APERC Gas Report 2020

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Foreword

In many ways 2020 was a unique year. The COVID-19 pandemic forced us all to change the way we live, work, and play, and it changed the ways we produce and consume energy. Widespread lockdowns have caused an unprecedented drop in global energy demand, but natural gas proved to be the most resilient of the fossil fuels. Even after the pandemic subsides and lockdowns becomes a thing of the past, natural gas, as the least carbon-intensive fossil fuel, is expected to play an increasingly important role in the future.

Global demand for natural gas grew robustly over the past decade. The growth was even faster in the APEC region, driven mostly by growing demand in the United States and China. Amid ongoing concerns about air pollution and climate change, government actions to address these challenges are likely to spur further growth in natural gas consumption in the APEC region.

The release of this third edition of the APERC Gas Report reflects not only the ongoing importance of natural gas to the APEC economies but also the dynamism of the gas market in the region. This report is part of a series of APERC Fossil Fuel Reports, along with the Coal Report 2020 and Oil Report 2020. Fossil fuels, including natural gas, remain critical fuel sources, especially in the power and industry sectors, and are expected to remain a substantial component of the energy mix in most APEC economies for years to come.

I would like to express my sincere gratitude to the authors and contributors for their time and effort in writing and publishing this report. However, I would also like to note that the views expressed in this paper are those of the authors and not necessarily of APERC.

Kazutomo IRIE
President
Asia Pacific Energy Research Centre (APERC)
February 2021

Acknowledgments

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Editor

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Contents

Abbreviation and acronyms

Abbreviation

bcm	billion cubic metres
LNG	liquefied natural gas
GW	gigawatts
MTPA	million tonnes per annum
MBtu	million British thermal units
USD	US Dollar
GDP	Gross Domestic Product
CAGR	Compound Annual Growth Rate
FSRU	Floating storage regasification unit

Acronyms

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
EGEDA	Expert Group on Energy Data and Analysis
EIA	Energy Information Administration, USA
EU	European Union
IEA	International Energy Agency

List of tables

List of figures

Executive summary

After 10 years of robust growth, global natural gas consumption and production declined in 2020 as economic activity slowed due to lockdowns and other government responses to the COVID-19 pandemic. Before the pandemic, the world's natural gas consumption grew by 30% in the past decade, reaching almost 4,000 bcm in 2019, compared to 3,058 bcm in 2009.

APEC members played an outsized role in the growth of the world gas market. In 2019, APEC consumed more than half (57%) of the world's gas production and accounted for 67% of the year-over-year growth in global consumption. APEC economies include four of the world's five largest gas consumers: the United States of America, the Russian Federation, the People's Republic of China, and Canada.

Since 2009, APEC gas demand growth has been dominated by the USA and China. Following the rapid increase in U.S. shale gas production and the resulting gas price declines, gas demand in the US grew by 36% from 2009 to 2019. China's demand has more than tripled in the last decade. In contrast, Japan, still the world's largest LNG importer, recorded an overall 3% decrease in gas demand during from 2009 to 2019 period, after demand peaked in 2012. Moreover, already before the COVID-19 pandemic hit, APEC gas demand had already slowed down, growing only by 1.5% in 2019 compared to 5.1% the previous year.

In terms of supply, world gas production increased by an average of 2.4% per year from 3,062 bcm in 2009 to 3,619 bcm in 2019. In 2017-2019 gas production growth accelerated: the average growth rate was 4.2%. Gas production in APEC grew faster: in 2009-2016, it increased by an average of 2.7% per year, in 2017-2019 - by 6% per year. APEC economies accounted for 72% of world gas production growth, which was supported by increases in the United States, Russia, Australia, and China. This growth led to an increase in the APEC's share of global production from 57% in 2016 to 60% in 2019.

Although most (70%) of the world's natural gas is consumed domestically, about 1,320 bcm of gas were traded internationally in 2019. International gas trade increased steadily in the past decade, except for 2014. Traded volumes grew by 48% from 2009 to 2019 (4% CAGR). Between 2014 and 2019, gas trade grew at an even faster rate (5.6%), more than double of that of the 2009-2014 period. In 2019, international trade rose by 5.2% compared to the 2018. LNG trade increased faster than pipeline trade and increased its share of total trade from 27% in 2009 to 36% in 2019. Increased LNG trade has increased regional market integration as well as enlarged the number of both gas exporting and importing economies.

The APEC region has some of the most active gas trading economies in the world, including three of the top five world exporters (Russia, the United States and Canada) and three of the top five world importers (Japan, China and the United States). APEC, as a whole, is a natural gas net exporter: 60% of gas exports were shipped by pipeline while the remainder was shipped as LNG. On the natural gas imports side, by contrast, 46% was pipeline gas and 54% was LNG in 2019.

COVID-19 has temporarily stalled the global gas market. Gas consumption in APEC economies is estimated to decline in absolute terms in 2020, the first time this has happened since 2009. Government responses to the COVID-19 pandemic have varied by economy but many governments have instituted various types of lockdowns which have reduced economic activity and demand for all fuels, including natural gas. So, while

the year 2019 exhibited a slowdown in gas demand growth, APERC projections indicate that gas consumption in APEC economies will decrease by 0.8% in 2020. As in 2019, we expect the aggregate change in gas consumption will be the result of a combination of slower growth in some economies and absolute declines in others.

The pandemic has also affected gas production in the APEC region. Gas production fell in all APEC economies with the sole exception of China, but nowhere did it fall more than in Russia. Cumulative data through September 2020, shows that gas production in Russia shrank by 6% compared to the previous year. Reduced demand both domestically and in Europe, Russia's primary export markets, forced the production decline. Overall APEC gas production was down an estimated 3% in 2020.

Contrary to expectations, impacts on gas trade brought a collection of breakthroughs and record highs. APEC gas imports down by 0.9% on an accumulated year over year basis as of November 2020. APEC imports had been growing steadily since 2014, increasing by 1.5% per annum in 2019 and by 5.1% in 2018. This overall decrease in gas imports results from a combination of trends in major APEC importers, including the effect of the pandemic on gas demand. While gas output decrease in Australia and the USA, LNG exports reached their historical maximum level despite a global demand decrease for natural gas. Thailand and Mexico had considerable drops on domestic production and smaller decreases on demand, which resulted on the former importing more LNG and the latter, more US piped gas than ever before. Finally, both Chinese Taipei and China reached an unprecedented level on LNG imports, which is only estimated to keep growing in the next five years.

The gas price crises in Northeast Asia at the end of 2020 and start of 2021 was the latest major development for global gas markets. While during the first half of 2020 gas prices touched historical lows. these benchmarks started to recover on the third quarter of 2020. In mid-December, a complex interaction of factors Asian made spot prices suddenly rise by ten-fold, reaching a record high of over USD 30/MMBtu. This "perfect storm" included a cold snap in Northeast Asia, unavailability nuclear in Japan, record high-demand in China, limitations on coal-fuelled generation in Korea, lower LNG inventories and liquefaction plants outages. Asian LNG prices returned to levels like those of early December by late January. However, this short-lived crisis highlighted and evidenced once again the fragility of LNG markets in Northeast Asia, creating an opportunity on how to develop relevant infrastructure and policies to reduce volatility and exposure to unexpected conditions which could jeopardize energy security.

According to APERC's preliminary results of the APEC Energy Outlook 8th Edition, APEC total gas demand is projected to grow at an average annual rate of 1.5% between 2019 to 2025 and the gas production in APEC will increase by 6% over the following six years.

China is expected to be, by far, the main source of growth in APEC, increasing at a 5% CAGR and growing consumption by over 100 bcm by 2025. While China's gas demand did not decline in 2020, this average growth rate is a substantially slower pace than the double-digit rates seen during most of the 2015-2020 period. About 80% of growth in natural gas production from 2019 to 2025 comes from Russia and China. China natural gas production is expected to grow by 30%, surpassing Canada to become the third-largest natural gas producer in APEC. At the same time both the USA and Russia continue to expand their

liquefaction capacity and may increase their role as pipeline and LNG exporters, while Canada and Mexico are expected to join the LNG exporting club by 2025.

This report identifies three key dynamic to follow in the region:

1. The Impact of the gradual expansion on Russian exports to China via the Power of Siberia pipeline and the Yongqing-Shanghai pipeline.
2. Growth for natural gas and particularly LNG imports in Thailand, Malaysia, Indonesia and soon in Viet Nam and the Philippines, amid challenges from LNG price volatility, affordability versus coal and the development of receiving infrastructure.
3. Amid economic recovery from the COVID-19 pandemic, the role of natural gas will be in each economy's recovery path and how gas is integrated in strategies for low-carbon energy transitions and reaching their National Determined Contributions (NDC's). A key message is that while the COVID-19 pandemic provides an opportunity for a transition to lower carbon energy systems, in developing economies it also can be taken as a pretext to prioritize energy security, nationalistic energy policies and differ investments on infrastructure.

APEC members have played an outsized role in the global gas markets over the last 20 years. The future energy and climate policies of the APEC economies can be expected to continue to play a pivotal role in the natural gas market in the coming 20 years.

Section 1. Natural gas updates in APEC economies

Economy	Topic
Australia	• LNG exports grew by 2% in 2020 and reached a record high for the 9th consecutive year, despite outages in the Prelude and Gorgon LNG facilities and a decline in global gas demand caused by the COVID-19 pandemic. • Domestic gas production fell by 1% in 2020 and gas supply remains tight in Southeast Australia.
Brunei Darussalam	• Production decreased by 2% in 2020, while demand grew by 4%. • LNG exports fell by 7.3% in 2020 to 8 bcm, more than offsetting 2% growth in 2019.
Canada	• Following the restrictions caused by the COVID-19 pandemic, estimated demand shrunk by 5% and imports from the USA declined by 8%. • Gas production had an estimated 2% decline in 2020, while exports to the USA fell by 9%. • LNG Canada, the only liquefaction plant under construction in this economy, faced delays caused by the pandemic and is now expected to enter service in 2025.
Chile	• Gas demand rose marginally in 2020 after increasing by 22% in 2019, supporting a 10% increase in LNG imports as pipeline imports from Argentina and domestic production both declined. • None of the 3 proposed regasification terminals in the Biobío region have received a final investment decision (FID) and approval seems less certain as Chile considers how to achieve its carbon neutrality goal by 2050.
China	• China, the world's largest gas importer, experienced record-high gas consumption in 2020 with a year-over-year increase of 6%. • While production also grew in 2020, LNG imports grew by 12% with pipeline imports estimated to be at levels similar to those in 2019. • President Xi announced a net-zero carbon emissions goal by 2060, with concrete policies yet to be published but with an expected increasing role for natural gas at the expense of coal and petroleum. • The Chinese government established the China Oil & Gas Piping Network Corporation (PipeChina) in 2019, as the single manager and operator of all pipelines, LNG import terminals, and gas storage facilities. • The Power of Siberia gas pipeline became operational in late 2019. In 2020, PipeChina commissioned a 1,110 km long pipeline with 27 bcm/y of capacity that connected the Power of Siberia to the Beijing region.
Hong Kong, China	• Gas consumption, all of which is imported from the PRC, increased by an estimated 54% in 2020.
Indonesia	• Gas demand fell by 8% in 2020, while gas production shrank by 10% or 6 bcm, which continued the downward trend that began 2015.

	• LNG exports dropped by 4% in 2020, driven mostly by a decrease of Japanese demand and imports. The Tangguh LNG Phase 2 expansion, currently in progress, is expected start-up by mid-2022 after delays caused by the COVID-19 pandemic. • The 3 LNG receiving terminals were overwhelmingly fed by intra-Indonesian trade (4.9 bcm), with marginal volumes (0.3 bcm) being imported in 2019.
Japan	• LNG imports dropped by 5% in 2020 to their lowest level since 2010. Despite the decline, which continued a trend that started in 2017, Japan remained the world's largest LNG importer. • Prime Minister Suga announced a carbon neutrality goal by 2050, with a roadmap yet to be published and an unclear role for LNG imports in the future. • Gas import volumes will remain highly dependent on demand from Japan's power sector which is challenged by uncertainty on the restart of nuclear reactors, increasing shares of solar PV and wind generation, and exposure to extreme weather events.
Korea	• LNG imports fell by 1.8% in 2020, a further decrease from the 3% decline in 2019, leaving imported volumes at around 50 bcm. LNG imports grew during the first half of 2020 but experienced a steep decline in the second half of the year that more than offset first half gains. • President Moon pledge a carbon neutrality target by 2050, with an expected increase in natural gas consumption as coal is gradually phased-out.
Malaysia	• Malaysia, the fifth largest LNG exporter, saw its LNG exports go down by 7% in 2020, with less demand from importers facing the effect of the pandemic. LNG exports grew by 19% in 2019. • Gas production experienced a 10 bcm or 16% contraction in 2020. • In 2020, Malaysia's LNG imports declined marginally to approximately 4 bcm.
Mexico	• Estimated gas consumption fell by 5% in 2020, with USA pipeline imports growing by 4% at the expense of declines in LNG imports (-63%) and domestic gas production (-6%). • The 800 km-long Sur de Texas-Tuxpan offshore pipeline was commissioned in 2019 and increased US importing capacity by 40%. The last segment of a pipeline system connecting Texas and West Mexico became operational in 2020. • Energía Costa Azul (ECA) LNG liquefaction project was the only FID in 2020 and its first train is estimated to be operational by 2024. New Fortress LNG receiving terminal, currently under construction, is estimated to be commissioned in 2021.
New Zealand	• In 2019, New Zealand's Parliament approved a law committing to carbon neutrality by 2050, which envisions a phase-out of natural gas in the buildings sector, relegating it to the industrial and power sectors. • Demand decreased marginally in 2020, while production fell by 6%.
Papua New Guinea	• LNG exports increased by 1% in 2020, reaching a record high of 12 bcm with increased flows to Chinese Taipei and China.

Peru	• The strict lockdowns led to a consumption drop of 17% in 2020 while production declined 11%. LNG exports, relatively more resilient, fell by 4% to 5 bcm.
Philippines	• Gas demand declined by 9% in 2020 driven by reduced power generation. • FGEN LNG, signed an EPC contract in 2020, and is expected to receive the first LNG cargoes in the archipelago by late 2022. Three other regasification terminals have received permits and are at various stages of development.
Russia	• Natural gas output declined by 6% as pipeline exports to Europe, its main destination, declined 15% after COVID-19 restrictions were implemented in 2020. • LNG exports decreased marginally in 2020 despite Sakhalin 2 LNG exporting record volumes. • After the commissioning of the Power of Siberia pipeline, Gazprom is building an 803 km-long pipeline to add feed gas from the Kovyktinskoye field in Irkutsk region. • Constructions of the Yamal LNG T4, Arctic LNG 2 and Portovaya LNG T1 remain underway and are estimated to be operational before 2025.
Singapore	• Despite COVID-19, gas demand showed resiliency in 2020, growing by 8%. LNG imports grew even more by 14%, reaching a historical high above 5 bcm.
Chinese Taipei	• LNG imports are set to also reach a record-high with an 8% increase as of November and imports estimated to be over 23 bcm in 2020. • An LNG receiving terminal in Taoyuan is in construction and is scheduled to be operational by late 2022 while an EPC contract was signed for another receiving terminal in September 2020.
Thailand	• Consumption and production declined in 2020 by 6% and 11%, respectively. As a result, LNG imports grew by 6% and reached a historical high of 7 bcm, still well below the economy's nameplate regasification capacity. • The construction of the Nong Fab LNG receiving terminal has been delayed and is now expected to become operational by late 2022,
United States	• As of November 2020, the USA saw the largest drop in consumption in APEC of 17 bcm or 2%, a sharp contrast to the 23 bcm annual growth seen in 2019. • The USA also had the largest decline in production with a cumulative drop of 11 bcm or 1% in the first 11 months of 2020. Despite lower domestic production and outages at different liquefaction plants, US LNG exports increase by 30% in 2020 and surpassed the 45 bcm mark for the first time. • Liquefaction capacity continues to expand with the commissioning of over 15 MTPA in 2020 alone and about 30 additional MTPA of capacity under construction at Calcasieu Pass LNG, Golden Pass LNG and Sabine Pass T6.
Viet Nam	• Given the decline of domestic production and growing domestic demand, Viet Nam's government set a goal of importing 7 bcm of LNG in 2025 and up to 20 bcm by 2035. Two projects are under construction: the 2 MTPA Hai Linh terminal and the 3 MTPA Thi Vai terminal, which are expected to begin operations in 2021 and late 2022, respectively.

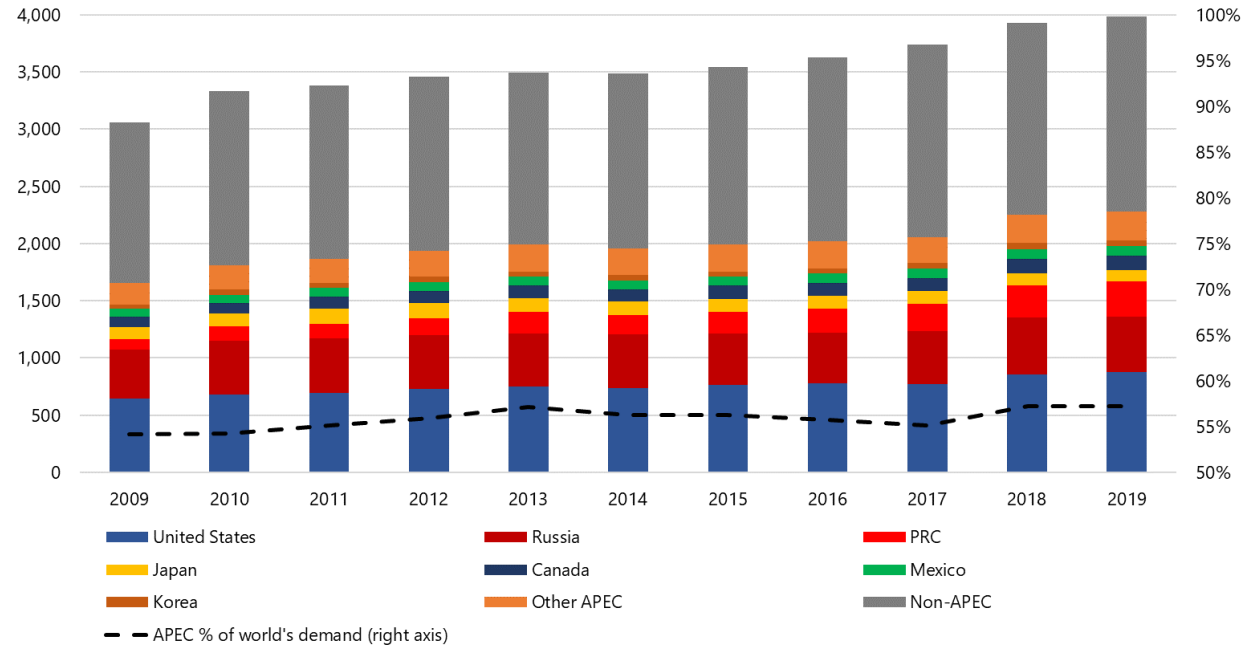
Section 2. Gas demand

2-1 World and APEC natural gas demand

The world's natural gas consumption grew by 30% in the past decade, reaching almost 4,000 billion cubic meters (bcm) in 2019, compared to 3,058 bcm in 2009. The 21 economies that compose the Asia Pacific Economic Cooperation (APEC) have contributed substantially to this growth. In 2019, APEC members consumed more than half (57%) of world's gas production and accounted for 67% of the year-over-year growth in global consumption.

