, 2021.

DOE has stated that the LNG infrastructure sector is a private sector–led and –driven initiative, and the government is dependent on the private sector (*Business World*, 2021). As of 13 May 2021, five LNG terminal projects targeted for operations from 2022 to 2025 received an NTP. Two projects proposed by FGEN LNG and Energy World Gas Operations Philippines Inc. received permits to construct, which is the second stage of the permitting process. DOE mentioned that financial viability is one of the main criteria used to evaluate the application, and the government supports the project to proceed if it is financially viable.

Also worth noting is that FGEN LNG's original plan was to construct an onshore LNG terminal featuring a 200,000–cubic metre (m^3) onshore storage tank. But after considering the costs and time frame, FGEN LNG decided to pivot towards an interim offshore LNG terminal, which could be ready to accept a floating storage regasification unit (FSRU) in 2022. FGEN LNG is only required to modify the existing jetty without demolishing it with the interim offshore terminal. Furthermore, in April 2021, First Gen Corporation announced that it had selected BW Paris of BW Group as its FSRU, which has an LNG storage capacity of 162,400 m^3. The lease is for 5 years, and it is expected to receive the first cargo in the fourth quarter of 2022.

LNG outlook for the country

The Philippines desires that the upcoming LNG imports will help the country attain gas supply security for power generation and other potential natural gas applications in the industry, commercial, residential, and transport sectors.

In March 2021, DOE announced to promote the Philippines as an LNG hub that will ultimately serve the energy needs of the country and the Southeast Asian region. The government also called LNG terminal investors to address a common goal – expanding the Philippines's LNG and clean energy industries (DOE, 2021b).

Lastly, if all seven proposed LNG projects were completed and fully utilised, the total LNG receiving capacity in the Philippines would reach 24.66 mtpa.

2.2. Viet Nam

Background

Viet Nam's TPES was 83.46 Mtoe in 2018. Coal accounts for the largest share of 44%, followed by oil (2%) and natural gas (10%).[10] The total installed capacity in 2020 was 69.2 GW; hydro (30%) and coal (29%) are the largest sources, followed by oil and renewables (26%) and oil and gas (13%). In the same year, coal contributed half of the country's power generation, followed by hydro (30%) and oil and gas (14%).[11]

Like the Philippines, Viet Nam is self-sufficient in natural gas supply and heavily relies on coal. Five operating natural gas pipeline systems are currently operating (Table 2.5): (i) Cuu Long

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[10] IEA, 'Viet Nam', https://www.iea.org/countries/viet-nam#reports

[11] IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', Viet Nam's presentation material, 2021.

Basin Pipeline System (2 billion cubic metres [Bcm]), (ii) Nam Con Son Gas Pipeline System (7 Bcm), (iii) Phu My–Nhon Trach Pipeline System (phase 1: 2 Bcm, phase 2: 3.8 Bcm), (iv) Phu My–My Xuan–Go Dau Low-Pressure Gas Pipeline System (1 Bcm); and (v) PM3 CAA–Ca Mau Gas Pipeline System (2 Bcm).[12]

Table 2.5. Viet Nam's Natural Gas Pipeline System

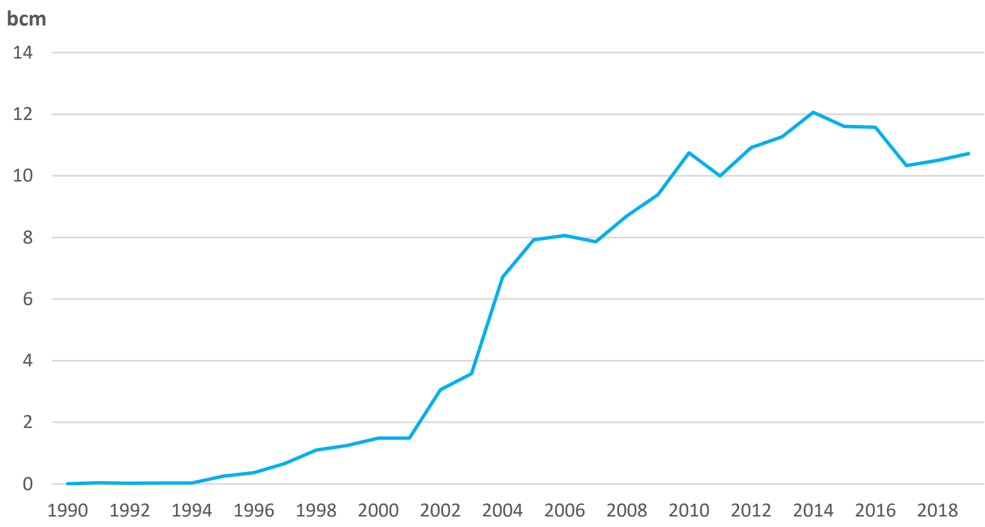
Gas Pipeline	Capacity	Transport Destination
Cuu Long Basin Pipeline System	2 Bcm	Ba Ria, Phu My power plants, Phu My Fertilizer Plant, and consumers
Nam Con Son Gas Pipeline System	7 Bcm	Nam Con Son Gas Processing Plant
Phu My–Nhon Trach Pipeline System	2 Bcm (phase 1) 3.8 Bcm (phase 2)	Power plants in Nhon Trach, Hiep Phuoc, and consumers along the pipeline
Phu My–My Xuan–Go Dau Low-Pressure Gas Pipeline System	1 Bcm	Consumers in Phu My–My Xuan–Go Dau Industrial Parks
PM3 CAA–Ca Mau Gas Pipeline System	2 Bcm	Power Plants of Ca Mau No. 1 and No. 2

Source: PVN, Major Projects, https://www.pvn.vn/sites/en/Pages/detailv4.aspx?NewsID=4c4ab3a0-8568-4a12-af85-6e1857a2111a (accessed 17 September 2021).

Viet Nam's natural gas production has increased significantly since 2001, growing from 1.48 Bcm to around 12 Bcm in 2014 and slightly declining to 11 Bcm in 2019 (see Figure 2.3.).[13] The majority of natural gas supply is consumed in the power sector. In 2018, 87% of the gas supply is consumed in power generation (APERC, 2021).

[12] PVN, Gas industry major projects, http://www.pvn.vn/sites/en/Pages/detailv4.aspx?NewsID=4c4ab3a0-8568-4a12-af85-6e1857a2111a?

Figure 2.3. Viet Nam's Natural Gas Production



Source: Compiled by IEEJ with IEA's data (IEA, Viet Nam, 2021, https://www.iea.org/countries/viet-nam#reports)

As a developing economy, the country's population and economy have been growing fast since 2000. Its population grew by 21%, from 80 million in 2000 to 96 million in 2019. Its GDP grew by more than seven times from US$31 billion in 2000 to US$262 billion in 2019.[14] Parallel with the fast economic growth, energy demand also grows significantly, especially in the power sector. Power generation grew almost ninefold from 23 TWh in 2000 to 227 TWh in 2018. The trend is forecasted to continue.[15]

Viet Nam's master plan for gas industry development and import target

Again, like the Philippines, the Viet Nam government has forecasted that the natural gas resource will be depleted in the next decade, dropping from a peak of about 19 Bcm to around 10 Bcm in 2030 (Figure 2.4).[16]

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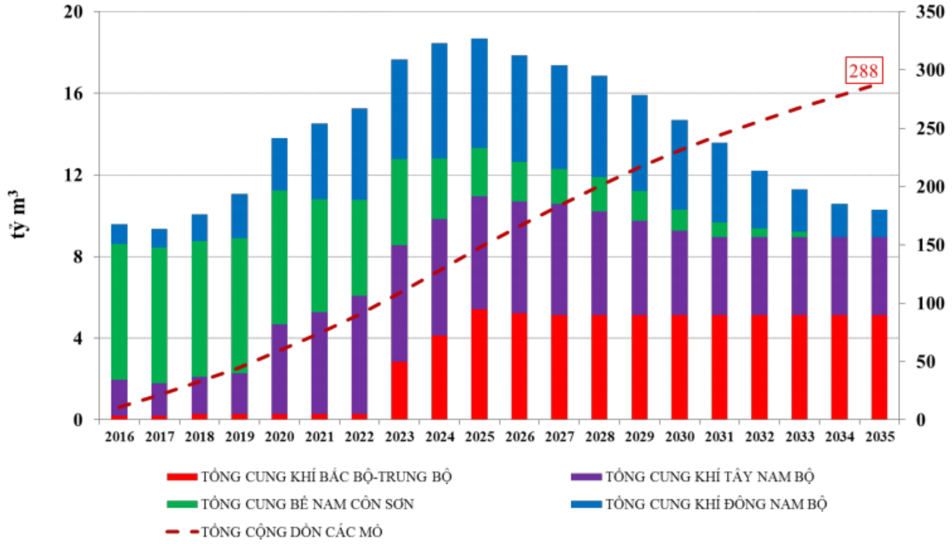
[14] World Bank, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=VN.
[15] IEA, Viet Nam, https://www.iea.org/countries/viet-nam#reports.
[16] MOIT, 'Vietnam Gas Industry Master Plan', http://www.jccp.or.jp/country/docs/4_CPJ-5-18_MOIT.pdf (accessed 10 September 2021).

Figure 2.4. Viet Nam's Natural Gas Production Forecast, 2016–2035



Source: MOIT , 'Vietnam Gas Industry Master Plan, http://www.jccp.or.jp/country/docs/4_CPJ-5-18_MOIT.pdf (accessed 10 September 2021).

Recognising the important role of gas in the country, the government aims to develop other domestic gas resources and import LNG. For domestic development, under the government's direction, the Viet Nam Oil and Gas Group, Petro Vietnam (PVN), and PV Gas, a major subsidiary of the PVN, are developing two major gas projects to deliver 5–7 Bcm of additional gas supply per year from Block B, Ca Voi Xanh field to southern and central markets (APERC, 2021). These two projects are expected to produce gas in 2021 and 2023, respectively (Australian Government, 2019).

Besides, the government announced the master plan for gas industry development in 2016, planning to import LNG in 2021. The master plan set a target to import around 5 million tonnes of LNG by 2025, 10 million tonnes by 2030, and 15 million tonnes by 2035 (accounting for about 1.6% of total world LNG imports). The plan also forecasted that gas demand in Viet Nam would reach 11–15 Bcm per year in 2016–2020, 13–27 Bcm per year in 2021–2025, and 23–31 Bcm per year in 2026–2035 (MOIT, n.d.).

