

APERC Gas Report 2022



PUBLISHED BY:

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Cover photo: PETRONAS

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Foreword


This report provides details of developments and changes in world natural gas demand and supply, especially in the Asia Pacific region, as well as the vital role of APEC economies in shaping and balancing world gas demand and supply for the 2011 to 2021 period. APEC economies continue to play a major role in global gas demand and supply, accounting for 58% of total world natural gas consumption and 61% of total world gas production in 2021. Four APEC economies were among the five world's largest gas users in 2021, and at the same time, three APEC economies were among the five world's largest natural gas producers, exporters, and importers.

APEC natural gas demand has continued to grow since 2011, with an exception in 2020 due to the COVID-19 pandemic. APEC natural gas demand grew faster than the rest of the world over the same period, particularly from the power and industry sectors. A similar trend for APEC natural gas production during the same period, as shale and other non-conventional gas production increased substantially in the APEC region.

World and APEC gas demand and supply recovered in 2021, exceeding the 2019 level. However, the recovery was slow due to several waves of COVID-19 and geopolitical tension between Russia and Ukraine. The situation led to a tight supply and high gas prices towards the end of 2021.

The challenging situation in 2021 continued in the first three quarters of 2022 and became even more difficult with the start of the Russia-Ukraine war in February 2022. Benchmark spot natural gas prices across the world hit record highs twice, in March and August 2022, with unprecedented high volatility. The high gas prices and tight supply could slow down the global and APEC gas demand in 2022 and delay the implementation of energy transition in a few APEC economies. The geopolitical tension, tight supply, and high gas prices and volatility situations most likely continue in 2023, coupled with the expectation of a worldwide economic recession.

This report is part of the APERC fossil fuel reports series, published annually. I hope this report will be one of the references by the policymakers across APEC to consider their energy security as well as plan their energy transition and decarbonisation program. I would also like to express my sincere gratitude to the authors and contributors for their time and effort in writing and publishing this report. I am also grateful to APEC member economies for providing updated data through the APEC Expert Group on Energy Data and Analysis.



Kazutomo IRIE

President

Asia Pacific Energy Research Centre

December 2022

Acknowledgements

We would like to take this opportunity to thank the APEC Expert Group on Energy Data and Analysis for supplying economy data, and researchers at APERC for providing the latest update on the gas development of each APEC economy. We also thank the administrative staff at APERC for their joint support role.

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Abbreviation and acronyms

Abbreviation

bbl	barrel
bcf/d	billion cubic feet per day
bcm	billion cubic meter
GJ	giga joule
kWh	kilowatt hour
m ³	cubic meter
Mtpa	million tonnes per annum
MMBtu	million British thermal units

Acronyms

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
EIA	Energy Information Administration
FSRU	Floating Storage Regasification Unit
IEA	International Energy Agency
JKM	Japan-Korea Marker
LNG	Liquefied Natural Gas
NEA	Northeast Asia
NBP	National Balancing Point
SEA	Southeast Asia
TTF	Title Transfer Facility
USA	United States of America

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Key Highlights

Asia-Pacific Economic Cooperation (APEC) economies accounted for 58% of the world's natural gas consumption in 2021. Four APEC economies remained among the world's five largest gas consumers in 2021: the United States, Russia, the People's Republic of China, and Canada. The United States is the world's largest natural gas consumer, with a total consumption of 858 bcm, accounting for 21% of the world's natural gas consumption in 2021. China's natural gas demand has increased by 175% since 2011, growing from 4% of the world's natural gas consumption in 2011 to 9% in 2021.

APEC natural gas consumption rebounded in 2021, surpassing the pre-COVID-19 pandemic level. Cold winter, a resumption of economic activities, and increased trade contributed to 'APEC's natural gas demand recovery in 2021. APEC natural gas consumption grew 5% in 2021 compared to 2020 and was 3% higher than in 2019.

Unprecedented high natural gas prices, tight supply, and a few months of strict lockdown in China will likely reverse 'APEC's post-COVID-19 pandemic demand growth in 2022. APEC natural gas consumption will decline slightly in 2022 as energy affordability becomes the main reason for the natural gas demand reduction, resulting from switching to lower-cost fuels and energy conservation activities.

APEC's share of the world's natural gas supply grew from 57% in 2011 to 61% in 2021, mainly contributed by 271% of shale gas production growth in the United States over the same period. The United States and Russia are APEC's leading natural gas producers, accounting for 69% of APEC natural gas production in 2022. Australia and China recorded the highest production growth in APEC from 2011 to 2021, 167% and 90%, respectively, contributed by both conventional and unconventional gas production growth.

APEC's natural gas production in Southeast Asia declined by an average of 1.1% per annum between 2011 to 2021. All APEC economies in the region face the same difficult situation, depleting natural gas resources. Indonesia recorded the most rapid production decline among the economies, a 28% reduction over a decade.

APEC remained a net natural gas exporter in 2021. APEC's total export volume was 108 bcm higher than the total import volume in 2021.

Australia was APEC's largest LNG exporter in 2021, and Russia remained the world's largest natural gas exporter via pipeline in the same year. The United States has become the world's largest LNG exporter and has the world's largest LNG export capacity in the first half of 2022. Most of the increase in the United States LNG export in 2022 replaced the Russian gas supply shortfall.

China became the world's largest LNG importer in 2021 but is likely to last only one year. Japan is expected to regain its position as the world's largest LNG importer in 2022 as China's total gas demand declines following several strict lockdowns in 2022 and increased coal use.

The uncertainty of the Russia-Ukraine war and the expected global economic recession will shape the natural gas market trends and developments in 2023. The trends and developments to watch:

- Global tight gas supplies as LNG import flows shifted from Asia to Europe due to the reduction of Russian gas into Europe, could prolong the high global natural gas spot prices in 2023.
- The flow of Russian LNG into Asia could increase in 2023 as most developing economies in Asia seek lower gas prices.

Section 1: Natural gas updates in APEC economies

Economy	Update
Australia	<ul style="list-style-type: none"> • Australia's natural gas consumption dropped by 5.1% to 40.4 bcm in 2021, a first-time drop between 2011 to 2021, mainly due to declining natural gas consumption in electricity generation. • Australia was the world's leading LNG exporter in 2021. LNG exports increased by 1.4%, from 102.6 bcm in 2020 to 104.1 bcm in 2021. • Prelude LNG export facility restarted production in April 2022 after a fire incident in December 2021. • An LNG import facility (FSRU) with a capacity of 150 000 cubic metres and to be powered by renewable energy was granted development approval in December 2021. It will be constructed in the Outer Harbour of Port Adelaide and is expected to be commissioned in the first half of 2024.
Brunei Darussalam	<ul style="list-style-type: none"> • Brunei's natural gas consumption decreased by 10.2% in 2021 from 2020 levels. • LNG exports declined by 8.6% in 2021, on the back of declining natural gas production.
Canada	<ul style="list-style-type: none"> • Canada's natural gas consumption rebounded by 6.1% to 136.8 bcm in 2021, surpassing the COVID-19 pre-pandemic level, and demand increased across sectors. • Natural gas production rose by 3.2% to 189.4 bcm in 2021, driven by increased domestic demand and exports to the United States. • The first LNG export facility, LNG Canada, with a 14 Mtpa capacity, is under construction and expected to start operation in 2025.
Chile	<ul style="list-style-type: none"> • Chile's natural gas consumption increased by 6.1% to 6.3 bcm in 2021, slightly lower by 0.5% than the COVID-19 pre-pandemic level. • Natural gas imports via pipeline from Argentina rebounded in 2021 and rose in the first half of 2022. Pipeline imports are expected to increase to 300,000 cubic metres per day until September 2023, subsequently reducing LNG imports and replacing declining domestic production.
China	<ul style="list-style-type: none"> • China's natural gas consumption continued the increasing rally in 2021, rising by 12% from the previous year, driven by increasing post-pandemic economic activities across sectors. • Natural gas production grew by 4.0% in 2021 and expected continue to grow in 2022 with the operation of the first large-scale ultra-deep-water gas field, Deep Sea No 1 since June 2021. • China was the world's largest LNG importer in 2021. LNG imports increased by 17.4% to 104.8 bcm from the previous year. Natural gas imports via pipeline grew by 22.8% to 58.0 bcm in 2021, primarily due to increased imports from Russia via the Power of Siberia pipeline.

Economy	Update
	<ul style="list-style-type: none"> Total LNG import terminal capacity reached 83.85 Mtpa, additional 6 Mtpa with the operation of Shandong LNG, Qingdao LNG and Zhoushan ENN LNG. Additional 75.42 Mtpa of capacity is under construction and expected to be in operation between 2022 and 2025.
Hong Kong, China	<ul style="list-style-type: none"> Hong Kong, China's natural gas consumption dropped by 3.3% to 5.4 bcm in 2021, a year after a significant increase in 2020, as staggered fuel switching from coal to gas for electricity generation takes place. The first LNG import terminal in Hong Kong, China, with a capacity of 1.2 Mtpa, is expected to commence operation in the first half of 2023.
Indonesia	<ul style="list-style-type: none"> Indonesia's natural gas consumption recovered in 2021, increasing by 3.0% to 40.2 bcm even though it was slightly lower than COVID-19 pre-pandemic level. Natural gas production continued with a downward trend in 2021, decreasing by 0.4% to 58.4 bcm due to depleting mature gas fields. However, natural gas production in Indonesia is expected to increase in 2022 and 2023 with additional recoverable reserves in the Meliwis gas field. LNG exports dropped by 3.8% to 14.99 bcm in 2021 due to declining gas production in Indonesia, coupled with the obligation of LNG producers to designate 25% of supply to the domestic market. LNG imports, specifically inter-state, increased by 18.8% to 0.19 bcm in 2021 with the reopening of the economy after COVID-19. LNG trade activities are expected to rise in 2023 with the completion of Sengkang LNG plant, and Java-1 and Cilacap FSRUs by the end of 2022 and early 2023.
Japan	<ul style="list-style-type: none"> Japan's natural gas consumption rebounded to 107.4 bcm in 2021 and surpassed the COVID-19 pre-pandemic level in 2019. It was driven by strong demand from the power sector due to the cold winter in early 2021. Despite the increase in consumption, LNG imports slipped by 0.2% to 98.8 bcm in 2021, its lowest level in the past decade. The declining trend is expected to continue for the next few years as Japan plans to increase nuclear share in the fuel mix for electricity generation by restarting their idled nuclear power plants.
Korea	<ul style="list-style-type: none"> Korea remained the third largest LNG importer in the APEC region in 2021. LNG imports grew by 15% in 2021 as LNG demand increased in line with the increase in economic activities. Korea plans to build four nuclear power plants by 2030 as one of the measures to reduce Korea's import dependence on fossil fuels in electricity generation.
Malaysia	<ul style="list-style-type: none"> Malaysia's natural gas consumption and production recovered in 2021, increasing by 2.0% and 6.9% from the previous year. The increase was lower than the 2019 level as Malaysia reopened its economic sectors in phases due to the resurgence of COVID-19 cases. LNG exports and natural gas exports via pipeline increased by 2.1% and 30.6%, respectively, as global demand recovered in 2021. In contrast, LNG imports and natural gas imports via pipeline declined by 29.2% and 11.9% in 2021, as the

Economy	Update
	<p>demand from the power sector fell due to increased natural gas prices in the second half of 2021.</p> <ul style="list-style-type: none"> • Malaysia's second Floating Liquefied Natural Gas (FLNG) was commissioned in February 2021 and sent its first LNG cargo to customer in March 2021. The operation of the second FLNG is expected to increase domestic exploration and production activities at remote and stranded gas fields.
Mexico	<ul style="list-style-type: none"> • Mexico's natural gas consumption grew by 5.7% to 73.6 bcm in 2021, slightly below the pre-pandemic level. • Natural gas production shrank to 30.6 bcm in 2021, 40% less than the 2011 level, due to depleting natural gas reserves and a lack of new discoveries. • LNG imports fall to less than 1 bcm in 2021, replaced by growing pipeline imports from USA. Total pipeline imports grew steadily and reached 61 bcm in 2021, more than fourfold the 2011 level, as more pipelines connecting West Texas to Central and Southwest Mexico began operation between 2019 to 2021. • First LNG liquefaction plant, Energia Costa Azul, with a capacity of 3.25 Mtpa is under construction and is expected to be in operation by the end of 2024.
New Zealand	<ul style="list-style-type: none"> • Gas production decreased by 13% in 2021, which was attributable to the significant decline in the output from the largest field, Pohokura. • Gas consumption registered declines across all end use sectors, including the power sector.
Papua New Guinea	<ul style="list-style-type: none"> • Gas production declined by 2% in 2021. Maintenance activities at the PNG LNG facility drove the decrease in its LNG export by 5% in the same year. • Economic recovery post-COVID-19 pandemic saw its overall consumption rebounding significantly by almost 22%. • TotalEnergies recently has signed a technical cooperation agreement with Australia-based Lakes Blue Energy for a potential exploration of Buna – estimated to contain 3.3 trillion cubic feet of natural gas – located offshore northern Papua New Guinea.
Peru	<ul style="list-style-type: none"> • Natural gas consumption rebounded by 17% in 2021, as Peru focused on its economic recovery following the COVID-19 pandemic. • While production declined marginally in 2021, LNG export decreased significantly by 28%. The export decline in 2021 was attributable to the repairs on a compressor at its 4.4 Mtpa Pampa Melchorita liquefaction plant, therefore making the plant offline between July and August.
Philippines	<ul style="list-style-type: none"> • A 14% decrease in production was recorded in 2021, continuing its declining trend from the domestic Malampaya gas field. Correspondingly, its consumption fell by the same magnitude, primarily driven by reduced gas input to the existing power plants for electricity generation. • Given the estimated depletion of the Malampaya gas field by early 2027, the Philippines is now transitioning towards LNG importation. As such, three new LNG import terminals are expected to commence operationalisation by early 2023.

Economy	Update
Russia	<ul style="list-style-type: none"> • Production rebounded by 10% in 2021, following a sharp drop in 2020 due to COVID-19 pandemic. Export and consumption also recorded increases of 3% and 16%, respectively. • Gazprom recently launched its 1.5 Mtpa, two-train Portovaya LNG liquefaction plant on the northern coast of the Gulf of Finland. An additional production train is being planned, potentially adding another 2 Mtpa of production capacity. • Other developments are also expected in the near term, which include: <ul style="list-style-type: none"> ○ Construction of a 'Power of Siberia 2' gas pipeline, connecting Russia and China via Mongolia in 2024; and ○ Construction of a 19.8 Mtpa Arctic LNG 2 liquefaction plant in Siberia in 2023 by Novatek.
Singapore	<ul style="list-style-type: none"> • Gas consumption increased marginally in 2021. However, re-export more than doubled amid increased demand for LNG within the Asia-Pacific region in 2021.
Chinese Taipei	<ul style="list-style-type: none"> • LNG imports reached an all-time high of 26 bcm in 2021, driven by increased demand. • CPC Corporation, in collaboration with Bechtel and MRY, begins construction of two LNG storage tanks, each with 180,000 m³ storage capacity, for the CPC Taichung Phase III LNG import terminal.
Thailand	<ul style="list-style-type: none"> • Production declined by 2% in 2021, primarily driven by declining Erawan gas field. LNG import surged by 12%, while consumption increased by 2%. • PTT is on track to commission the 7.5 Mtpa Nong Fab LNG terminal in October 2022. The terminal, however, has received its first cargo from Qatar in June 2022. • PTT also has agreed to a long-term 20-year deal to purchase 1 Mtpa of LNG from US Cheniere commencing 2026, indexed to the Henry Hub price plus a fixed liquefaction fee.
United States	<ul style="list-style-type: none"> • Production reached an all-time high of 966 bcm in 2021. • LNG export rose significantly by 25% in 2021, with China being the dominant importer. In addition, growth in exports is attributed to the start-up of a new production unit at Cheniere Energy Inc.'s Sabine Pass LNG export terminal in Louisiana. • Gas imports surged by 10%, attributable to the increase in pipeline gas from Canada in 2021. • United States became the world's largest LNG exporter in the first half of 2022 as LNG demand increased significantly from Europe since the Russia-Ukraine crisis began in the fourth quarter of 2021. • Three under-construction LNG export facility projects, Golden Pass LNG, Plaquemines LNG, and Corpus Christi Stage III, with a combined peak export capacity of 5.7 bcf/d (60 bcm), will start their commercial operation by 2025.
Viet Nam	<ul style="list-style-type: none"> • Domestic production and consumption continued their declining trend in 2021, registering a decrease of 19% in that year.

Economy	Update
	<ul style="list-style-type: none"> • Thi Vai LNG import terminal (Phase 1), with a capacity of 1 Mtpa is expected to begin commercial operations in 2023. • Son My LNG terminal, with a total installed capacity of 6 Mtpa (2 phase) is expected to begin commercial operations in 2026. The terminal will supply natural gas to southern Viet Nam, specifically to Son My power station and Son My 2 power station.

Section 2: Gas Demand

2-1 World and APEC natural gas demand

Global and APEC natural gas consumption has increased since 2011, with an exemption in 2020 due to the COVID-19 pandemic. APEC's gas consumption grew 28% from 1 853 bcm in 2011 to 2 375 bcm in 2021. The growth was higher than the global natural gas consumption growth at 22%, leading to the increase of APEC's share from 55% to 58% over the same period.

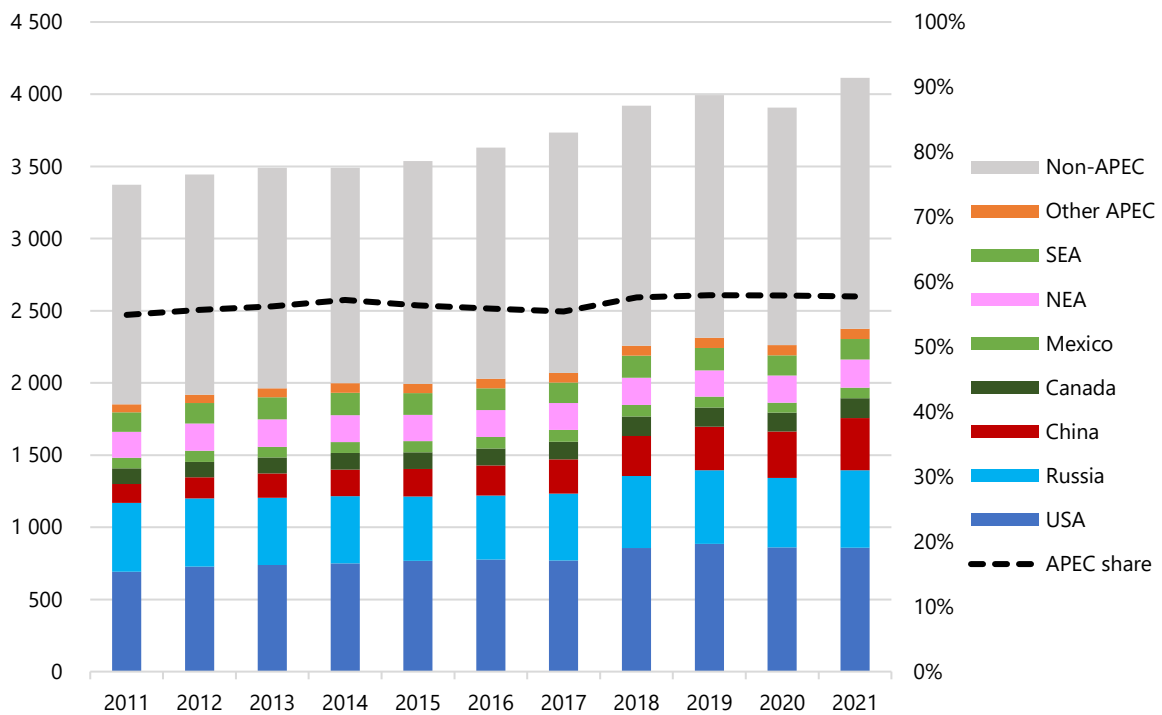
Global natural gas consumption reached above 4 000 bcm for the first time in 10 years, surpassing the 2019 level. Strong economic recovery from COVID-19 lockdowns, coupled with colder winters in Northeast Asia, Europe, and Russia and colder spring than usual in Europe, drove up consumption by above 5% in 2021 relative to 2020 levels. In addition, electricity from renewables was at its low level, driven by the low availability of wind and hydropower in Europe and global, respectively.