APEC economies include four of the world's five largest gas consumers: the United States of America, the Russian Federation, the People's Republic of China, and Canada.[1]

Figure 2-1 Natural gas demand in APEC and the world, 2009-2019 (bcm)



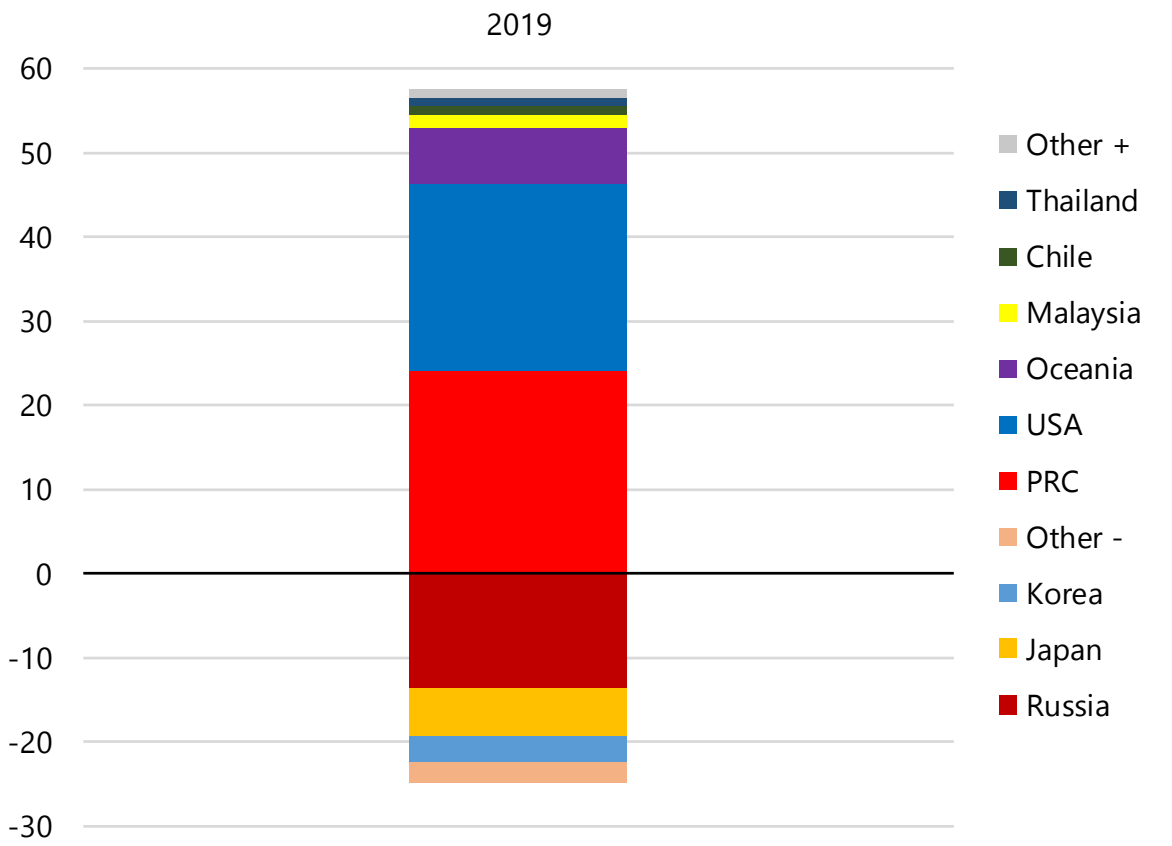
Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Growth in global gas consumption slowed in 2019, increasing by only 1.5% in 2019, compared to 5.1% in 2018 (Figure 2-1). APEC economies showed an even greater deceleration. APEC gas demand grew by 1.5% or 33 bcm in 2019, but that was a drop from 9.2% growth in 2018. This deceleration was driven primarily by slower growth in the USA and China, but it was also the result of opposing dynamics across the 21 APEC economies. Gas consumption grew in the USA, China, Malaysia and Thailand. In contrast, gas consumption fell in Russia, Indonesia and Korea reversing earlier growth trends. Some economies, including Japan and

[1] Hereinafter referred to as USA, Russia, and China.

Chinese Taipei, where gas demand had decreased in 2018, saw further consumption declines. Finally, gas demand grew in 2019 even faster that it did in 2018 in Australia, Chile, and Peru, however in a moderate magnitude when compared to APEC-wide demand (Figure 2-2).

Figure 2-2 Natural gas demand growth in APEC by economy, 2018 to 2019 (bcm)



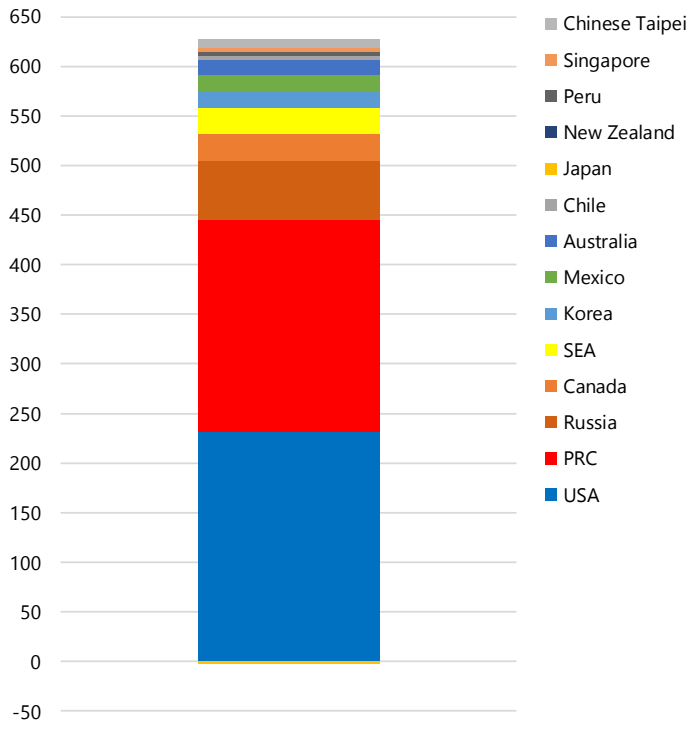
Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Gas consumption in APEC economies is likely to decline in absolute terms in 2020, the first time this has happened since 2009. Government responses to the COVID-19 pandemic have varied by economy but many governments have instituted various types of lockdowns which have reduced economic activity and demand for all fuels, including natural gas. So, while the year 2019 exhibited a slowdown in gas demand growth, global gas consumption is likely to shrink by 3.3% in 2020 (according to the IEA estimates). In contrast to the global total, APERC projections indicate that gas consumption in APEC economies will decrease by only 0.8% in 2020. As in 2019, we expect the aggregate change in gas consumption will be the result of a combination of slower growth in some economies and absolute declines in others. A detailed examination of the effects of the COVID-19 pandemic on gas consumption will be presented in Section 5.

When describing gas demand growth in Asia-Pacific and APEC, market analysts often focus on large Northeast Asian LNG importers like Japan, Korea and Chinese Taipei or, most recently, on emerging Southeast Asian importers like Thailand and Indonesia. However, this is not the whole story, as these economies have not been the primary drivers of demand growth in APEC during the last decade. Since

2009, APEC gas demand growth has been dominated by the USA and China, both in absolute and percentage terms (Figure 2-3). Following the rapid increase in U.S. shale gas production and the resulting gas price declines, gas demand in the US grew by 36% from 2009 to 2019, or 231 bcm. China's demand grew by 214, but from a lower baseline in 2009, more than tripling in the last decade. In contrast, Korea's gas demand grew by only 17 bcm in the past decade and Japan, still the largest LNG importer, recorded an overall 3% decrease on its gas demand during from 2009 to 2019 period, after demand peaked in 2012.

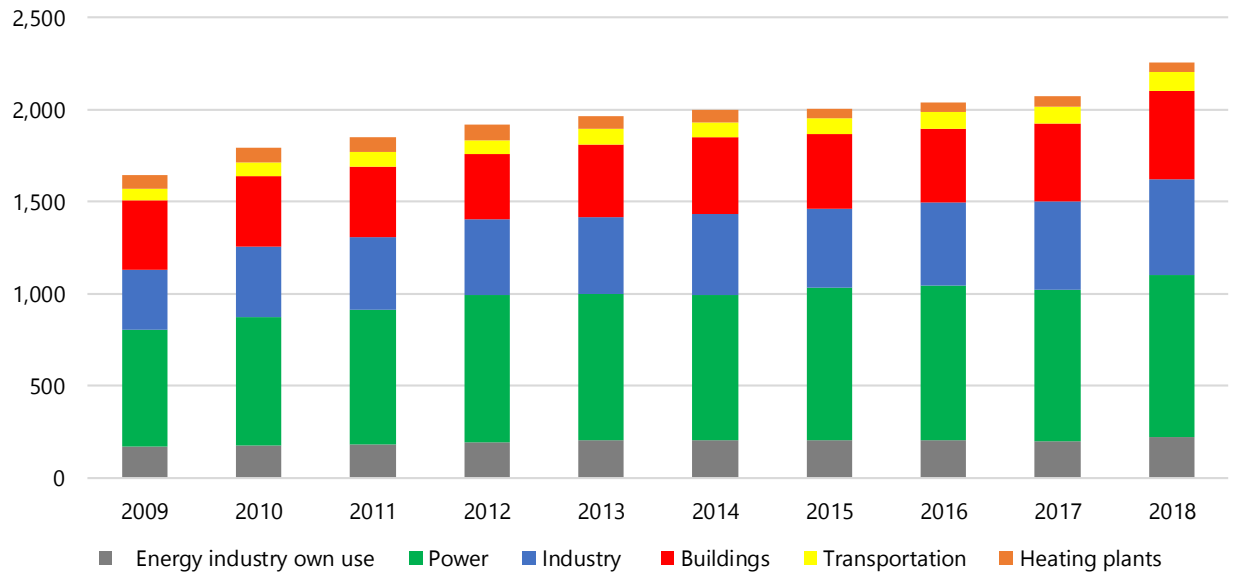
Figure 2-3 Natural gas demand growth by economy, 2009 to 2019 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

The growth in demand across the region has responded to different factors but for most APEC economies, the power and industrial sectors played a dominant role (Figure 2-4). All sectors in the APEC region have seen growth in gas consumption from 2009 to 2018. It has been the power sector, however, that has shown the largest increase with consumption growing by 247 bcm during this period, a 3.2% annual average increase. Although not as large a consumer in absolute terms, industry has seen an even faster growth with an average 4.8% per year from 2009 to 2018, which represented a total increase of 196 billion cubic meters. Gas demand in other sectors have also grown but to a lesser extent, with gas consumption in buildings growing by 105 bcm and in transportation 36 bcm from 2009 to 2018. In some APEC economies, heating needs during winter play a major role for gas demand in the buildings sector and for heating plants, depending on the severity and length of cold temperatures. This is an important contributor to buildings gas demand annual variations in economies including China, USA or Russia, which contrasts with the steady growth trend seen in the power or industrial sector.

Figure 2-4 APEC Natural gas demand by sector, 2009-19 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

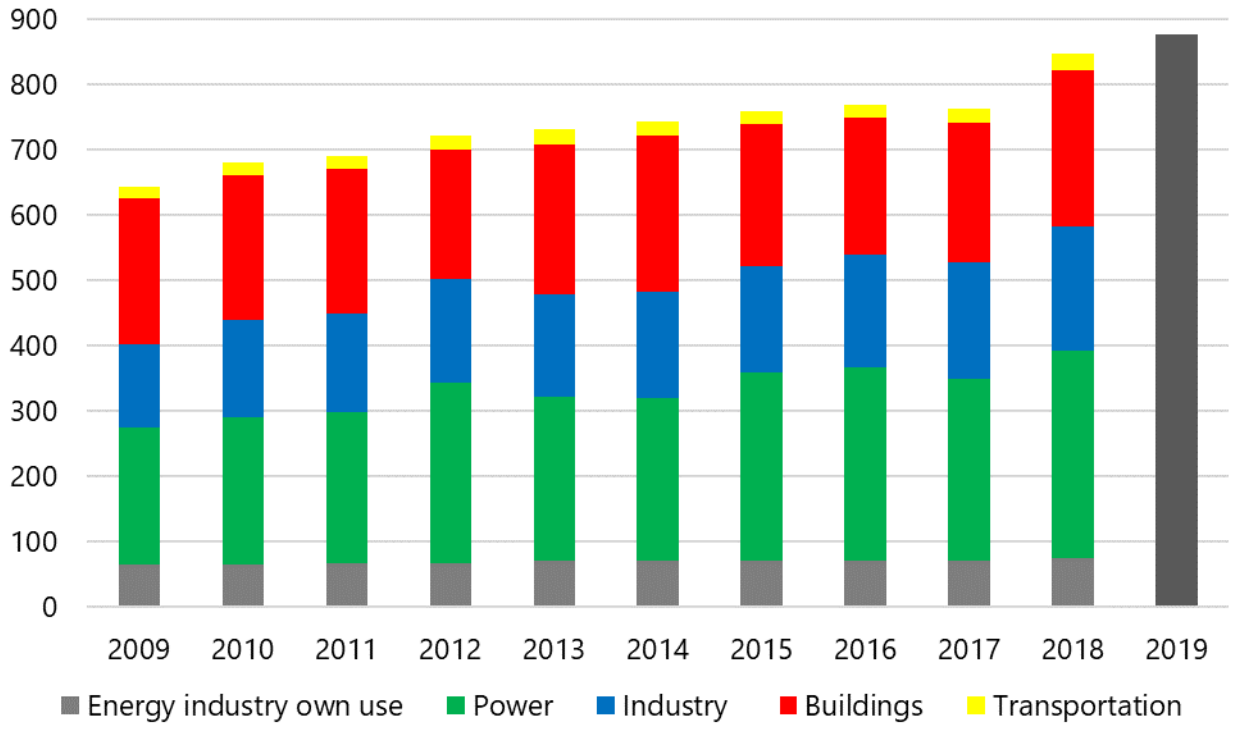
Gas demand growth driven by the power sector has been caused by both fuel-switching (away coal and fuel oil) and increasing demand for electricity. About 44% of this growth took place in the USA, followed by 18% in China in the period from 2009 to 2018. Moreover, this growth more than offset reductions in gas-fired power generation in economies like Malaysia or Russia. In the industrial sector, however, gas demand growth was led by the United States (32%) and China (31%), which together accounted for almost two thirds of incremental demand. Finally, growth in the buildings sector was led by China and Russia, while in the transportation sector, more than half of incremental gas demand took place in China alone, during this period.

As a result of the growth in all sectors, gas was the fastest growing fuel in APEC from 2009 – 2019 and it plays an increasingly important role in most of the 21 APEC economies. For all APEC economies gas accounts for at least 10% of total primary energy supply, except for China and the Philippines. The following sections of this report examine the specific dynamics of gas demand in the 5 largest gas consumers in the APEC region and relevant developments in the past year.

2-1-1 United States

The United States consumed 878 bcm in 2019 making it the largest gas user in APEC and the world. US gas demand has grown by 231 bcm or 36% from 2009 to 2019 making it the largest single contributor to APEC's increased gas use over the period (see Figure 2-5). While total primary energy demand in the US plateaued over the past 10 years, natural gas demand has grown, increasing its share of primary energy supplies from 25% in 2009 to over 30% in 2018. Gas demand growth in this period has been encouraged by the low gas prices resulting from increased shale gas production, mostly from the Appalachian and Permian basins. The Henry Hub benchmark has reflected this abundance of gas with monthly average prices of 3.20 USD per million British thermal units (MMBtu) over the 2010 – 2019 period (EIA, 2020a). Although the price has been relatively volatile, the monthly average price has not exceeded 5.00 USD per MMBtu since March 2010.

Figure 2-5 Natural gas demand in the United States by sector, 2009-19 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

The low gas prices have enabled a rapid growth in all demand sectors but primarily the power sector, where gas-fired generation has increasingly displaced coal. Gas demand growth slowed from 2018 to 2019 when it increased only by 3% compared with 11% in the previous year. This is the result of two main trends, a slower growth rate in power generation and industry, as well as a marginal reduction on the buildings sector. While gas demand in the power sector grew by an impressive 65% from 2009 to 2019, it only increased by 6.8% in 2019 compared to the previous year. Industrial gas demand followed a similar trend, growing by 37% during the same period, but in 2019 increasing only marginally (0.1%) (EIA, 2020b). As for the buildings sector, gas demand did not grow and remained practically at the same levels in 2019 as in the previous year and actually lower than in 2014. These annual variations but relative stability in the mid-term respond to the variations in weather during the heating season in the US. Finally, as explored in Section 3, along with domestic rising demand, the US has taken advantage of the increasing gas production by boosting the gas exports both via LNG and by pipeline.

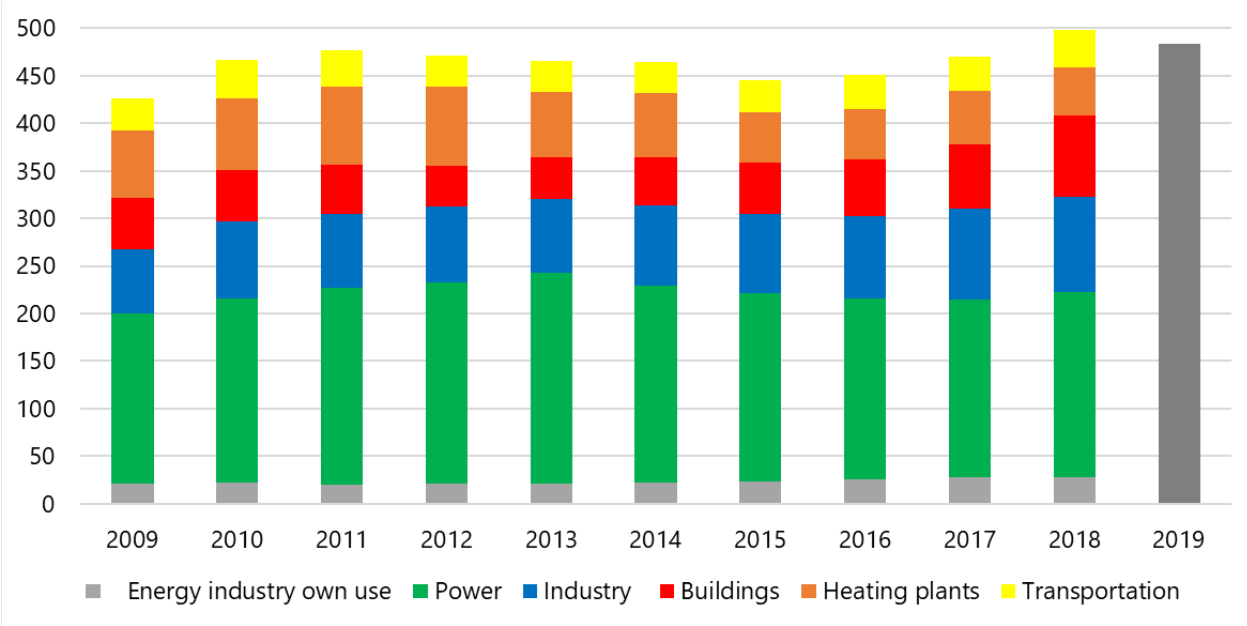
2-1-2 Russia

Russia is the second largest gas consumer and producer in the world and is also the world's top natural gas exporter. Gas demand in Russia rose from 2009 to 2019 by 14%, reaching 484 bcm and supported mostly by steady growth in the industrial and power sectors sector (4.4 and 1.0% CAGR, respectively). The buildings sector grew by 59% from 2009 to 2018, but it showed substantial variation on a year-on-year basis, responding mostly to space-heating needs in winter. For example, the buildings sector gas demand fell by

more than 20% in 2012 but rose by 25% in 2018. Growth from these sectors has more than offset the 20% reduction in gas use in the heating district sector or heat-only plants during the same period.

Despite this growing trend compared to 2009, gas demand declined in 2019 compared to the previous year by 3% or 14 bcm, making it the largest gas demand decrease in absolute terms in all APEC 21 economies. This fall in gas demand may be driven by a lower economic growth rate in Russia compared to the previous two years, as Russian GDP only grew by 1.3% in 2019 (World Bank, 2020). Disaggregated sectorial data was not yet available at the time of publication, but preliminary electricity data shows a decrease in gas consumption for power generation.

Figure 2-6 Natural gas demand in Russia by sector, 2009-19 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Historically, power generation was the largest energy consuming sector in Russia in 2018, consuming about 38% of primary energy supplies, and gas remains the leading fuel for power generation, accounting for 46% of the total in 2019. As a result, gas continues to be the leading fuel in Russia's primary energy mix, representing 54% of total primary energy supply in 2019.