LNG terminal development

To achieve the LNG import target, the government encourages developing LNG terminal systems and related facilities. In 2021–2025, it plans to build three to four LNG terminals with an estimated capacity of 1–3 mtpa for each terminal mainly in southern Viet Nam. For 2026–2035, the government plans to build five to six LNG terminals with an estimated 3 mtpa for each terminal (MOIT, n.d.).

Two LNG terminals will be operating commercially soon: the Hai Linh LNG terminal and the Thi Vai LNG terminal.

The planned Hai Linh LNG terminal is owned by Vietnamese oil company Hai Linh Co. Ltd. and located onshore in the southern province of Ba Ria-Vung Tau. Construction is completed, and commercial operation is expected to start in 2021 with an initial capacity of 2–3 mtpa. It will have the potential to expand to 6 mtpa. After commercial operations in 2021, the Hai Linh LNG terminal, the first LNG terminal in Viet Nam, will supply natural gas to its Hiep Phuoc thermal power plant in Ho Chi Minh City. Hai Linh Co. Ltd. also talks about supplying gas to the state-owned power company Vietnam Electricity or EVN's power plants (S&P Global, 2020).

The state-owned PV Gas and its partners in the coastal area southeast of Ho Chi Minh City own the planned Thi Vai LNG terminal. Construction began in 2019 and is expected to be completed in October 2022. It will have a 1 mtpa capacity in the first phase in 2022, with the potential to rise to 3 mtpa in 2023 in the second phase (GIIGNL, 2021). The media reports that PV Gas signed master sales purchase agreements with Shell Singapore and Gazprom Marketing and Trading Singapore for LNG supply (Pham, 2020a).

The construction of the Son My terminal in Binh Thuan province is planned to start in 2021 (APERC, 2019a). The Bac Lieu project is also scheduled to start construction in 2021, and the completion is slated for 2024. It will be the first large-scale LNG project developed by a foreign investor, Delta Offshore Energy.

As domestic gas production declines, LNG demand is forecasted to surge in 2021–2022 when the power shortage is more severe in the south (i.e. Ho Chi Min City) and the domestic gas supply starts to be exhausted. In addition to new power plants intended to use LNG are those that previously planned to use coal but would like to switch to natural gas. Examples are the Long An (*Vietnam Investment Review*, 2020) and Vung Ang 3 power plants (Vietnam Energy Online, 2020).

Table 2.6. LNG Terminal in Viet Nam (including Planned Projects)

LNG Terminal		Capacity (mtpa)	COD[a]	Investor	LNG Import Source	Status
Hai Linh		2–3	2021	Hai Linh	N.A.	Completed construction, for operation soon
	(Phase 2)	6	N.A.		N.A.	Planning
Thi Vai		1	2022	PV Gas	N.A.	Under construction
	(Phase 2)	2	2023		N.A.	Planning
South West LNG (Ca Mau)		1	2022–2025	N.A.	N.A.	Planning
	(Phase 2)	2	After 2025	N.A.	N.A.	Planning
South East LNG (Tien Giang)		4–6	2022–2025	N.A.	N.A.	Planning
Thai Binh (FSRU)		0.2–0.5	2026–2030	N.A.	N.A.	Planning
North LNG (Hai Phong)		1–3	2030–2035	N.A.	N.A.	Planning
Khanh Hoa LNG		3	2030–2035	N.A.	N.A.	Planning
Son My, Binh Thuan		1–3	2023–2025	PV Gas, Shell, AES	N.A.	Planning
	(Phase 2)	3	2027–2030		N.A.	Planning

	(Phase 3)	3	2031–2035		N.A.	Planning
Ninh Thuan		6	N.A.	Gulf Energy	N.A.	Planning
Bac Lieu (FSRU)		3	2024	Delta Offshore Energy	United States	Planning
Thua Thien Chan May LNG		2.87	2024	Chan May LNG	United States	Planning
Cai Mep Ha		9	2023	T&T Group, Gen X Energy	N.A.	Planning
	(Phase 2)		2026		N.A.	Planning
	(Phase 3)		2030		N.A.	Planning

[a] Commercial operation date.

Source: IEEJ analysis.

Draft PDP 8 and LNG-to-Power project development

Since most natural gas is used to generate power, the power development plan is the anchor of LNG development as LNG-based power would determine investment direction. In March 2021, the Ministry of Industry and Trade of Vietnam released the draft national power development plan for 2021–2030, with a vision to 2045 (hereafter Draft PDP 8).

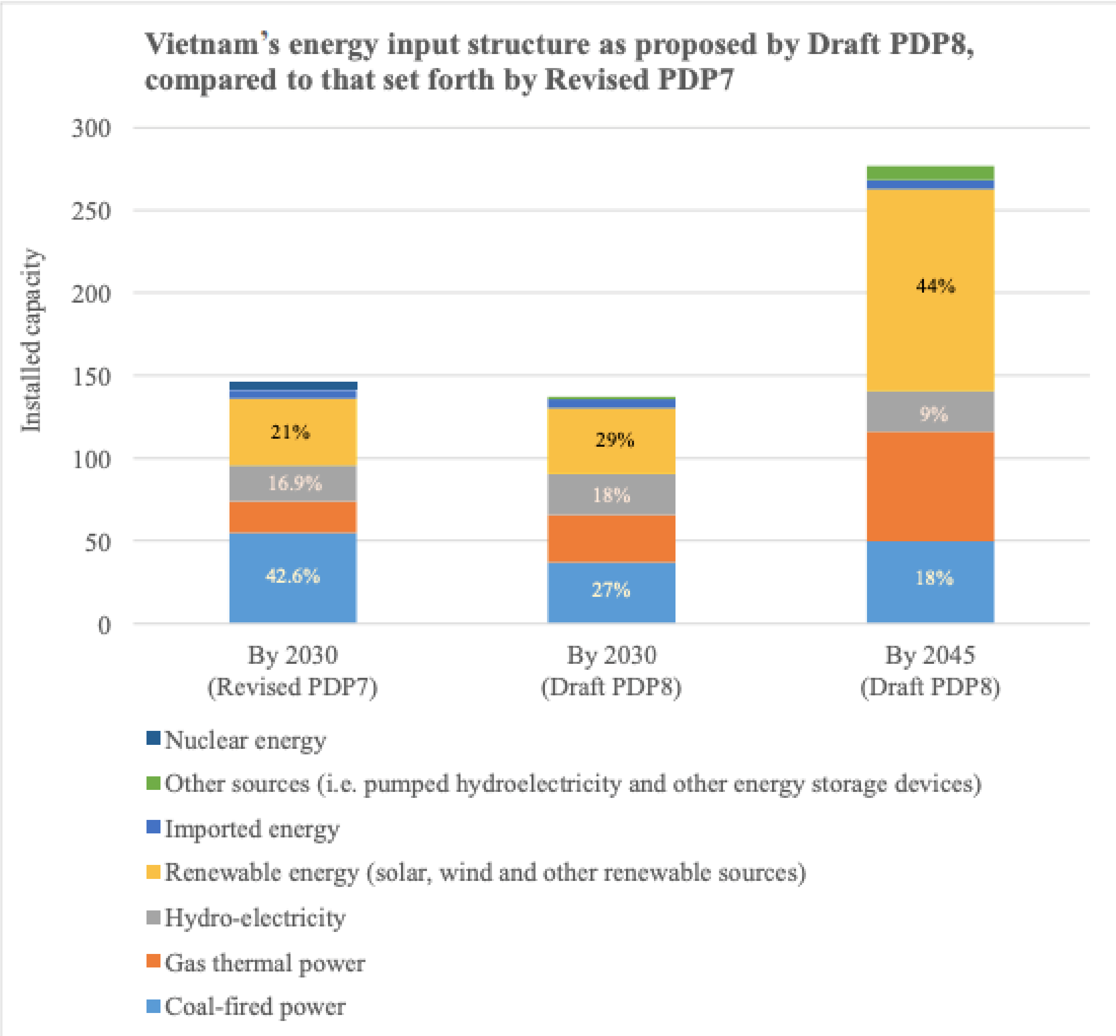
Draft PDP 8 shows a clear shift from a coal-focused capacity structure towards a renewable- and gas-focused capacity structure by 2045. The highlights of the Draft PDP 8 are as follows:

Coal-fired power: no new coal-fired power to be developed
Draft PDP 8 reduced the share of coal-fired power input from 43% in the Revised PDP 7 to 27%. No new coal-fired power plants will be developed except the ones already being constructed.

Gas-fired power: further increase after 2030
Draft PDP 8 increases the share of gas-fired power from 6% in the Revised PDP 7 to 21%. In addition, PDP 8 recommends a plan to construct an additional 5 GW gas-fired capacity in the north utilising LNG, 500–700 MW with flexible source (internal combustion engine, ICE) in the north, and 900 MW of ICE in the south.

Renewables: account for more than 40% of total capacity by 2045
The share of renewable energy, especially wind and solar, also increases from 21% in 2030 in the Revised PDP 7 to 29% in Draft PDP 8, and further increases to 44% in 2045. By 2030, onshore and offshore wind power is expected to reach 9 GW and 3 GW, and solar 7 GW.

Figure 2.5. Viet Nam's Installed Capacity Structure, Comparison of Revised PDP 7 and Draft PDP 8 (MW)



Source: Ohno and Tsunematsu (2021).