Global natural gas consumption grew above 6% for the first and second quarters of 2021. However, the growth slowed significantly in the second half of 2021, at 3% in the third quarter and 1% in the last quarter of 2021, due to high spot gas prices in Europe and Asia due to the tightening global gas market.

Three APEC member economies led the global gas consumption in 2021, United States remained the dominant natural gas user at 20.9%, followed by Russia at 13.1% and China at 8.8%. APEC natural gas consumption raised slightly higher than global natural gas consumption, 5.2% in 2021 relative to 2020 levels, driven by the consumption trend of the top three natural gas users. China and Russia registered the largest year-on-year increase of about 12%, while United States' demand contracted by 0.4%.

Natural gas consumption in Northeast Asia and Southeast Asia grew slower in 2021, 3.5% and 2.1%, respectively, due to the resurgence of new COVID-19 cases in the same year's first quarter and third quarters. Many economies in both regions implemented a strict lockdown, resumed economic activities, and reopened borders in phases.

Figure 2-1: Natural gas demand in APEC and the world, 2011-2021 (bcm)



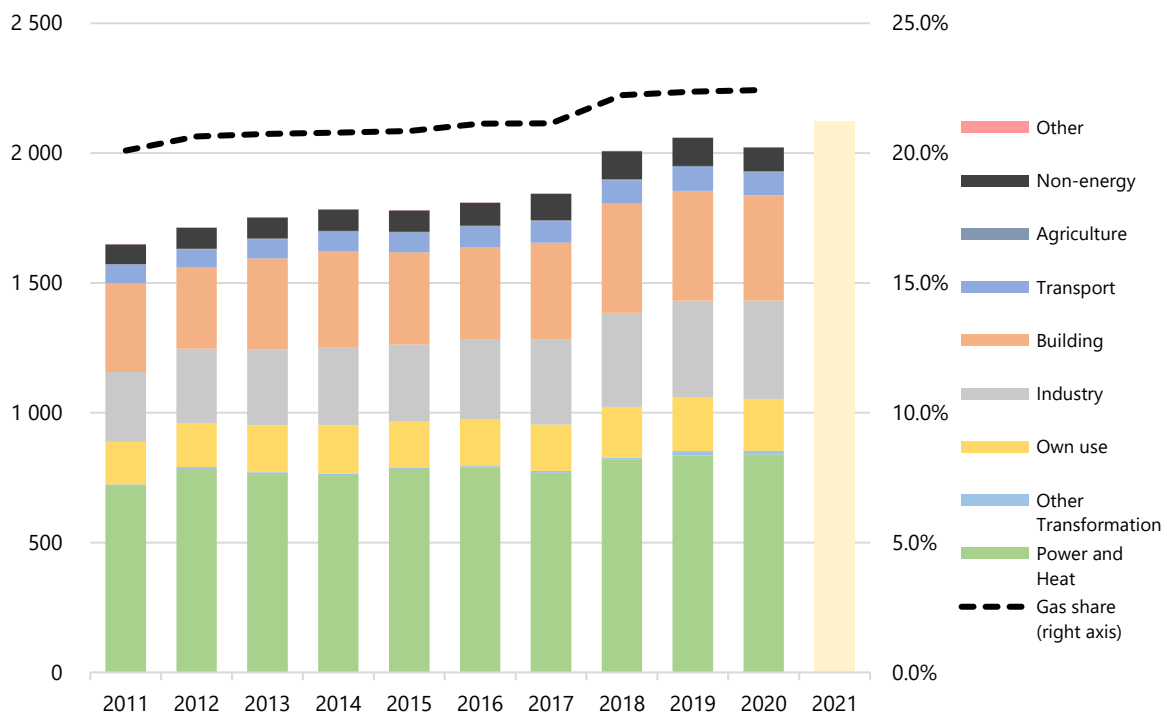
Source: IEA, Natural Gas Information 2022; CEDIGAZ

APEC consumed almost 840 bcm of natural gas for its power and heat generation in 2020, thus being the most dominant sector. Despite reduced economic activities due to the COVID-19 pandemic, the sector remained resilient in 2020 (0.4% growth from 2019 levels), supported by low benchmark natural gas prices in all regional gas hubs. Gas prices at the Henry Hub benchmark were at their lowest in 25 years, driven by milder winter and lower-end-used demands, and JKM LNG spot prices were at their lowest since its existence.

Buildings and industry sectors made up the next two major natural gas users. Like the power and heat sector, the industry remained resilient throughout the COVID-19 pandemic, with a slight uptick in demand. On the other hand, buildings experienced a drop of 4.2%, primarily driven by the lower demand in commercial and public buildings from increased work-from-home activities during the pandemic.

Feedstock volume for non-energy uses declined year-on-year by almost 15% within APEC, driven mainly by the significant fall in volume demand in the United States to produce fertilisers and methanol.

Figure 2-2: Natural gas demand in APEC by sector, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ; EGEDA; APERC analysis

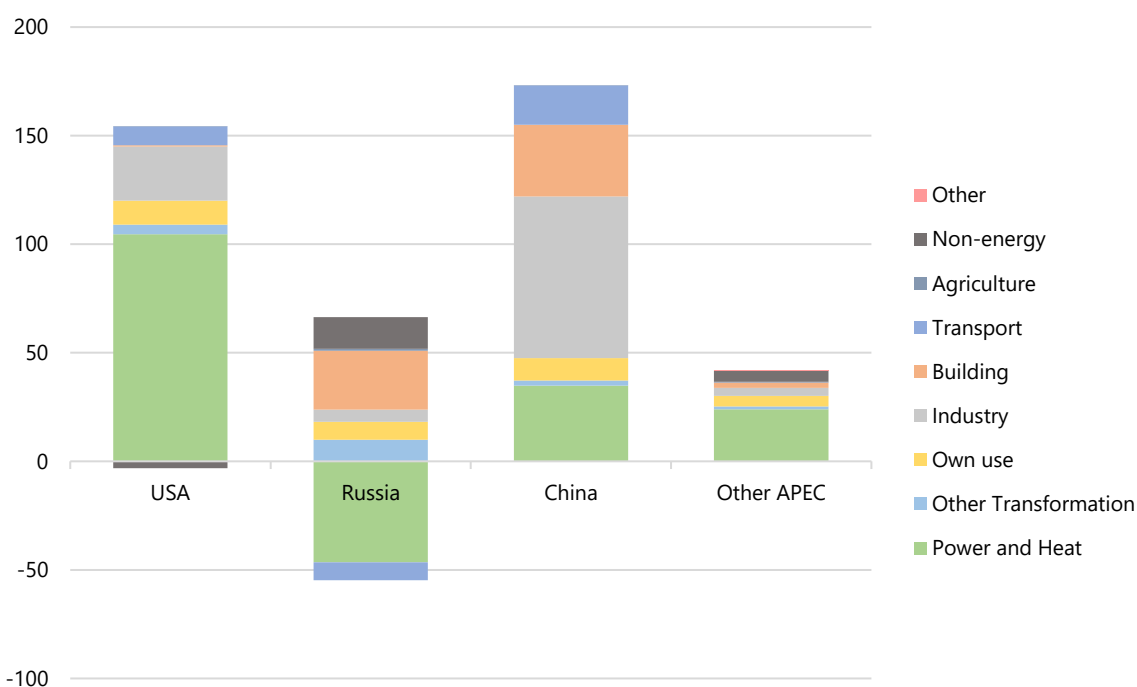
Economic activities in the top three natural gas users in APEC, the United States, Russia and China, led the changes in natural gas demand in APEC, accounting for 89% of the differences between 2011 and 2020.

Coal-to-gas transition in the United States, electricity generation has seen the natural gas demand increased by 105 bcm in 2020 relative to 2011 levels – the largest of all sectors. Its industry sector was the second largest, with an increase of 25 bcm as the sector's demand for coal waned between 2011 and 2020.

On the other hand, Russia experienced a decline of 47 bcm for its power and heat generation and 8 bcm for its transport in 2020 relative to 2011 levels due to the economic slowdown coupled with impact of COVID-19 pandemic. However, the decline was offset by more robust demand from other sectors, including heating in residential and commercial buildings, which required an additional 66 bcm of gas over the same period.

China's most significant gain in volumetric gas demand came from its industry sector, with almost 75 bcm between 2011 and 2020. The gain was mainly driven by its shift from coal to cleaner energy sources policy, especially coal to gas in industry and electricity generation.

Figure 2-3: Changes in natural gas demand in APEC by sector, 2011-2020 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ; EGEDA

2-1-1 United States

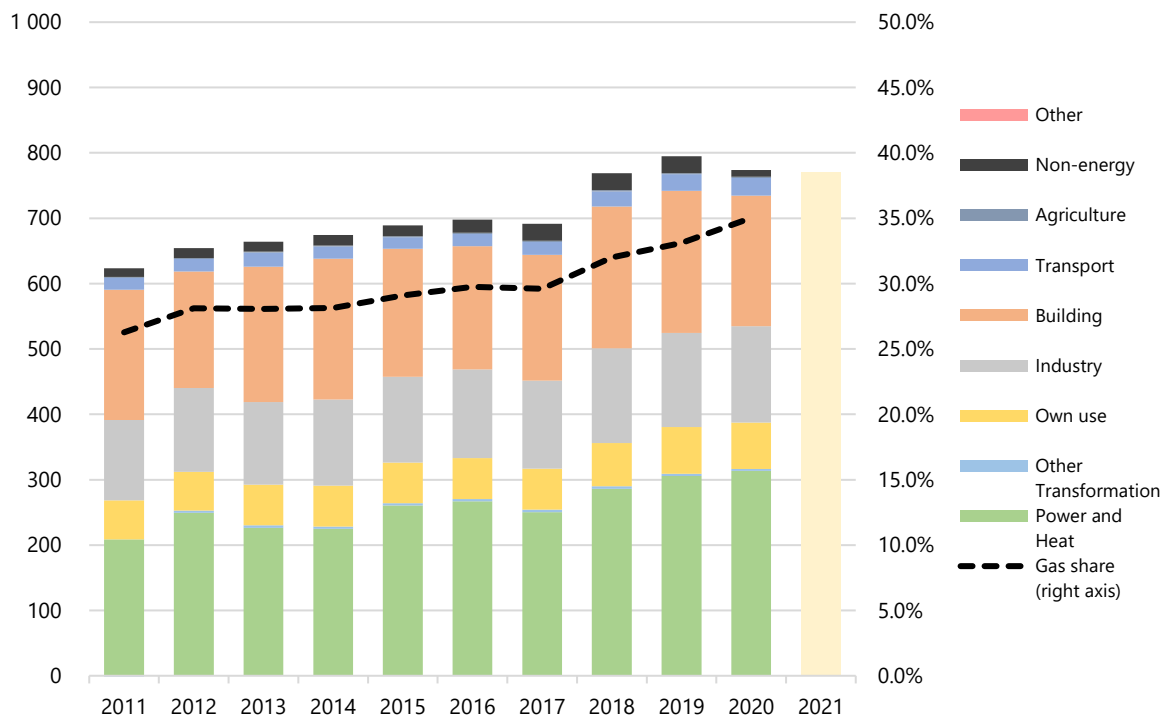
The United States has been the global leader in natural gas consumption over the past decade, through which its demand has grown by 24%. The impact of COVID-19 pandemic has seen the economy consumed about 774 bcm in 2020, 21 bcm lower than the highest level recorded in 2019 (795 bcm).

Power sector has been the dominant user, accounting for 40% of the total gas consumption in 2020, followed by buildings (26%) and industry (19%) sectors. Over the past decade, coal-to-gas transformation in the United States' electricity generation mix has increased the gas demand by 50%.

While power and industry sectors showed resilience throughout the COVID-19 pandemic, buildings sector recorded a significant fall of 17 bcm in its volumetric demand in 2020, relative to the previous year levels. Warmer winter months in 2020 resulted in declining heating requirements in both residential and commercial buildings, in addition to reduced work-from-office activities for the latter brought about by COVID-19 pandemic.

United States utilises a small volume of natural gas for synthesising agriculture fertilisers and methanol. Reduced production of these commodities driven by COVID-19 pandemic has driven down the 2020 natural gas demand to the lowest level in a decade.

Figure 2-4: Natural gas demand in United States by sector, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ

2-1-2 Russia

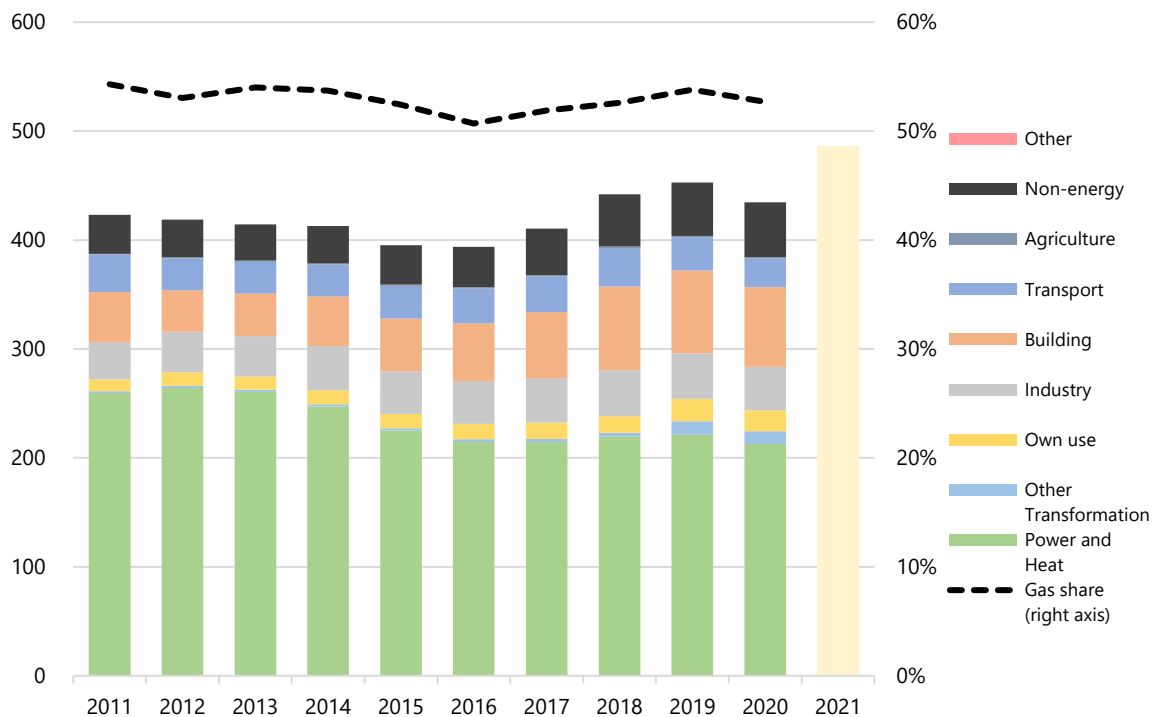
The economic situation influenced annual natural gas consumption growth in Russia. For the past decade, consumption was at its lowest in 2016 due to the economy contracting 2% in the previous year. The consumption started recovering in 2017 before being halted by the COVID-19 pandemic in 2020.

Russia remained the world's second-largest natural gas user in 2020, even though its natural gas consumption fell (4%) for the first time after growing in three consecutive years, resulting from low economic activities due to the COVID-19 pandemic.

Russia consumed almost 435 bcm of natural gas in 2020, of which power and heat accounted for nearly half of the consumption. Building represented 17% of the consumption in 2020 and showed significant growth among other sectors, doubling from 2011 to 2018 before declining in 2019.

The percentage of natural gas consumption by sector in Russia has been consistent in the past decade as natural gas prices are relatively low for end consumers and regulated by the Russian state.

Figure 2-5: Natural gas demand in Russia by sector, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ

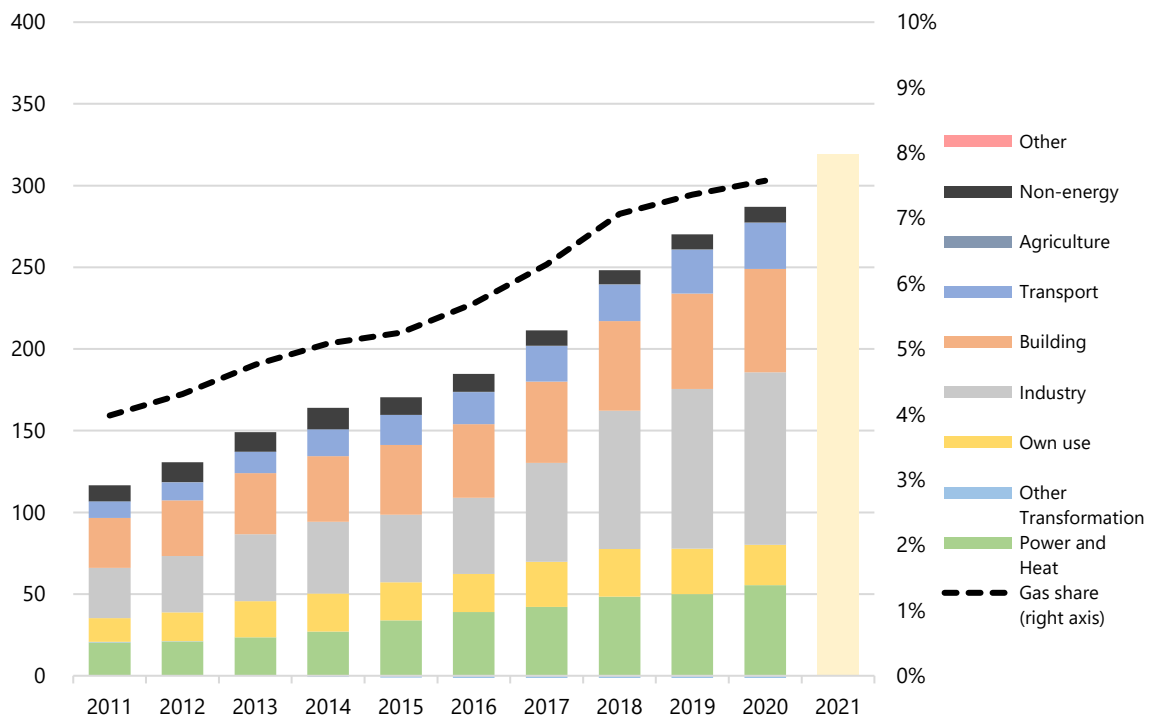
2-1-3 China

China's natural gas consumption grew in 2020 despite declining consumption trend in most APEC economies due to the COVID-19 pandemic. Unlike other APEC member economies' final energy demand structure, the industry has been the largest natural gas user in China, leading the growth of natural gas consumption for the past decade. Since 2011, the industry has recorded the highest growth among other sectors except in 2015 due to the economic slowdown. Industry's consumption tripled in 2020 compared to 2011 and was above one-third of the total consumption in 2020.