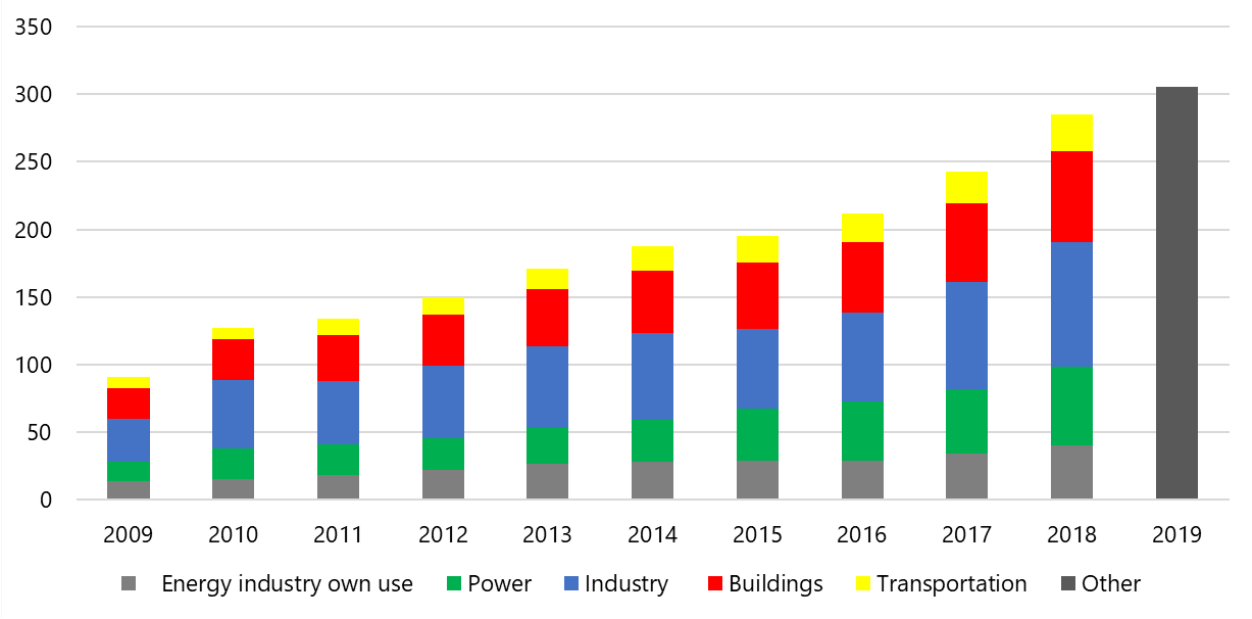
2-1-3 China

From 2009 to 2019, China's gas demand rose by 214 bcm from 90 bcm in 2009 to 304 bcm in 2019, at an average annual growth rate of 13 percent. Despite the rapid growth, gas remains China's third most consumed primary fuel, far behind coal and oil. Note, gas demand growth slowed down notably in 2019 compared to previous years.

While China's gas consumption has more than tripled in the past decade, it still accounts for a relatively small share of the economies total primary energy supply. China's primary energy supply grew robustly by 39% from 2009 to 2018. Coal remains by far the most consumed fuel in this economy, accounting for 62% of the total in 2019, which is 11 percentual points more than in 2009. In contrast, gas accounted for only

7% of total primary energy supply in 2018, one of the lowest shares in the APEC region, although high compared to the 2% share it held in China in 2009.

Figure 2-7 Natural gas demand in China by sector, 2009-19 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Gas demand grew by 8.6% (18 bcm) from 2018 to 2019, which would be high in other economies but in China it contrasts with the 18% growth rate seen in the previous year. Unlike other APEC economies where power-generation is the sector that consumes the most gas, industry is not only the largest sector accounting for 33% of gas demand but also the one that grew the most in 2018 (13 bcm). Nevertheless, all sectors had a two-digit growth rate in 2018, supported by growing transmission infrastructure across regions in China. This trend is projected to continue as the second section of the Yongqing-Shanghai pipeline, a 1,100 km-long project which will allow Russian piped gas exports flow to Shanghai, became operational in December 2020 (Daiss, 2020). This allows more gas availability for power generation but also for the buildings sector, particularly for space-heating, a major issue in the past, as noted in this report's 2018 edition.

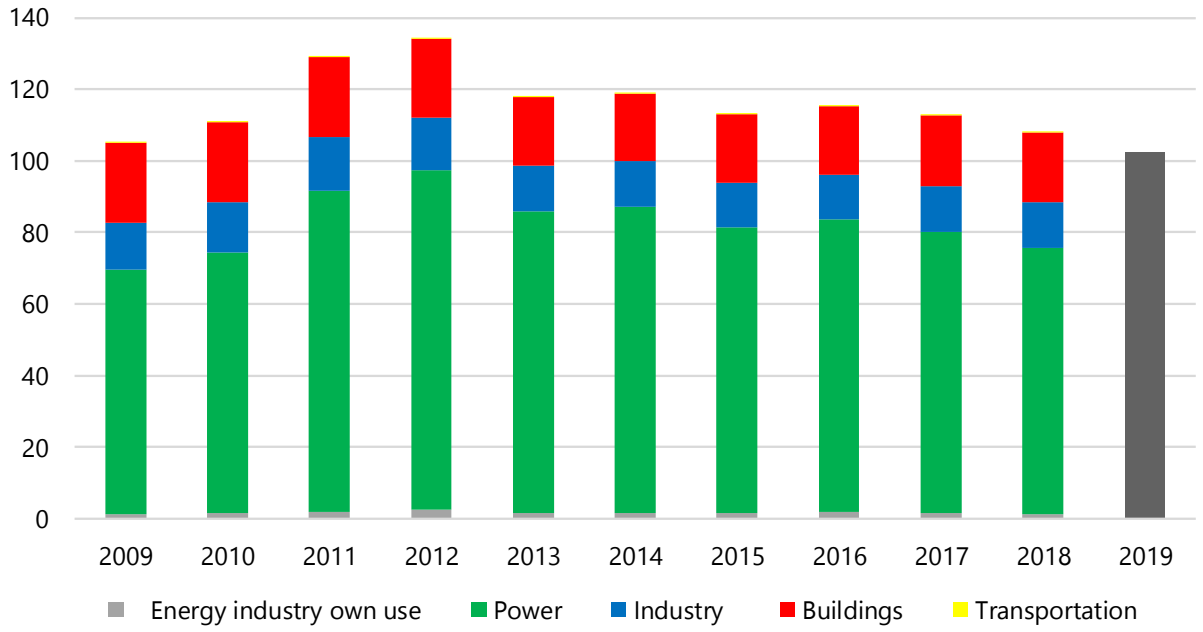
Finally, two major developments took place on China's gas sector at the end of 2019: the commissioning of the long-awaited first Russia-China gas pipeline and the creation of a state-owned company responsible for the construction and operation of crude oil, oil products and gas pipelines across China (Downs & Sheng, 2020). The first gas interconnection between Russia and China, named the Power of Siberia gas pipeline, became operational with flows equivalent to 4 bcm/year, with volumes planned to ramp up to nameplate capacity (38 bcm/year) in the coming years (Elliot, 2020). This is a major infrastructure project in China, particularly for its Northern regions, increasing gas supply and diversifying it from traditional piped importers like Turkmenistan and Myanmar and mitigating exposure from LNG imports. On the other hand, the establishment of the China Oil & Gas Piping Network, meant a transition to more centralized network that used to be dominated by China's three major energy companies: China National Petroleum Corp, China

Petrochemical Corp and China National Offshore Oil Corp. This new company is expected to enable increased third-party access and enhance pipeline interconnections across China.

2-1-4 Japan

Despite three years of declining gas demand, Japan remained the world's largest LNG importer in 2019. LNG imports accounted for 97% of Japan's total gas supply, as domestic production is marginal, and the Japanese archipelago does not connect with any international pipelines. Japanese demand decreased by 5% in 2019, falling to 103 bcm, the minimum since 2009.

Figure 2-8 Natural gas demand in Japan by sector, 2009-19 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

This steeper decline in gas demand in 2019 is part of a diminishing trend that started in 2013, and responds a complex number of factors, most of which them are related to the power sector. Japan's electricity demand decreased by an annual average 0.9% from 2009 to 2019, mostly driven by demographics and energy efficiency measures. Following the Fukushima Daiichi Accident, all nuclear power plants were shut down in 2012, and only 9 of the 54 existing reactors have restarted operations as of August 2020 (JNSI, 2020). Ten additional reactors have been approved to resume operations and 15 have been permanently decommissioned; meaning nuclear power in Japan will not go back to pre-Fukushima levels (JNSI, 2020). Nuclear power accounted for 25% of power generation in 2010, which was substituted with a ramp-up on power generation from coal and LNG, as well as an increase on energy efficiency measures (IEA, 2020).

LNG-fired power generation peaked in 2012 at 135 bcm, driven by a 31% increase of gas for power generation compared to the pre-Fukushima era. Since 2014, gas demand from the power sector has fallen by 13%, resulting from an unchanged coal-fired generation, an increasing share of solar generation and a slow recovery on nuclear power. In 2019, natural gas-fired power generation accounted for 34% of the total while nuclear to only 6.4%. Additionally, since 2010 other demand sectors have overall reduced their gas

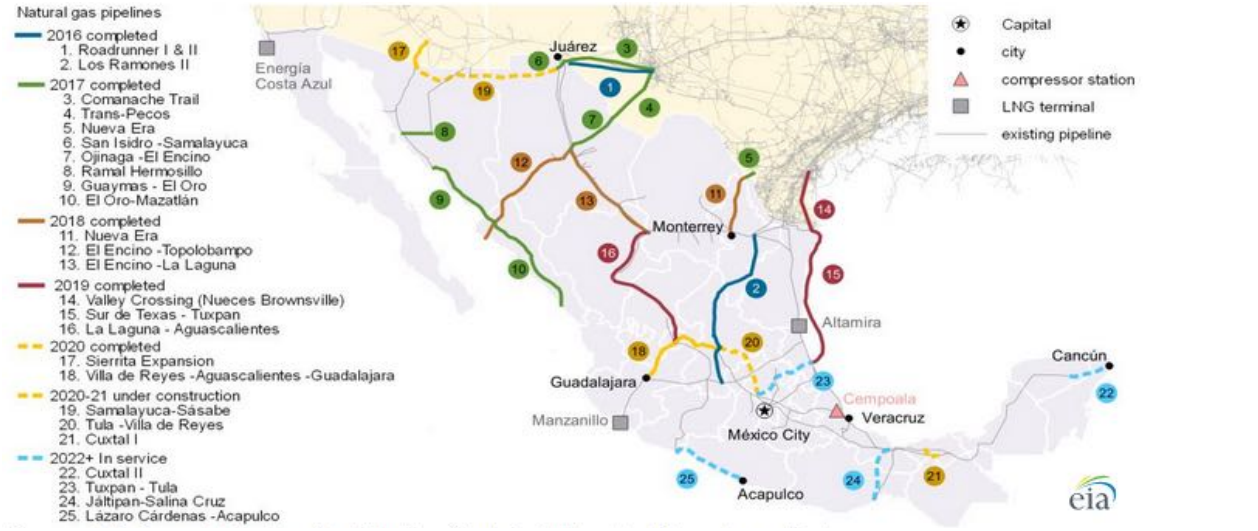
demand by 9%. Industrial energy demand peaked in 2011 and has been flat at around 13 bcm ever since. Buildings energy demand has oscillated between 19 and 23 bcm since 2009, largely dependent on heating needs and weather. Finally, transportation demand in Japan remains negligible at less than 0.1 bcm. The future of natural gas demand in Japan remains uncertain given the recent pledge to achieve net-zero greenhouse gas emissions by 2050 (Suga, 2020).

2-1-5 Mexico

Gas consumption in Mexico has experienced a sustained growth in the past 10 years at a 2.2% average annual growth rate, reaching 84 bcm in 2019, making it the sixth largest gas consumer in the APEC region. Mexico is currently a net importer of natural gas, as the gap between decreasing domestic production and growing demand has widened in the past decade. This demand growth is being driven mainly by oil-to-gas switch in the power sector and pipeline expansions that include more interconnections with the US to boost imports from the Permian Basin. Most of these pipelines were underwritten by the state-owned electric utility, Comisión Federal de Electricidad (CFE). CFE has also promoted the construction of gas-fired power plants in regions with no previous access to natural gas, acting as the anchor consumer for most of these pipelines. While at least seven of these projects had major delays, US piped gas imports have been essential to meet increasing demand, as domestic production has fallen by 47% since 2009.

One of the most important recent developments was the commissioning of the 800 km-long Sur de Texas-Tuxpan offshore pipeline, which increased US importing capacity by 40% (CENAGAS, 2020). The Sur de Texas-Tuxpan directly links the US with consumptions centers in the Gulf coast in Mexico, including power generation facilities but also interconnections with pipelines that can potentially take gas to regions without access to it. The commissioning of this pipeline displaced LNG imports traditionally used to balance the pipeline grid. Mexican LNG imports accounted to 1.9 bcm in 2020, 61% less than in 2018.

Figure 2-9 Gas pipelines commissioned since 2016, under construction and planned



Sources: US, Energy Information Administration, 2020.

In 2020, two major gas projects became operational. The last segment of the "Wahalajara" system, a set of pipelines connecting the Permian basin's Waha hub in Texas to the Mexican city of Guadalajara, became operational in June 2020. This pipeline system allows consumers and power generators in Central and Western Mexico to benefit from the competitive gas prices in the Permian basin, instead of higher priced LNG from the Manzanillo terminal or other gas supplies. The commissioning of the Cuxtal pipeline, allows gas flows coming from the SISTRANGAS (national gas pipeline network) with a pipeline that takes gas to the Yucatán peninsula, a region with gas scarcity problems in recent years. Both new projects may prompt an increase in pipeline imports, as gas demand decreased only marginally as result of the ongoing pandemic. Three other main pipelines in other regions, remain under development but have experienced delays caused primarily by social opposition in nearby communities (CENAGAS, 2020). Finally, gas demand growth in Mexico will mostly depend on the extent to which CFE uses more of its spare capacity on existing pipelines or reaches agreements with other users including other generators, industrial and residential consumers.

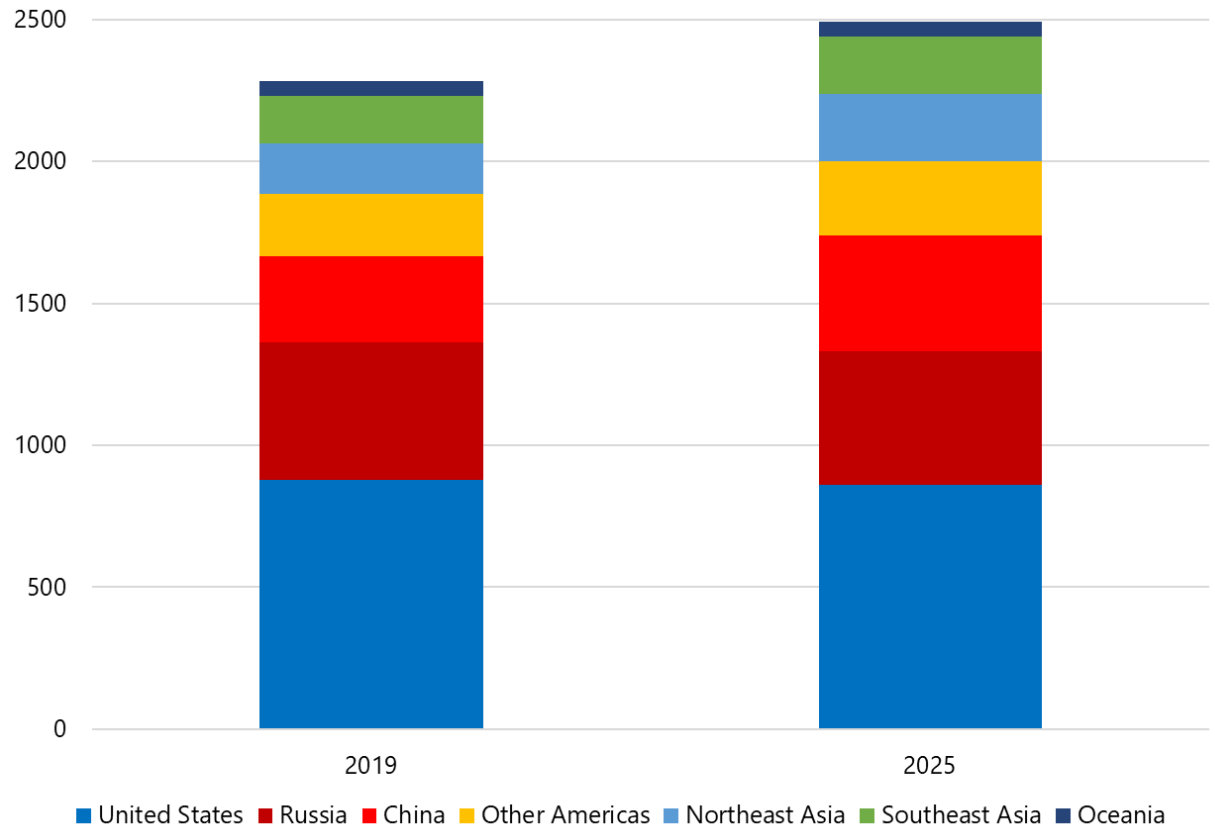
2-2 Gas demand outlook

According to the Asia Pacific Energy Research Centre's (APERC) preliminary results of the APEC Energy Outlook 8th Edition, APEC total gas demand is projected to grow at a 1.5% CAGR between 2019 to 2025, reaching 2,491 bcm by 2025. This overall slow growth results from a decrease on gas demand during 2020, caused by the different measures taken to contain the COVID-19 pandemic across the region. Most APEC economies are estimated to have a fall on demand on 2020 and a gradual recovery starting from 2021, however seven economies do not recover the consumption levels seen in the pre-COVID era.

Conversely, China, will be, by far, the main source of growth, increasing at a 5% CAGR and growing consumption by over 100 bcm in 2025. While China's gas demand did not decline in 2020, this average growth rate is a substantially slower pace than the double-digit rates seen during most of the 2015-2020 period. Industry and the power sector continue to be the two main engines of growth in this economy. Additionally, the carbon-neutrality goal by 2060 announced last year, has yet to have a clear strategy in the much awaited 14th five-year energy plan, but it will very likely require further coal-to-gas substitution in the power, industry and heating sectors.

Natural gas demand in the US is projected to fall by 2% (18 bcm) in 2025 compared to 2019, after a decline caused by the pandemic effects and a slowdown driven by the industrial sector. This contrasts to the previous five years where power generation lead gas demand growth in the US. Russia, another large gas consumer, is projected to see an overall decline of 3% (14 bcm), in a similar trend as the one seen in the US, in which the pandemic effects lead to a lethargic recovery, driven mostly by the industrial sector. Northeast Asia is projected to see a 34% increase (60 bcm), driven mostly by Chinese Taipei ambitious goals of increasing phasing out nuclear power and increasing gas for power generation and supported by modest increases in Korea and Japan following their respective net-zero goals by mid-century.

Figure 2-10 Gas demand outlook in APEC, 2019-2025 by region (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020, APERC, 2020.

Southeast Asia is another source of growth that more than offsets demand decreases in other APEC sub-regions, increasing gas demand by 37 bcm in 2025 compared to 2019. Much of this increase is projected to happen in Indonesia, mostly to meet incremental demand from the power sector, as well as in Thailand where gas is projected to both meet surging demand and displace coal. While demand growth is limited in Malaysia and Singapore, Viet Nam and Philippines are estimated to quickly increase their demand as soon as they both start LNG-imports in 2021 and 2022, respectively.

The "Other Americas" region is estimated to increase its gas demand at a rate of 3% CAGR up to 2025. This is lower than usual, with most growth happening in Canada and Mexico, which more than offsets a 4% decrease in Chile. Elsewhere in Oceania, gas demand is projected to decline marginally by 2025, resulting from declines in New Zealand, stagnant demand in Australia caused by persistent renewable energy gains in the power sector and demand rises in Papua New Guinea.

The share of natural gas in the APEC fuel mix also grows from 23% in 2018 to 25% in 2025, as coal demand declines and oil demand show slow growth. Power generation by natural gas remains the main driver of natural gas supply growth in this scenario and represents about 45% (1121 bcm) of total primary gas supply in 2025. Additionally, every demand sector contributes to this growth, with industry demand increasing by 53% to reach 797 bcm by 2025. Finally, natural gas is estimated to account for at least 10% of TPES in every APEC economy by 2025, with the exception of Chile, China and the Philippines.