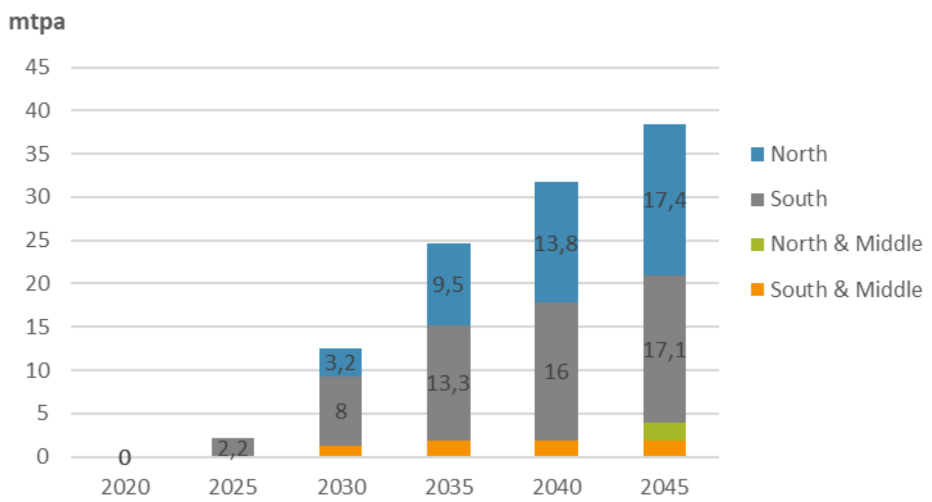
Table 2.7. Viet Nam's Installed Capacity Target, by Select Fuel

	Revised PDP 7, %	Draft PDP 8, %	
	2030	2030	2045
Installed capacity (MW)	N.A.	137,662	276,601
Coal	43	27	18
Gas	15	21	25
Hydro	17	18	9
Renewable	21	29	44

Source: Ohno and Tsunematsu (2021).

LNG demand is expected to rise significantly in the next decade to reach the capacity target. In a high-demand scenario, LNG demand will increase from 2.2 mtpa in 2025 to 38.4 mtpa in 2045. In terms of the demand region, while the south area will start as the largest demand area in 2025, the north area will catch up and become the largest demand area, with 17.4 million tonnes per year in 2045. Currently, most LNG projects are in the south, but the north is expected to have significant demand expansion, providing opportunities for potential investors.

Figure 2.6. Viet Nam's LNG Demand in High Scenario, 2020–2045



Source: IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', Saigon Asset Management's presentation on LNG development in Viet Nam.

The growth potential of LNG demand in Viet Nam has attracted various investors to develop LNG-to-power projects. The Revised PDP 7 approved 10 LNG-to-power projects (Table 2.8). This will require significant upfront investments to build infrastructure across the LNG-to-power chain, and the government is looking for investors and sponsors for foreign capital and expertise.

The US's engagement

Many sponsors are US companies in these approved projects, demonstrating the US's interest in Viet Nam's LNG market. The possible reasons are geopolitical and market concerns. Geopolitically speaking, it is of interest to the US to diversify markets for its LNG exports because of the tension between the US and China. There are still significant volumes of the US-produced LNG under construction that need to secure outlets regarding market concerns.

Under the Indo-Pacific Strategy and Asia EDGE (Enhancing Development and Growth through Energy) initiative, the US government is currently working closely with US industries to advocate the development of LNG infrastructure projects in Viet Nam. To be more engaged in the LNG-to-power projects in Viet Nam, in addition to supplying LNG, US companies also engage in financing and constructing power plants.

In October 2019, the US-based power company AES received approval for a combined cycle gas turbine (CCGT) power plant in Son My 2 with 2.2 GW from the Viet Nam government (NS Energy, 2019). In October 2020, AES and PV Gas signed a joint venture to develop Son My LNG terminal during the Third Indo-Pacific Business Forum (Pham, 2020b).

Chan May LNG is also a US–Viet Nam joint venture with an initial capacity of 2.4 GW in phase 1, expected to be operational in 2024, and a total capacity of 4 GW for the entire plant scheduled to be operational in 2027. Chan May LNG is 60% owned by US investors and 40% by Vietnamese investors. The project company has stated that the project has considerable support from the US government as US LNG suppliers still have LNG volumes to market. In addition, several institutions have shown interest in financing the projects, including the US Exim Bank, the US International Development Finance Corporation, and the International Finance Corporation (Vu, 2020).

The US-headquartered Delta Offshore Energy is developing the Bac Lieu LNG-to-power project. The project consists of a 3 mtpa floating LNG import terminal and a 3.2 GW combined cycle power plant in the Mekong Delta in Bac Lieu province. The LNG is expected to be imported from the US, which will help balance the US–Viet Nam trade. In January 2021, Delta Offshore Energy signed a 25-year power purchase agreement (PPA) with EVN, which is the final major step of the LNG-to-power project. The company claims that this is the first 100% privately funded major project in Viet Nam (Pekic, 2021; Pham, 2020c).

Table 2.8. Viet Nam's LNG-to-Power Project

Project Name	Location	Capacity (MW)	Expected COD	Project Sponsor	Note
Hiep Phuoc	HCMC	1,200	2022	Hai Linh	Power plant only. LNG is imported through Hai Linh LNG terminal in Vung Tau.
Son My 1 (BOT)	Binh Thuan	2,000	2027	EDF[a], Sojitz, Pacific Group, Kyushu Electric Power	Power plant only. LNG is imported via Son My LNG Terminal.
Son My 2 (BOT)	Binh Thuan	2,200	2026–2027	AES	Power plant only. LNG is imported via Son My LNG terminal.
Nhon Trach 3,4	Dong Nai	1,300–1,760	2023–2024	PV Power	Power plant only. LNG is imported via Thi Vai LNG terminal.
Ca Na (Phase 1)	Binh Thuan	1,500	2025–2026	It is an EVN project. Ongoing investor selection process	Fully integrated project with import terminal, storage, regasification plants, and power plant.
Bac Lieu	Bac Lieu	3,200	2024–2027	Delta Offshore Energy	Fully integrated project with FSRU, pipelines, and power plant.

Long Son	Ba Ria - Vung Tau	3,600–4,500	2025–2026	EVN GENCO3, Mitsubishi, GE, Pacific Corporation, Vietnam's Viet Nam's Power Engineering Consulting Joint Stock Company 2 (PECC 2) and TTC Group	Fully integrated project with FSRU, pipelines, and power plant.
Long An	Long An	3,000	2025-2026	Vina Capital & GS Energy	Power plant only. LNG is imported via Thi Vai LNG terminal.
Quang Ninh	Quang Ninh	1,500	2026–2027	Proposed by PV Power & Colavi (Viet Nam) & Tokyo Gas & Marubeni	Fully integrated project with FSRU, pipelines, and power plant.
Hai Lang	Quang Tri	1,500	2026–2027	Proposed by T&T Group	Fully integrated project with FSRU, pipelines, and power plant.

[a] The EDF Group of France.

Source: IEEJ–ERIA Workshop, 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition', Saigon Asset Management's presentation on LNG development in Viet Nam.

Table 2.9. Viet Nam's Newly Proposed LNG-to-Power Project

Project Name	Location	Capacity (MW)	Expected COD[a]	Project Sponsor	Note
Khanh Hoa Petrolimex Terminal Project	Khanh Hoa	4 plants with a combined capacity of 6,000 MW	N.A.	Proposed by Vietnam National Petroleum Group (Petrolimex)	The complex has 180,000 m^3 LNG storage facility. Petrolimex signed an agreement with Eneos in 2019.
Ca Mau 3	Ca Mau	1,500	2026–2027	PV Power	N.A.
Chan May LNG	Thua Thien Hue	2,400–4,000	2024 (Phase 1) 2027 (entire plant)	US–Viet Nam joint venture	A complex with an LNG terminal and storage facilities
Hai Phong	Hai Phong	4,000	N.A.	ExxonMobil and JERA	LNG import facilities and gas-fired power plants

[a] C operations date.
Source: *ET Energy World* (2020).

Challenges in Viet Nam

As much as LNG is a promising business in Viet Nam as the government supports LNG-to-power, various challenges, along with the development of the LNG value chain, exist. The potential challenges are listed as follows:

Technical aspect
The construction and design of LNG terminals, regasification units, storage, and pipeline network to power plants are capital-intensive and require knowledge and experience. As a new member of the LNG importing club, Viet Nam needs to establish technical and safety regulations and standards on the design and operation of LNG storage and onshore gas recycling systems.

Legal framework
Draft PDP 8 is under review, and further amendments are required. Thus, even though LNG demand is expected to grow significantly, there are still uncertainties before the policy direction is confirmed. Furthermore, foreign investors are looking for a stable and clear legal and regulatory framework to evaluate the risks.

Historically, state-owned enterprises dominated the power market in Viet Nam. However, the government has recognised the need to liberalise the power market and has implemented reforms in phases for the power market. The ongoing regulatory reform plays a vital role in the LNG market development of Viet Nam.

Funding guarantees
The upfront investment cost coupled with a long development timeline poses a risk for investors. The financing of LNG terminal and power plant needs to be underpinned by agreements: the terminal use agreement with the terminal owner and the PPA with a power company, such as EVN. Given the interconnected nature of these commercial agreements, a government guarantee and undertaking (GGU) for foreign investors and financial institutions are essential. Currently, no GGU exists in Viet Nam, which would potentially hamper the project development.

LNG affordability
The biggest challenge of the LNG-to-power project is that there is no output pricing or offtake guarantee mechanism for LNG-fired power plants despite LNG-fired power plant investors having requested such arrangements. As a result, LNG could turn out to be costly relative to electricity tariffs in Viet Nam remaining relatively low.

The price of input LNG fuel accounts for 80% to 90% of the output price of power, meaning that the profit margin for LNG-fired power plant investors may not be material enough for them to weather such risks. In addition, the government has been unable to provide any guarantee. As such, some financial institutions refuse to extend loans to investors to implement LNG projects.

For LNG-to-power to develop, an offtake mechanism must ensure the purchase of LNG power output or investors must be ready to assume risks even without any pricing guarantee or offtake mechanism.

The current situation in Viet Nam is that all LNG power plant projects are still projects existing only on paper because no capital disbursement has been made. Moreover, construction has not begun due to such LNG power plant projects failing to secure output channels.

2.3. Indonesia

Background

Indonesia has considerable energy resources, including oil, natural gas, and renewable energy resources. Most oil and gas resources are in western and eastern Indonesia. Recently completed and proposed LNG projects include Dongi-Senoro, Tangguh, and Abadi Masela, all in eastern Indonesia.

Oil and coal are the dominant fuel, accounting for 70% of the country's TPES in 2019. Indonesia's TPES was 236.8 Mtoe in 2019, and coal accounted for the largest share of 36%, followed by oil 34% and gas 18%. The final energy consumption was 147 Mtoe in 2019, with oil representing the largest share of 33%, followed by renewables (25%), coal (17%), electricity (16%), and gas (9%).