Building and power, and heat sectors are China's second and third largest natural gas users, accounting for 31% of total consumption in 2020. Both sectors consistently grew from 1% to 4% since 2011, supported by the shift from coal to clean energy resources, particularly in electricity generation, as China committed to reducing its local air pollution.

Total natural gas consumption in China increased by 12% in 2021, mainly contributed by the cold winter in the first quarter and a strong rebound in economic activity in the first half of 2021. However, the growth slowed in the second half of 2021 as natural gas prices increased significantly due to the tight supply market.

Figure 2-6: Natural gas demand in China by sector, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ

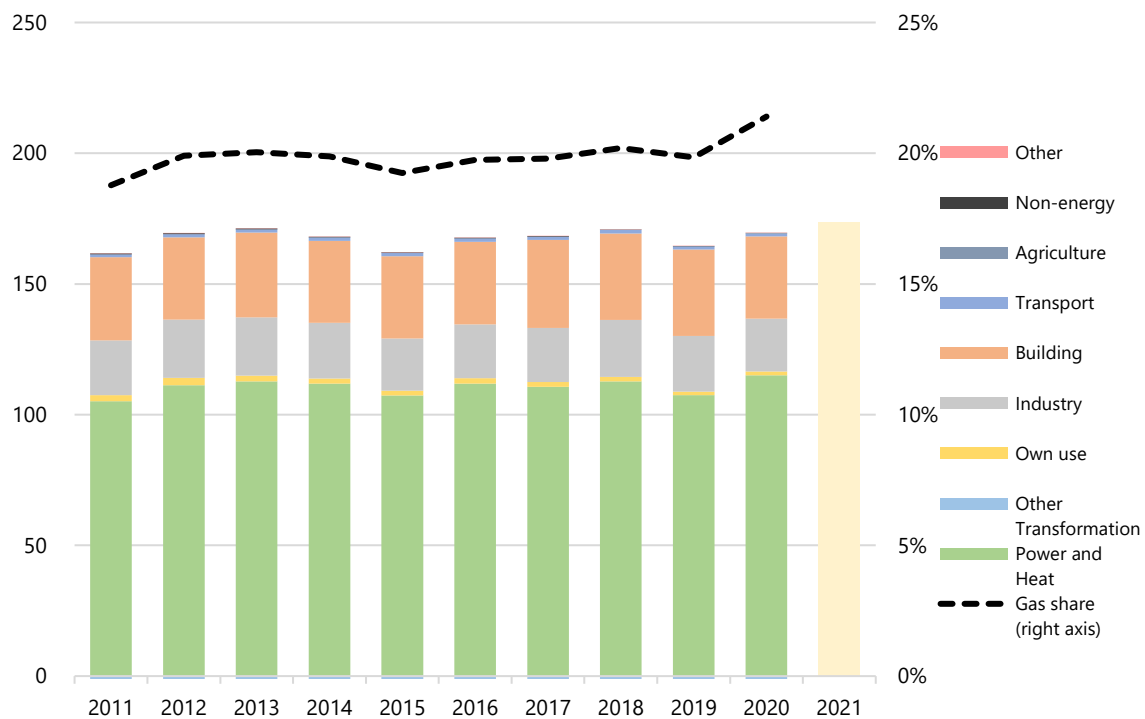
2-1-4 Northeast Asia

Northeast Asia economies (Hong Kong, China; Japan; Korea and Chinese Taipei) depend almost 100% of their natural gas demand on imported LNG and pipeline gas. Between 2011 and 2020, total gas consumption grew modestly by 5%, driven by demand growth of 9.8 bcm in the power and heat sector. The rest of the sectors, however, experienced demand declines. Industry sector registered contractions of 3% due to reduced economic activity driven by COVID-19 pandemic lockdown in 2020 while building sector's gas demand reduced by 1%.

Japan remained the dominant natural gas user within the region, accounting for about 60% of the total share on average over the last decade. Despite its dominance, there has been a gradual decline in Japan's natural gas demand throughout the same period, driven by a confluence of factors in its power sector, including growth in electricity generation from coal and solar.

Apart from Japan, other Northeast Asia economies registered growths in their gas demand, mainly in meeting the demand for their power sector. The region's second-largest user, Korea, expanded its demand by 21% over the last decade. Chinese Taipei and Hong Kong, China recorded the largest growth of 60% and 59%, respectively, throughout the same period.

Figure 2-7: Natural gas demand in Northeast Asia by sector, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ

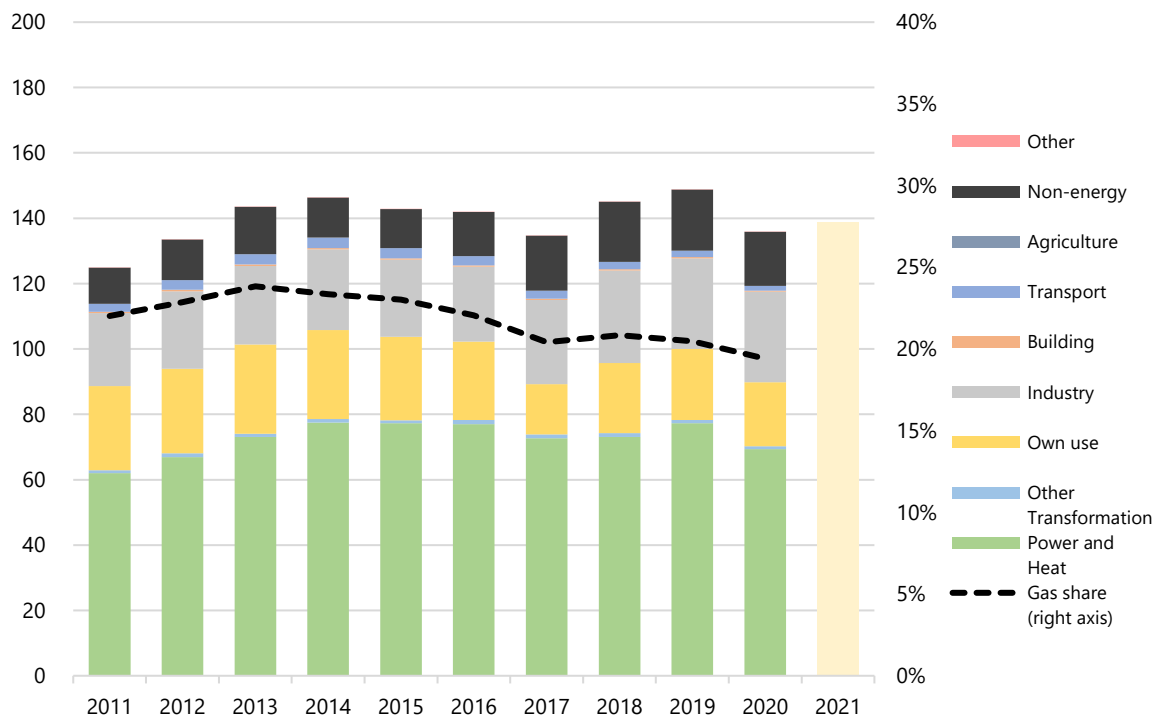
2-1-5 Southeast Asia

The Southeast Asia economies (Brunei Darussalam; Indonesia; Malaysia, the Philippines; Singapore; Thailand; and Viet Nam) recorded a 9% growth or an increase of 11 bcm in 2020, compared to 2011 level. In 2020, natural gas demand in Southeast Asia recorded the most significant drop, by almost 13 bcm in a year since 2011 due to a reduction of natural gas input for electricity generation and industry in the region.

The power and heat sector remained Southeast Asia's primary natural gas users in 2020. The power and heat sector share grew from 50% in 2011 to 54% in 2016 before declining to 52% in 2020 as Indonesia, Malaysia, Thailand, and Viet Nam are shifting from gas to coal in their electricity generation mix. The main factors that drove the shift were the affordable coal cost as the least cost option has been adopted for the dispatch of electricity generating units and the availability of domestic coal resources in this region.

On the other hand, the share of gas requirements in industry sector expanded from 18% to 20% over the same period, indicating that the gas demand in the industry sector was partly driven by the region's growth in gross domestic product (GDP).

Figure 2-8: Natural gas demand in Southeast Asia by sector, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ

2-2 Gas demand outlook

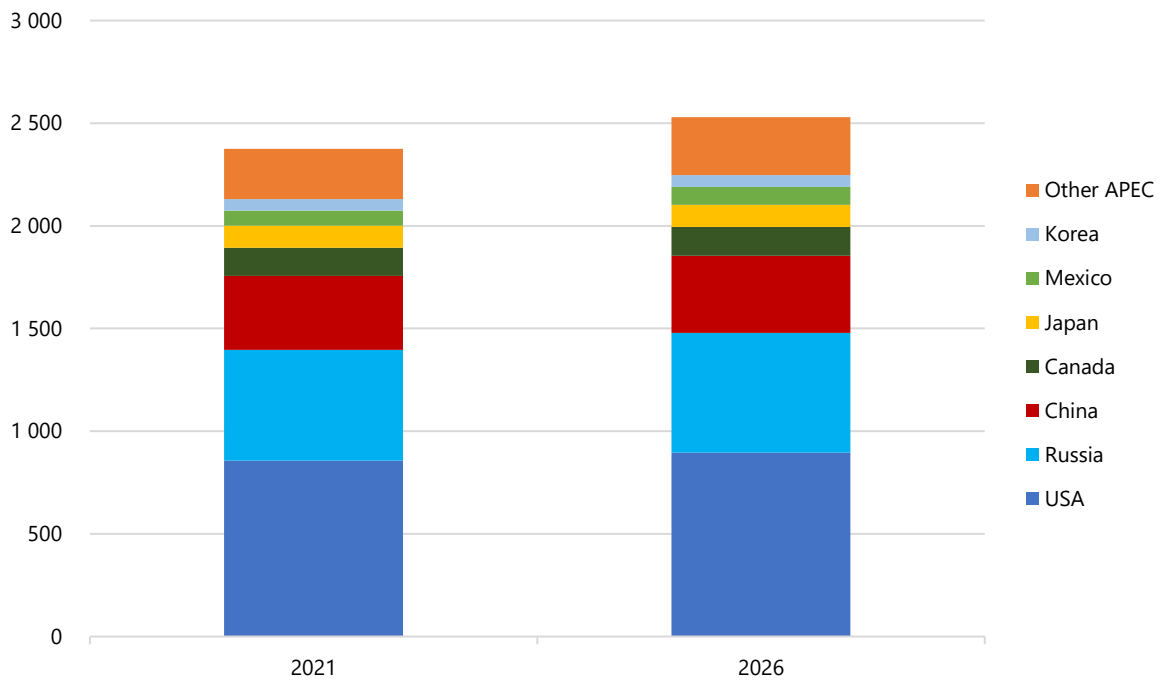
Economic response and recovery initiatives carried out by APEC economies have seen a rebound in APEC's overall gas demand that reached an all-time high in 2021 from 2020 levels. Furthermore, the Reference Scenario of the recently launched 8th Edition of the APEC Energy Demand and Supply Outlook envisaged an increase of almost 155 bcm in APEC's total gas demand between 2021 and 2026, corresponding to an annual growth of 1.3%. Much of this increase is expected to originate from Russia and United States, with an increase of 45 bcm and 39 bcm, respectively.

Southeast Asia is also expected to expand its gas demand at a rate of 4.2% per annum, corresponding to a volumetric increase of 13 bcm over the next five years. Much of this increase is coming from Indonesia (6 bcm), as the economy aims to displace coal with gas and thus making gas as the dominant source of Indonesia's electricity generation. Similarly, Malaysia's plans to halt new coal power plants in the future will see a sizeable increase in gas requirements for its power sector (4.1 bcm). Marginal growths are expected in other Southeast Asia economies in Brunei Darussalam, the Philippines, Singapore, Thailand and Viet Nam. Elsewhere, other Americas region's gas demand is forecasted to grow at a slower pace of 1.4% annually, with most growth happening in Mexico. On the other hand, a growth of 0.3% per year is expected in both Northeast Asia and Oceania regions.

It should be noted that the 8th Outlook projection, inclusive of gas demand analysis was carried out before the Russia-Ukraine conflict, when the gas price was still low. The conflict has brought about spikes in TTF-indexed gas price throughout 2022, reaching over USD70/MMBtu in August before declining to about USD39/MMBtu two months later. The actual demand may deviate from this

Outlook, given the current situation of high gas prices, its tight supply market, the conflict, and global economic slowdown.

Figure 2-9: Natural gas demand outlook in APEC economies, 2021-2026 (bcm)



Source: APEC Energy Demand and Supply Outlook 8th Edition

Section 3: Gas supply

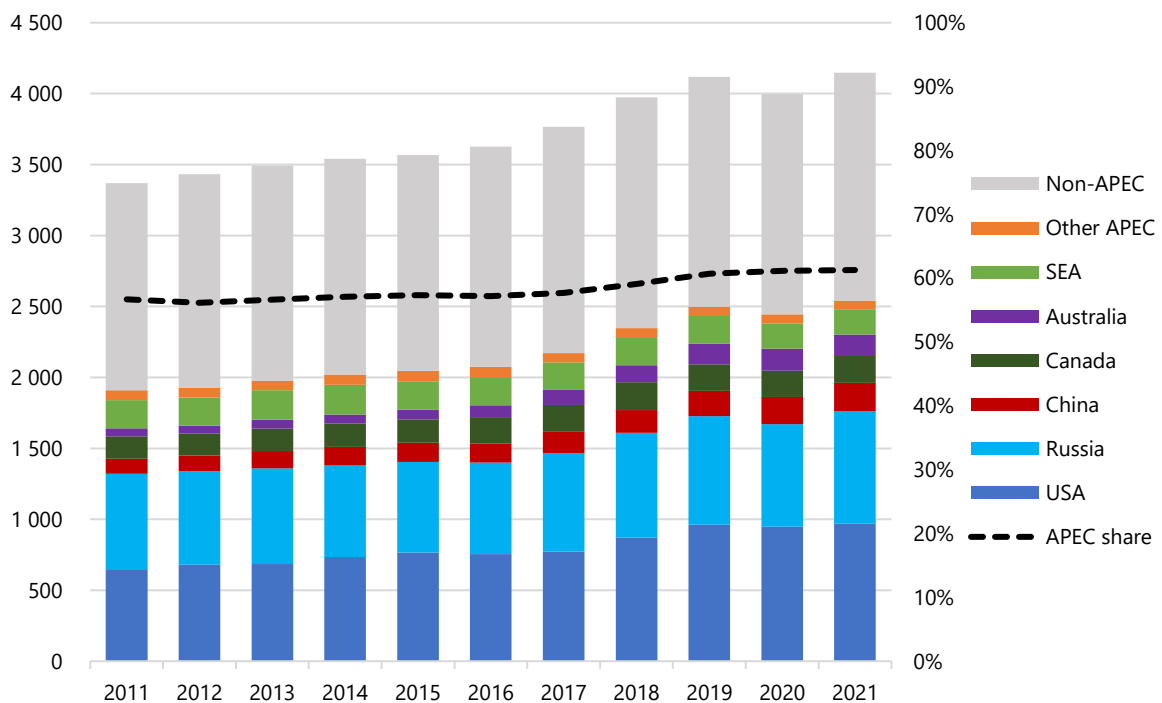
3-1 World and APEC natural gas supply

Over the last decade, most of the world's gas production has been coming from the APEC region, with the region's production increased from 1 910 bcm in 2011 to 2 542 bcm in 2021. APEC's share of the world's natural gas supply thus represented over 61% in 2021. On the other hand, production from non-APEC region increased by only 10% throughout.

The United States and Russia remained the two largest gas producers within APEC, accounting for 37% and 32% of the overall APEC production on average, respectively between 2011 and 2021. Over the same period, the greatest volumetric increase in the production came from Australia, whose production increased by over 2.5-fold from 56 bcm to 151 bcm. China also registered a substantial increase of almost twice, from 105 bcm to 200 bcm.

Southeast Asia and other APEC regions registered declines in their productions by 10% and 13%, respectively.

Figure 3-1: Natural gas production in APEC, 2011-2021 (bcm)



Source: IEA, Natural Gas Information 2022; CEDIGAZ

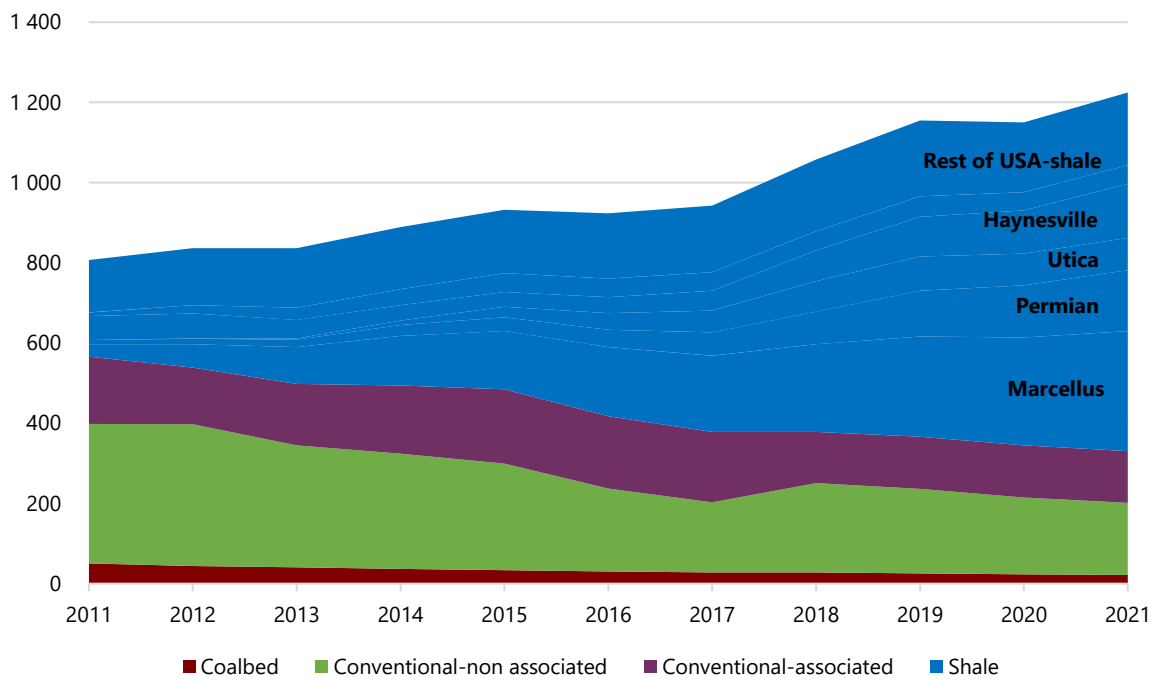
3-1-1 United States

United States retained its status as the biggest natural gas producer in APEC in 2021. Total production grew from 1 150 bcm in 2020 to 1 224 bcm in 2021, representing a 6% increase.