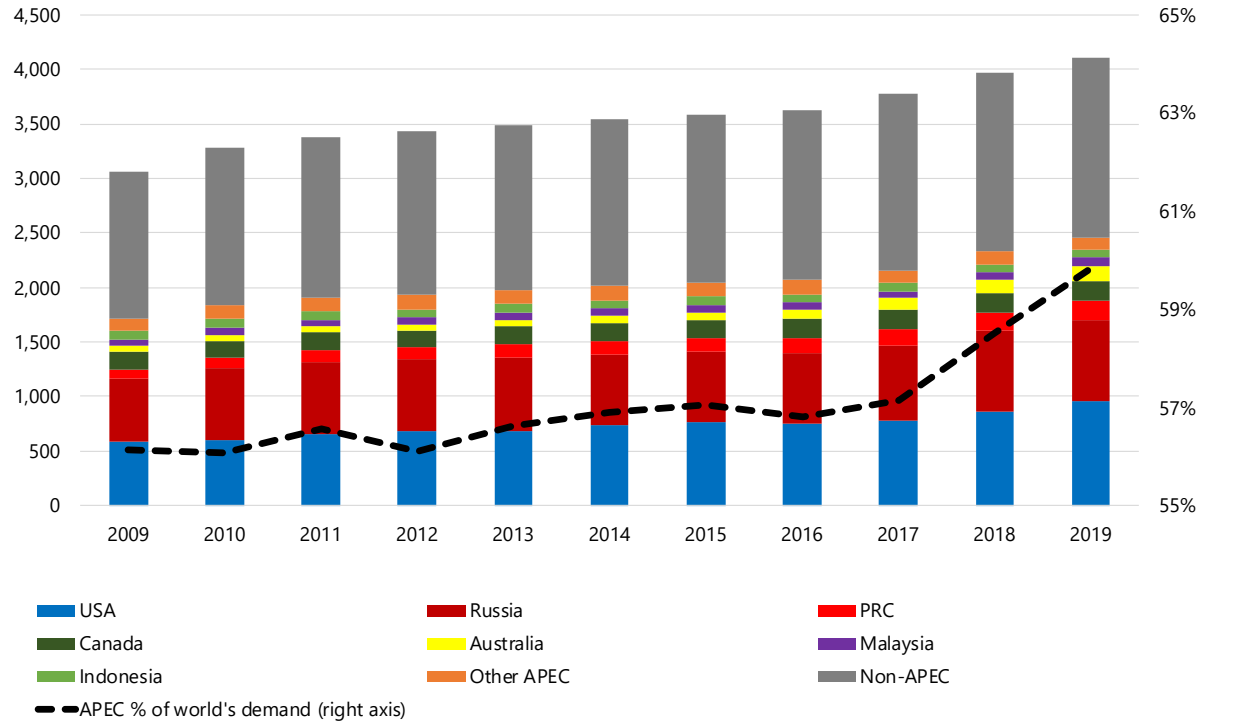
Section 3. Gas supply

3-1 World and APEC natural gas supply

World gas production increased by an average of 2.4% per year from 3,062 bcm in 2009 to 3,619 bcm in 2019. From 2017 to 2019, the global gas production growth accelerated to 4.2% per year. Gas production in APEC economies has been growing faster than production in the rest of the world. From 2009 to 2016, APEC gas production increased by an average of 2.7% per year; from 2017 to 2019 it grew an average of 6% per year. This faster growth led to an increase in the APEC's share of total gas production from 57.1% in 2016 to 60.1% in 2019 (Figure 3-1).

APEC countries accounted for 72% of world gas production growth from 2009 to 2019. This growth was concentrated in the United States, Russia, Australia, and China, which alone accounted for 70% of the world's gas production growth over the last 10 years.

Figure 3-1 Natural gas production of APEC member economies, 2009-2019 (bcm)



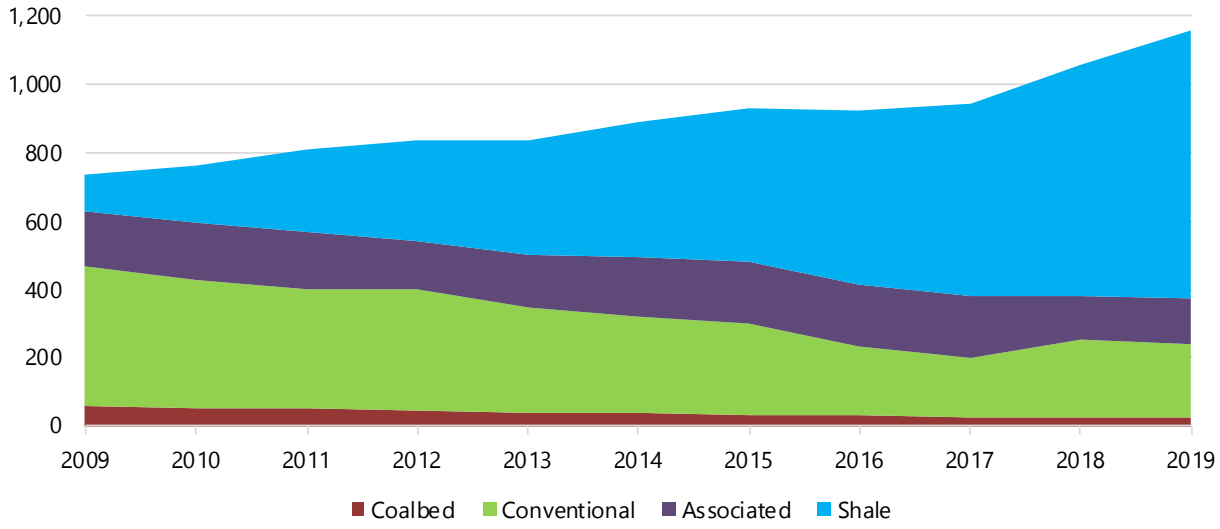
Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

3-1-1 United States

The USA is the leader in gas production in APEC. In 2019 marketed natural gas production was 954.8 bcm or 38.8% of the total APEC production. Between 2018 and 2019, the USA increased marketed gas production by 181.5 bcm, which accounted for about half of the USA production growth over the past ten years.

A significant change occurred in the structure of gas production. In 2009, 55% of gross natural gas was produced at conventional gas fields and only 15% from shale fields. In 2019, the share of shale gas production was 68%, up seven-fold, and shale gas alone exceeded the total amount of gross gas produced in the USA in 2009. The share of conventional gas production in 2019 was less than 20% (Figure 3-2).

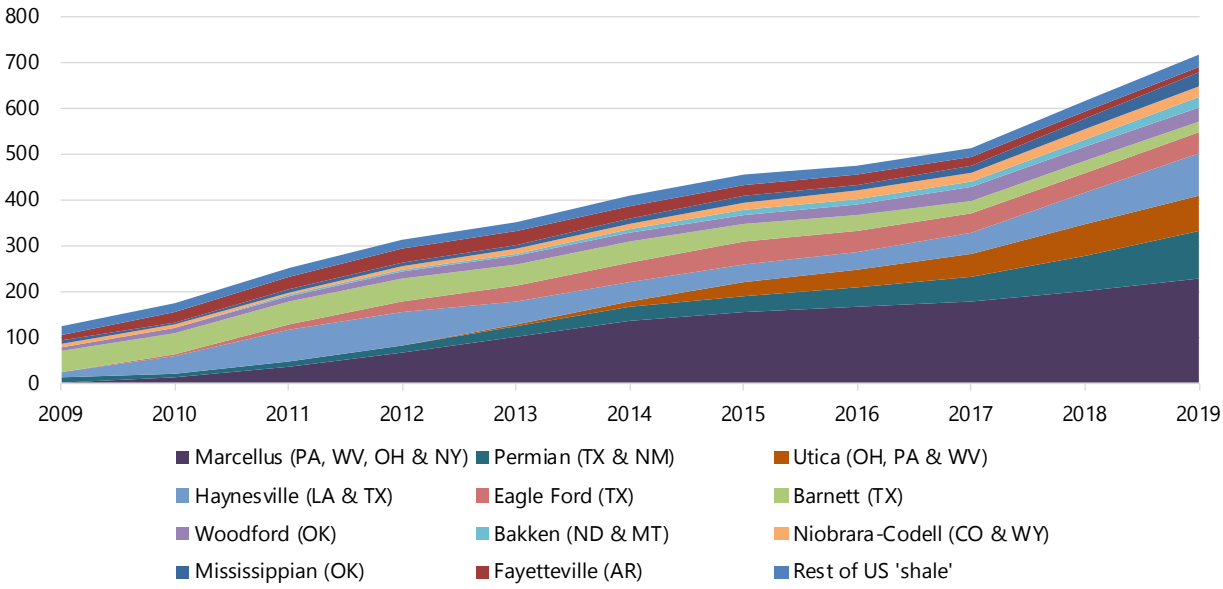
Figure 3-2 USA gross natural gas production, 2009-2019 (bcm)



Source: EIA, 2020.

Production from the abundant gas resources in the Permian and Appalachian Basins provided 70% of USA shale gas in 2019. Those two regions have accounted for more than 75% of shale gas production growth over the last ten years (Figure 3-3). Technical innovation and the resulting lower production costs led to a 63% increase in total domestic production from 2009 to 2019, half of which occurred in 2018 and 2019.

Figure 3-3 USA shale gas production, 2009-2019 (bcm)



Source: EIA, 2020.

The increased production enabled the United States to become a net exporter of natural gas in 2017 and led to a 10-fold increase in LNG production from 2017 to 2019. The switch from net gas importer to net gas exporter has also caused a decline in Canadian gas production. U.S. net natural gas pipeline imports from Canada decreased from 2018 to 2019, continuing a trend that began in 2008. This decrease in net imports is expected to continue as Appalachian production growth continues to displace some of Canada's natural gas imports in traditional U.S. markets. [EIA, 2020].

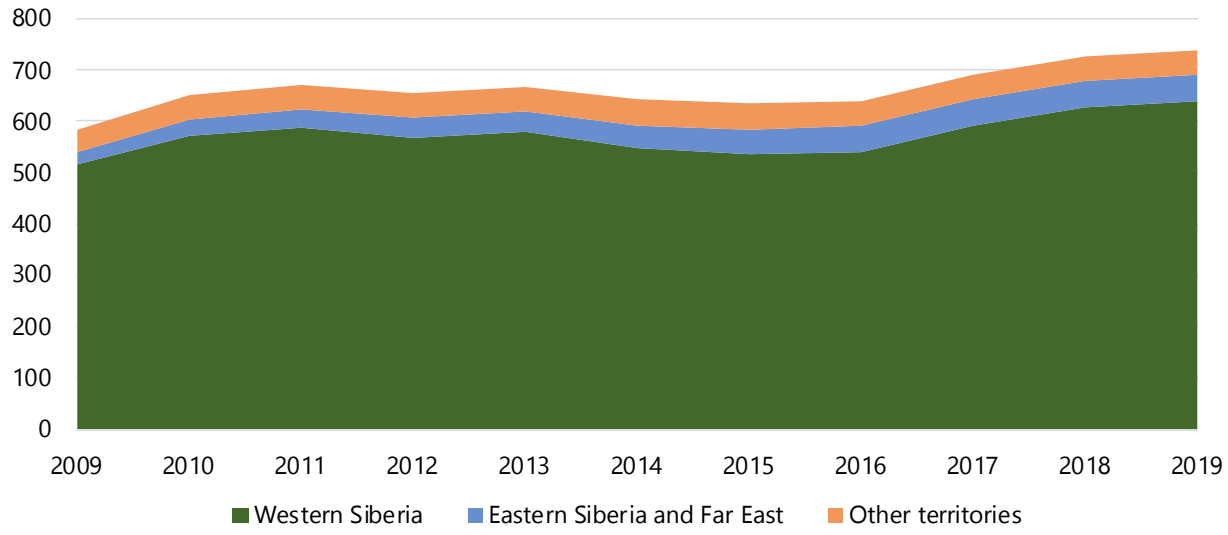
By the end of 2019, the U.S. became the third-largest LNG exporter and accounted for about 10% of the global LNG market. The new USA trains that came on-line in 2019 provided more than half of the additional global LNG capacity in 2019, which worldwide totalled nearly 28 million tons per year. The Federal Energy Regulatory Commission also approved 13 more applications to build onshore LNG facilities in the United States. Some of these new projects were expected to reach FID in 2020, but they have been delayed until 2021 and possibly beyond, as the global economy responds to the effects of the COVID-19 pandemic (Norton Rose Fulbright, 2021).

3-1-2 Russia

Russia remains the second-largest producer of natural gas in the APEC region. In 2019 gas production amounted to 750 bcm, or 30.5% of the total APEC production. Between 2018 and 2019, production increased by 54.8 bcm. The key producers Gazprom and Novatek accounted for 82% of the increase.

The territorial structure of natural gas production in Russia remains unchanged: over 90 percent of gas is produced in Western Siberia. Gazprom is the primary natural gas producer in Russia. However, despite a 7% increase in production over the period, its share in gas production gradually decreased from 80% in 2009 to 67% in 2019. Novatek increased gas production 2.3 times over the period and increased its share of gas production from 6% in 2009 to 10% in 2019. A key driver of this production increase was the launch of Yamal LNG plant.

Figure 3-4 Gas production in Russia, 2009-2019 (bcm)



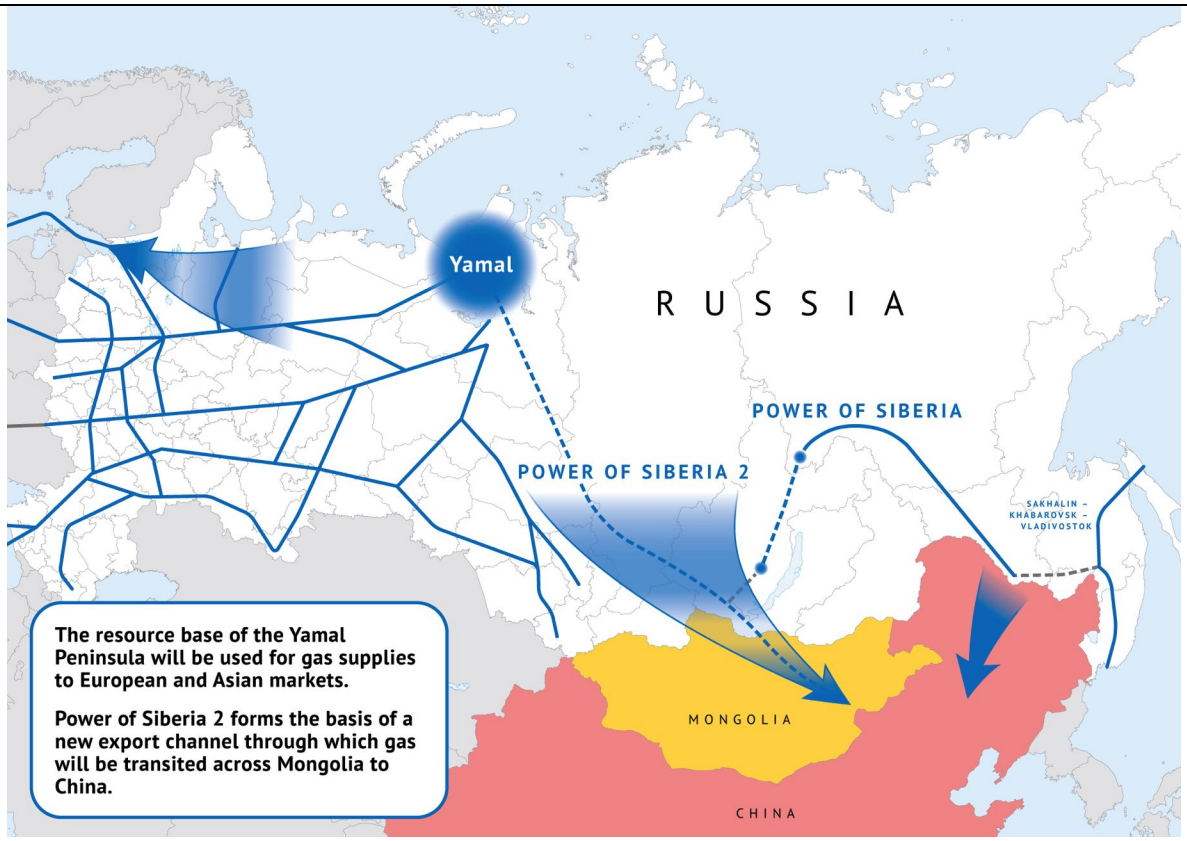
Source: Federal State Statistic Service, 2020.

In May 2014, Gazprom and the China National Petroleum Corporation signed a Sales and Purchase Agreement for gas to be supplied via the Power of Siberia gas pipeline. The Agreement provides for a 30-year supply of 38 bcm of gas from Russia to China starting in 2025. Initial gas supplies began to flow on December 2, 2019. Once the Power of Siberia gas pipeline starts operating at full capacity, gas production in Eastern Siberia and the Far East will increase to approximately 100 bcm per year, up from 54 bcm in 2019.

In 2020, Gazprom has begun assessing the possibility of supplying up to 50 bcm of gas per year through Mongolia. This assessment followed the December 2019 signing of a Memorandum of Understanding between Gazprom and the Mongolian government. The document provides for a joint assessment of the possibility of implementing a project for pipeline gas supplies from Russia to China via Mongolia. In August 2020, the Memorandum of Intent was signed about establishing a special purpose company, which will be based in Mongolia, to develop a feasibility study for the construction and operation of the gas pipeline. The feasibility study is expected to be completed in the first quarter of 2021 [Gazprom, 2020]. It should be noted that the Chinese counterparties have not yet publicly expressed interest in this potential project.

Gas supplies for a potential second Power of Siberia pipeline are expected to come from the Kovyktinskoye gas field in the Irkutsk Region, fields in the Krasnoyarsk Territory, fields in the Yamal-Nenets Autonomous Area and fields on the Yamal Peninsula [Gazprom, 2020]. The route of the proposed Power of Siberia 2 gas pipeline, unlike the already built Power of Siberia gas pipeline, passes through populated and industrially developed territories with a large potential for natural gas consumption.

Figure 3-5 Power of Siberia gas pipelines

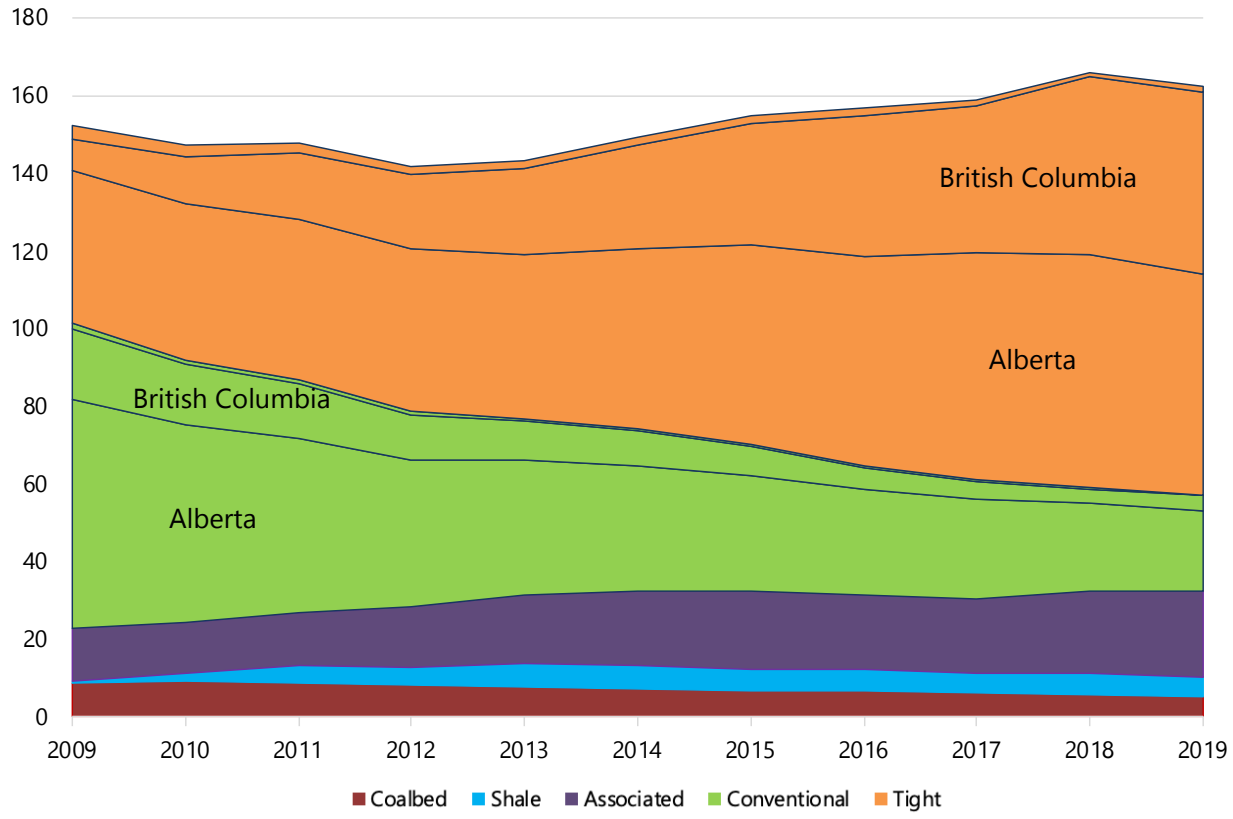


Source: Gazprom, 2020.