To promote the development priorities for domestic energy resources, the government announced the National Energy Policy (NEP) in 2014 to set targets to encourage coal and gas use while minimising the use of oil. NEP's target of transforming primary energy supply is as follows (IAEA, 2018):

Table 2.10. Primary Energy Supply Target in Indonesia

	2019 TPES	2025 target	2050 target
Oil	34%	<25%	<20%
Coal	36%	>30%	>25%
Gas	18%	>22%	>24%
Low-carbon energy sources and renewables	13%	>23%	>31%

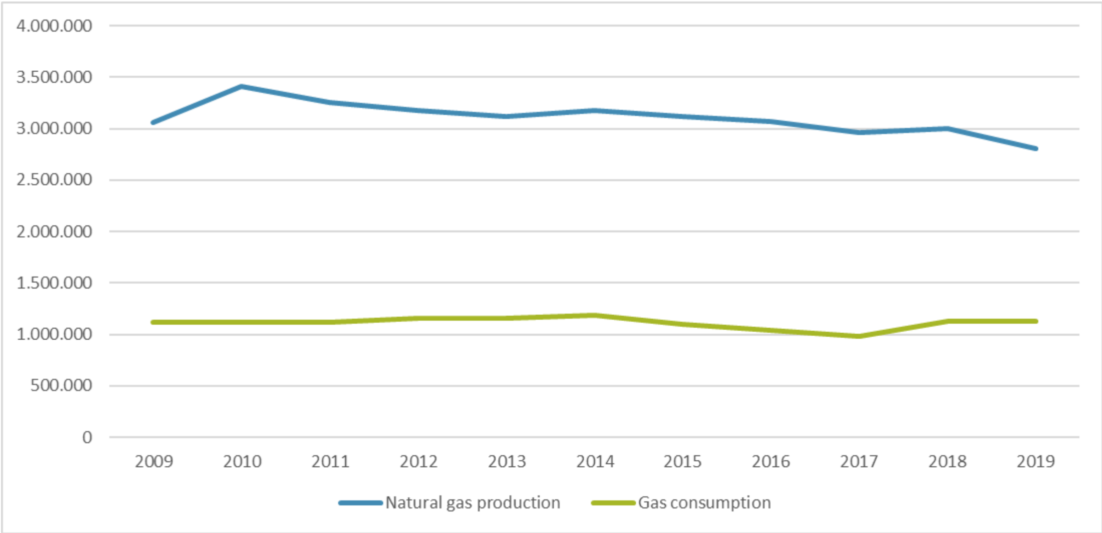
Sources: MEMR (2020), APERC (2019b).

Natural gas production and LNG trade

Indonesia's large natural gas reserves are in Badak in East Kalimantan, Corridor in South Sumatra, the Natuna Sea, the Makassar Strait, the Masela Block in Maluku, and Bintuni Bay in Papua. Smaller offshore gas reserves are in West and East Java (APERC, 2019a). With abundant natural gas resources, Indonesia started exporting LNG from Tangguh, Bintuni Bay, Papua in 2009. It is the seventh-largest LNG exporter in the world as of 2020. The country exported 15 million tonnes of LNG, with 4.2% of the world's LNG exports in 2020 (GIIGNL, 2021).

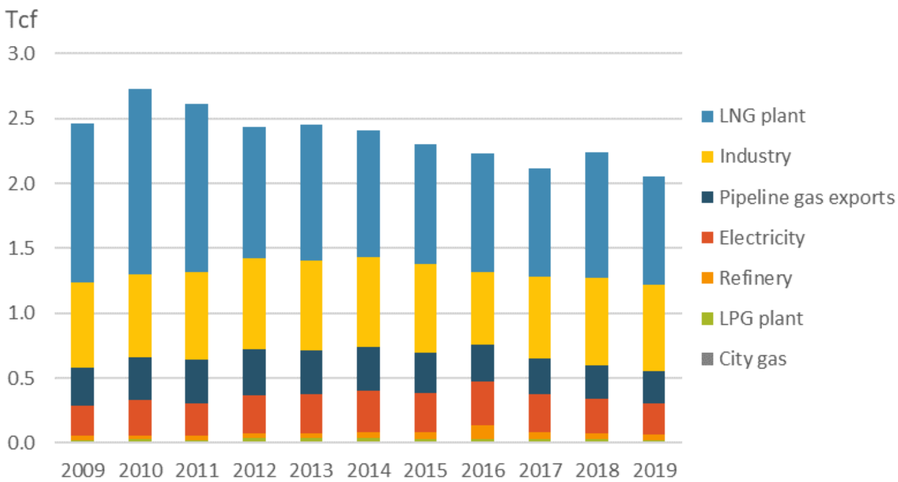
The country's natural gas production stands at around 3 Tcf, but it has started decreasing since 2014 because the gas fields are depleting. As a result, production declined by 12% from 3.2 Tcf in 2014 to 2.8 Tcf in 2019 (Figure 2.6).

Figure 2.7. Natural Gas Production in Indonesia, 2009–2019



Source: MEMR (2020).

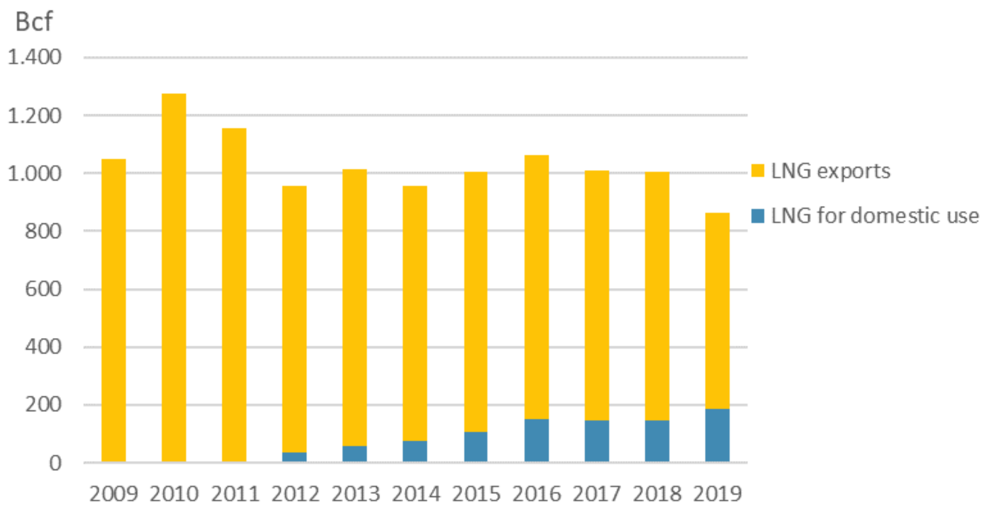
Figure 2.8. Natural Gas Demand, by Use in Indonesia, 2009–2019



Source: MEMR (2020).

In 2019, 41% of the gas production was liquefied at two LNG plants, and 32% was consumed in the industry sector. Pipeline gas exports and the power sector accounted for 12% each, refinery 2%, and LPG plant 1% (Figure 2.7). In 1977, all the LNG produced was exported to other countries (Pradipta, 2016). However, as domestic demand for gas grew, Indonesia had started to 'import' (from East Kalimantan to West Java) LNG domestically since 2012. Domestic LNG demand grew almost fourfold from 37 Bcf to 185 Bcf between 2012 and 2019. The growing trend of domestic LNG demand is expected to continue while the LNG exports (into international markets) declined by 58% from 2010 to 2019 (Figure 2.9).

Figure 2.9. LNG Production, by Use, 2009–2019



Source: MEMR (2020).

Recent regulatory framework for gas market

Gas price adjustment to create more gas demand

To further stimulate gas demand in the country, the Indonesian government announced in 2020 the capping of gas prices for strategic industries and power plants. The gas price should be US$6 per Million British thermal units (MBtu) at the plant gate for strategic industries: fertiliser, petrochemical, oleochemical, steel, ceramic, glass, and gloves latex industries. For power plants, the gas prices should be adjusted variably for each allocation between US$4–US$8/MBtu, with a price formula linked mainly to Indonesian crude price.[17]

The adjustment is aimed at the upstream gas price and the transportation and midstream costs. It is translated into the upstream gas price of US$4–US$7/MBtu. Prices are adjusted so that more gas demand could be boosted while not economically jeopardising the upstream companies.

[17] IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', Pertamina's presentation material.

The government's subsidy for this gas price comes from the government's share in the related gas fields. Pertamina is assigned to supply gas to industries with regulated gas prices. In 2020, a total volume of 2,601 billion British thermal unit per day (BBtud) gas prices was adjusted: almost half is provided to the strategic industries with 1,505 BBtud of gas and 1,396 BBtud of gas for power plants.

The gas price adjustment has positively impacted the strategic industries as it has encouraged and stimulated the production growth of these industries, especially for those heavily relying on gas as their feedstock or fuel, such as the fertiliser industry.

GHG reduction target by 2030
The Indonesian government has committed to reducing GHG emissions up to 29% in 2030 by promoting cleaner fossil fuel, renewable energy, and energy efficiency increase, including the use of natural gas in generating power (UNFCCC, n.d.). The gas price adjustment for strategic industries and power plants is also a measure to promote more use of natural gas.

Infrastructure development

Natural gas plays an essential role in Indonesia. It serves as a fuel for power generation and feedstock for the petrochemical industry and provides economic revenue through LNG exports. Indonesia has three LNG liquefaction plants: Bontang (11.5 mtpa capacity), Tangguh (7.6 mtpa), and Donggi-Senoro (2.0 mtpa) (GIIGNL, 2021). The Bontang project is 100% owned by the Indonesian government, while the other two projects have overseas investors involved. The Tangguh LNG Phase 2 expansion is currently under construction and is expected to operate by mid-2022 after construction delays caused by the COVID-19 pandemic.

As domestic gas demand is projected to increase and domestic gas production decreases, the country becomes a potential market for its LNG production from the existing LNG infrastructure. However, Indonesia has over 14,000 islands, making it difficult to have an integrated natural gas pipeline network. Therefore, to deliver more gas to remote areas and islands, some innovative solutions were introduced in the country, including small-scale LNG, ISO tanks and trucks, and LNG-to-power.