Over the last decade, shale gas has been the main driver of the economy's gas production, with its production share increased from only 30% in 2011 to 73% in 2021. Investments in horizontal wells drilling and hydraulic fracturing techniques have driven down the cost of gas production, therefore giving rise to shale gas revolution. The Marcellus formation beneath the Appalachian Basin in the eastern United States produced almost 300 bcm of dry gas, which is equivalent to about 33% of the United States' total shale gas production in 2021. The Permian basin, located in West Texas and Southeast New Mexico, accounted for the second largest shale gas production, with a production of 152 bcm in 2021.

The substantial rise in shale gas coincides with declines in production from other types over the last decade. The share of conventional (non-associated) gas production decreased by 28%, while that of conventional (associated) also fell by 10% between 2011 and 2021.

Figure 3-2: Natural gas production in United States, 2011-2021 (bcm)



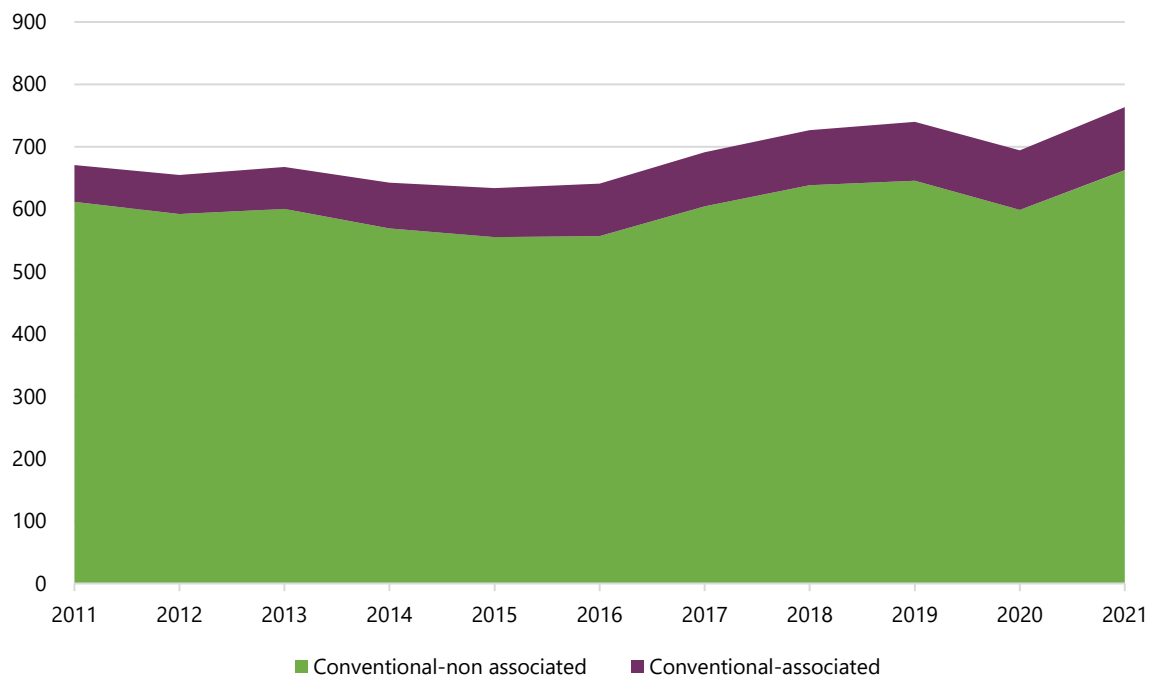
Source: U.S. Energy Information Administration (EIA)

3-1-2 Russia

Russia is the second largest natural gas producer in APEC. Following the COVID-19 pandemic in 2020 that saw Russia's gas production declined by 6%, there was a substantial rebound in the production, reaching an all-time high of 764 bcm in 2021.

Western Siberia has been the largest source of Russia's conventional gas production over the last decade. In 2021, the area produced 595 bcm of gas, accounting for 90% of the total conventional production in that year. The remaining 10% of production, equivalent to 67 bcm, came from Eastern Siberia and Far East, and other territories.

Figure 3-3: Natural gas production in Russia, 2011-2021 (bcm)



Source: ROSSTAT, 2022

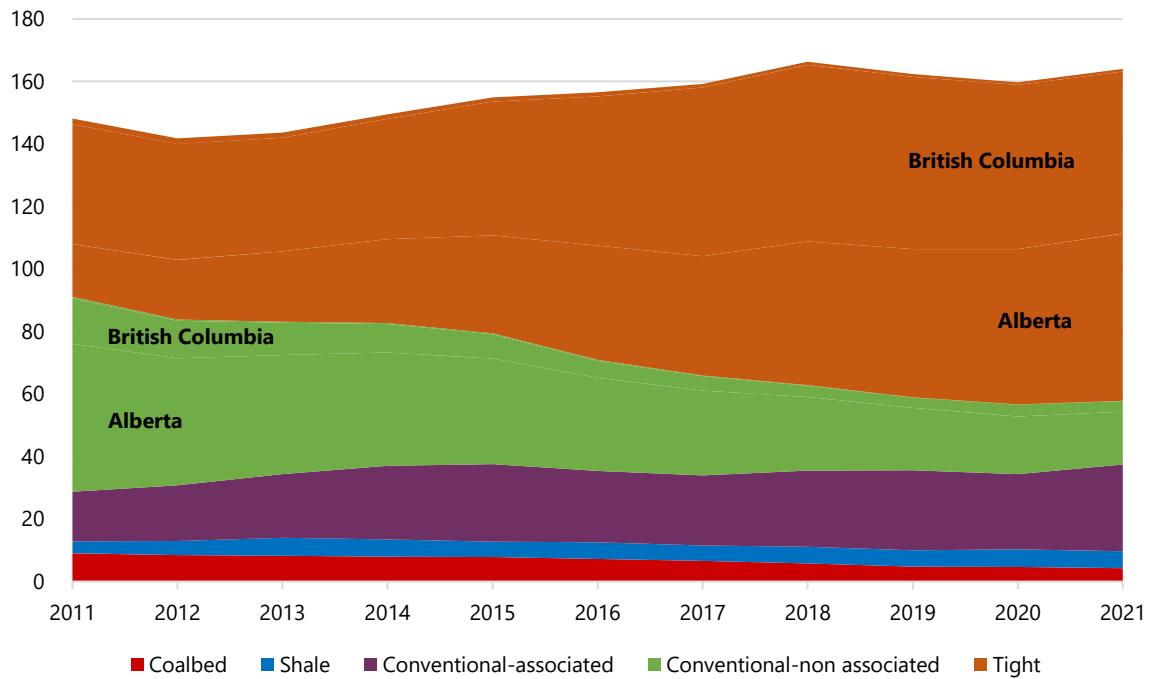
3-1-3 Canada

Canada's production reached 164 bcm in 2021, following a 3% growth on a year-on-year basis. Majority of the production originates from the Western Canadian Sedimentary Basin (WCSB), covering the provinces of Alberta, British Columbia and Saskatchewan.

Unconventional tight gas production from Alberta, British Columbia and Saskatchewan provinces accounted for about 65% of total gas production in 2021. Over the last decade, tight gas production has grown considerably from its 2011 share of 38% to 65% in 2021. Shale gas production remained marginal in 2021, producing only 5 bcm.

The increase in tight gas production helps offset declines in conventional (non-associated) production from Alberta and British Columbia, which has dropped by 68% between 2011 and 2021. The increase of 75% in conventional (associated) production between the same period has also contributed to the stability of Canada's total gas production.

Figure 3-4: Natural gas production (marketed production) in Canada, 2011-2021 (bcm)



Source: Canada Energy Regulator, Canada's Energy Future 2021

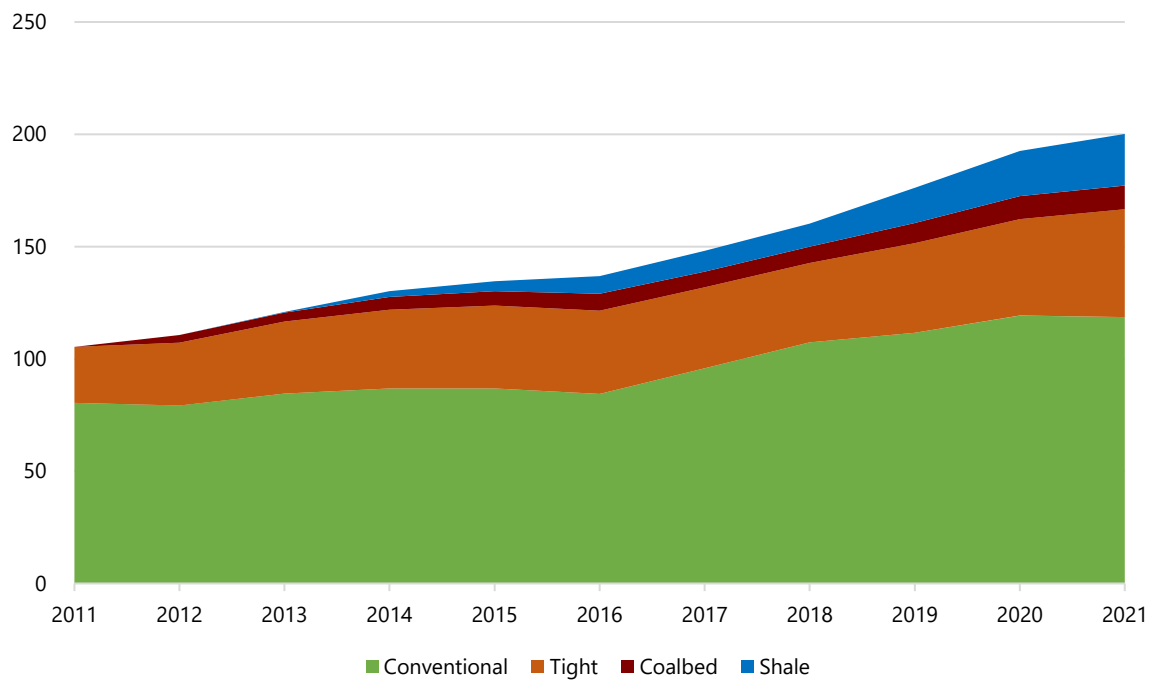
3-1-4 China

China's gas production increased by 7.6 bcm in 2021, despite of it being a slower growth compared to the previous year. Conventional gas production accounted for 59% of the total production in 2021, albeit declining marginally year-on-year. Tight gas production contributed 24% of the overall production, followed by shale gas at 11% and coalbed gas production at 5%.

Shale gas production has experienced a substantial growth of over 110 times since China commenced its production in 2012, spurred by higher investments to exploit unconventional gas resources. Despite that, shale gas production of 2.2 bcf/d (23 bcm) in 2021 was still below the government's 2020 target of 2.9 bcf/d (30 bcm), equivalent to almost 30 bcm annually. Although most of the shale gas reserves are concentrated in Sichuan, Yangtze and Tarim basins, almost all shale gas extraction activity is limited to the Sichuan basin in central China.

Tight gas production in China has grown since 2010, when companies initiated an active drilling program that lowered the drilling cost per vertical well and improved well productivity. In 2021, China's produced 4.6 bcf/d (48 bcm) of gas from tight formations, up from 1.6 bcf/d(17 bcm) in 2010.

Figure 3-5: Natural gas production in China, 2011-2021 (bcm)



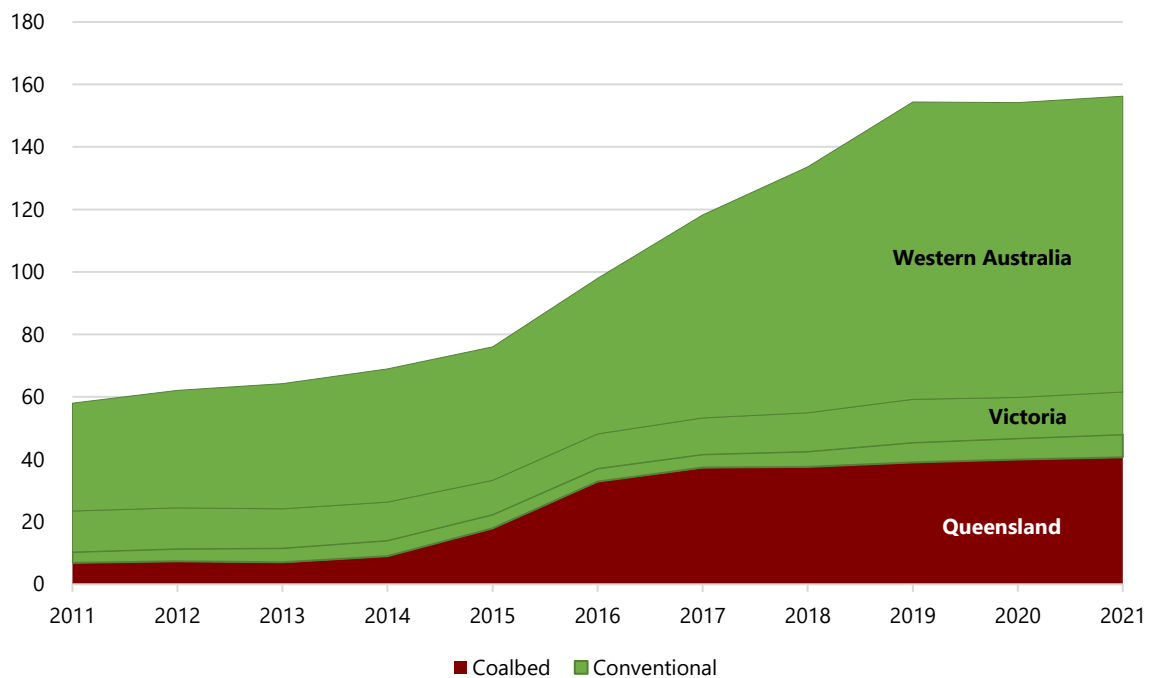
Source: IEA, *Natural Gas Information 2022*, www.polymerupdate.com, www.hydrocarbonengineering.com, www.spglobal.com

3-1-5 Australia

Australia's natural gas production increased marginally by 2%, reaching 156 bcm in 2021. Conventional gas and coalbed gas remain Australia's vital resources for gas production. Substantial conventional gas production came from Western Australia, accounting for 61% of the total production in 2021, while Victoria and other regions contribute another 14%. On the other hand, coalbed gas production from Queensland region was almost 41 bcm in 2021, which accounted for 26% of Australia's gas production.

Since the initiation of the economy's first coalbed gas-to-LNG export terminals in Queensland for exports to Asian markets in 2015, the share of total coalbed gas production has risen substantially from just 12% a decade ago to 26% in 2021. On the other hand, the contribution of overall conventional gas production declined from 88% in 2011 to 74% in 2021, albeit significant rise in production from Western Australia.

Figure 3-6: Natural gas production in Australia, 2011-2021 (bcm)



Source: Department of Climate Change, Energy, the Environment and Water

3-1-6 Southeast Asia

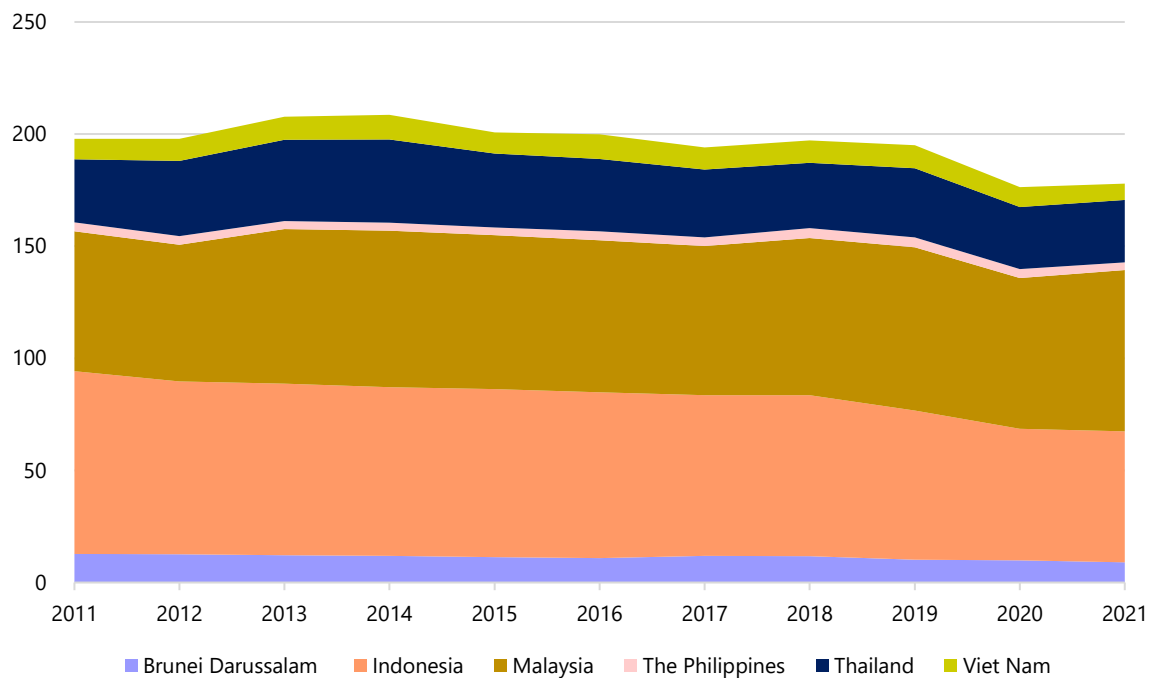
Southeast Asia's gas production has been on the decline since 2011, despite a marginal rebound of 0.9% in 2021 from 2020 levels. Almost all the region's gas-producing economies experienced production declines, apart from Malaysia whose production expanded steadily over the past decade.

Indonesia was the region's dominant natural gas producer ahead of Malaysia prior to 2018. However, a decline of 28% from almost 82 bcm in 2011 to 58 bcm in 2021 was partly due to policies and regulations that limit private sector participation. In addition, lack of new discoveries forced the operators to resort to maturing existing gas fields to look for new yields.

Malaysia registered a 15% increase from 62 bcm to almost 72 bcm over the same period. Production is primarily influenced by the demand from power and industry sectors, which collectively increased by 18% between 2011 and 2020. A boost in production also was due to several projects that came online between 2017 and 2020 which include NC3, NC8 and Kanowit fields offshore Sarawak state, and Telok, Bertam and Damar fields off the coast of Peninsular Malaysia, in addition to several upgrade work to increase output at older fields in Baram Delta basin in Sarawak.

Thailand, who remained the third largest Southeast Asia gas producer, peaked its total production in 2014 at 37 bcm due to the boost in its largest asset, the Erawan field. However, output decline from the Erawan asset substantially influenced the overall production from 2014 onwards until 2021, where production reached almost 28 bcm. As a result, Thailand is expanding its dependence on pipeline gas from Yadana, Yetagun and Zawtika gas fields in neighbouring Myanmar as well as LNG imports to meet the production shortfall.