3-1-3 Canada

Canada's production of natural gas has been relatively stable from 2009 to 2019. Natural gas production in 2019 amounted to 176.7 bcm (about 7% of APEC). The share of tight gas produced in Canada increased from 33% in 2009 to 65% in 2019. The majority of unconventional production comes from Alberta (54%) and British Columbia (44%). The share of conventional gas declined from 52% in 2009 to 15% in 2019. Canada has historically exported natural gas by pipeline to the United States. Due to increased shale gas production in the USA and reduced exports, gas production in 2019 decreased by 6.5 bcm compared to the previous year.

Figure 3-6 Gas production in Canada, 2009-2019 (bcm)



Source: Canada Energy Regulator, 2020.

Future large-scale gas development in Canada will depend on increased demand for gas exports, mainly as LNG. Over the past several years, a number of groups have opposed the extraction and export of natural gas from Canada. While this can hinder the construction of approved projects, economic challenges are the primary reason that only one large-scale LNG project has reached FID over the past decade.

Currently, four LNG projects are planned, and six projects are announced in Canada, seven of which are on the western coast. LNG projects also emphasize the importance of having sufficient capacity to transport natural gas to LNG facilities. The construction of four pipelines to supply the upcoming LNG liquefaction projects is currently under consideration. The largest planned pipeline – Coastal GasLink Project – is to be

commissioned in 2023. However, uncertainty about the exact timing remains due to continued disputes with indigenous peoples' territories that the pipeline traverses.

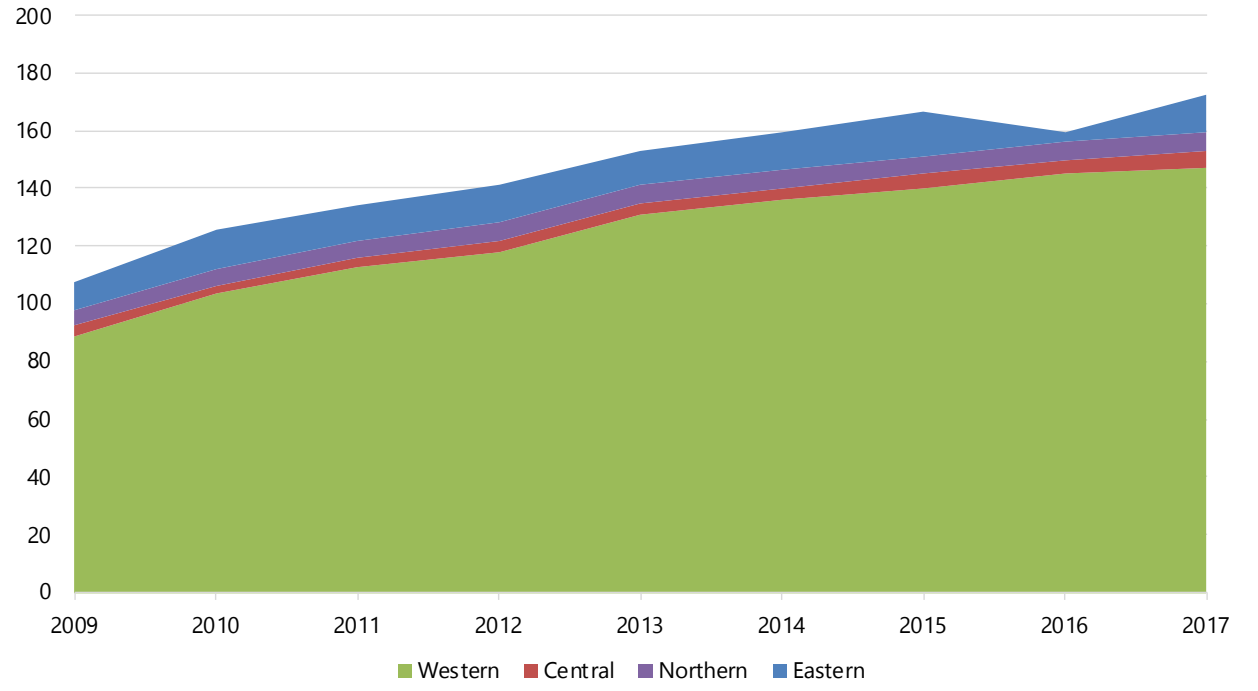
3-1-4 China

China continues to increase natural gas production at an average annual growth rate of 7.6%. In 2019, its production amounted to 177 bcm, or about 7% of total APEC production. More than 80% of gas is produced in the western regions. At the same time, gas consumption is growing faster than domestic production, which has led to a significant growth in imports. As in the USA and Canada, incremental Chinese gas production is primarily coming from unconventional gas fields.

In 2018, 46.9 bcm of unconventional gas were produced, accounting for 29.3% of total gas production. Unconventional gas production was mainly concentrated in Western regions (the Ordos Basin, the Sichuan Basin and Shanxi) as well as conventional gas production. Among them, sandstone gas production in Shaanxi accounted for 97.0% of the economy, shale gas production in Chongqing and Sichuan together accounted for 94.5%, and coalbed methane production in Shanxi accounted for 70.6%. [National Bureau of Statistics, China, 2019]. About 15.5 bcm of shale gas were produced in China in 2019, which was almost twice as much as in 2016 [S&P Global Platts, 2020].

China also recently announced a policy to extend subsidies for another three years on domestic production of unconventional gas. Zhao Wenzhi, an influential researcher at the Chinese Academy of Engineering, forecasts that shale gas production in China could reach 280 bcm by 2035, or 23% of the economy's total gas production. [Reuters, 2019].

Figure 3-7 Gas production in China, 2009-2017 (bcm)



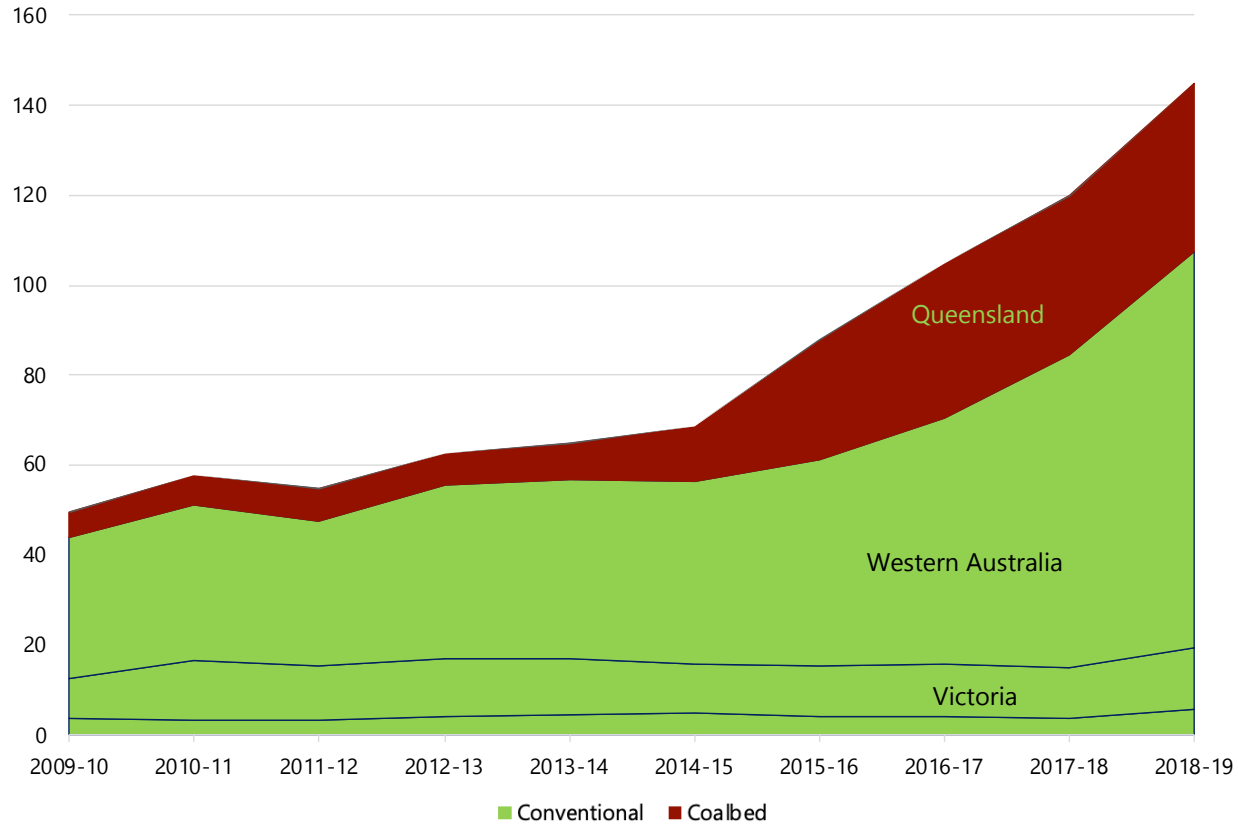
Source: China Energy Statistical Yearbook, 2018.

3-1-5 Australia

Australia is one of the fastest-growing natural gas producers in the Asia-Pacific region. Over the 2009-2019 years, production has increased 2.9 times to 142.4 bcm. The most dynamic increase in production occurred in 2017-2019: the average annual growth rate was 20.5%. The 60% increase in natural gas production over the last 5 years was due to an increase in conventional gas production in Western Australia and a 37% increase in coalbed methane production in Queensland.

The increase in gas exports accounted for 75% of gas production growth. The increase in gas production in Western Australia was enabled by several liquefaction projects becoming operational. Such large-scale projects include the Gorgon LNG project and the Australian Pacific LNG project, and the Wheatstone LNG project. Ichthys LNG was launched in late 2018. The first LNG Cargo shipped from the Prelude floating LNG (FLNG) facility in June 2019. The owner of the Prelude FLNG stopped production in early February 2020 due to a severe power failure. Activities on restarting operations continued throughout the year, but full production would not resume in 2020.

Figure 3-8 Gas production in Australia, 2009-2019 (bcm)



Source: Department of Industry, Science, Energy and Resources, Commonwealth of Australia, 2020.

There have been some changes in domestic regulations in Australia in recent years. In August 2016, the government of the south-eastern state of Victoria announced a policy to indefinitely prohibit advanced shale gas drilling technology, such as hydraulic fracturing (fracking). The ban applies to onshore drilling but

excludes offshore oilfields, with the possibility of future restrictions on new developments. In July 2017, the Australian government announced it would implement the Australian Domestic Gas Security Mechanism (ADGSM), which can impose LNG export restrictions if there is an imminent domestic gas supply shortage. In January 2020, a review of the ADGSM was published, which recognized the rule's effectiveness and recommended that it to be extended until 2023.

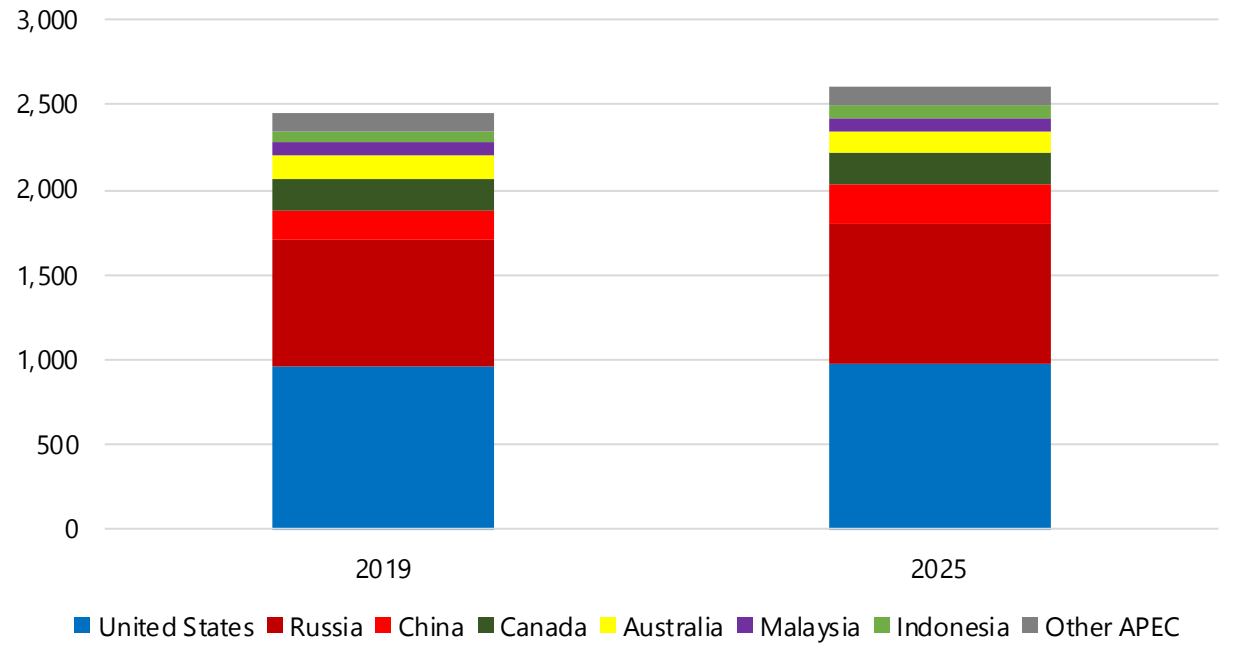
3-2 Gas production outlook

Natural gas production in APEC has grown robustly over the past 10 years, led by growth in the United States, China and Australia. USA natural gas production rose from 584 bcm in 2009 to 955 bcm in 2019, a 63% increase, becoming the largest natural gas producer in the world. Over the same period, China's gas production doubled (108%) and Australia's more almost tripled (188%).

According to the preliminary modelling results of the Reference Scenario for the 8th Edition of the APEC Energy Demand and Supply Outlook, gas production in APEC increases from 2,458 bcm in 2019 to 2,613 bcm in 2025, a 6% increase over six years.

About 80% of growth in natural gas production from 2019 to 2025 comes from Russia and China. China natural gas production grows by 30%, surpassing Canada to become the third-largest natural gas producer in APEC. Natural gas production in Russia is expected to increase by 72 bcm from 750 bcm in 2019 to 822 bcm in 2025. The increase in production will be provided in connection with the commissioning of the Novatek Arctic LNG-2 plant and the production of gas for supply to China via Power of Siberia pipeline.

Figure 3-9 Natural gas production outlook of APEC member economies, 2009-2025 (bcm)



Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020, APERC, 2020.

Section 4. Gas trade

Although most (70%) of the world's natural gas is consumed domestically, about 1,320 bcm of gas were traded internationally in 2019. International gas trade increased steadily in the past decade, except for 2014. Traded volumes grew by 48% from 2009 to 2019 (4% CAGR). Between 2014 and 2019, gas trade grew at an even faster rate (5.6%), more than double of that of the 2009-2014 period (Figure 4-1). In 2019, international trade rose by 5.2% compared to the 2018. LNG trade increased faster than pipeline trade and increased its share of total trade from 27% in 2009 to 36% in 2019. Increased LNG trade has increased regional market integration as well as enlarged the number of both gas exporting and importing economies.

The APEC region has some of the most active gas trade dynamics in the world, including three of the top five world exporters (Russia, the United States and Canada) and three of the top five world importers (Japan, China and the United States) (IEA, 2020). APEC as a whole is a natural gas net exporter; 60% of gas exports were shipped by pipeline while the remainder was shipped as LNG. On the natural gas imports side, by contrast, 46% was pipeline gas and 54% was LNG in 2019.

Among the 21 APEC members, 9 economies are currently net natural gas exporters, 9 are net importers and 3 do not trade gas (New Zealand, the Philippines and Viet Nam).1 The Philippines and Viet Nam are projected to begin imports of LNG by 2022. In both cases, increased demand for power generation has pushed up gas demand, but domestic production has been stagnant and is projected to decline after 2020.

Traded gas volumes in APEC have grown faster in comparison with global gas trade. Between 2009 and 2014, APEC gas trade increased by an average of 0.3% per year, while in the period 2014-2019 – by 8.8% per year. This growth led to an increase in the APEC's share in the world gas trade from 32% in 2014 to 36% in 2019.

LNG global trade grew from 2009 to 2019 by 228 bcm (94% growth from 2009 to 2019, 6.8% CAGR). APEC LNG trade almost tripled (10.5% CAGR) during the same period. (Figure 4-2). Moreover, most of global LNG trade growth has taken place in the APEC region. While APEC LNG trade more than doubled between 2014 and 2019, LNG trade outside the APEC region only grew by 3% during the same period.

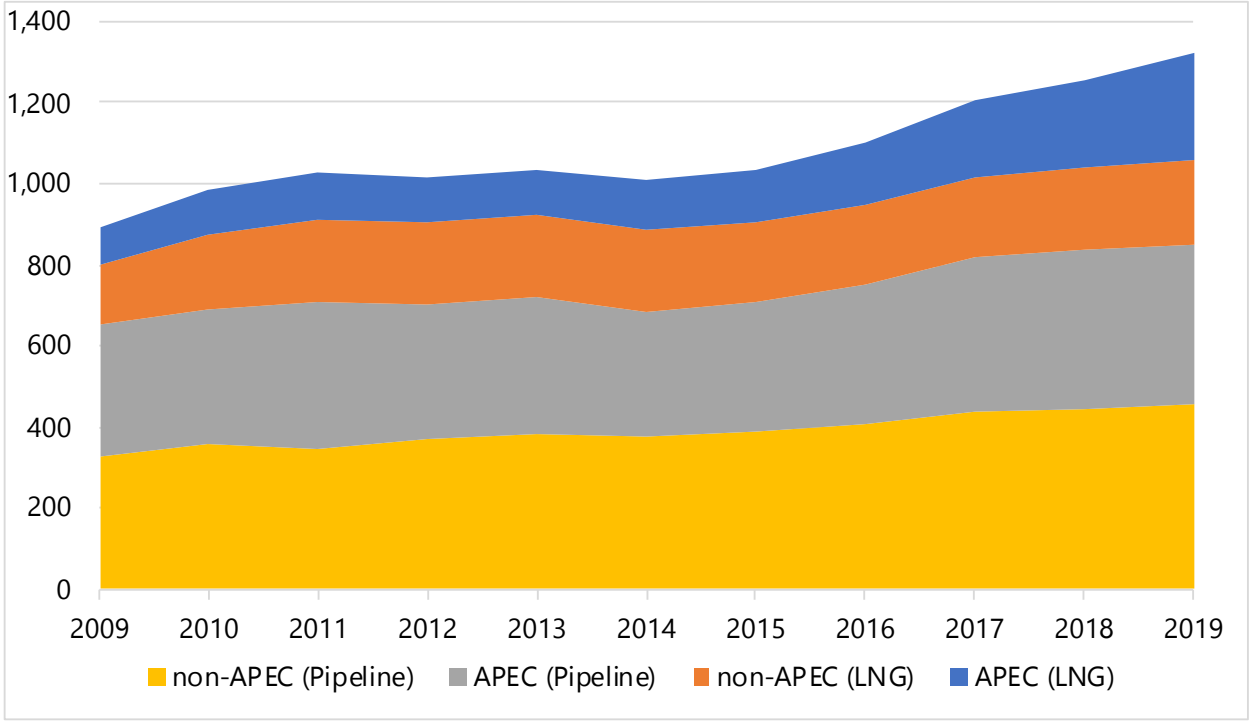
The volume of gas traded via pipelines increased by 30%, or 198 bcm from 2009 to 2019, with more than 80% of this growth occurring after 2014. In contrast to LNG, pipeline gas trade grew by 26% in the APEC region and by 22% outside it between 2014 and 2019.

The APEC region was a net natural gas exporter in 2019, as it has been the case for the past decade except for 2014 (Figure 4-2). This was due to a decrease in gas exports from Russia because of lower demand from Ukraine and some EU economies. Interestingly, APEC net trade via LNG and pipeline show exact opposite trends. APEC is an LNG net importer and pipeline gas exporter. The largest LNG importers in APEC are Japan, China and Korea. As for pipeline trade, Russia is the largest net exporter to non-APEC economies,

[1] The 9 APEC economies that are gas net exporter economies are: Australia, Brunei Darussalam, Canada, Indonesia, Malaysia, Papua New Guinea, Peru, Russia and the United States. The 9 net importers are: Chile, China, Hong Kong, Japan, Korea, Mexico, Singapore, Chinese Taipei and Thailand.