Small-scale LNG terminals
In 2014, the government issued the National Gas Policy Road Map 2014–2030, which proposed to develop small-scale LNG infrastructure to supply gas to the small islands in eastern Indonesia. Small-scale LNG terminals offer relatively low initial investment requirements with a smaller capacity than traditional LNG receiving terminals (ERIA, 2021b). According to the International Gas Union criteria, small-scale LNG has a liquefaction and regasification capacity of 0.05–1.0 mtpa and vessels with 60,000 m^3 or less.

The first small-scale LNG terminal is in Benoa Bali; it began operations in April 2016. The LNG terminal operated by Pelindo Energi Logistik intended to supply gas to a 250 MW power plant in Pesanggrahan, Bali, at 40 million standard cubic feet per day. The LNG facility consists of two main infrastructure elements: a floating regasification unit (FRU) and a floating storage unit

(FSU). LNG from Badak was stored at the FSU sent to the FRU, and then transported to the PLN power plant in Pesanggrahan. The total investment reported was US$500 million.

After 3 years of operations, the FSU and FRU were decommissioned and replaced with a new FSRU, Karunia Dewata, in December 2018. The new FSRU is equipped with four independent LNG tanks of a combined capacity of 26,000 m^3.

Another recent example is Pertamina's task to supply 55 small-scale gas-fired power plants across Indonesia, especially in the eastern part. It is challenging to build gas infrastructure and establish an LNG supply chain under the constraints of a landscape where most demands are far from the supply location.

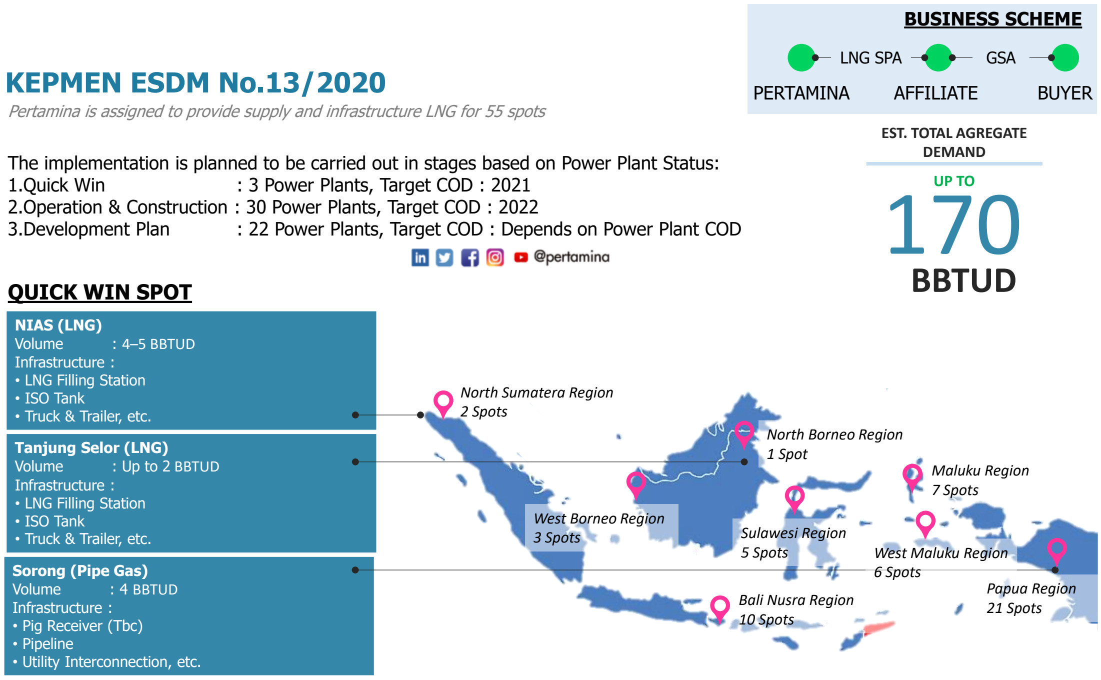
This project is separated into three phases:

- Quick Win: 3 power plants, target COD[18] 2021
- Operation and construction: 30 power plants, target COD 2022
- Development plan: 22 power plants, target COD depending on power plant's COD

The first phase Quick Win project – which includes NIAS (LNG), Tanjung Selor (LNG), and Sorong (Pipe Gas) – are expected to operate in 2021. Pertamina will use ISO tanks, trucks and trailers, and other solutions to deliver LNG to demand areas in this phase.[19]

[18] Commercial operation date.
[19] IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', Pertamina's presentation material.

Figure 2.10. Pertamina's LNG Supply to 55 Spots



Source: IEEJ–IEF Workshop, 'The Global Future of Natural Gas in a Low Carbon World – The Future of Natural Gas in Southeast Asia', Pertamina's presentation material.

LNG-to-powership to provide electricity to off-grid villages

To reach more villages unconnected to the power grid, Indonesia adopts LNG-to-powership to provide electricity to those households from floating power plants. In 2015 and 2016, the country's state utility company PT PLN (Persero) signed five contracts with Turkey-based company Karpowership to deploy five powerships of combined capacity 1,000 MW for 5 years.

Karadeniz Powership Zeynep Sultan (125 MW), Onur Sultan (470 MW), Gökhan Bey (125 MW), Yasin Bey (125 MW), and Nezih Bey (37 MW) have been operating since 2016. Since 2018, Karadeniz Powership Onur Sultan in Medan has been operating with Indonesia's indigenous gas. Karpowership has been supplying 30% of North Sulawesi's, 55% of East Nusa Tenggara's, 80% of Ambon's, and 10% of Medan's total electricity needs (Karpowership, 2021).

In September 2020, Powership Zeynep Sultan, the project in Amurang, started transitioning to becoming Indonesia's first LNG-to-power project after successfully converting its first two dual-fuel engines (LNG Industry, 2020). The LNG is converted from liquid to gas via an FSRU operated by PT Sulawesi Regas Satu, a joint venture of PLN GG and PT Humpuss.

The electricity supply plan to 2026 that the government set out in 2019 says mobile power plants like this are expected to play a role in supplying electricity to rural and remote areas in a country where more than 2,500 villages are still not connected to the grid (Shell, 2019a).

2.4. Myanmar

Background

Like Indonesia, Myanmar is also endowed with natural resources such as oil, natural gas, coal, hydropower, and biomass. In 2018, Myanmar's TPES was 23.83 Mtoe, with biofuels and waste representing the dominant share of 46%, followed by oil (29%) and gas (17%). Power generation was 18.77 TWh in 2018, with hydropower (47%) and gas (44%) being the primary sources for power generation.

Myanmar has always been self-sufficient with gas until 2020. The country's natural gas production increased significantly from 6.8 Bcm to 21.2 Bcm between 2000 and 2016. However, as the gas field depleted, production had declined by 4% to 20.3 Bcm in 2018 from 2016. Myanmar began exporting pipeline gas to Thailand and China in 1999 and 2013, respectively. However, as Myanmar's gas field depletes, exports are also expected to decrease.

In recent years, the rapid growth of electricity demand and variability of hydropower output have resulted in significant power shortages in Myanmar. These have led the country to consider importing LNG as it is expected to be the fastest solution through utilising existing gas-fired units.

Government's LNG-to-power policy

In the Japan Producer-Consumer Conference 2020, Myanmar's Minister of Electricity and Energy announced that the country plans to build three LNG-powered plants of 3,000 MW to meet the growing electricity demand. One of the projects was awarded to a Japanese consortium in line with a government-to-government agreement. The strategy to use LNG for power generation allows Myanmar to construct new pipelines to carry regasified LNG to other parts of the country for industrial uses, especially for fertiliser, cement, and steel production. Myanmar is looking into expanding the LNG terminal facilities to have more LNG trades in the next stage, which will open more opportunities for LNG producers and exporters.[20]

Infrastructure development

Currently, Myanmar has one Thanlyin LNG FSU with a capacity of 0.5 mtpa. In May and June 2020, Myanmar received its first LNG cargoes from Petronas and officially joined the LNG importer club. The cargoes were shipped from Petronas LNG Complex in Bintulu on free-on-board basis (Bajic, 2020).

This FSU supplies LNG to an onshore regasification terminal, which feeds two power plants in Yangon, 400 MW Thaketa and 350 MW Thanlyin. This is the first facility where Myanmar uses imported LNG as a fuel source for power generation. The LNG-to-power project is financed, constructed, and operated by CNTIC VPower, a joint venture of China National Technical Import and Export Corporation and Hong Kong's VPower Group.

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[20] LNG Producer–Consumer Conference (2020), https://www.lng-conference.org/english/videos/ (17 September 2021).

LNG imported in Yangon is expected to supply another gas-fired power plant Thilawa, with a 1,250 MW capacity. It is still at the planning stage and is expected to come online by 2024.

Several LNG projects are also being developed. The Ahlone LNG power plant in Yangon is Myanmar's first LNG project involving an onshore LNG terminal and regasification unit. The PPA was signed in January 2021 between Electric Power Generation Enterprise under the Ministry of Electricity and Energy and TTCL Power Myanmar Co. The project is expected to be completed in early 2024 and is one of the 3,000 MW LNG-to-power projects (Htwe, 2021).

In May 2021, the Myanmar Investment Commission (MIC) approved 15 projects, including a US$2.5 billion LNG-to-power project, which would be the biggest single investment since the military takeover on 1 February 2021. MIC did not reveal details in the press release, but some sources said the approved LNG project is likely to be the Chinese-backed Mee Lin Gyaing power project in the country's Irrawaddy Delta, judging from the project cost. China signed a letter of intent with Myanmar's then-government National League for Democracy in 2020 to speed up the project development under the Belt and Road Initiative agreement.

The Mee Lin Gyaing project with a capacity of 1,390 MW is developed jointly by Yunnan Provincial Energy Investment Group Co. Ltd., UREC, Zhefu Holding Group Co. Ltd., and Supreme Group. Completion is expected in 2023; 35% of the power produced will be distributed to the Ayeyarwady Region, the rest to Yangon via the national grid.

However, the military coup is still ongoing in Myanmar, and the economy is unstable. The United Nations (UN) even has warned in April 2021 that Myanmar is approaching economic collapse (UN News, 2021). Therefore, whether these LNG-to-power projects could develop on time depends on how and when the coup ends.