Figure 3-7: Natural gas production in Southeast Asia, 2011-2021 (bcm)



Source: IEA, *Natural Gas Information 2022*

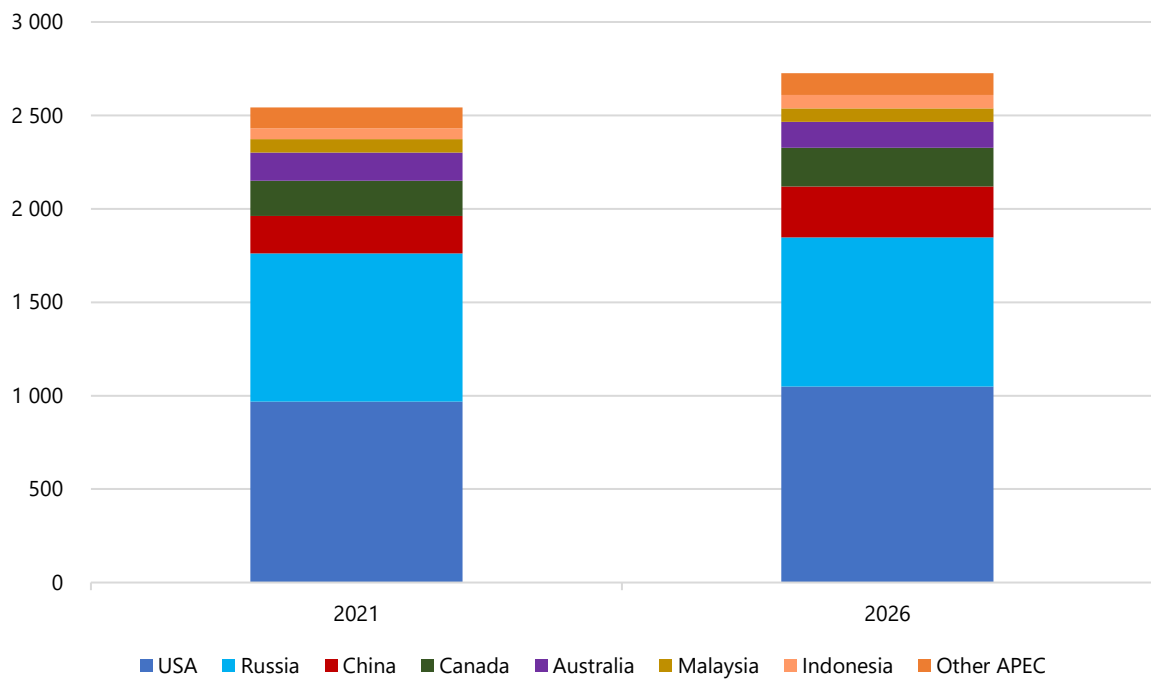
3-2 Gas production outlook

APEC's total gas production is expected to increase by 7.2% between 2021 and 2026, from 2 542 bcm to 2 726 bcm, based on the Reference Scenario of the 8th Edition of the APEC Energy Demand and Supply Outlook.

The United States is expected to retain its status as the largest gas producer, as well as projected to have the largest gain in gas production of almost 81 bcm over the next five years. Russia is envisaged to remain the second most dominant producer, despite having a marginal increase of 5.5 bcm over the same period. Alongside the United States, China is also forecasted to substantially increase its production by 72 bcm, followed by Canada and Indonesia with increases of 17 bcm and 13 bcm respectively.

While Malaysia's gas production is expected to be stable over the next six years, Australia is the only economy that is envisaged to decrease its production from 151 bcm to 138 bcm over the same period.

Figure 3-8: Natural gas production outlook in APEC economies, 2021-2026 (bcm)



Source: CEDIGAZ; APEC Energy Supply and Demand Outlook 8th Edition, 2022

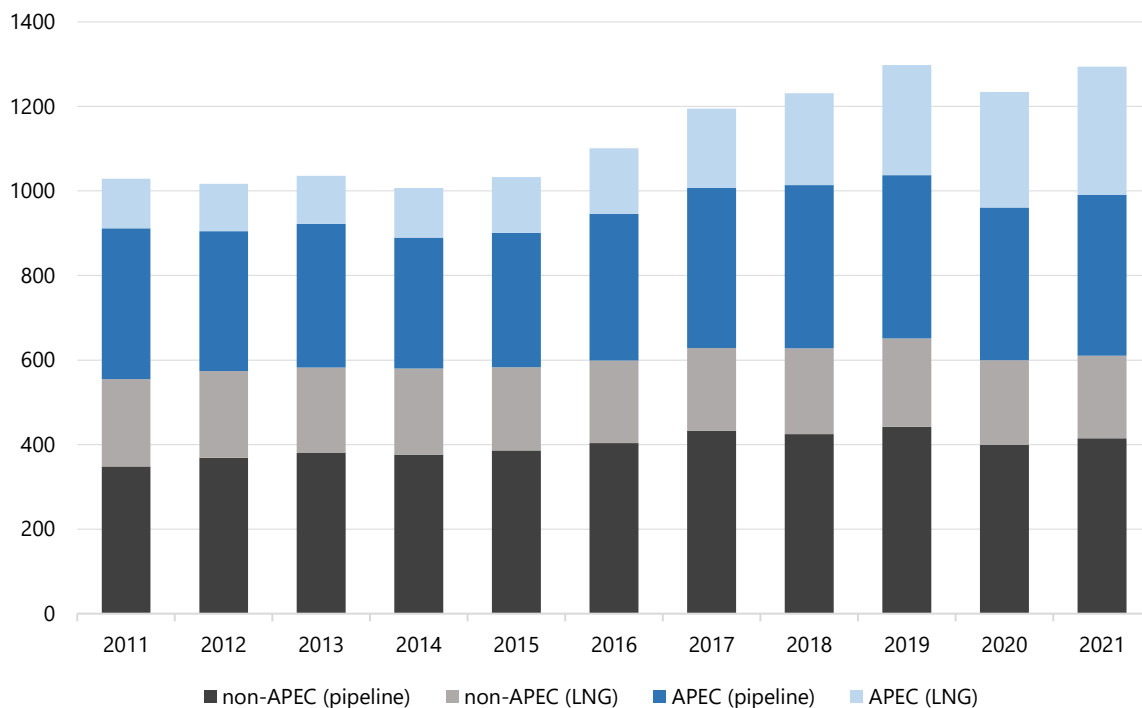
Section 4: Gas trade

4-1 World and APEC natural gas trade

Global natural gas trade amounted to 1 294 bcm in 2021 – an increase of almost 5% from the previous year (1 234 bcm). Global LNG trade rose by over 5% over the same period, following a flat growth between 2019 and 2020 during the COVID-19 pandemic that influenced the global gas demand. Most of the LNG trade has taken place in the APEC region, where it rose by almost 11% from 273 bcm to 303 bcm, whereas the non-APEC LNG trade contracted by over 2% over the same period.

World pipeline gas trade also registered a growth of 4.6% over the same period, with most of the increase originating from the APEC region (5.5% or 20 bcm increase).

Figure 4-1: Natural gas trade, 2011-2021 (bcm)



Source: CEDIGAZ

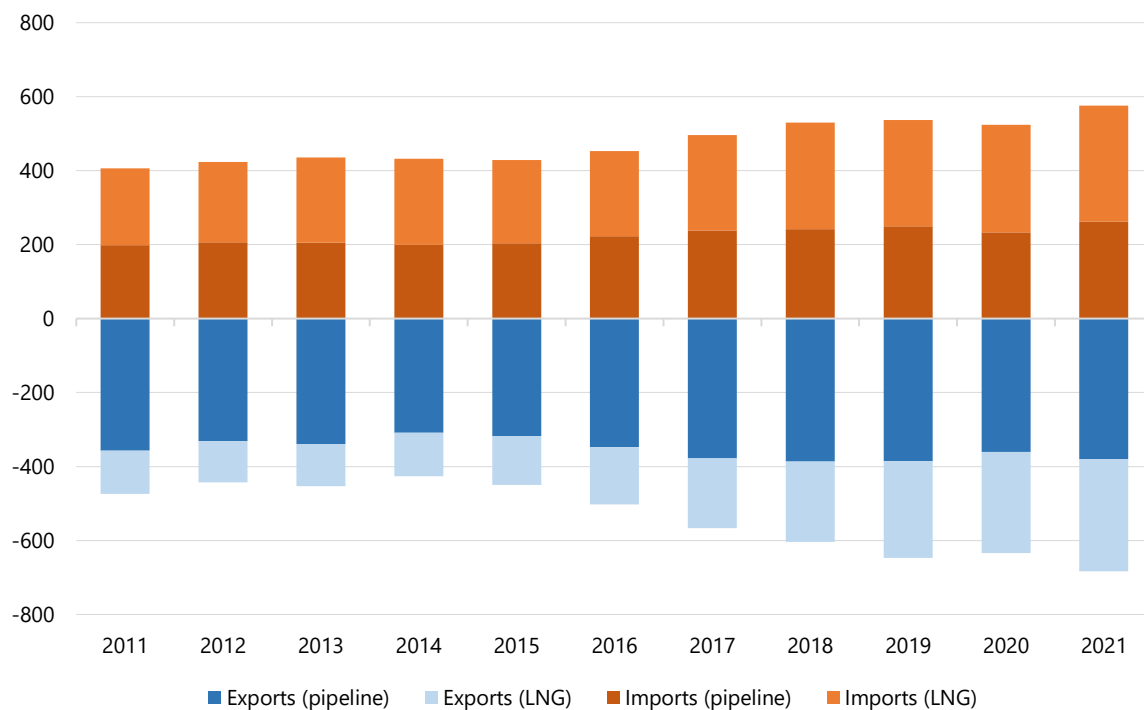
APEC's exports volume has been consistently on the higher side compared to imported gas volume over the past decade, except for 2014 when exports from Russia decreased due to lower demand from Ukraine and some European Union economies. Total APEC exports volume increased by 8% or almost 50 bcm in 2021, with LNG exports being dominant (30 bcm increase) over pipeline export (20 bcm increase). Nonetheless, pipeline exports accounted for 56% of the total exports in 2021, as Russia at present houses large pipeline infrastructure that is destined for several non-APEC economies, predominantly in Europe.

On the other hand, LNG imports volume rose by 10% or almost 52 bcm in 2021 – the first time that the growth rate has reached two digits over the last decade – as China purchased more LNG than any

other economy in the world in that year. In aggregate, LNG imports contributed 54% of the total imports in 2021, as compared to 46% contribution from pipeline imports.

Over the past decade, shares of pipeline gas activities (import and export) have been declining, while those of LNG activities have been on the rise, thanks to the recent expansion of liquefaction and regasification terminals and increased flexibility of the LNG trade within the APEC region.

Figure 4-2: APEC natural gas trade, 2011-2021 (bcm)

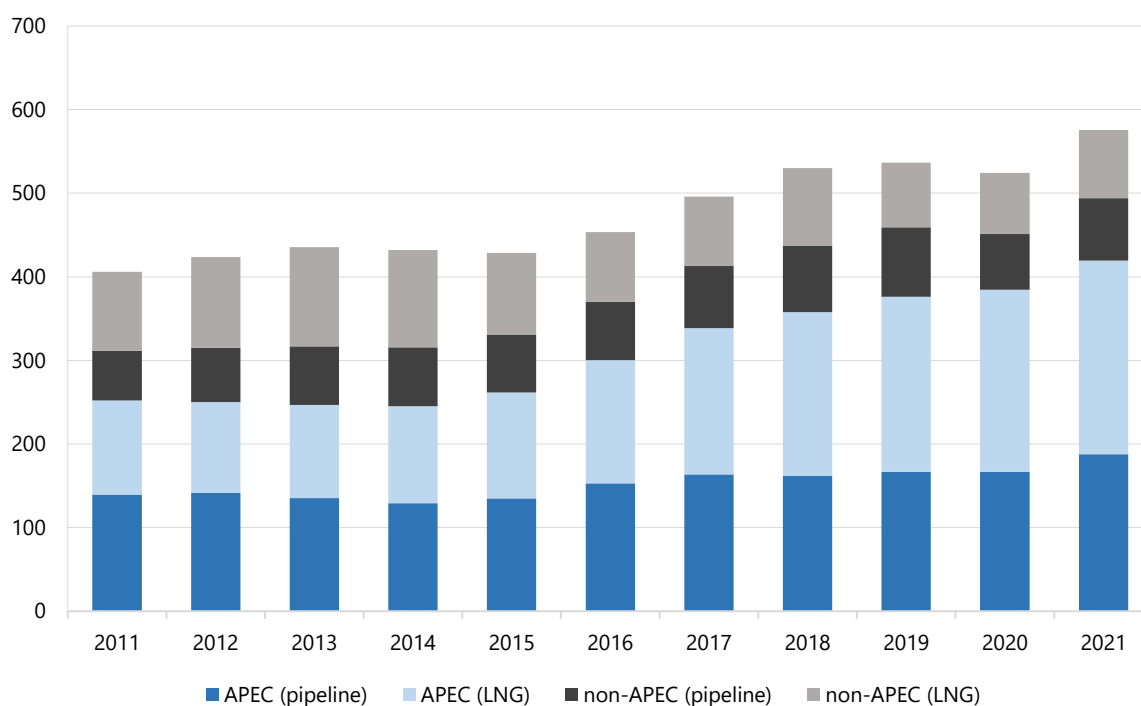


Source: CEDIGAZ

4-2 Gas imports in the APEC region

Over the past decade, APEC natural gas imports have increased substantially from 406 bcm to almost 576 bcm in 2021 at an annual rate of 3.5%. APEC remained a major import player collectively, with LNG imports volume surging greater than global imports by more than twice over the same period, from 113 bcm to 232 bcm. In addition, pipeline gas imports also increased considerably from 139 bcm to 188 bcm in 2021, implying the growing need for natural gas in the APEC.

Figure 4-3: Natural gas imports by origin and type in APEC, 2011-2021 (bcm)

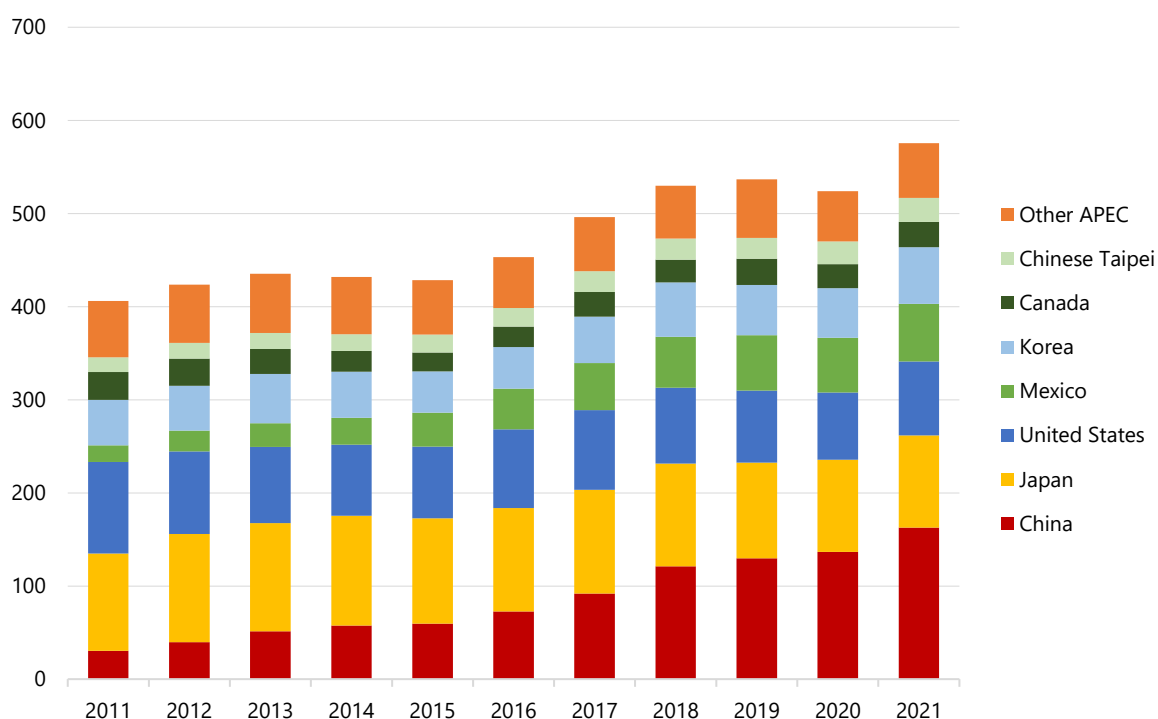


Source: CEDIGAZ

Over the last decade, total volume of imported gas increased by 41% or close to 170 bcm, with China's volume rose by over five-fold or 132 bcm. Substantial volumetric increase is also observed in Mexico, whose import volume increased by more than three times or 44 bcm in 2021, following the expansion of Mexico's pipeline infrastructure which increased its reliance on dry gas from the United States. Increases of 12 bcm and 10 bcm were also registered in Korea and Chinese Taipei, respectively, over the same period.

China has been the leading natural gas importer in APEC and world since 2018, following decades of Japan's dominance prior to that year. The geographical advantage of China allows the economy for easy access to both pipeline gas infrastructure and LNG import terminals compared to Japan, whose gas imports are entirely in the form of LNG due to its archipelagic nature. In addition, rapid surge in domestic demand outpaced gas production in China as well as increased awareness for the protection of environment drove up the import volume to 121 bcm in 2018. Three years later in 2021, import volume further went up to 163 bcm, supported by rapid expansion of LNG import terminals capacity and increase in pipeline gas volume from Russia and Central Asia economies (Kazakhstan, Turkmenistan, and Uzbekistan).

Figure 4-4: Total natural gas imports by APEC economy, 2011-2021 (bcm)



Source: CEDIGAZ

4-2-1 APEC LNG imports

Northeast Asia region has been the major importer of LNG, accounting for about 90% of the total APEC LNG imports over the past decade. Volumetrically, the region registered an increase of LNG import from 185 bcm in 2011 to 290 bcm in 2021.

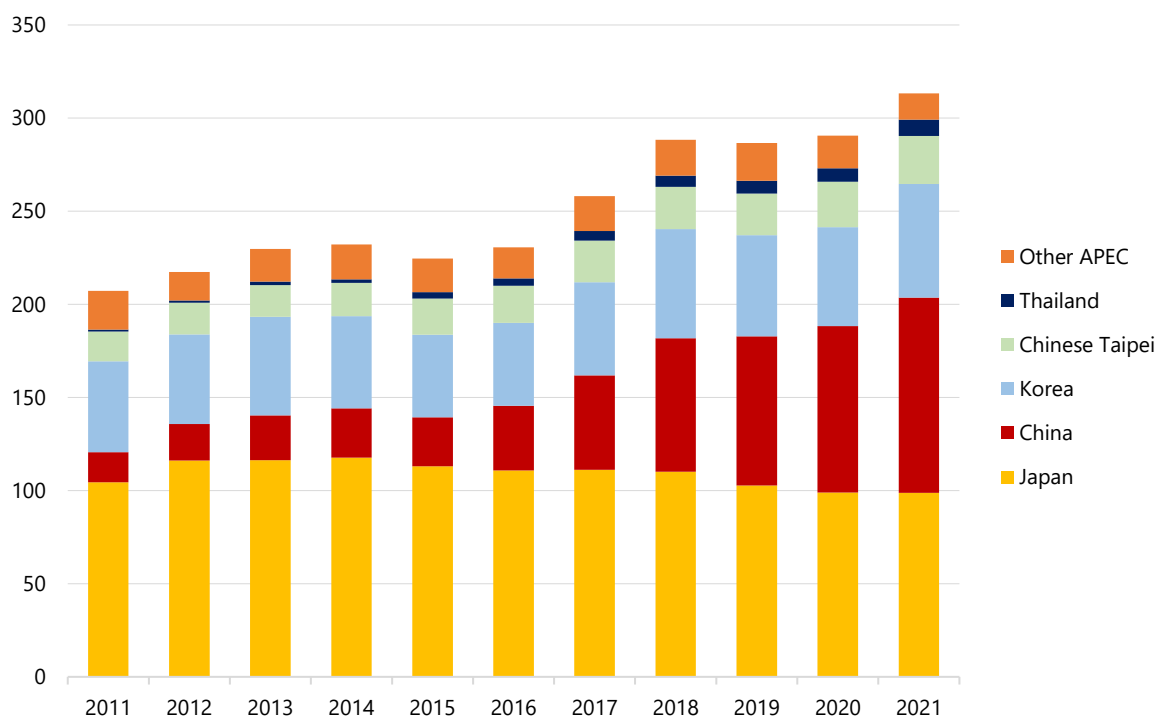
China's LNG import has been growing rapidly since its maiden import from Australia in 2006. 15 years later, China imported more volume of LNG than any other economy and eventually surpassed Japan as the world's largest LNG importer. In 2021, China imported almost 163 bcm of LNG – which accounted for 33% of the total APEC LNG imports – thanks to substantial inflow of spot LNG volumes from the United States with lowered LNG import tariffs imposed by China on United States, in addition to recent expansion of regasification terminals in Qingdao and Zhoushan (Phase 1 and Phase 2) that are capable of collectively receiving over 10 Mtpa of LNG per year.