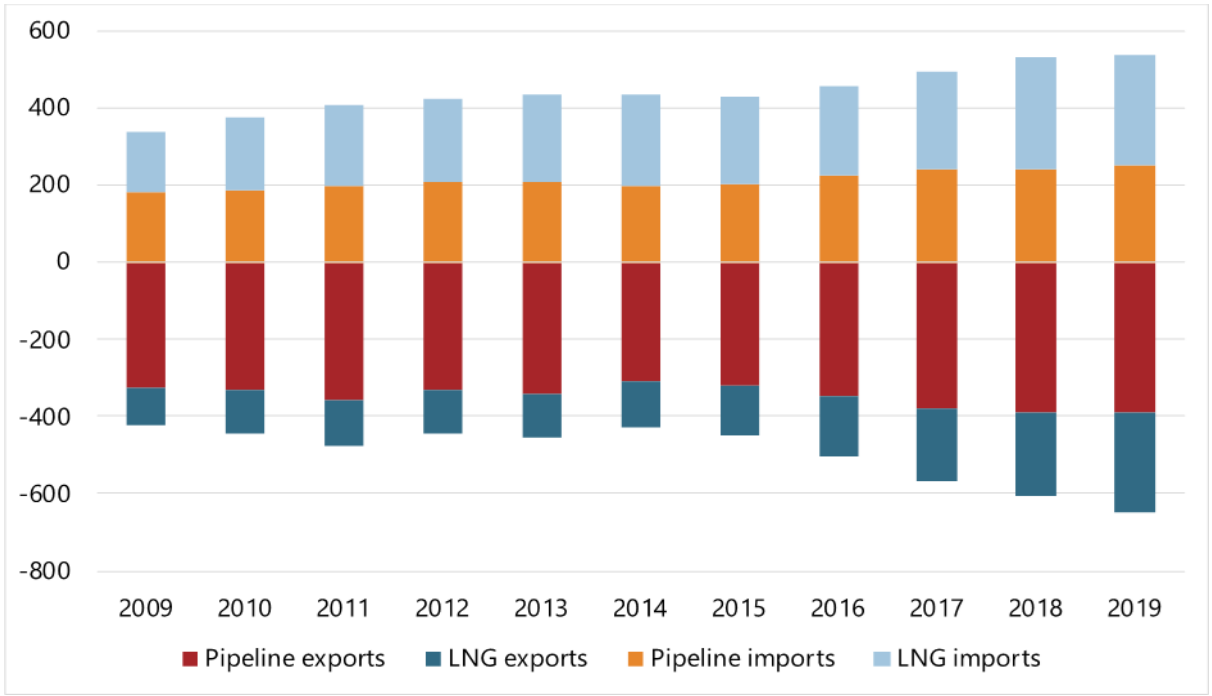
predominantly to European markets. It should be noted, however, that due to the rapid growth of LNG production from 2014 to 2019 in Australia and the U.S., and to a lesser extent in Russia, APEC net LNG imports are declining rapidly.

Figure 4-1 Natural gas trade, 2009-2019 (bcm)



Source: CEDIGAZ, 2020.

Figure 4-2 APEC Natural gas net trade, 2009-2019 (bcm)



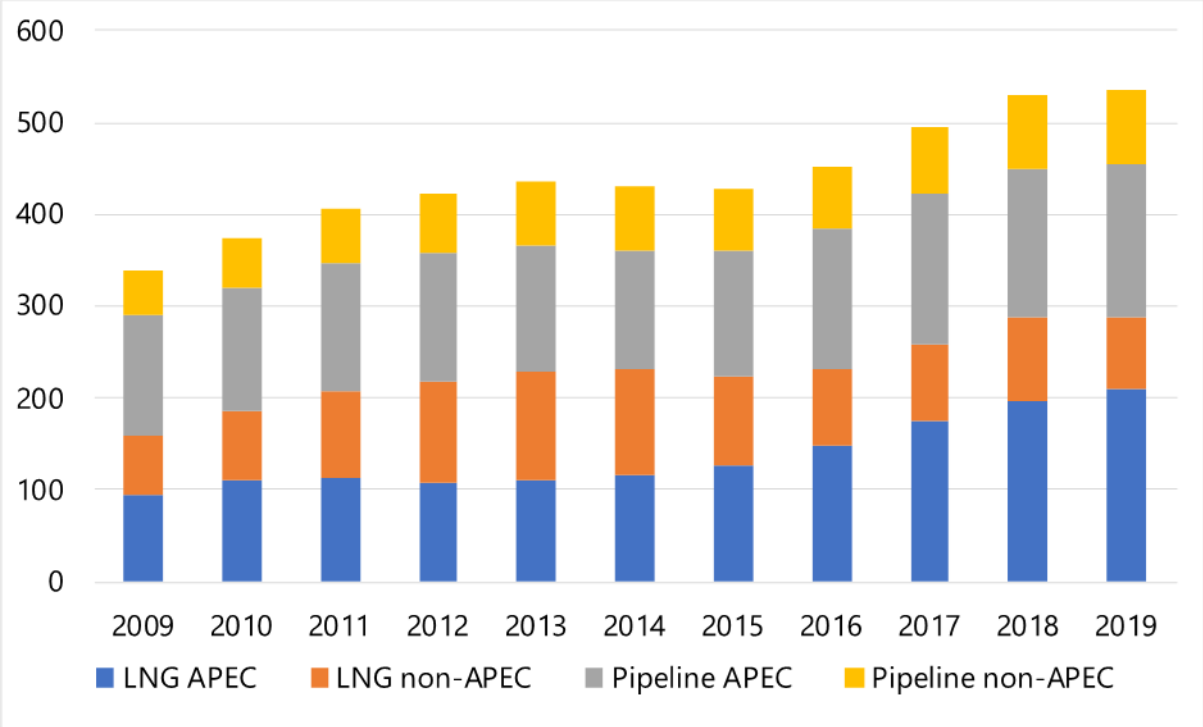
Source: CEDIGAZ, 2020.

4-1 Gas Imports in the APEC region

Global natural gas imports have increased globally at a fast pace from 2009 to 2019, growing at a 3.1% CAGR and reaching 1,234 bcm in 2019. APEC member economies have played a fundamental role on this trend, growing faster than global imports but also increasing its share out of the total. APEC gas imports rose by 58%, from 338 bcm in 2009 to 536 bcm in 2019. Additionally, APEC gas imports accounted for 58% of the growth in global imports or 151 bcm while APEC's share of global gas imports increased from 37% in 2009 to 42% in 2019, highlighting the growing need for natural gas in the APEC region.

Increased APEC gas imports reflects robust gas demand growth in most APEC economies. Demand growth has outpaced domestic production in economies like China, Mexico, Korea and Chinese Taipei and hence the need to fill that supply gas with imports. The growth in overall APEC gas imports results from this robust growth despite an expected decrease on imports in the US (30 bcm down from 2009). Most APEC gas imports (76%) were result of intra-APEC trade or coming from other APEC economies, such as Australian LNG exports to China or Canadian pipeline exports to the US, while the reminder 24% came mostly from places like Qatar or Turkmenistan. As of 2019, 14 out of 21 APEC economies import natural gas, of which 9 are net importers. Canada and Russia are example of economies that import some volumes of gas but are net exporters.

Figure 4-3 APEC Natural gas imports by origin and type, 2009-2019 (bcm)



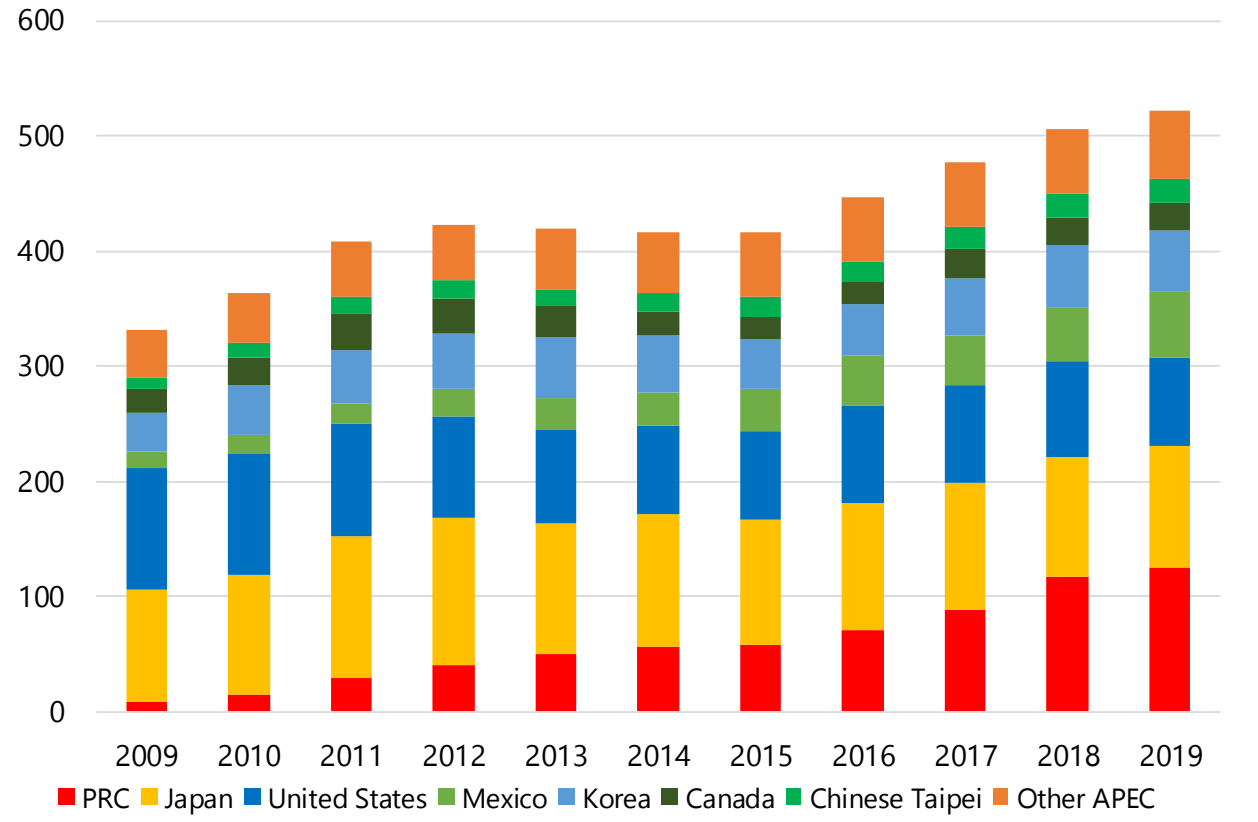
Source: CEDIGAZ, 2020.

In 2019, overall APEC natural gas imports rose by only 6 bcm or 3%, equivalent to half of the volumes imported by Thailand. Overall APEC imports totalled 676 bcm in 2019 of which most of them (54%) were

shipped as LNG and the reminder 46% by pipeline. While both type of imports have grown since 2009, LNG imports growth has outpaced pipeline imports, with LNG increasing its share from 47% in 2009 to 54% in 2019. LNG imports to the APEC region accounted for 60% of total imports growth during the same period.

When looking at APEC's increasing trend for gas imports by economy, no other economy contributed most to this than China, where natural gas imports grew from 8 bcm in 2009 to 130 bcm in 2019. China became in 2018 the largest natural gas importer not only in APEC, but in the world. This is driven by rapid growing demand, that has outpaced rising domestic production. This rise on Chinese LNG imports is supported by additions in both LNG receiving capacity, increase on domestic transmission pipeline infrastructure and the commissioning of the Power of Siberia pipeline, which allows Russian gas imports to flow to Northern China since December 2019. In that same year, about 60% of Chinese gas imports were LNG while the reminder was piped imports from Turkmenistan, Myanmar, Russia and other exporters. Chinese gas imports may keep increasing after the announcement of the carbon neutrality goal by 2060 and $C0_2$ emissions peak by 2030; gas accounts for only around 8% of primary energy demand (MFA, 2020).

Figure 4-4 APEC natural gas imports by economy, 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

Other APEC economies have also seen an important growth in its imports, notably Mexico where gas imports more than quadrupled from 2009 to 2019, accounting for 59 bcm in 2019, of which over 90% were US piped imports. Korea recorded the third largest growth on gas imports during the same period, growing

by 58% and with the totality of them being LNG. On as similar trend to Korea, Chinese Taipei almost doubled its gas imports during the same period. As seen in Figure 4-5, Japan, formerly the world's largest natural gas importer, registered an overall growth of its gas imports by 20% in the same period. However, Japanese gas imports grew rapidly since 2011, following the outage of virtually all nuclear-based generation because of the Fukushima-Daiichi accident, and then peaked in 2014. Japanese imports, all of them coming via LNG, have decreased every year ever since. Other gas importers with rising trends include Thailand, Singapore and Chile where most of growth is driven by the power sector. Conversely, gas imports have only decreased in Russia and the United States, both being major gas producers and net exporters. In both cases, imports decrease result from integrated pipeline systems with their gas exporting neighbours and domestic increasing production that has reduced the need for larger imports. In 2019, the US imported about 77 bcm, predominantly from Canada via pipeline, which was 5% less than in 2018 and still placed the US as the third largest gas importer in APEC. Russia imported 19 bcm that same year, most of it from Kazakhstan and Uzbekistan, as in some regions, economical and seasonal needs make more practical gas imports rather than domestic production.

4-1-1 APEC LNG imports

As mentioned before, LNG has played a critical role on the expansion of natural gas trade both globally and in the APEC region. Since 2009, not only have global LNG traded volumes grown by 88%, but also the number of importers increased from 22 to 42. Most of the global incremental growth on LNG demand in the past decade (54%) took place in the region. This comes with little surprise, considering that 4 of the top-5 world's largest LNG importers are part of APEC (Japan, China, Korea and Chinese Taipei). These 4 economies together accounted for 55% of global LNG imports and 72% of those in APEC in 2019. Out of the 21 APEC members, 12 are LNG importers and between 2009 and 2019, all of them increased their imports LNG imports except for Canada and the US, as domestic production rose. Overall APEC LNG imports increased 82% during the same period, despite a marginal decrease of 1.5 bcm (0.5%) in 2019, which resulted from a slowdown on growth and decreases in Japan and Korea, as explained further below.

China's demand for LNG has seen an unparallel growth in the past decade, driven by a set of policies aimed at improving air quality and reducing the share of coal, which dominates the economy's energy sector. China started importing LNG in 2006, and its imports have grown by an impressive 26.5% CAGR, becoming the world's second largest LNG importer in 2017. In 2019, China's LNG imports totalled 80 bcm, a more than tenfold increase compared to 2009 and 12% growth with respect to 2018. Chinese LNG imports are expected to keep growing in the short term as there is plenty of room for growth in power generation, industry, buildings and, to a lesser extent, transportation. Moreover, the 22 LNG receiving terminals averaged in 2019 a 74% utilisation rate (IGU, 2020). Additionally, the establishment of China Oil & Gas Piping Network (PipeChina) in 2019 may favour increases on the pipeline grid capacity and interconnectivity between importing entry points, production areas, LNG receiving terminals and consumption centres. However, LNG imports growth may not be as strong as the pre-2020 levels since, at least, 6 projects that would add LNG receiving capacity were delayed in 2020 due to the pandemic effects (ArgusMedia, 2020).

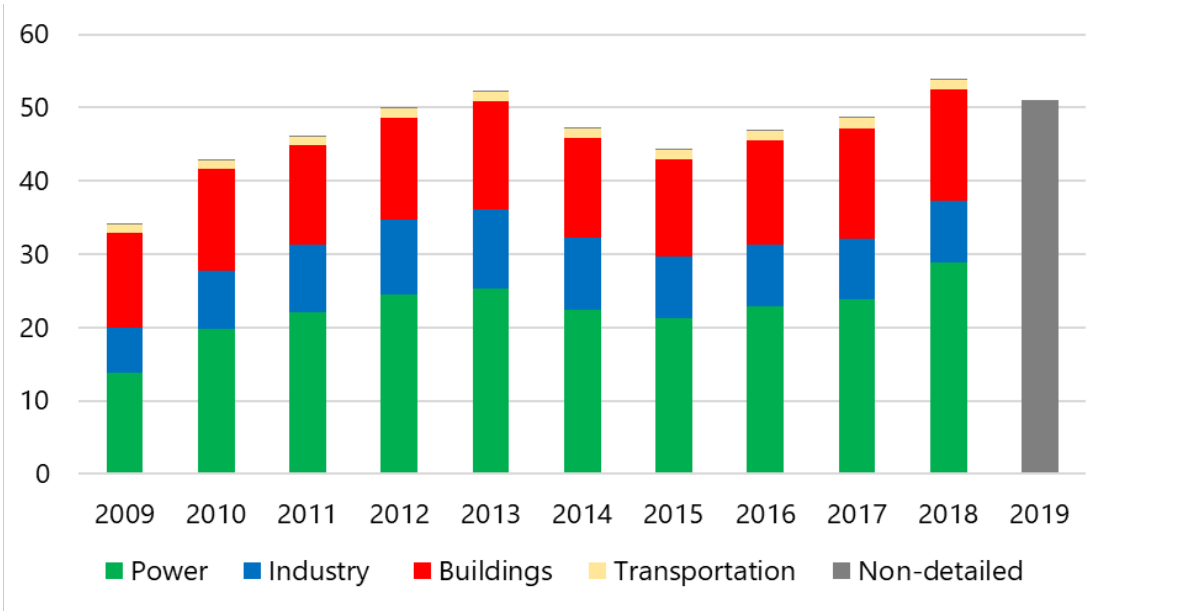
The three traditional LNG importers (Japan, Korea and Chinese Taipei) account together for 44% of APEC LNG imports, and have also increased their volumes since 2009, albeit at slower rates than those seen in China. These three Northeast Asian economies share some common factors that drive their respective LNG

demands, amongst the main ones: domestic gas production is negligible, do not have international pipeline interconnections and their power generation matrixes are supported by nuclear, coal and gas in similar shares. This last factor is a key variable on LNG demand, as any variation in each of these electricity market or any of these fuels would directly impact LNG demand. Probably the clearest example of this interdependence happened in 2012, in the aftermath of the Fukushima Daiichi nuclear accident In Japan, when nuclear reactor was taken off the grid, creating a sudden demand rise for coal and natural gas to meet power demand. Similarly, coal-fuelled capacity additions or retirements have similarly affected LNG demand in Korea and Chinese Taipei.

Japan continues to be the largest LNG importer, despite a steady decrease on imported volumes since it peaked in 2014 at 118 bcm. LNG imports to Japan totalled 103 bcm, a 7% reduction compared to 2019. This was mostly driven by lower demand from the power sector, as overall power generation has decreased for two years, following decreasing demographics. Additionally, 9 nuclear reactors have restarted operations and solar PV has increased its share since 2012, as detailed in chapter 2.

Korean LNG imports stood at 54 bcm in 2019, equivalent to more than half of Japanese imports. However, LNG imports grew faster than in Japan from 2009 to 2019, rising by 58%, supported mostly by power demand and despite a consecutive two-year decline in 2014 and 2015. While, LNG demand growth recovered its rising trend, LNG imports fall in 2019 by 7% or around 5 bcm. Like in Japan, this fall on LNG imports was mainly driven by lower demand from the power sector, as overall generation levels decreased as well as nuclear and solar PV generation grew at the expense of LNG and coal. Korea's LNG imports may see further decreases in the short-term as about 9 GW of nuclear and coal-fuelled capacity is added by 2025, according to the latest government's gas plan. Only after that, Korea's LNG imports may see growth again with the target for 2030 at similar levels to those seen in 2019.