Chapter 3. Implications of Decarbonisation and Carbon Neutrality on the ASEAN LNG Market: Present and Future

3.1. Global Policy Trend of Decarbonisation and Carbon Neutrality

Recently more countries have become committed to tackling climate change by announcing decarbonisation or carbon neutrality targets. China, the largest carbon emitter, and the US, the second-largest emitter, have committed to reducing carbon emissions in the next few decades. Below we present the carbon neutrality targets of the United Kingdom, the European Union, China, Japan, and the United States.

The United Kingdom

In June 2019, the United Kingdom (UK) became the first economy to pass a net-zero emissions law by 2050. This legislation commits the UK to a legally binding target of net-zero emissions by 2050. This net-zero target was recommended by the Committee on Climate Change, the country's independent climate advisory body. It clearly defines net-zero, meaning any emissions that would be balanced by schemes to offset an equivalent amount of GHGs from the atmosphere, such as planting trees or using technology like carbon capture and storage (Government of the United Kingdom, 2019).

European Union

The European Commission set out a vision for a climate-neutral European Union (EU) in November 2018, exploring pathways for transition in all key sectors. The vision is a European strategic long-term vision for a prosperous, modern, competitive, and climate-neutral economy. In March 2020, the commission proposed the first European Climate Law to enshrine the 2050 climate-neutrality target. This target aims to be climate-neutral by 2050, i.e. an economy with net-zero GHG emissions (European Union, 2021).

China

In September 2020, in an address to the UN General Assembly, China's President declared the country's aim to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060. China's strategy focuses on industrial growth on decarbonised technologies, such as electric vehicles and fuel cell vehicles.[21]

Japan

In October 2020, Japan's prime minister declared the country's aim for net-zero GHG emissions by 2050 to realise a carbon-neutral, decarbonised society. He emphasised that

[21] Ministry of Foreign Affairs of the People's Republic of China, Statement by H.E. Xi Jinping President of the People's Republic of China At the General Debate of the 75th Session of The United Nations General Assembly, 2020, https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1817098.shtml (accessed 17 September 2021).

addressing climate change was no longer a constraint on economic growth but provocative climate change measures to bring dynamic economic growth.[22]

The United States

In April 2021, the US president announced a new target for the country, achieving by 2030 a 50%–52% reduction from 2005 economy-wide net GHG gas pollution levels. On the first day of the president's inauguration, 20 January 2021, the country rejoined the Paris Agreement and set a course to reach net-zero emissions economy-wide by 2050 (The White House, 2021).

3.2. Emerging Market of Carbon-Neutral LNG

Drivers of carbon-neutral LNG

Following the decarbonisation and carbon-neutrality targets declared worldwide is a growing attention towards the decarbonisation and carbon neutrality for LNG. Even though natural gas or LNG is considered a relatively clean fuel as its CO_2 emissions are half of coal's emissions when combusted in a power plant, it is still a fossil fuel.

In February 2021, the European Commission adopted the European Green Recovery Plan to provide funds to member states for their post-COVID-19 recovery. The funding's guideline follows the principle of 'Do no significant harm' and climate tracking methodology as assessing whether to support the investment. The EU stated that it does not necessarily exclude gas infrastructures as natural gas in some regions is necessary for the energy transition (EURACTIV, 2021). The European Environmental Bureau (EEB) is concerned about the flexibility given to the member states as gas should not be labelled as a bridge fuel in the energy transition. The EEB further stated that fossil fuel has no role in the decarbonisation of the EU, and gas should be a stranded asset (EEB, 2021).

On a global scale, more than 3,100 asset owners, asset managers, and service providers signed the Principles for Responsible Investment (PRI), with a total of US$110 trillion in assets under management. PRI signatories commit to incorporating environmental, social, and corporate governance (ESG) factors into their investment and ownership decisions. Furthermore, banks and lenders are voluntarily joining industry-led groups such as the Partnership for Carbon Accounting Financials, which has 70 members with US$9 trillion in assets under management (Eccles, 2020).

As more investors and customers challenge natural gas, the declining costs for renewable energy, such as wind and solar, also increase pressure for LNG producers and force them to look for ways to reduce or offset their carbon footprints. As a result, the market of carbon-neutral or decarbonised LNG is emerging.

[22] Prime Minister of Japan and His Cabinet, Policy Speech by the Prime Minister to the 203rd Session of the Diet, 2020, https://japan.kantei.go.jp/99_suga/statement/202010/_00006.html (accessed 17 September 2021).

What is carbon-neutral LNG?

There is currently no consensus on the term 'carbon-neutral LNG' (CNL). Various definitions have been applied so far, ranging from an ambitious target to offset LNG cargo's full life cycle GHG emissions to offset part of the value chain.

Based on current practices in the LNG industry, the term 'carbon-neutral' does not mean the LNG cargo creates zero GHG emissions. Instead, it means the GHG emissions associated with the upstream production, liquefaction, transportation, and, if required, combustion of the gas are measured, certified, and offset through the purchase and use of carbon credits, which support reforestation, afforestation, or other renewable projects (Wood Mackenzie, 2020). In other words, in current industry practices, the CNL is achieved by purchasing carbon credits rather than decarbonising the LNG value chain through technologies.

It is noteworthy that the GHG emissions of LNG cargoes include CO_2 and methane emissions because they are two of the largest components of emissions from the entire LNG value chain. The life cycle GHG emissions of LNG cargoes can be classified through the following three scopes based on the Greenhouse Gas Protocol, the world's most widely used GHG accounting standards (GIIGNL, 2020):

- Scope 1: emissions are direct emissions from owned or controlled sources
- Scope 2: emissions are indirect emissions from the generation of purchased energy
- Scope 3: emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions

The inclusion of scopes varies with the methodology of emission calculation of each company.

In response to current practices, there have been some concerns. Given that the original motivation is to reduce carbon footprints created along the LNG value chain while pursuing the net-zero target, the current practices are questioned to be greenwashing by environmental groups as no carbon footprints are actually reduced. However, given the technical difficulty and additional costs and time taken to decarbonise the LNG value chain, the current practice serves as a good starting point to pave the long way for the decarbonisation of the sector.

Recent initiatives

The European Union's methane strategy, 2020

In October 2020, the European Commission published the *EU Strategy to Reduce Methane Emissions*. Methane is the second-biggest contributor to climate change, after carbon dioxide. Although the EU accounts for a small share of global methane emissions, it has significant leverage as the largest importer of oil and gas. Therefore, tackling methane emissions is essential to reaching the EU's 2030 climate targets and the 2050 climate neutrality goal, as well as contributing to the commission's zero-pollution ambition (The European Commission, 2020).

The strategy sets out measures to cut methane emissions in Europe and internationally. Energy, agriculture, and waste sectors are estimated to account for around 95% of methane emissions associated with human activity worldwide (The European Commission, 2020). Therefore, the commission has prioritised monitoring, reporting, and verification of methane emissions. To reach this objective, the commission is promoting an international methane emissions observatory in collaboration with the United Nations Environmental Programme (UNEP) (Caltagironi and Piebalgs, 2021), and implementing the measurement and reporting framework devised by the Oil and Gas Methane Partnership (OGMP) measurement and reporting framework.

The OGMP is a climate and clean air coalition initiative launched in 2014. It is led by UNEP in cooperation with the European Commission, the UK government, the Environmental Defense Fund, and leading oil and gas upstream companies. As of 14 May 2021, 62 companies with assets on five continents representing 30% of the world's oil and gas production have already joined the partnership.[23]

With increased awareness of methane emission issues, the OGMP is developing the OGMP 2.0 reporting framework as the gold standard reporting platform on methane. The framework seeks to improve the reporting accuracy and transparency of anthropogenic methane emissions in the oil and gas sector.

Less than 25% of methane emissions in the EU's gas supply chain occur domestically and 80% of volumes consumed in the region are sold through long-term contracts with non-EU suppliers. Thus, LNG producers or suppliers associated with the LNG trades with the EU, and ultimately the global natural gas market, are expected to be inevitably impacted.

Media reports in November 2020 claimed that French gas and power utility Engie had pulled out of an LNG deal with the US-based NextDecade because of the government's concerns about the impact on climate change through methane emissions (Reuters, 2020a).

Japan's CNG Buyers Alliance, 2021

In March 2021, 15 Japanese companies, including Tokyo Gas and its customers, Asahi Group, Mitsubishi Estate, Sumitomo Mitsu Trust Bank, and other companies, established the Carbon Neutral LNG Buyers Alliance. The alliance aims to promote the use of CNL, led by Tokyo Gas as the CNL procurer and supplier, and other companies as the regasified CNL purchaser. The alliance recognises choosing CNL as vital to Japan's target of achieving a carbon-neutral society by 2050 (Tokyo Gas, 2021).

[23] Oil and Gas Methane Partnership, http://ogmpartnership.com/ (accessed 17 September 2021).

Recent practices in LNG trade

As more LNG buyers take carbon footprints into their trade considerations, LNG producers and sellers have been encouraged to pursue carbon offsetting with the cargoes. This study lists all the CNL deals as of 15 May 2021.

1) Tokyo Gas and GS Energy from Shell, 2019
In June 2019, Tokyo Gas and Korea-based GS Energy received the world's first CNL cargoes from Shell. Tokyo Gas became the first company in Japan to supply carbon-neutral city gas to customers. Carbon credits used for this deal were bought from Shell's global portfolio of nature-based projects, including the Katingan Peatland Restoration and Conservation Project in Indonesia and the Cordillera Azul National Park Project in Peru (Shell, 2019b).

2) India from JERA, 2019
In June 2019, JERA announced that it delivered its first CNL to India. The cargo was from Abu Dhabi Gas Liquefaction Company Ltd.. The credits bought from Indian renewable electricity projects were used to offset only the emissions generated by the downstream use (JERA, 2019).

3) CPC from Shell, 2019
In March 2020, Taiwan's oil and gas company, CPC Corporation, received its first CNL cargo at Yung-An LNG receiving terminal. The carbon credits used for the deal were purchased from Shell's global portfolio of nature-based projects, including the Katingan Peatland Restoration and Conservation Project in Indonesia, the Cordillera Azul National Park Project in Peru, and The Form Reforestation Project in Ghana (Shell, 2020).