On the other hand, import volume in Japan reached 99 bcm in 2021 – the second successive year that Japan's import volume reached below 100 bcm. Shrinking domestic demand over the past decade due to a confluence of factors, including lower heating in households, and lower industrial production resulted in declining trend in overall LNG demand in Japan. Nonetheless, Japan kept its position as one of the biggest importers in Asia with its share closely behind China in 2021 (32%).

Korea remained the third largest importer with an import volume of 61 bcm in 2021, an increase of over 12 bcm over the last decade. While Qatar being Korea's major LNG trading partner, ramping up of LNG inflow from Australia and United States brought about much of the import increase.

Elsewhere in the Southeast Asia region, there has also been an increasing trend in LNG imports within the region between 2011 and 2021, particularly in Malaysia and Thailand. Malaysia's LNG import surged from just 0.08 bcm in 2011 to 2.5 bcm in 2011. One of the key factors of this surge is the existing 20-year import agreement between Malaysia's Petronas and Australia's Gladstone LNG (GLNG), in which Malaysia can import a maximum of 3 Mtpa from GLNG. Australia thus accounted for almost 90% of Malaysia's total LNG imports in 2021. Thailand's LNG import expanded substantially from 0.85 bcm to 8.91 bcm between 2011 and 2021, with almost 40% of its import coming from Qatar.

Figure 4-5: LNG imports by APEC economy, 2011-2021 (bcm)



Source: CEDIGAZ

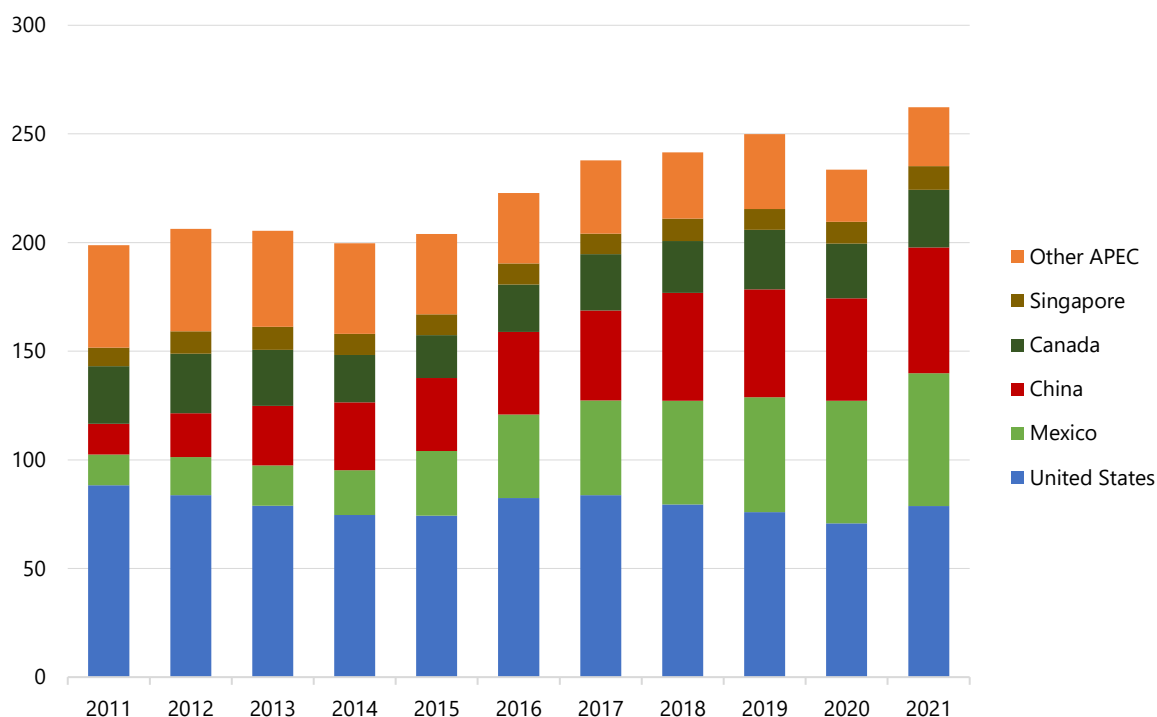
4-2-2 APEC pipeline imports

United States has been the leading importer of pipeline gas in APEC, accounting for over 30% on average of the overall APEC pipeline gas imports over the last decade. That said, the trend has been showing a decline from 88 bcm in 2011 to 79 bcm in 2021, as 79 bcm in 2021, due to decreased inflow from Canada. The continued development of shale gas in the United States implies that the United States now relies less on Canadian gas to meet the domestic demand.

Mexico – the second largest pipeline gas importer in APEC – has seen a sizeable increase of over four times in pipeline gas imports from the United States over the past decade, from just 14 bcm in 2011 to 61 bcm in 2021. Several new pipelines in Central and Southwest Mexico have been recently commissioned, including the expansion of the Wahalajara system that runs from Waha hub in the Permian Basin in the United States to Guadalajara and other demand centres in West and Central Mexico. Imports from the United States will help meet Mexico's growing gas requirements, especially in power and industry sector, thus offsetting declines in the economy's domestic gas production.

Like Mexico, volume of pipeline gas into China also expanded by four times over the past decade, reaching 58 bcm in 2021, thus making China the third leading importer in APEC. Turkmenistan remains China's major trading partner, although its share plunged from total dependence in 2011 to just 53% in 2021, as China diversified its pipeline import strategy to include Kazakhstan, Myanmar, Russia, and Uzbekistan. Russian gas volume more than doubled in 2021 (over 10 bcm) relative to 2020 levels, thanks to the Power of Siberia pipeline that has been in service since 2019. The pipeline, which runs from Russia's Chayanda gas field to China's Heilongjiang province, can transport a maximum volume of 38 bcm, which is expected to be reached in 2025.

Figure 4-6: Pipeline imports by APEC economy, 2011-2021 (bcm)



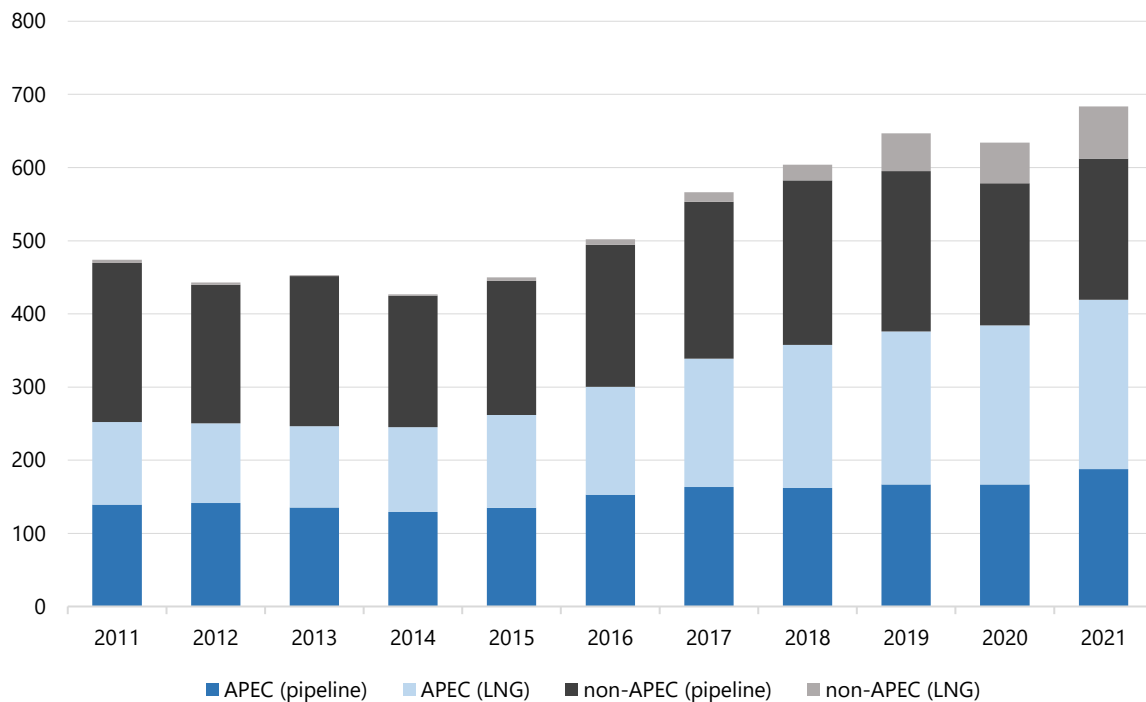
Source: CEDIGAZ

4-3 Gas exports in APEC region

APEC natural gas exports rose at a rate of 3.7% per annum over the past decade, reaching almost 685 bcm in 2021. LNG outflows from APEC economies amounted to 303 bcm in 2021 – a huge increase of 186 bcm from 2011 levels. Conversely, pipeline gas exports from APEC economies only grew by 24 bcm over the same period, reaching 381 bcm in 2021. Majority of the APEC export destination is within the region, of which the share has increased from 53% in 2011 to 61% in 2021. Even with COVID-19 pandemic, APEC exports within the region continued to grow but at a slower pace, thanks to a rapid growth in APEC's LNG exports.

Given substantial growth of exports from APEC economies, the export volume to non-APEC economies rose in a smaller amount compared to that of the APEC economies. Hence, non-APEC share in terms of export destination declined from 47% in 2011 to 39% in 2021, albeit a 16-fold increase in LNG imports from over 4 bcm to 71 bcm over the same period.

Figure 4-7: APEC natural gas exports, 2011-2021 (bcm)

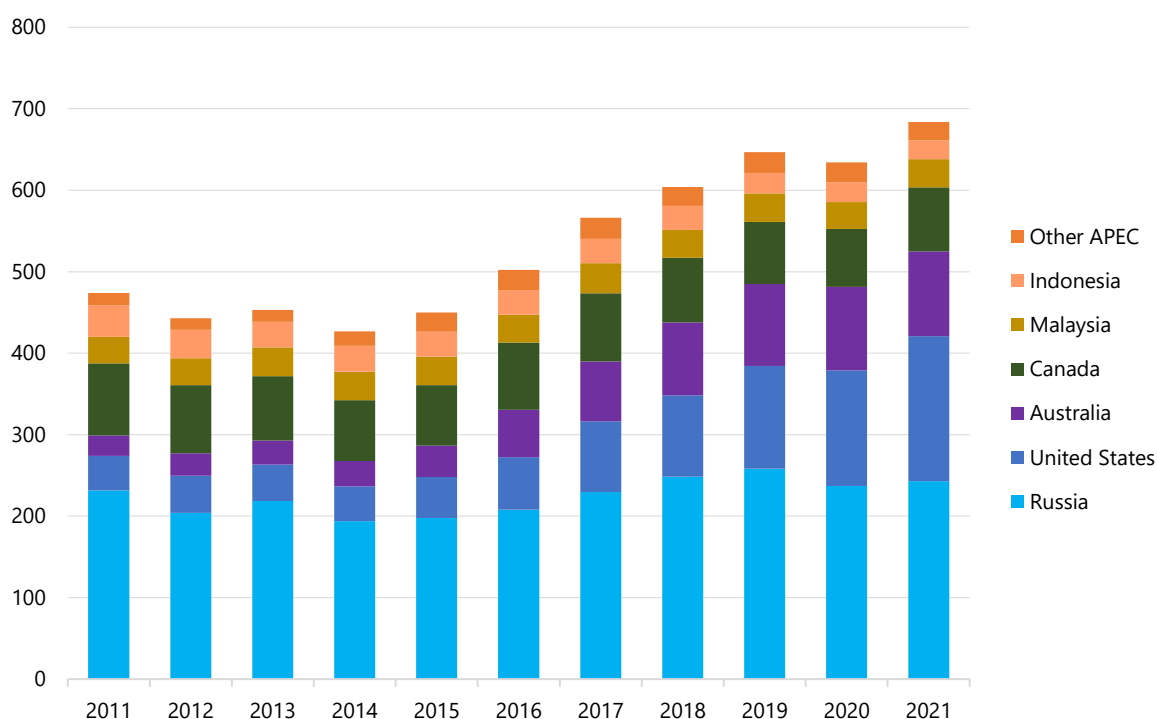


Source: CEDIGAZ

Despite a steady volume of APEC natural gas exports in early 2010s with a 5-year average at 449 bcm, the export volume rapidly increased to 684 bcm in 2021. The average annual growth rate during 2016-2021 was at 6%. Russia and United States are the major exporters of natural gas within APEC, altogether accounting over 60% of the APEC's total exports in 2021. While Russia's export trend remained stable between 2011 and 2021, United States registered a noticeable increase by fourfold owing to its LNG and pipeline infrastructure expansion.

Australia overtook Canada to be the APEC's third largest natural gas exporter since 2018. Australia's natural gas exports grew at the same rate as US, reaching a volume of 105 bcm in 2021, driven solely by its LNG production and export expansion. Nonetheless, recent upstream development delays and trade restriction may hamper larger export volumes, causing its trade to stagnate. Meanwhile, Canada's exports have been in a downward trend due to its takeaway capacity constraints and increased self-reliance in gas in US. Provided that, we could expect modest export growth from these two economies in the near future.

Figure 4-8: Natural gas exports by APEC economy, 2011-2021 (bcm)



Source: CEDIGAZ

4-3-1 APEC LNG exports

APEC economies experienced an upward trend of LNG exports from 117 bcm in 2011 to 303 bcm in 2021, accounting for an annual growth rate of 10%. Between 2020-2021, APEC LNG export capacity increased by 29.7 bcm (10.9%) compared with 2020. United States significantly contributed to an overall trend while other economies' export capacity remained stagnant. Australia continues to be the largest LNG exporter at 104.1 bcm surpassing Malaysia in 2015 after the two-capacity buildout in East Australia (Queensland Curtis and Gladstone). Additionally, Russia and Malaysia closed in the 3rd and 4th ranking with export volume approximately at 35.9 bcm each.

Dwindling upstream gas supplies and limited number of new developments ensue in Australia's export capacity to plateau until the two new commissions of Santos Barossa and Scarborough LNG projects in mid-2020s. However, new projects are planned to compensate a decline in North-West Shelf, Australia's largest LNG project, rather than total capacity add-ons. Furthermore, Australia Domestic Gas Security Mechanism (ADGSM), which became effective in July 2017 and extended until 2030 in August 2022, has restricted LNG exporters to increasingly secure its supply for domestic market, bringing down the LNG prices that was peak at more than AUD20/GJ in 2017 to average price of around AUD10/GJ. Under this mechanism, projected domestic demand will affect the direction of Australia's LNG exports.

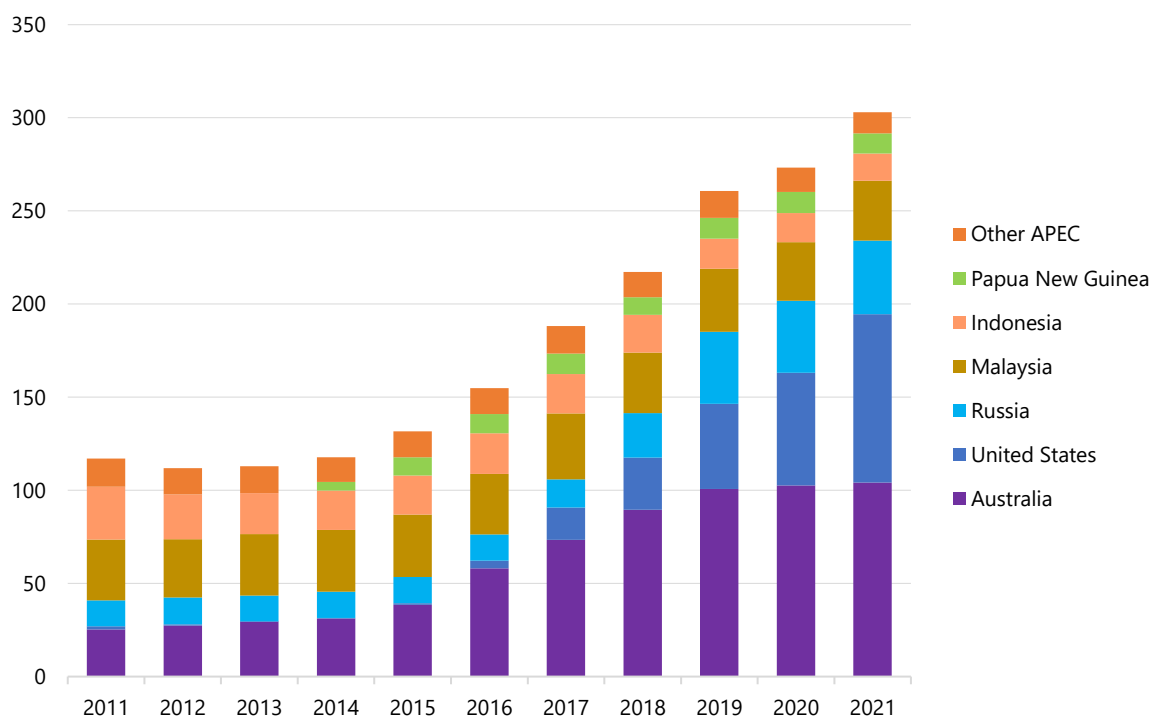
In United States, LNG exports have quickly grown since 2016 after launching its first LNG export, reaching 90.4 bcm in 2021 and setting new record high. Substantial LNG exports volume was essential to meet robust demand from Asia and depleting storage inventories after the heating season in Europe. The United States LNG exports to Asia was higher than exports to Europe, accounting at 47%

and 34%, respectively, sharing a similar trend as in 2020. The volume of United States LNG exports to China, Korea, and Japan individually stood between 9-12 bcm in 2021. Three large-scale liquefaction facilities – Golden Pass, Plaquemines, and Corpus Christi – are expected to be online by 2025, a total peak nameplate capacity of 58 bcm. Thus, we can systemically expect even higher export volume, enabling United States to be the world's largest LNG exporter in the near term.