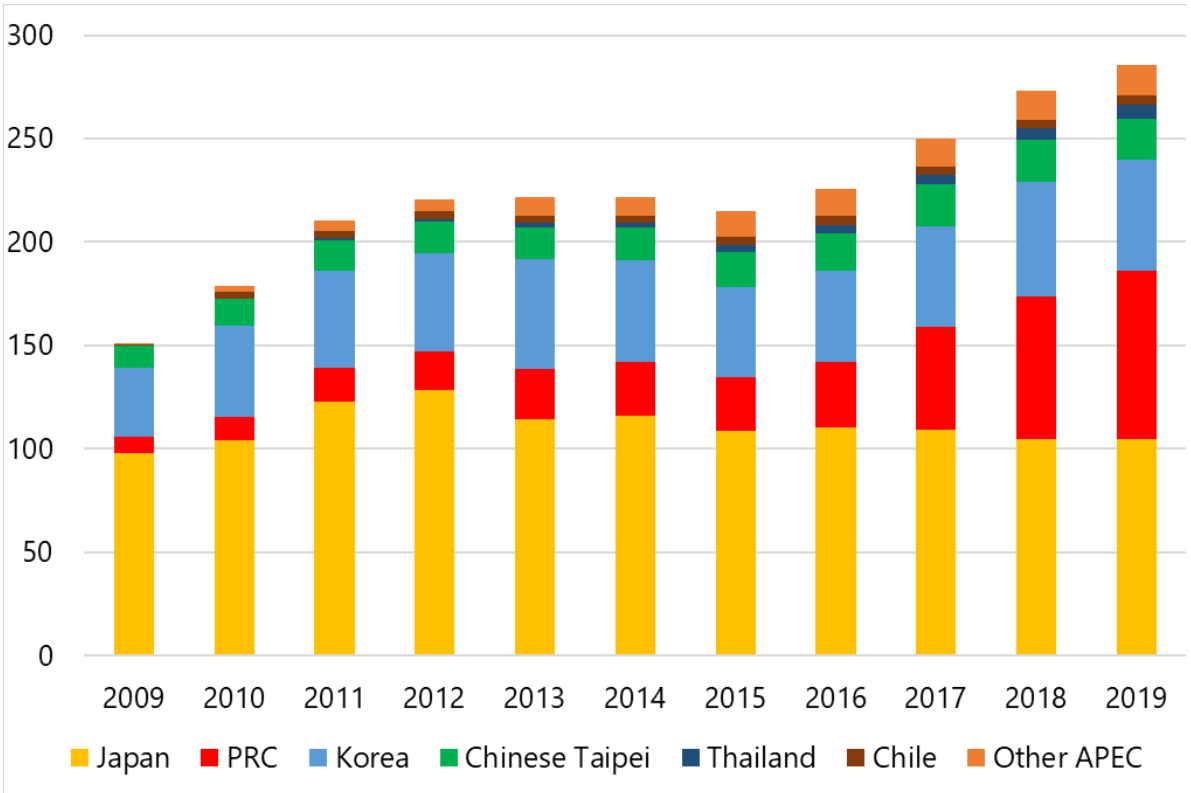
Figure 4-5 Korea's LNG imports by use, 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

Unlike Japan and Korea, Chinese Taipei, the world's 5th largest LNG importer, saw a steady growth on its LNG imports from 2009 to 2019, almost doubling them. As in these two economies, the bulk of demand growth in Chinese Taipei is driven by the power sector, where both overall generation and the share of natural gas have increased consistently since 2009. However, Chinese Taipei's LNG imports did not grow for the first time since then in 2019 and actually dropped by 1.9%, as power demand marginally fell, and some nuclear reactors restarted operations after maintenance. The future for Chinese Taipei LNG imports faces uncertainty in the short term as the construction timeline of new receiving terminals may not keep up with the growing gas demand for power generation and other sectors. Further, the government has set a goal phasing-out all its nuclear power plants in 2025, which accounted for 12% of power generation and rising gas-fuelled power generation to 50% by 2025 from 34% in 2019 (MOEA, 2020a). At the same time, Chinese Taipei's two LNG receiving terminals operated over 100% of its nameplate capacity in 2019 (IGU, 2020). A third terminal in Taoyuan is in construction and is scheduled to be operational by late 2022 (MOEA, 2020b). Other LNG receiving capacity additions include the construction of a fourth terminal, which EPC contract was signed in September 2020, and a third expansion of the exiting Taichung terminal (CPC, 2020) (CTCI, 2020). Finally, a terminal in Keelung owned by Taipower is still in the stage of environmental impact assessment and facing delays (Huang, 2020). Only after the commissioning of these projects, LNG imports may see growths rates similar to the 6.6% CAGR seen from 2009 to 2019.

Figure 4-6 LNG imports in APEC by economy, 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

While the three traditional Northeast Asian LNG importers will continue to play a decisive role in LNG trade dynamics, other than China, LNG demand growth has taken place in Southeast Asia in recent years. More importantly, these economies have substantial potential to for LNG demand growth supported, amongst other common factors, by increasing demand for power generation (coming from rising demographics and economic growth), an important share of coal in the power generation mixes, declining domestic gas production and unique geographical conditions. At the same time, materialising such potential development requires the overcoming of some decisive challenges including LNG price volatility, affordability relative to coal and other fuels, the need for infrastructure development which requires large investments and clear government regulations.

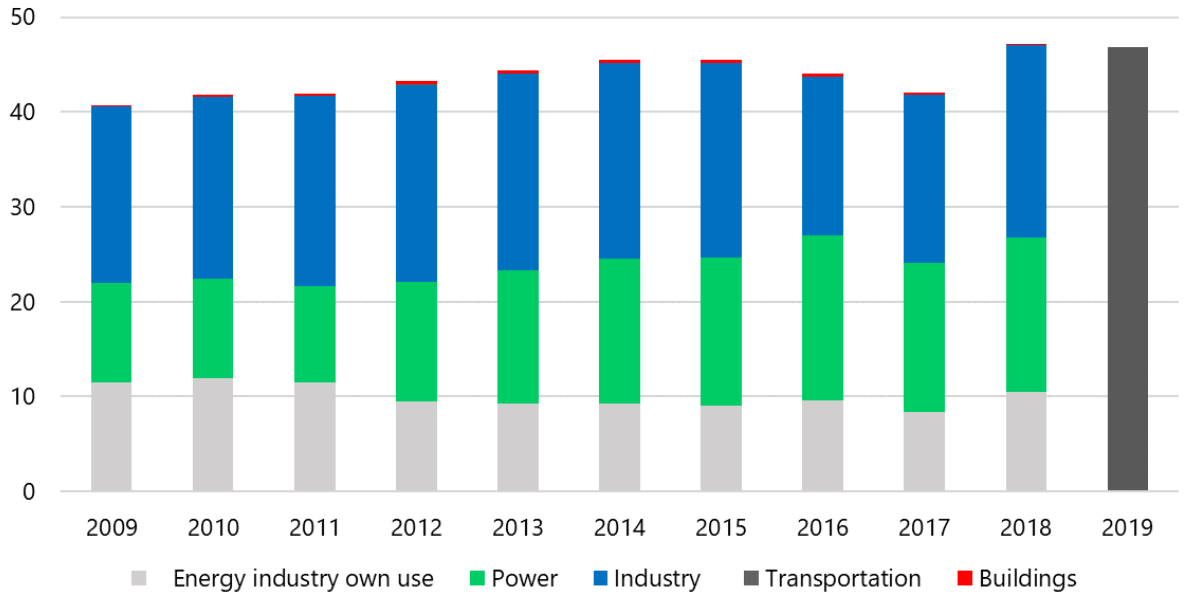
Thailand joined the LNG importers club in 2011 with the commissioning of their Map Ta Phut facility, the only receiving terminal in the economy. LNG imports in Thailand have grown steadily and hit a record-high on 2019 of 7 bcm. Nevertheless, LNG accounted for only 13% of total gas supply in Thailand and piped imports from Myanmar for 15%, with the reminder fed with domestic production. Thailand's LNG potential lies in its power sector, where gas accounted for 64% of total generation in 2019. Rising electricity demand has pushed gas demand growth by 26% from 2009 from 2019, while production has declined since 2015 by 9%, increasing their supply gap. While neighbouring Myanmar's production also has a declining trend, the Map Ta Phut terminal only ran at 40% of capacity in 2019 (IGU, 2020). Additionally, the construction of a second receiving terminal has been delayed and is now expected to be operational in 2022, while a potential floating storage regasification unit (FSRU) has been in plans for a few years now and is projected to be completed by 2024. These issues illustrate that, unlike Chinese Taipei, the lack of infrastructure is not a bottleneck at the moment for LNG imports growth but rather considerations on affordability and rigidity with ongoing contracts with both gas suppliers and power generators. Nevertheless, with the growing supply gap, LNG may play a key role in Thailand and is projected to grow by over 35 bcm in 2037, according to the Ministry of Energy's Gas Plan 2018 (ME, 2018).

Malaysia is one of the world's largest traditional LNG exporters and while it remains a net LNG exporter, it started importing LNG in 2013, with imports growing fast and reaching 3.5 bcm in 2019. Natural gas demand rose to high-record of 47 bcm in 2019, driven by power generation and industry, while gas production rose 3% in 2019 to reach 70 bcm, despite this production surplus, about one fifth of gas supply came from gas imports of which one third were via LNG. This is mostly explained by Malaysia's geography, in which most of gas production takes place around the Sarawak state in Sumatra, while consumption centres are in the Malay peninsula. In 2019, most LNG imports came from Australia, while additional volumes (not accounted as imports) were domestically produced and transported via LNG to peninsular Malaysia. With LNG receiving terminal at only 40% of capacity, third-party access granted to an importing company for the first time in 2021 and rapid growing electricity demand, LNG imports may continue to see its growing trend (IGU, 2020). However, one of the key questions for this would be the policies implemented in the power sector regarding coal, natural gas, and renewables capacity additions.

Indonesia shares some similarities to Malaysia in terms of LNG development: being a net LNG exporter, gas demand being dominated by the power sector and a complex geography. Indonesia has over 14 thousand islands and a population of over 270 million people with a growing trend and a fast-growing economy (5.4% CAGR since 2009), which translates to an enormous challenge to meet energy demand growth.

Natural gas plays a large role in the Indonesian energy sector, accounting for 21% of power generation in 2019. While historically a large LNG exporter, gas production has been on a declining trend, falling by 11% from 2009 to 2019. Domestically, gas consumption growth has not grown as much as primary energy demand, which increased at a 4.2% CAGR from 2015 to 2018 and gas consumption did so by a lean 0.9% and coal by 12%. In fact, gas demand decreased by 2% in 2019 to 44 bm, essentially the same volume as 2010. Mostly due to its geography, Indonesia does not have an integrated pipeline network, and has 3 LNG regasification facilities and 1 FSRU under development. Following These terminals are fed overwhelmingly by intra-Indonesian trade (4.9 bcm), with some marginal additional volumes (0.3 bcm) being imported in 2019 (IGU, 2020). However, with power generation projected to grow annually over 5%, decreasing domestic production and LNG receiving infrastructure already in place, LNG imports have strong potential growth and increasingly so with, further regasification capacity additions. However, such potential for LNG faces major challenges, as the government's Electricity Supply Business Plan 2019-2028 (RUPTL) opts instead for coal, with over 20 GW of coal-fuelled capacity planned and about 4.2 GW of gas-fuelled additions (MEM, 2019).

Figure 4-7 Indonesia's gas demand by use, 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

As Indonesia, the Philippines also have an archipelagic geography and a rising energy demand supported by rising demographics of almost 110 million people and a rapid economic growth (6.4% CAGR, 2014-2019). The Philippines, however, is one of the three APEC members (along with Australia and Viet Nam) that do not trade natural gas, meaning that demand growth is condition to production of the Malampaya field. As a result, natural gas had a share of only 6% of its total primary energy supply in 2019, one of the lowest in the APEC region. While around 92% of gas supply is consumed in power generation, gas accounted for 21% of total generation in 2019, with coal rising to 55% of the share. Gas production, and hence demand, grew by 0.6 bcm or 15% from 2009 to 2019, totalling 4.5 bcm. However, the government plans to start importing LNG to counterbalance declining production and meet incremental demand (DoE, 2018). As of 2020, four

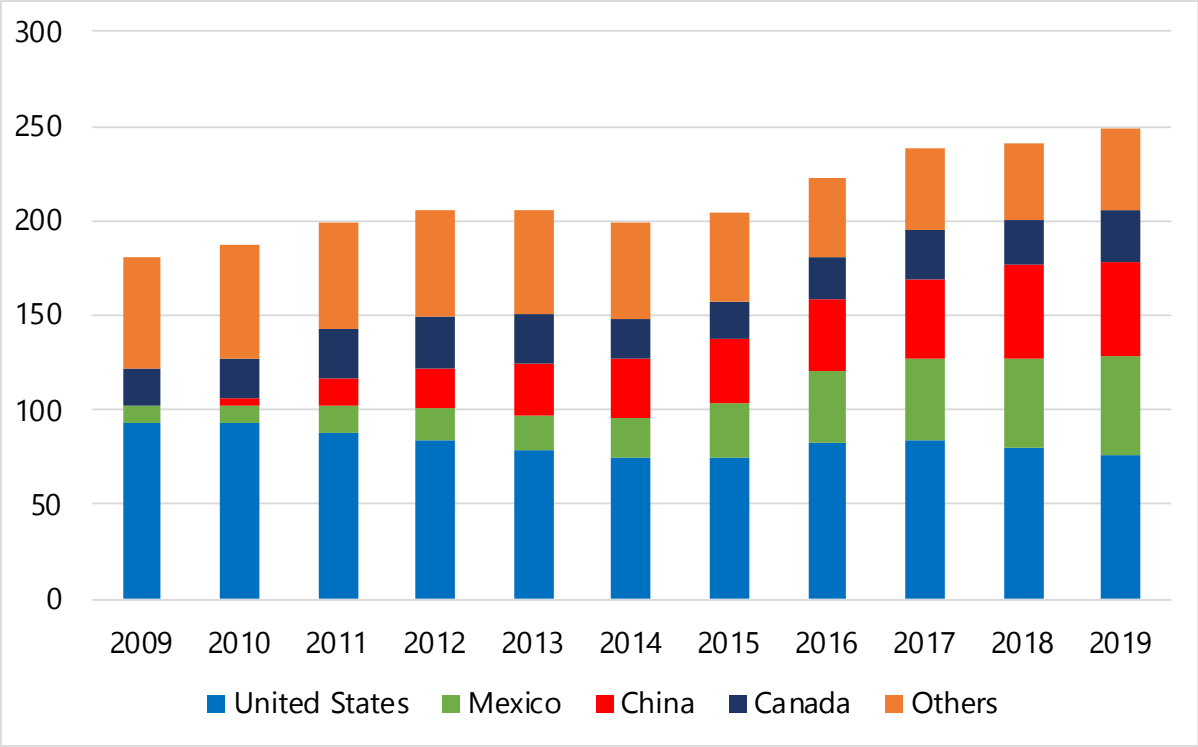
projects with a combined regasification capacity 20 bcm (15 MTPA) have received permits and are on diverse stages of development (Dela Cruz, 2020). The most advanced of these projects is a 6.8 bcm capacity receiving terminal in Batangas City, which EPC contract was signed in 2020, and is expected to be operational by late 2022 (OGJ, 2020).

Viet Nam shares with the Philippines some of the mentioned opportunity and challenges for LNG development: autarkic gas sector, heavy reliance on coal and rapid growing energy demand derived from faster economic growth (6.8% CAGR, 2014-2019) and increasing population of almost 100 million people. Viet Nam's power generation has more than doubled from 2013 to 2018, with coal-fuelled capacity more than quadrupling during the same period and absorbing most of this growth. About 87% of gas supply went to the electricity sector in 2018, but gas accounted for 17% of total generation and only 5% of total primary energy supply in 2018. Despite a 2% increase on production in 2019 9.7 bcm, it has been on a declining trend since 2014, and is projected to continue to so in coming years, creating a supply gap to the fast-growing energy demand. The government planned since 2016 to start importing LNG by 2021, setting a goal of 7 bcm (5 MTPA) in 2025 up to 20 bcm by 2035 (MOIT, 2017). As of 2020, two projects are already under construction: the 3 MTPA Thi Vai terminal project to be operational in late 2022 and the 2 MTPA Hai Linh terminal which is slated to become the first operational terminal in early 2021 (Yep, 2020a). Two other projects (Son My and Bac Lieu) have received government approval, while 3 other terminals are approved in the next draft plan, with at least three more projects being under consideration (Yep, 2020b). As Viet Nam joins the LNG importing club, it is projected that receiving terminals will be used at top capacity to meet increasing power demand as well as increasing the use of gas in the industrial, buildings and transport sector.

4-1-2 Pipeline imports from APEC economies

While LNG trade has increased at a faster rate than piped gas, particularly in the APEC region, gas pipeline trade remains the backbone of gas trade both within APEC and with economies outside the APEC region. While the APEC region is, by far, a net piped gas exporter, pipeline gas imports from APEC economies increased by 68 bcm (38%) from 2009 to 2019 and reached 249 bcm in 2019. Overall APEC growth was driven by China and Mexico, which more than compensated imports decreases in the USA and Russia. Despite this growth, APEC LNG imports have grown even faster and piped imports share of total imports fall from 3% in 2009 to 46% in 2019. About 70% of piped gas imports were intra-APEC trade, or coming from other APEC economies, while the rest came from exporters such as Turkmenistan, Kazakhstan, and Myanmar, amongst a few others.

Figure 4-8 Pipeline imports, 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

Only 10 APEC economies have international gas pipeline interconnection and only six are net importers. The majority of APEC piped gas trade (63%) takes place in North America between the US, Canada, and Mexico. Despite being a net gas exporter and a 18% decline since 2009, the US remained in 2019 as the largest piped gas importer in APEC at 76 bcm, with virtually all of these volumes coming from Canada. Conversely, Canadian piped import stood at 28 bcm in 2019, 40% more than in 2009, all of which came from the US. This results from an integrated pipeline grid and shorter distances from US producing areas to consumption centres, particularly in Eastern Canada.

Mexico was the second largest piped gas importer in 2019, growing by 5% and totalling 53 bcm, with the US being the sole supplier of these volumes, mostly coming from the Permian Basin. Between 2009 and 2019, Mexico's piped gas imports surged by 5.5 times, with its share of APEC's total rising from 7% to 32% during the same period. As explained in chapter 2, growing imports from Mexico are driven mostly by rising demand from the power sector, while domestic production is in decline. Further growth for Mexican piped imports will depend to the extent that the domestic pipeline grid is expanded, where at least 4 major projects have construction delays of over two years (CENAGAS, 2020). Additionally, state-owned utility CFE has reserved most of these pipelines capacity, increased demand in industry and other sector will largely depend on whether and how CFE share this capacity with other stakeholders.

Only in China has pipeline imports grow more than in Mexico, Chinese piped imports started in 2010 and have risen to 50 bcm in 2019, most of which come from Turkmenistan (64%). Although piped gas imports to China has a marginal decrease of 0.1 bcm in 2019, piped imports are projected to increase as the first

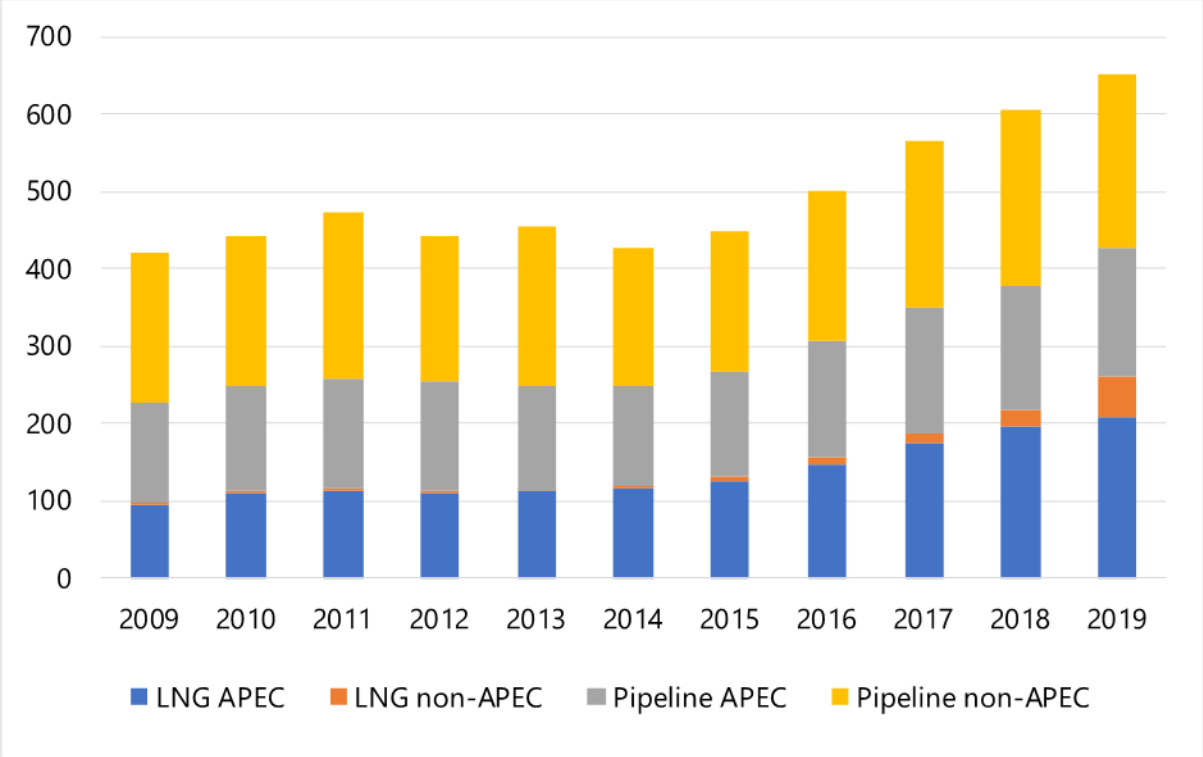
gas interconnection with Russia was commissioned on December of that year. The Power of Siberia, as the pipeline is dubbed, is a key infrastructure development for both economies and while its was around 5 bcm/year in 2020, it is set to increase gradually to 38 bcm/year by 2024 (Gazprom, 2020). Moreover, PipeChina commissioned on June 2020, a 1,110 km long pipeline that allows flows from the Power of Siberia to go to the Beijing region, which may significantly boost Russian piped imports, by adding 27 bcm/y of capacity (Daiss, 2020). The last stretch of this pipeline system will reach Shanghai

4-2 Gas exports in the world and the APEC region

Gas exports from APEC economies had an overall increase of 230 bcm (55%) from 2009 to 2019, reaching 651 bcm with increases from all gas exporters except for Canada, Indonesia, and Mexico. Out of the 21 member economies, 10 of them exported gas in 2021, of which only Mexico is not a net gas exporter. Interestingly, more than half of incremental trade (65% or 150 bcm) took place between APEC members, or intra-trade, with LNG trade accounting for about 77% of the increase (116 bcm).