4) China National Offshore Oil Corporation (CNOOC) from Total, 2020
In September 2020, Total delivered its first CNL cargo to the CNOOC. The cargo was delivered from the Ichthys liquefaction plant in Australia to China's Dapeng LNG receiving terminal. Two projects offset the carbon footprint of the cargo: Hebei Guyuan Wind Power Project, which aims to reduce emissions from coal-based power generation in northern China, and Kariba REDD+ Forest Protection Project, which aims to protect Zimbabwe's forests (Total, 2020).

5) Hokkaido Gas from Mitsui & Co., 2021
In March 2021, Hokkaido Gas received its first CNL from Mitsui & Co., which is the first time for Mitsui & Co. to supply CNL. The deal was based on the long-term LNG contract concluded in October 2017. Mitsui & Co. offset the carbon emissions on a life-cycle basis, including feed gas production, liquefaction, and combustion using carbon credits from an international forest conservation project (Mitsui, 2021).

6) Shell from Gazprom, 2021:
In March 2021, Shell took a delivery from Gazprom of the first-ever CNL cargo in Europe. The cargo was delivered to the Dragon LNG terminal in Wales, enabling Shell to supply carbon-neutral gas to the UK domestic market. It was also Gazprom's first attempt into the emerging CNL market (Shell, 2021).

7) POSCO from the RWE, 2021
In March 2021, Korean steel producer POSCO received a CNL cargo from the RWE at the Gwangyang LNG receiving terminal. The carbon emission intensity of the cargo delivery was estimated using the Wood Mackenzie LNG Emissions Tool. The RWE also mentioned that the company is now ready to supply all its customers with CNL (RWE, 2021).

8) Toho Gas from Diamond Gas, 2021
In April 2021, Japan's Toho Gas received its first CNL cargo from Mitsubishi Corporation's wholly owned Diamond Gas International at the Chita LNG receiving terminal jointly operated by Toho Gas and JERA (Toho Gas, 2021).

9) Pavilion Energy, 2021
In its LNG procurement tender in April 2020, Singapore's Pavilion Energy asked LNG sellers to propose quantifying GHGs associated with each LNG cargo produced, transported, and imported into Singapore. They also encouraged bidders to offer carbon offsets as sales deals (Pavilion Energy, 2020).

In April 2021, Pavilion imported Singapore's first CNL cargo. The company stated that the carbon credits used for the offset are from the Natural Climate Solutions projects Evio Kuinaji Ese'Eja Cuana in Peru and Liangdu Afforestation in China. Pavilion aims to support its customers in transitioning towards a lower carbon future with solutions to meet their climate targets and potential regulatory requirements (Pavilion Energy, 2021).

10. Shell from Cheniere, 2021
In May 2021, Cheniere Energy announced that it delivered a CNL cargo from the Sabine Pass Liquefaction to Europe in early April. It was part of a long-term LNG contract between Cheniere and Shell. Cheniere bought the carbon offsets from Shell's global portfolio of nature-based projects (Cheniere Energy, Inc., 2021a).

Table 3.1. Carbon-Neutral LNG Deal, 2019–May 2021

Date	Seller	Buyer	Delivery Destination
June 2019	Shell	Tokyo Gas	Japan
June 2019	Shell	GS Energy	Korea
June 2019	JERA	N.A.	India
March 2020	Shell	CPC	Taiwan
September 2020	Total	CNOOC	China
March 2021	Mitsui	Hokkaido Gas	Japan
March 2021	Gazprom	Shell	United Kingdom
March 2021	RWE	POSCO	Korea
April 2021	Diamond Gas	Toho Gas	Japan
April 2021	N.A.	Pavilion	Singapore
May 2021	Cheniere	Shell	Europe

Sources: Shell (2019b); JERA (2019); Shell (2020); Total (2020); Mitsui (2021); Shell (2021); Pavilion Energy (2021); Toho Gas (2021); RWE (2021); Cheniere Energy, Inc. (2021a).

3.3. How Will the Emerging CNL Market Impact the ASEAN LNG Market?

Impact on the additional cost of CNL

Current practice: carbon offset prices

In current industrial practices, the GHG emissions of CNL cargoes are offset through credits bought from renewable electricity projects and nature-based projects. Today's most prominent carbon credits are certified emission reductions under the UN and verified emission reduction carbon credits from international carbon offsetting standards.

The carbon offsetting cost through reforestation ranges from US$4 per tonne of CO_2 equivalent (tCO_2e) to US$14/$tCO_2e$ or more[24] (Person, 2021). Taking an average of US$10/$tCO_2e$ as an example, the carbon offsetting cost of a typical LNG cargo with 250,000 tCO_2e of GHG emissions would be around US$2.5 million, approximately US$0.6/MBtu.

Decarbonisation opportunities in LNG value chain: efficiency improvements and CCUS

Natural gas liquefaction and regasification are highly energy-intensive processes, which may be associated with fugitive methane and carbon emissions (API, 2015). The design optimisation of plants and enhanced efficiencies in the value can greatly minimise emissions from LNG. LNG

[24] EKOS, 'Why Should Businesses Measure the Carbon Footprint of their Business Operations?', https://ekos.co.nz/faqs (accessed 17 September 2021).

companies have shown significant improvements and innovation despite past claims that further modifications have a limited effect on plant efficiency (Ransbarger and Phillips, 2007).

For example, TotalEnergies (formerly Total) reports that it has integrated an advanced technology called lithium bromide absorption chillers to optimise liquefaction efficiency (TotalEnergies, 2020). In addition, LNG Canada boasts of efficient plants that, through more efficient gas turbines and hydroelectricity, emit half the amount of CO_2e from an average LNG plant (KPMG Global Energy Institute, 2015). Furthermore, companies are experimenting with new technologies to avoid emissions. Shell, for example, successfully conducted a pilot program at its Oman LNG facility in 2018 to capture digital data on methane leak sources using the most advanced 3D map and laser scanning technology.[25]

Despite the continued innovation in efficiencies, companies with carbon neutrality goals also have much progress to make. It is possible to eliminate a company's scopes 1 and 2 emissions through efficiencies and renewables at LNG facilities. However, they are insufficient to avoid CO_2 emissions during natural gas combustion (scope 3). For example, NextDecade, owner of the proposed Rio Grande LNG export facility, evaluated that design optimisation reduced CO_2e emissions from its five trains by 21%. In contrast, a proven CO_2 capture, utilisation, and CCUS technology would reduce emissions by a more significant 90% (NextDecade, 2020). As such, companies are tapping into other technological and accounting solutions to make LNG close to being carbon-neutral, utilising carbon offsetting, CCUS, and emerging energy fuel types.

Who should pay for the additional costs?

The ultimate question of the CNL is who should pay for the additional cost of carbon offsetting. Should it be the supplier or the buyer? The International Group of Liquefied Natural Gas Importers (GIIGNL, 2020) stated in its report 'LNG Carbon Offsetting: Fleeting Trend or Sustainable Practice?', 'who should bear the cost of offsetting the CO_2' is often a strategic choice for LNG companies and a result of the balance of power between suppliers and buyers. The report further pointed out that companies are usually willing to bear the cost of the emissions they are responsible for, and they can monitor precisely.

In JERA's delivery of CNL to India, the amount of CO_2 equivalent to the emissions associated with the production and transportation was not included in the carbon offset initiative. Only the emissions generated by the downstream use of LNG in India were offset (JERA, 2019). JERA deemed it challenging to take responsibility for the emissions associated with the Abu Dhabi Gas Liquefaction Company Ltd.'s upstream activity or shipping segment.

Some customers have joined for corporate branding

In Tokyo Gas, some of their customers show interest in carbon-neutral city gas because of corporate branding. The customers come from various sectors with the same vision, contributing to a sustainable society. Here is the list of Tokyo Gas' customers of CNL.

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[25] Shell, 'Tackling Methane Emissions', https://www.shell.com/energy-and-innovation/natural-gas/methane-emissions/_jcr_content/par/textimage_438437728.stream/1587995196996/53beef2f8ba2e90560c074f56552e2acfe30582b/shell-methane-case-study.pdf (accessed 17 September 2021).

Table 3.2. Tokyo Gas's City Gas Customers Supporting Carbon-Neutral LNG

Sector	Customer	Reason for Support
Commercial	Mitsubishi Estate and Marunouchi Heat Supply Marunouchi Building and Otemachi Park Building	The companies would like to enhance the corporate values and achieve a sustainable society through urban planning by adopting carbon-neutral city gas.
Commercial	New Otani - Hotel New Otani Tokyo	Considering the global environment is an essential part of the company's hospitality. By purchasing carbon-neutral city gas, the company hopes to reduce its environmental impact and promote harmony with the global environment with an awareness of the Sustainable Development Goals (SDGs).
Commercial	Tamagawa Academy & University	The school promotes the development of global citizens with a broad perspective and the spirit of 'the earth is our home'. Using the CNL is a valuable teaching tool for students and children who will be responsible for the future.
Industry	Sakai Chemical Industry - Onahama Office, Matsubara Plant	The company hopes to contribute to the SDG efforts of their business partners and achieve their management mission of 'supporting vibrant and comfortable lifestyles and future with the power of chemicals'.
Industry	Yakult Honsha - Yakult Central Institute	Purchasing carbon-neutral gas is in line with its corporate slogan, 'Contributing to the health and happiness of people around the world'. It is also part of the company's environmental measures that contribute to a sustainable society.
Transport	Toyosu Hydrogen Refueling Station	The station aims to become Japan's first to produce hydrogen from carbon-neutral city gas to promote environmental friendliness.

Source: IEEJ–ERIA Workshop 'A Flexible LNG Market and Promotion of Investment in ASEAN – Under a New Era of Price Volatility and Energy Transition,' Tokyo Gas's presentation material.

Impact on potential investment of LNG projects

As more LNG buyers and consumers are increasingly considering the carbon footprints of LNG, decarbonising the LNG sector has become imperative. This is ultimately expected to become an essential factor for investors when investing in new LNG projects, and even related infrastructure.

France stops supporting gas projects from 2035
As mentioned above, according to some media reports, in October 2020, the French government asked power group Engie to hold off on signing an LNG contract with the US because of environmental concerns.

Furthermore, the French government announced in the same month that France would stop providing state export guarantees to projects involving dirty forms of oil such as shale from 2021, followed by all types of oil from 2025 and natural gas from 2035. In France, the state export guarantees are essential for companies' investment as they need the guarantees to get loans from financial institutions. Ultimately, the French government's goal is not to support French companies' overseas fossil fuel investment with export financing. The later date for natural gas is that gas could help some countries transition to cleaner energy (Reuters, 2020b). Without the government's support, it will be more difficult for companies interested in investing in LNG projects.