Russia LNG export rose by three times between 2011 and 2019 before stabilising. The LNG exports were at 39.6 bcm in 2021, accounting for an increase of 2.5% compared to 2020. Japan and China were the major export destination with volumes of 8.7 and 6.0 bcm, respectively. On March 16, 2021, the Russian government approved the long-term LNG development programme with objectives to expand its LNG production to 140 million tonnes by 2035 and capture higher global market share. However, political uncertainty caused by Russia-Ukraine conflict has directed to project postponement due to technological and financial constraints as European investors withdraw.

Southeast Asia LNG exports continued to decline for the fifth consecutive year falling to below 60 bcm compared to nearly 70 bcm in 2017 due to declining natural gas production in mature oil and gas fields as well as underinvestment in exploration and production. While Malaysia LNG exports slightly increased by 2.1% reaching 32.1 bcm in 2021 compared with 2020, Indonesia and Brunei LNG exports decreased by 6.7% and 8.6%, standing at 14.5 and 7.3 bcm, respectively. In 2021, PPT Public Company Limited, Thailand, re-exported its LNG surplus to Japan during economic slowdown, taking advantages of its long-term contract pricing, as well as infrastructure and proximity to Japan.

Figure 4-9: LNG exports by APEC economy, 2011-2021 (bcm)



Source: CEDIGAZ

4-3-2 APEC pipeline exports

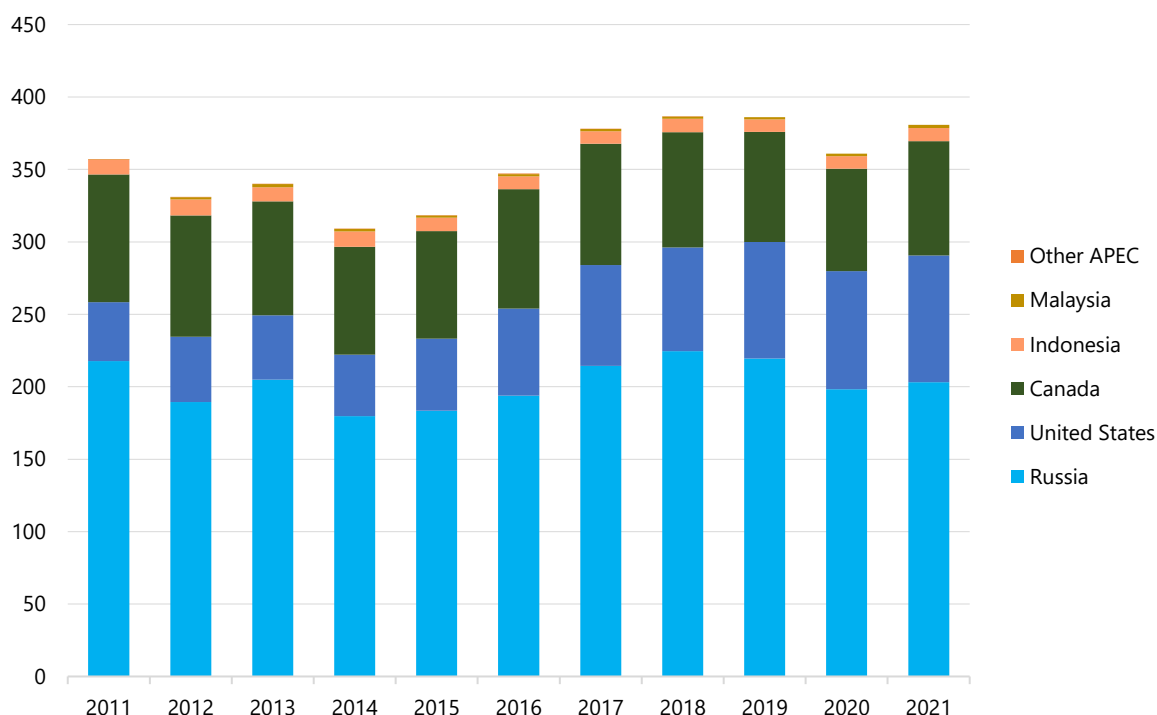
Pipeline exports within APEC grew modestly at a rate of 0.6% per annum over the past decade, from 357 bcm in 2011 to 381 bcm in 2021. The pipeline export volumes rebounded by 20 bcm from the previous year but have yet to reach the 2018 pre-pandemic level. Russia has the highest share accounting for more than half of APEC pipeline exports, followed by United States and Canada. Each holds export share at approximately 22%. The remaining pipeline exports came from Indonesia and Malaysia. Although Malaysia has relatively limited pipeline networks, its export volumes escalated at an average annual growth rate of 54% during 2011-2021.

Although Russia accounted for more than half of APEC's total pipeline exports its export volumes have fluctuated at 200 bcm for the last decade. The decline in pipeline export in recent years was a result of COVID-19 induced economic slowdown starting in early 2020, coupled with Russia shifting its piped gas trade approach with Europe from spot market to long-term supply contracts in 2021. As a result, Russia's export volume to Europe and United Kingdom declined from 165 bcm in 2019 to less than 115 bcm in 2021. Moreover, the sanctions for Russian gas gradually limited gas trading and the rupture of Nord Stream pipeline completely obstructed the gas outflow to Western Europe via Germany in September 2022. To maintain its high exports and fight against the Western sanctions, Russia needs to expedite its gas pipeline infrastructure with Asia, particularly China.

United States, on the other hand, more than doubled its exports over the same period (from 41 bcm to 88 bcm), of which more than two third went to Mexico and the remaining to Canada. A substantial increase in export volume to Mexico was attributed by a tremendous growth in associated gas production in the Permian Basin, spanning across Texas and New Mexico, as well as takeaway capacity development. In 2021, four new pipeline projects came online with a combined takeaway capacity of nearly 70 bcm, Expansion of natural gas pipeline network and construction of natural gas processing plants are necessary to support additional drilling activity, prevent supply bottlenecks, and ultimately maximise its pipeline gas exports potential. That is the output growth mainly determines the pace needed to construct takeaway capacity.

Canada saw a minor decrease in pipeline exports to United States, a sole importer, from over 80 bcm in 2016 to just 70 bcm in 2020. However, economic recovery from COVID-19 has driven Canadian pipeline gas exports back to near pre-pandemic level. The main reason for a sluggish growth in gas export stemmed from public concern over the environmental impacts of the oil sands sector, resulting in pipeline capacity limitations. According to Canadian Energy Centre, no new gas pipeline projects was completed during 2014-2020. Additionally, exports to the United States have been lower as the economy becomes heavily reliant on its domestic production. As a result, standstill gas pipeline development and fallen United States gas import demand will continue to weaken Canadian pipeline gas export trend.

Figure 4-10: Pipeline exports by APEC economy, 2011-2021 (bcm)



Source: CEDIGAZ

4-4 Gas trade outlook in APEC region

The Reference Scenario of the 8th Outlook forecasts natural gas trade in APEC economies to continue expanding between 2021 and 2026, with import and export volumes growing by 7% and 25% respectively.

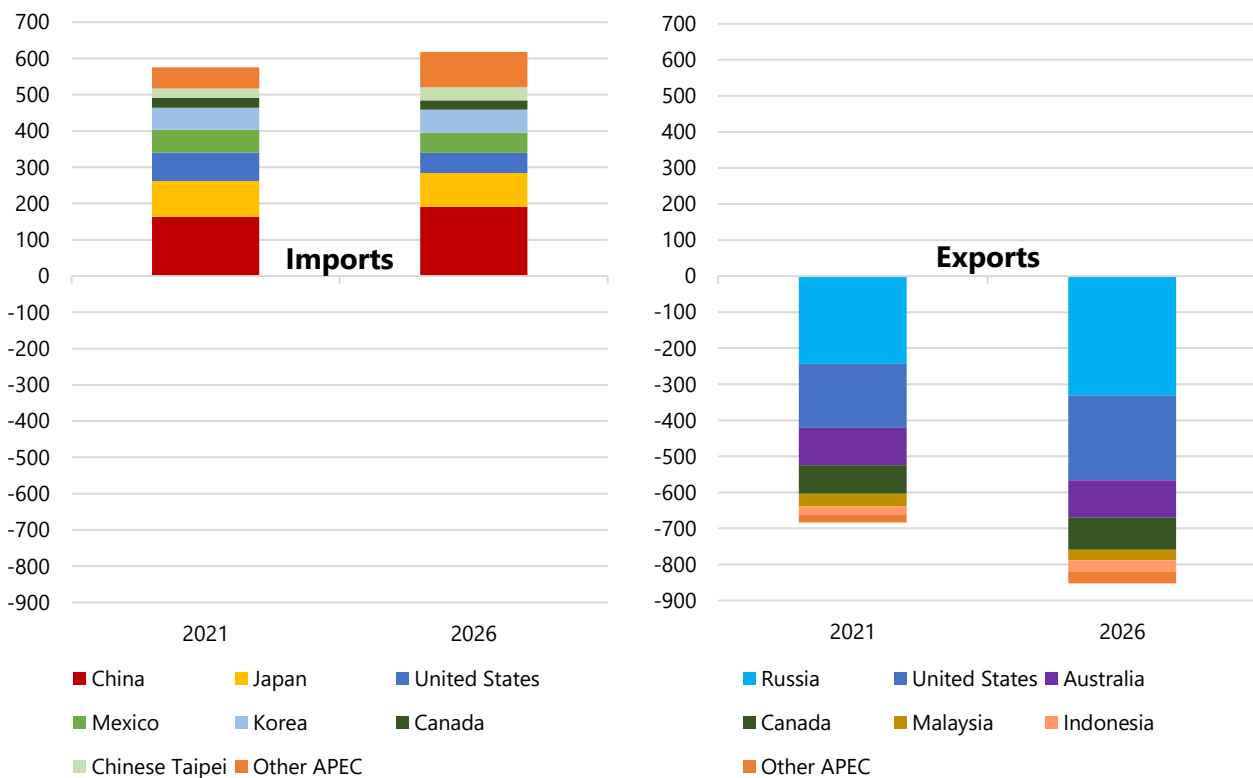
Import-wise, Northeast Asia and China are expected to remain the largest importers of gas within APEC, accounting for 32% and 31% of the total APEC imports in 2026, respectively. This is followed by Other Americas and Southeast Asia at 14% and 11% respectively. Despite the overall increase in import volumes, several individual economies are expected to reduce their reliance on imported gas, particularly United States whose import volume declines by 24 bcm in 2026 – the largest in APEC. This is followed by Mexico (6.4 bcm), Japan (5.4 bcm), Russia (4.6 bcm), Singapore (2.6 bcm), Canada (1.9 bcm) and Australia (0.8 bcm). Conversely, the largest increase in import volume is expected to originate from China (28 bcm), followed by Indonesia (14 bcm), Thailand (11.1 bcm) and Chinese Taipei (10.6 bcm).

The significance in China's LNG import volume in the next six years is in line with the economy's ambitious plan to add more regasification capacities within the period. Almost 80% of these capacities is expected to come from new terminals, while the remaining is from the expansion of existing terminals. The largest addition is expected to come from the Caofeidian Xintian LNG-owned Tangshan II terminal, which can yield a total of 584 bcf of gas (16 bcm) by 2026. The Yantai I terminal, to be operated by the Yantai LNG Group, is expected to contribute another 487 bcf (14 bcm) of gas by the same year.

Despite having a relatively small share, the Southeast Asia region is expected to register the fastest growth of 35 bcm over the next six years, surpassing China's 28 bcm growth. Indonesia leads the growth at 14 bcm as the economy combats its declining gas production at mature field. In addition, imported gas is crucial to meet the shortfall of domestic production as the economy aims to transition away from coal to gas in its power sector in 2026 and beyond. Thailand's 11.1 bcm growth in LNG volume is expected to be met through the Nong Fab LNG regasification which is expected to be commissioned in October 2022. The Philippines is also envisaged to import about 5.3 bcm of LNG, as the economy is no longer able to source its gas from its Malampaya gas field, which is expected to be depleted by early 2027. To mitigate potential shortfall in domestic gas output, the Philippines is expected to commission two new onshore regasification terminals (Atlantic Gulf & Pacific Co. and First Gen Corp.) in 2023 with a combined capacity of 8.2 Mtpa.

In terms of export, Russia and the United States are envisaged to dominate the gas exports in APEC, accounting for 39% and 28% respectively in 2026. Russia's gas exports are anticipated to increase as the Power of Siberia-1 pipeline is expected to operate at full capacity of 38 bcm destined for China. Russia is also expected to commence construction of the Power of Siberia-2 pipeline in 2024. The pipeline, which will carry about 50 bcm of gas annually from the Yamal reserves in west Siberia to China, is expected to go online by 2030. For the United States, most of its exports is expected to come from LNG, driven by additional liquefaction capacities at Golden Pass (36 Mtpa), Corpus Christi (over 11 Mtpa), Plaquemines (over 22 Mtpa) and Driftwood (over 11 Mtpa) which are slated to begin operation by 2025.

Figure 4-11: Imports and exports outlook in APEC, 2021-2026 (bcm)



Source: CEDIGAZ

Section 5: Gas prices

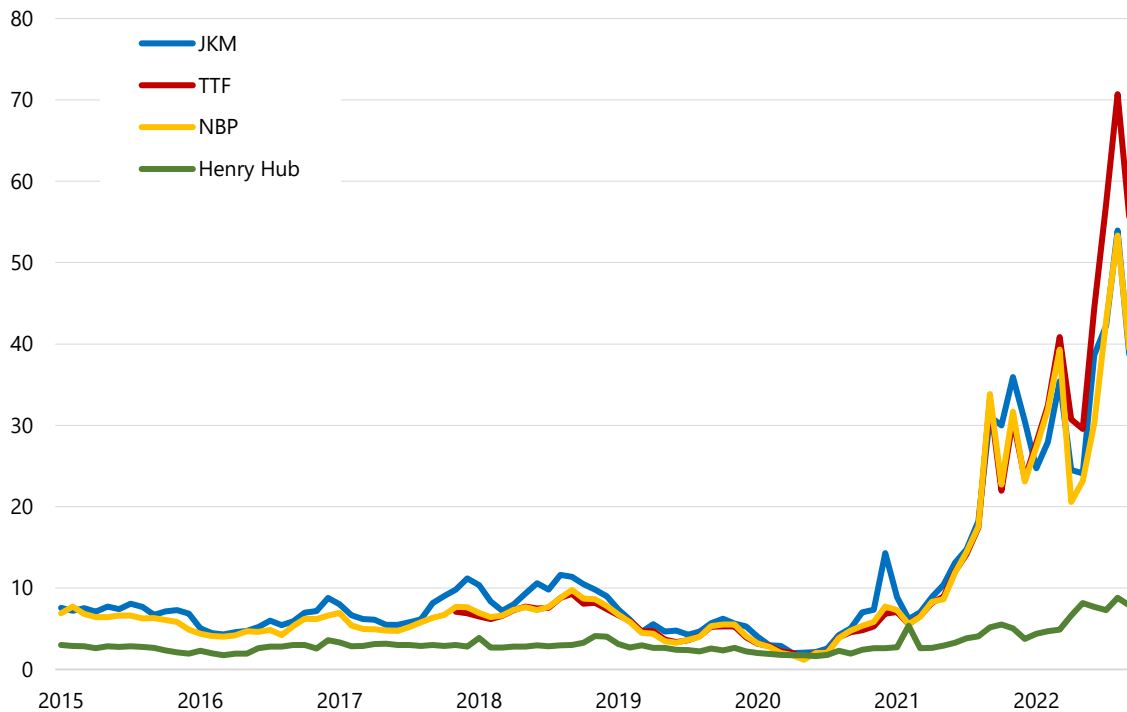
5-1 Gas prices collapsed in 2020 as COVID-19 pandemic triggered global movement restriction

Global natural gas spot prices plunged to the lowest level since 1995 in mid-2020 as global oil and gas demand fell due to a movement control order implemented worldwide after the declaration of COVID-19 pandemic by World Health Organisation in March 2020. Global natural gas prices started in recovering phase towards the end of 2020 as demand recovered with the reopening of economic activities and preparation for winter.

The global natural gas demand increased substantially as multiple unexpected situations happened by the end of 2020 and early 2021. The colder-than-average winter in Northeast Asia and Europe, regional liquefaction outages, lower nuclear availability in Japan, and limited coal-fired generation in Korea contributed to the tight supply situation in the global gas market. It resulted in the spike of JKM LNG monthly spot price to USD14.30/MMBtu in December 2020.

A similar trend happened for monthly natural gas spot prices at two European hubs. Monthly natural gas spot prices at NBP and TTF reached USD7.71/MMBtu in December 2020 and USD7.05/MMBtu in January 2021, respectively. The following month, Henry Hub's natural gas spot price peaked at USD5.35/MMBtu as the extreme cold temperature hit North America.

Figure 5-1: Monthly natural gas spot prices, January 2015-September 2022 (USD/MMBtu)



Source: Investing.com; EIA

5-2 Gas prices recovered to the pre-pandemic level in 2021 and kept rising as gas demand outpaced supply

The increasing natural gas spot prices continued through the second and third quarters of 2021 as natural gas markets faced an unprecedentedly continuous tight supply situation due to stronger gas demand post-COVID-19. Other than economic activity recovery, more robust gas demand was contributed by the efforts to increase gas storage levels after a significant draw during the cold winter in early 2021 and the heat waves in July in Northeast Asia.

Unprecedented hikes and high volatility of global natural gas spot prices started in the third quarter of 2021. The situation also resulted from other simultaneous events in Europe; among them was the increased share of gas in electricity generation due to low output from renewable sources, high carbon prices, and declining Russian gas supply via pipeline into Europe. Monthly natural gas spot prices at NBP and TTF reached the highest annual level in September 2021 at USD33.84/MMBtu and USD33.19/MMBtu, respectively. Higher gas demand in Europe has created stronger competition in Asia and pushed the monthly JKM LNG spot price to the highest annual level at USD35.95/MMBtu in November 2021.

The year 2021 also showed more unprecedented situations where global natural gas spot prices, except Henry Hub's spot price, are higher than crude oil spot prices for the first time in September 2021. The gap between JKM LNG spot prices and average oil-indexed LNG price in Japan has been getting bigger since April 2021, reaching about USD20/MMBtu difference in September 2021. The situation has led to a decline in LNG trade in the Asia spot market.

A combination of supply tightness, unplanned gas infrastructure outages and maintenance, growing geopolitical tensions in Europe, and weaker demand from Asia has diverted more uncommitted LNG fleets from Asia to Europe. At the same time, natural gas prices and volatility remained high towards the end of 2021.

5-3 Unprecedented high gas prices and volatility rally continue in 2022

Monthly natural gas spot prices in Europe and Asia eased in the first two months of 2022 before surging in the following month due to the Russia-Ukraine war that started on February 24. The Russia-Ukraine war increased the fear of disruption of natural gas supply via pipeline from Russia to Europe, resulting in monthly natural gas spot prices in Europe, both NBP and TTF reaching the highest historical level at USD39.31/MMBtu and USD40.83/MMBtu, respectively. Asia's LNG spot market was also affected by the Russia-Ukraine war, as the competition for LNG in the spot market grew, resulting in JKM LNG spot price reaching a new record high at USD35.44/MMBtu in the same month.

Besides the Russia-Ukraine war, multiple LNG plant outages due to shutdowns, planned and unplanned maintenance, and a sudden increase in LNG demand from Japan caused by the earthquake also contributed to the global natural gas prices surge in March 2022.

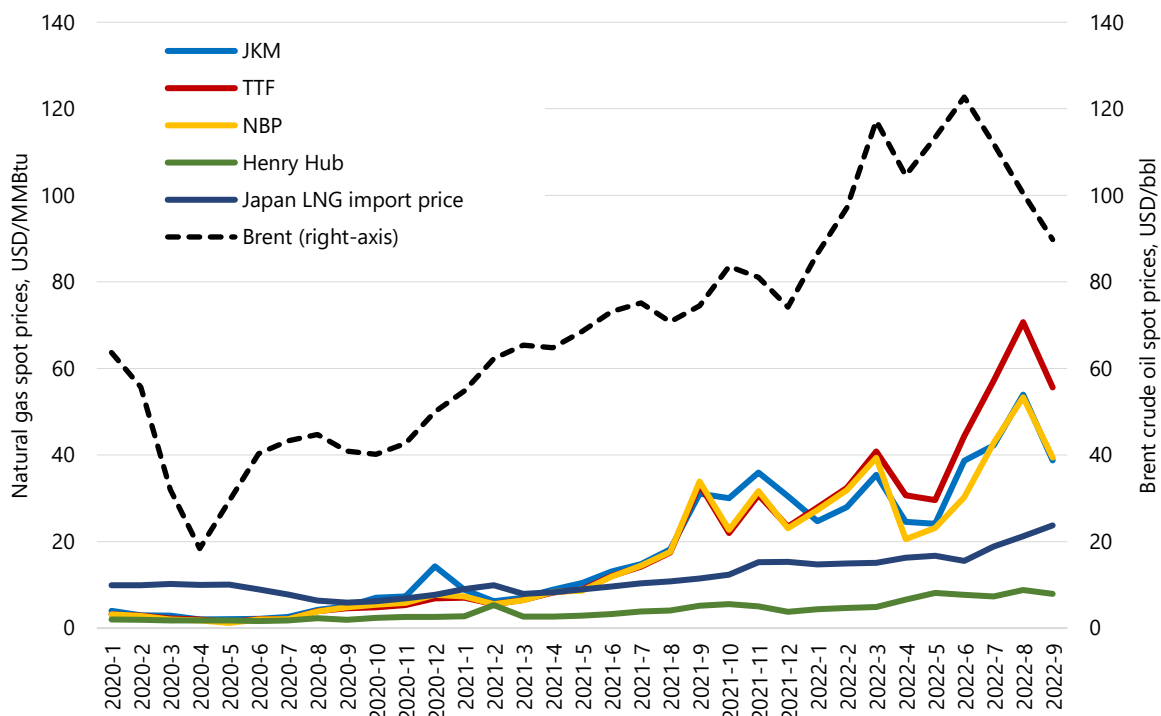
The growing pressure on the natural gas supply in the Europe gas market has also eliminated the premium of JKM LNG monthly spot price over TTF natural gas monthly spot price since January 2022. The price gap between prices widened after the Russian-Ukraine war started and kept widening after European announced the plan to replace Russian gas with other sources and conserve its energy consumption.

Europe and Asia natural gas spot prices moderated until May 2022 as Russian gas kept flowing into Europe. However, natural gas prices rebounded the following month and surged to a new highest historical level in August 2022. Other than the growing concern about the Russia-Ukraine war, the disruption of gas supply from Norway and Algeria, storage refilling for the upcoming winter, and the announcement of discontinued natural gas supply from Nord Stream 1 and 2 had triggered TTF monthly natural gas spot price to a new record high at USD70.71/MMBtu, almost 75% higher than the previous record in March 2022.

The extremely tight supply and high natural gas prices in Europe, coupled with the increased demand for winter preparation in Northeast Asia, drove other hubs' monthly spot prices to a new highest historical level in August 2022, with NBP recorded at USD53.33/MMBtu and JKM LNG at USD53.95/MMBtu. While increasing the United States LNG export volume has put much pressure on the domestic natural gas price as competition grew between the export and domestic natural gas markets. Consequently, Henry Hub's natural gas monthly spot price increased steadily and reached the highest level in history also in the same month at USD8.80/MMBtu.

In September 2022, global natural gas monthly spot prices started to show a declining trend as the global LNG supply improved with the commissioning of a new LNG terminal in the Netherlands and the resumption of Prelude LNG plant operation in Australia. At the same time, the dropped gas demand from the industrial and power sectors due to high gas prices and the increased gas storage level also eased the global gas supply tightness.

Figure 5-2: Monthly natural gas and Brent crude oil spot prices, January 2020-September 2022 (USD/MMBtu and USD/bbl)



Source: Investing.com; EIA; ycharts.com

5-4 Gas prices likely to remain high in the near term

The increasing LNG export volume from the United States and the expectation of lower gas demand due to the risk of global economic recession in 2023 could ease the tight gas supply market and moderate natural gas prices in the near term. However, the global natural gas spot prices are likely to remain high following the uncertainty over the Russia-Ukraine war, combined with the anticipation that non-Russian sources of LNG and pipeline gas will not be enough to offset the loss of Russian gas in 2023.

Section 6: Case study

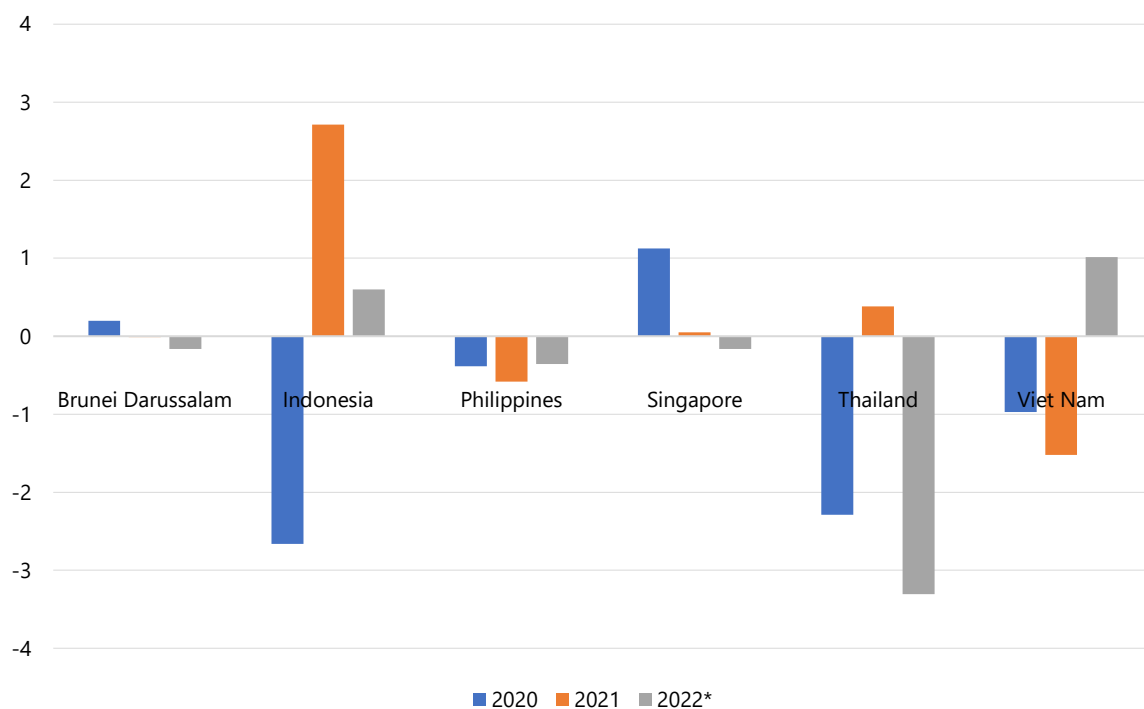
Other than Singapore, all other APEC economies in the Southeast Asia region have their own indigenous natural gas resources. These resources have been a significant contributor to economic growth for these economies. However, all these economies face similar challenges as their indigenous gas resources are depleting and becoming insufficient to meet growing domestic demand.

Soaring global natural gas prices since mid-2021 have put additional pressure on Southeast Asia economies, especially in light of their decarbonisation plans. Besides filling the gas supply shortfall due to depleting natural gas resources, Southeast Asia economies require a significant volume of gas to replace coal consumption through the next few decades, especially in industry and power sectors, as natural gas is relied on as a transition fuel.

6-1 Southeast Asia's response to high gas prices

Southeast Asian economies responded in different ways to rising natural gas prices, as shown in Figure 6-1. Brunei, Philippines, Singapore and Thailand's natural gas consumption showed a declining trend in 2022, ranging from 0.16 bcm to 3.31 bcm as of September 2022. In contrast, Indonesia's natural gas consumption continued to increase for the second consecutive year, while Viet Nam's natural gas consumption showed a recovery trend as of September 2022 after a decline in two previous years,

Figure 6-1: Annual changes in natural gas consumption in Southeast Asia region, 2020-2022 (bcm)



Source: JODIGas; CEDIGAZ

Note: *Annual changes in 2022 are calculated based on the first 8- or 9-months data and pro-rated basis.

Thailand is the Southeast Asia economy most negatively affected by rising gas prices. Thailand is the largest natural gas user in the region and relies on imports for about 33% of gas supplies. As of September 2022, the gas demand dropped more in Thailand than in any other ASEAN economy, about 3.3 bcm. Thailand reduced gas consumption and increased coal, diesel and fuel oil consumption for electricity generation as part of its short-term energy security measures. In addition, Thailand also extended its coal-fired power plant and biomass contracts for one or two years and cut the LNG import volume from the spot market.

Indonesia's natural gas prices were isolated from the impact of high global natural gas prices as the government regulates domestic natural gas prices to power and industry sectors. The fixed natural gas prices, which are well below the global market prices, have driven the increase in natural gas consumption in Indonesia in 2022. Indonesia is able to keep domestic natural gas prices at a low level with the enforcement of the Domestic Market Obligation (DMO) policy that requires gas producers to sell 25% of their production to domestic buyers at a set price. Besides the low price, the obligation also ensures the security of supply for the domestic market, as Indonesia's total natural gas demand is currently met by domestic production.

The Philippines and Viet Nam are expected to become the new LNG importers in the region by the end of 2022, with about 18 LNG receiving terminal projects in the pipeline to cater for the forecasted growing natural gas demand through 2050. High natural gas prices have delayed the start-up of three LNG receiving terminals until early 2023: AG&P LNG terminal and First Gen LNG terminal in the Philippines, and Thi Vai LNG terminal in Viet Nam. Both economies are considering revising the plan for the remaining LNG receiving terminals in response to the high gas prices.

In Singapore, the only economy in the region that relies on imported natural gas for all its gas supply, the government intervened to supply gas to the standby LNG facility for energy security. The intervention was taken as Singapore's power companies were reluctant to purchase gas due to high prices.

6-2 Short-term initiatives to cushion the effects of high gas prices on end-users' electricity tariffs

Southeast Asian efforts to cushion the impact of high gas prices seemed to be correlated with the status of self-sufficiency and net trade of each economy, as shown in Figure 6-2.

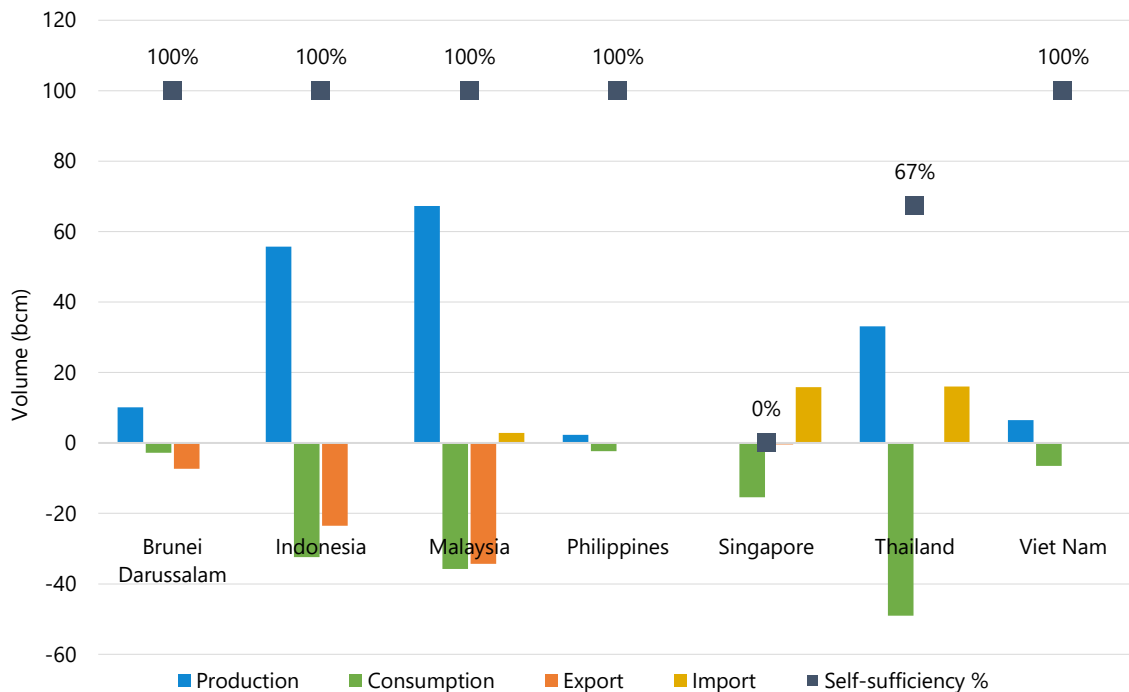
Brunei, as a self-sufficient natural gas supply economy in 2021 and probably a net natural gas exporter for the next few decades, was able to absorb all the impact of high global natural gas prices in recent years. The electricity tariffs in Brunei for all types of consumers remained at the same level since 2012.

Indonesia and Malaysia were also self-sufficient natural gas supply economies and net natural gas exporters in 2021. However, both economies can only afford to absorb part of the impact of high global natural gas prices on electricity generation.

The recent electricity tariff increase effective September 2022 in Indonesia is only applicable to consumers with monthly consumption of more than 3500 Volt-Ampere (VA). However, the electricity tariff increase was not purely due to high global natural gas prices, as Indonesia fixed natural gas prices for power generation and industry from 2021 to 2024. The electricity tariff increase was caused by the implementation of the Automatic Tariff Adjustment, which calculates the tariff based on inflation, exchange rate, coal price and Indonesia's crude oil price index.

In Peninsular Malaysia, electricity tariffs for commercial and industrial consumers were revised upward in January 2022. The Government of Malaysia decided to maintain all electricity tariff categories at the same level until December 2022 by allocating about MYR5.8 billion or USD1.318 billion to subsidise the increase of fuel costs, including natural gas, in electricity generation.

Figure 6-2: Natural gas balance and self-sufficiency in Southeast Asia region in 2021



Source: CEDIGAZ

The Philippines and Viet Nam dealt differently with the impact of high global natural gas prices on electricity tariffs, even though both economies are self-sufficient in gas supply and neither net gas exporters nor importers in 2021 and 2022. By 2020, both economies' governments did not intervene in the wholesale natural gas price determination and the wholesale natural gas prices were based on oil price escalation.

The Philippines adjusted the electricity tariff rate on a monthly basis according to the changes in cost along the electricity supply chain, including the natural gas cost for electricity generation. As of September 2022, electricity consumers have experienced a tariff increase of more than 50% since January 2021.

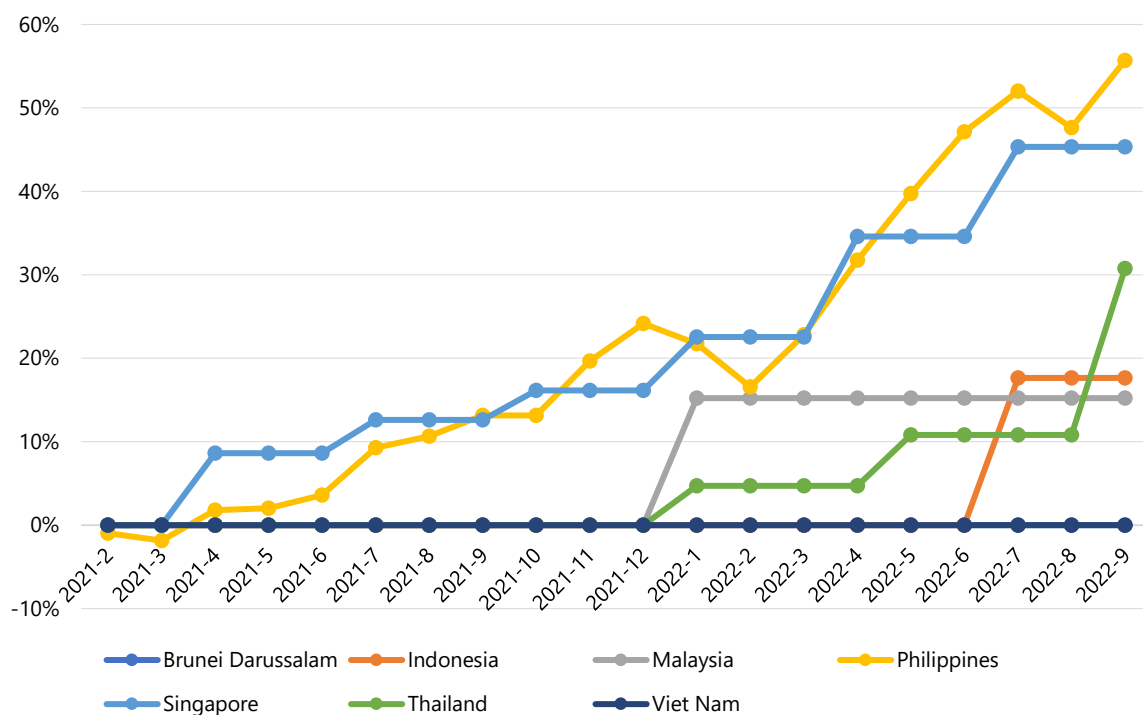
Viet Nam has been subsidising the increase of gas and other fossil fuel cost in electricity generation and kept the electricity tariffs unchanged since 2019 to curb inflation and stabilise its macroeconomics even though the actual electricity tariffs should be 10% higher than the enforced tariffs. The impact of increased natural gas and other fossil fuels prices on electricity generation costs per kWh in Viet Nam could be the lowest among Southeast Asia economies as Viet Nam has the highest share of renewables capacity, 49% in 2021.

In Singapore, electricity tariffs for commercial and residential consumers were adjusted every quarter based on the movement of fuel costs in electricity generation. The average electricity tariffs have

increased substantially by 45% since January 2022, as Singapore relied 95% of its electricity generation on natural gas and imported 100% of the natural gas from various sources. Singapore focuses on diversifying natural gas sources to ensure a reliable and sustainable electricity supply and providing utility rebates to vulnerable groups instead of allocating subsidies to reduce electricity generation costs.

Thailand imported about 33% of its gas supply in 2021. As of September 2022, an upward revision of electricity tariffs occurred each quarter of 2022 as the Government of Thailand could not absorb the increase in natural gas and other fossil fuel costs in electricity generation. Thailand has increased coal, diesel oil and renewables in the electricity fuel mix to minimise the impact of high global natural gas prices on electricity tariffs.

Figure 6-3: Changes of electricity tariffs in Southeast Asia compared to January 2021 level, 2021-2022



Source: DES-Brunei; MEMR; KeTSA; Meralco; SPG; Bangkok Post; Hanoi Times

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