Complex carbon offset trading process is difficult for smaller LNG traders
Despite the recent progress in carbon offsets, there remain challenges associated with domestic environmental policies, the carbon market's illiquid nature, and the disconnection of different credit systems. According to the International Group of Liquefied Natural Gas Importers (GIIGNL), uncertainty and vagueness at the international level run counter to company offsetting efforts. The GIIGNL reports that the Paris Agreement offers little clarity on carbon markets (Article 6) and that 'there is no certainty regarding which type of offsets will be allowed or when different emission trading systems will be linked together at the global level' (GIIGNL, 2020). To claim emission reductions, companies must spend more on other activities, including third-party verification and monitoring processes.[26] These requirements pose even greater obstacles to smaller LNG traders that lack the resources accessible to vertically integrated multinationals.

Investment approval will depend on buyer's request and demand
Cheniere Energy Inc, the largest US LNG producer, announced in February 2021 that it would provide its LNG customers with GHG data associated with each LNG cargo from the well head to the cargo delivery point to customers beginning in 2022 (Cheniere Energy, Inc., 2021b).

It is foreseeable that more LNG buyers and consumers will demand carbon offsetting credits to meet the government's GHG emissions reduction targets or fulfil social responsibilities. The investment in new coal plants has been proven difficult in ASEAN countries despite coal being the dominant fuel source for power generation. Although LNG is the cleanest fossil fuel that emits half of the carbon emissions than coal in combustion, it still emits GHG.

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[26] In most cases, each carbon credit is subject to a third-party verification process and represents the avoidance or removal of 1 tonne of CO_2.

Also, the investment in LNG projects greatly depends on demand potential. Natural gas might be 'dirty' for some countries looking to shift from fossil fuels. However, it is still a cleaner alternative fuel to coal and oil in ASEAN countries as it provides stable power generation and serves as a complementary fuel with renewables. Therefore, the focus should be on how to help implement CCUS technologies and establish a reasonable and affordable pricing mechanism for ASEAN countries to help facilitate energy transition in the ASEAN region. This is for the region not to be left behind the global transition pathway as the whole world bears GHG emissions.

Chapter 4. Conclusion: Pathway towards a Flexible LNG Market in ASEAN

4.1. Policy Support Needed to Sustain Infrastructure Development

ASEAN will be a key market for gas demand in the coming decades. The substantial potential demand is a huge opportunity for energy infrastructure investments. Still, it will only be materialised under the guidance of appropriate policy to promote quality infrastructure and resilience in ASEAN for sustainability. Governments should investigate the LNG infrastructure gap and place the right policy to encourage investment that will increase the demand for gas use.

The legal framework has been identified as one of the main challenges when developing infrastructure. Unclear or restrictive regulations could hinder investment and financing opportunities. Investors do not invest unless a clear legal framework provides sufficient incentives and return insurance. The Philippines has demonstrated a positive example. The government shows immense support by offering a series of legal frameworks and clear investor guidance and approving the LNG terminal project applications within a reasonable period without delays.

Leaving investment decisions in major infrastructure to market forces has been proven difficult given LNG-related infrastructure projects are capital-intensive. Concrete actions by governments or NOCs are required to develop infrastructure, such as LNG-receiving terminals, regasification plants, storage tanks, gas networks and pipelines or virtual pipelines, all essential to establish an LNG value chain domestically after importing LNG.

In addition, cooperation between LNG producers and consumers could also accelerate infrastructure development. In Viet Nam, several US companies such as AES and Delta Offshore Energy engage in the LNG-to-power projects through financing. The cooperation helps facilitate the development of LNG terminals and gas-fired power plants in Viet Nam. The US, a major LNG producer, can also export more LNG to Viet Nam while the former seeks more markets. This is the best scenario of a win-win strategy.

4.2. Create More Gas Demand with Innovative Solutions to Further Facilitate Investment: TPA, ssLNG, ISO Tanks, LNG-to-Powership, and VPS

One key element to a flexible LNG market is sufficient trade volumes. The global LNG trade has increased for 6 consecutive years since 2014 and stands at 356.12 million tonnes in 2020. Asia-Pacific is the largest market, with 254.43 million tonnes or 71.4% of total LNG imports (GIIGNL, 2021). The trend is expected to continue in Asia and the ASEAN region if the governments could create more gas demand to establish a more competitive gas market.

Currently, power generation and industrial heating are the major uses of natural gas in ASEAN. More gas-fired power plants will be constructed to meet the growing demand for electricity as new coal-fired power projects are difficult to be approved. In some cases, the introduction of third-party access (TPA) could allow more gas imports and, thus, a more competitive gas market. For example, Malaysia and Thailand have introduced a TPA scheme, enabling LNG importers that do not have terminals to utilise existing facilities. As such, importers would be more encouraged to import more LNG. This scheme incentivises the private sector to participate in the natural gas business and invest in the natural gas infrastructure.

In addition to the TPA scheme, small-scale LNG, LNG-to-powership, and virtual pipeline systems (VPSs) provide innovative solutions to reach more users in remote areas that pipelines cannot reach. Given the geographical characteristics in the ASEAN region, many countries are archipelagos, such as the Philippines and Indonesia. As a result, natural gas networks are limited to key demand areas, and gas delivery to remote areas or small islands is challenging.

Small-scale LNG (ssLNG) offers smaller capacity and lower initial investments than traditional receiving terminals and regasification facilities. ISO tank containers provide quick access to LNG for end users in locations far from main pipelines that require smaller volumes. VPS refers to delivering LNG with trucks to off-grid users. Malaysia's state company Petronas developed a VPS solution to provide industries in Peninsular Malaysia that are not connected to the natural gas infrastructure to switch to gas as a cleaner alternative. The LNG-to-powership successfully exemplifies how floating power plants supply electricity to rural and remote areas where the villages are still unconnected to the power grid.

These innovative solutions would (i) encourage new players to join the natural gas business, (ii) promote a more flexible LNG market to gain access to competitive LNG supply for economical and stable economic development, and ultimately (iii) enhance its energy security and send signals to the financial market accordingly. Also, ASEAN has long discussed the need to establish a regional gas trading hub which will require market liberalisation and competition policies to allow a gas-on-gas competition to reveal market equilibrium prices. Creating more gas demand will also facilitate the establishment of the gas trading hub.

Finally, the electricity tariff should also reflect the LNG costs reasonably to retrieve power generation costs and investment returns. This is more challenging in Viet Nam as the electricity tariffs are low because they are regulated under the current economic structure. If the electricity tariff does not correctly reflect LNG costs, the LNG-to-power development cannot be sustainable in Viet Nam.

4.3. Producers and Consumers Should Make the Best Efforts to Reduce LNG's Carbon Footprint in the Supply Chain and at the Consuming End and Eventually to Zero

While almost the whole world is talking about carbon neutrality, it may not fit in with the decarbonisation timeline in ASEAN countries. A representative from Petronas also emphasised in the IEEJ–EFI LNG workshop held in January 2021 that 'ASEAN continues to pursue cleaner environment policies, but the region’s prospect of adopting the net-zero target is unlikely in the foreseeable future’.

Fossil fuels are still the dominant fuel in ASEAN countries and will still account for 87% of the TPES in 2050 in BAU. Gas is widely recognised as a complementary fuel with intermittent renewables along the energy transition pathway. It is not practical to pursue carbon neutrality in the region but decarbonisation technologies, such as CCUS. Producers and consumers should make the best efforts to reduce the carbon footprints of LNG in the supply chain and eventually achieve net-zero at the consuming end.

ASEAN countries should help LNG consumers and producers reduce GHG emissions by encouraging them to improve production, transportation, and power generation efficiency. Governments should also support research and development activities of industrial players to promote the carbon-neutral use of LNG, such as carbon-neutral hydrogen or ammonia eventually. Finally, governments should make carbon footprint information visible and transparent to contribute to a sustainable society.

Furthermore, emissions monitoring, reporting, and verification (MRV) are the fundamentals of ensuring true carbon neutrality. Producers and consumers should work together to develop a methodology to monitor, report, and verify to enhance confidence in carbon-neutrality claims. Some LNG buyers mentioned that they have been cooperating with LNG suppliers to jointly develop an MRV methodology to view the emissions associated with their natural gas procurement from the well head to the discharge port. The aim is to create an internationally recognised and accepted methodology that can be applied industry-wide and promote sustainability within the LNG industry. This underlines the need to ensure MRV systems are in place before any offsetting strategy can be discussed. Although applying carbon offsetting to a single cargo is one thing, applying it on a multi-year LNG sale and purchase agreement with contractual flexibility could be more complicated and possibly more costly.

4.4. Pursue an LNG Pricing Mechanism that Provides Comfortable Price Levels for Both Consumers and Producers

Despite supply security, price is the most concerning issue when purchasing LNG. LNG prices are still vulnerable to several factors, including oil prices, weather changes, storage volumes, canal shipping flexibility, etc. Furthermore, the extreme gaps between spot and term-contract prices, extremely low or high levels of spot LNG prices, and extreme volatility are not sustainable.

Producers and consumers should work together to establish comfortable and affordable price levels for LNG consumers worldwide while profitable enough for producers. Emerging markets like Viet Nam, where LNG is an expensive fuel, could also enjoy LNG consumption.

Producers should reduce the supply cost as much as possible, and consumers should appreciate the value of LNG from environmental contribution. In addition, governments of LNG-consuming and -producing countries should support pricing mechanisms that provide transparent and timely information of the LNG markets in collaboration with key market players.

4.5. Continue to Encourage the Discussion of Relaxation of Destination Clauses and Improve Transparency of Trade and Price Statistics

According to IEEJ's destination clause survey conducted in December 2020, all respondents from industries, governments, research organisations, and law firms from LNG-importing countries agree that removing destination clauses is positive for a more flexible LNG market. Therefore, all the parties should continue to encourage the competition authority of LNG-importing countries to include relaxation of destination clauses into their discussion agenda.

Even though the market mechanism is the major driving force of the natural gas sector, the government still has to step in with its resources in these issues to initiate the discussion momentum. Once the momentum is initiated, it is easier for the stakeholders to continue other moves on government support.

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