Overall LNG exports have grown fast since 2014, with exports to other APEC members accounting for most of trade growth (62%), this is supported mostly by soaring Australian LNG exports to Japan, China, and Korea. In contrast, LNG exports to non-APEC grew rapidly starting in 2017, as US LNG exports to Europe rose and then Russian LNG exports followed suit in 2018. LNG exports from the U.S. and Russia to Europe exceeded 37 bcm in 2019, accounting for more than 70% of total APEC LNG exports from APEC to non-APEC economies and 13% of total gas exports.

Figure 4-9 APEC natural gas exports, 2009-2019 (bcm)



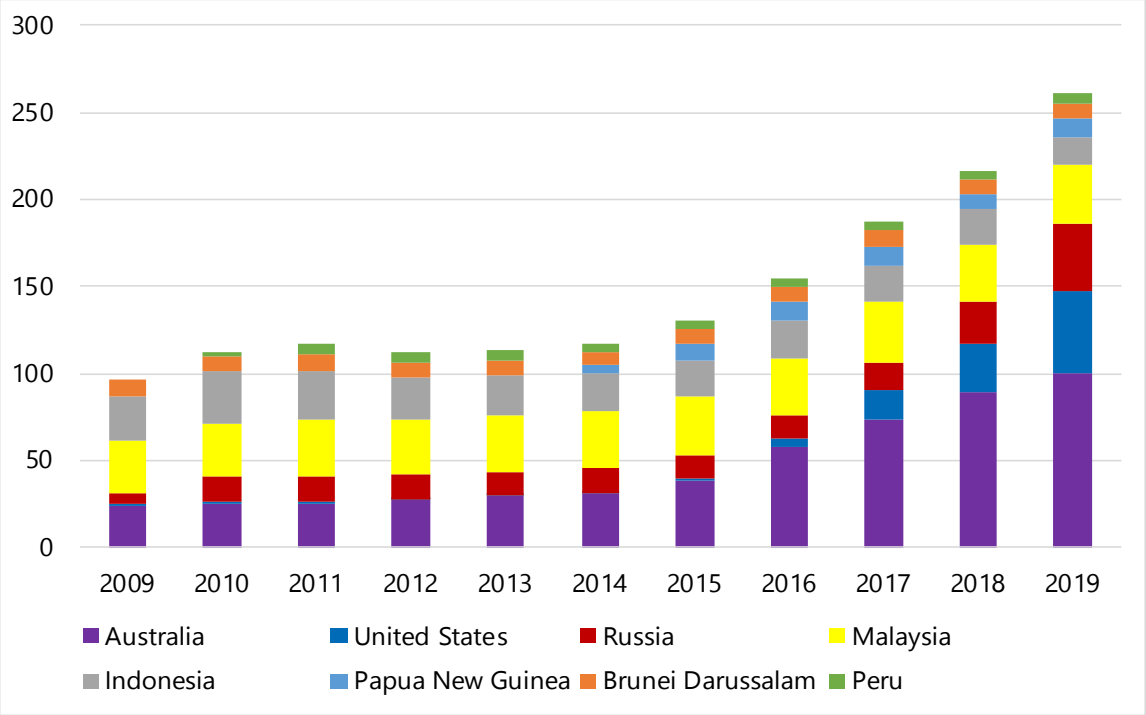
Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

4-2-1 APEC LNG exports

Global LNG exports grew at a 6.8% CAGR in 2009-2019, with a steady increase since 2014, when LNG exports grew at a 9.5% CAGR for the next five years in contrast to the 5.1% CAGR seen between 2009-2014. Until 2014, overall LNG exports from used to grow below the worlds average at a 1.0% CAGR, a stark contrast with the impressive 17.3% annual average growth from 2014 to 2019. This was overwhelmingly driven by a over 180 bcm of liquefaction capacity additions in Australia, the US and Russia, which only accelerated from 2015. APEC LNG exports doubled in 2019 compared to 2015 and almost tripled compared to 2009, reaching 261 bcm. This represents about 70% of the world's incremental LNG exports during the same period. Consequently, APEC LNG exports as a share of global LNG exports rose from 40% in 2009 to 55% in 2019.

Seven APEC economies are LNG exporters, all of them being net exporters too. When looking at the APEC-wide trend of growing LNG exports, it is no little surprise that LNG exports have been on a strong growing trend in all APEC LNG exporters with the one exception of Indonesia. LNG exports in this economy fell by 10 bcm or 38% between 2009 and 2019, mostly due to declining gas production and increasing domestic trade via LNG, a trend which is projected to continue. Other traditional LNG exporters such as Brunei and Malaysia have seen modest growth from 2009 to 2019, and a 3.9% and 4.3% increase in 2019, respectively. Brunei's exports totalled 8.6 bcm in the same year with most of them going to Japan, while Malaysia's LNG exports rose to 34 bcm and being directed mainly to Japan, China and Korea. Peru, which started exporting LNG in 2010, saw an 8% increase in 2019, totalling 5.1 bcm, essentially its 5-year average, with most cargoes heading to Korea, instead as to Mexico and Spain as it used to be. Papua New Guinea join the LNG exports club in 2014, with exports rising sharply and marking a high record of 11 bcm in 2019, with most cargoes to the four large Northeast Asian importers.

Figure 4-10 APEC LNG exports, 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

However, over 90% of LNG exports growth in APEC took place in Australia, USA and Russia, particularly since 2015, following the substantial increased in installed capacity in these economies. Australia became the world's LNG exporter with larger capacity in 2019 and quadrupled its LNG supplies between 2009 and 2019, Australia was the largest LNG exporter in APEC at 100 bcm in 2019, accounting for about 40% of total APEC LNG exports. In 2019, around 40% of these exports were sent to Japan with a similar share going to China, and the rest split in mostly APEC economies.

No other LNG exporter in the world increased more its supplied than the US in 2019, where growth amounted to 18 bcm in only one year, reaching 46 bcm and surpassing Malaysia as the second largest exporter in the region. US LNG exports have grown more than 10-fold since 2016 when Sabine Pass first train was commissioned. Interestingly, the destination of US LNG is one of the most diverse for LNG exporters with cargoes going to Europe, Asia-Pacific, India, and the Americas, but having on Korea its mains importer. Additionally, LNG exports to China fell by almost ten-fold and almost completely halted as consequence of bilateral trade disputes under the Trump administration, uncertainty remains on whether and how US LNG exports would grow again under the Biden administration,

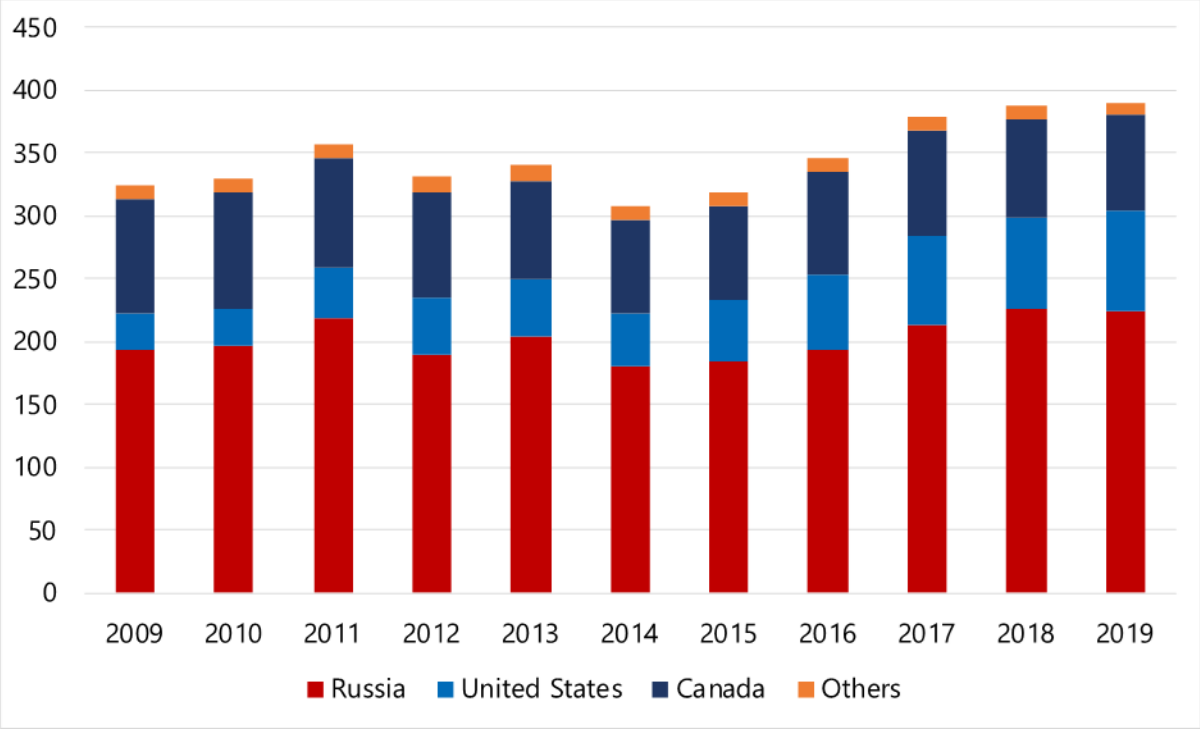
Russian LNG exports have also seen an impressive growth, with volumes more than doubling between 2017 and 2019, with the commissioning of Yamal LNG in the Russian Arctic. With Yamal LNG reaching full capacity in 2019, Russia increased its LNG exports to 38.5 bcm (14.8% growth) and became the third largest exporter in APEC. Russia is the only LNG exporter in the APEC region, of which most of its cargoes do not go other APEC economies, with most of them flowing to Europe, their traditional piped gas destination.

Finally, the APEC region is projected to have to new LNG exporters with final investment decisions (FIDs) taken in 2019 and 2020 in Canada and Mexico, respectively. LNG Canada is poised to become the world's largest liquefaction facility (19 bcm) and is expected to be operational in 2024 and located in the Pacific Coast (LNG Canada, 2020). In what at the moment of writing is the only FID in 2020, Sempra Energy is building the 4.4 bcm Energía Costa Azul (ECA) LNG Phase 1 in Mexico's North Pacific coast, which will use imported gas coming from the US taking advantage of existing infrastructure and its proximity with the US order (ECALNG, 2020). The terminal is adjacent to the existing ECA regasification facility, which is already interconnected to gas pipelines in Mexico and the US.

4-2-2 Pipeline exports from APEC economies

Global pipeline gas exports in 2009-2019 grew at 2.7% CAGR, while the APEC they did so by 1.9% during the same period. Only six APEC economies export natural gas via pipeline. Russia, the world's largest natural gas exporter and biggest piped gas exporter, sends most of its volumes to Europe, with some of the same to Central Asia and, since 2019, to China. In 2019, Russia's share of APEC pipeline gas exports was 57% and 26%, when compared globally. Russian gas exports, grew at a 2% CAGR from 2009 to 2019, with some fluctuations, including a 1% decline in 2019, totalling 224 bcm. While Russian piped exports to Europe may remain at similar levels during the next years, even with the 55 bcm/year of capacity addition, case the Nord Stream 2 project materializes, Russian exports to China are likely to have sharp increase in coming years.

Figure 4-11 Pipeline exports. 2009-2019 (bcm)



Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

On one hand, the three North American economies, as previously mentioned, share a relatively well integrated pipeline grid in which US piped exports have more than doubled since 2009. Increased production in the US has also displaced some markets that used to be supplied by Canadian imports, consequently decreasing by 16% from 2009 and 2019. Finally, Mexican gas exports to the US remain almost negligible, while flows in the opposite direction represent are the largest destination of US natural gas exports totalling 53 bcm in 2019, more than all US LNG exported volumes combined. Growth on US gas exports to Mexico accounted for 85% of total piped exports growth from 2009 to 2019.

Elsewhere in Southeast Asia, amid declining gas productions, piped exports from Indonesia have slowly decreased since 2012, with most of them going to Singapore and a marginal share to Malaysia. Indonesian exports fell by 7% in 2019, totalling 9 bcm. Similarly, Malaysia's piped gas exports, all of which go to Singapore, peaked in 2013 at 2.3 bcm and have been declining ever since, totalling 1.5 bcm

4-3 Gas trade outlook in the APEC region

According to the preliminary modelling results of APEC Energy Outlook 8th Edition's Current Policy Scenario, natural gas trade in APEC continues to grow, with exports rising by 25% and imports by 38% from 2019 to 2025. LNG imports are projected to play a major role within APEC, accounting for 56% of total imports and with a growing trend. According to the APEC Outlook, this rapid growth continues beyond the scope of this report, with LNG imports almost tripling by 2050.

The United States, which used to be a significant LNG importer, has steadily decreased LNG imports in recent years thanks to rapidly growing domestic production. Liquefaction capacity continues to expand with the commissioning of over 15 MTPA only in 2020 about 30 additional MTPA of capacity under construction with the Calacasieu Pass LNG, Golden Pass LNG and Sabine Pass T6. Given that US LNG do not have destination restrictions or oil-linked price schemes, US LNG exports have become one of the most competitive sources of LNG both in the APEC region and in Europe.

Canada also has increased its domestic gas production and has one large-scale LNG exports project in development in its Pacific coast, LNG Canada. However, it faces some delays due to the pandemic and is now expected to enter service in 2025. North American piped gas trade not only is poised to remain relevant but to grow through 2021, particularly in North America (US-Canada and US-Mexico).

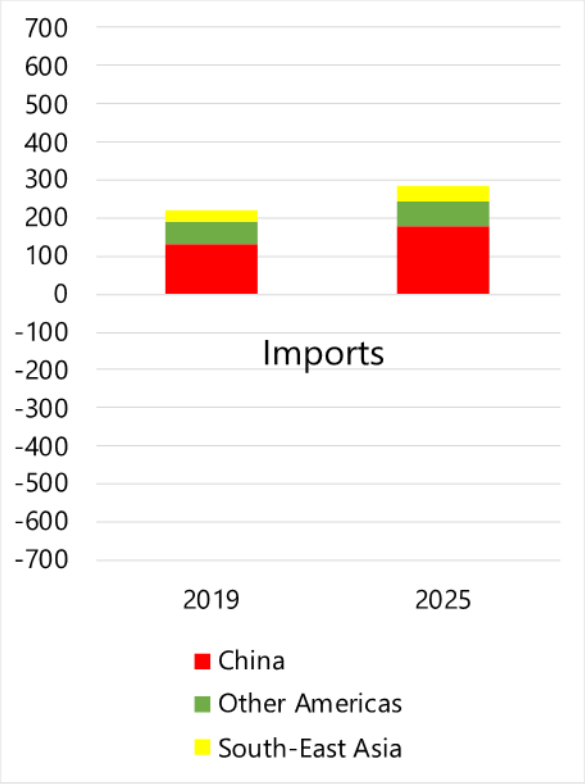
In Russia, after the commissioning of the Power of Siberia, Gazprom is building an 803 km-long pipeline to add feed gas from the Kovyktinskoye field. Constructions of the Yamal LNG T4, Arctic LNG 2 and Portovaya LNG T1 remain under construction and are estimated to be operational before 2025. Furthermore, the Power of Siberia pipeline, linking Russia and China is also under construction. The completion of these pipelines will significantly expand Russia's gas export capacity.

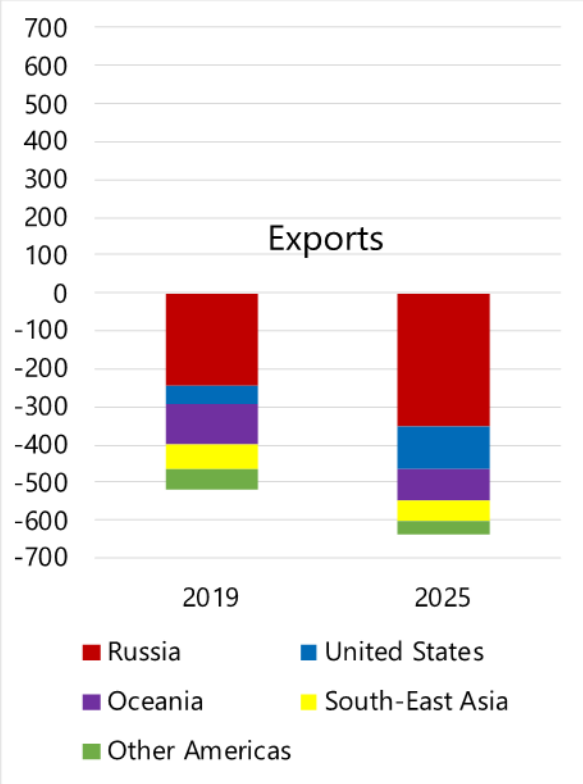
While LNG trades used to be dominated by volumes transported from Southeast Asia (mostly Malaysia, Indonesia and Brunei Darussalam) to Northeast Asia, including Japan, Korea and Chinese Taipei, global LNG trade flows have been diversified in recent years along with the increasing LNG production projects in places like the USA, Russia, Qatar and Indonesia. Additionally, more economies have started recently exporting LNG (Papua New Guinea and Cameroon) and others are expected to do it before 2025, including Mauritania, Mozambique, and Nigeria. With a larger number of LNG exporters and importers, LNG trade patterns are expected to continue diversifying through 2025.

Nevertheless, up to 2025 and after the economic havoc caused by COVID-19 pandemic, investment in the upstream sector faces high uncertainty. However, as mentioned, natural gas supply is expected to increase in the short-to-medium term because of the recent recovery of oil prices and start of several new LNG projects and pipelines.

A non-APEC member economy to take particular notice of in the region is Qatar, the world's largest LNG exporter. State-owned oil company Qatar Petroleum announced that it would increase its LNG production from 77 MTPA to 110 Mtpa by 2024. In 2018, Qatar Petroleum decided to increase the capacity of Qatar's expansion project by adding four liquefaction trains. Qatar's aim appears to be to maintain its market share against Australia, the United States, Russia and other competitors.

Figure 4-12 Imports and exports of gas. 2009-2019 (bcm)





Sources: IEA, Natural Gas Information 2020; CEDIGAZ, 2020.

Section 5. The impact of COVID-19 on gas markets

The COVID-19 pandemic affected virtually every sphere of human activity. The energy sector is, of course, no exception. With more than half of global population under some type of lockdown and economic activities severely affected, global energy demand is estimated to have fallen by 5% in 2020 compared to 2019, according to the International Energy Agency (IEA). This unprecedented shock on global energy demand affected all fuels, with coal consumption falling by 7%, oil by 8%, gas by 3%, and electricity by 2% (IEA, 2020).

As mentioned earlier, APEC gas demand represented about 57% of total global gas demand and 67% of the demand growth in 2019. APEC demand growth had already slowed in 2019, growing only 1.5% compared to 9.2% the previous year. The slowdown was driven by a variety of dynamics across the largest gas consuming economies in the region (see Section 2). At the same time, global gas production outpaced demand growth, creating an oversupplied global gas market before the pandemic hit. In APEC, gas production increased by 6% in 2019, with other major producers outside the region like Qatar or Norway showing similar growth rates.

5-1 Impacts of COVID-19 on APEC gas demand

The restrictive measures undertaken by governments to contain COVID-19 varied substantially across the APEC region both in strictness and timing. As a result, the effects on gas demand in different APEC economies were dramatically different (Figure 5-1). According to monthly data from APEC EGEDA and the IEA, as of November 2020, overall gas demand in APEC had a net decrease of around 14 bcm or -0.7% when compared to 2019.[1] While globally natural gas demand has proven to be the most resilient among fossil fuels, this has been more evident in the APEC region. Nevertheless, this is the first time since 2014, where APEC gas demand does not grow, after five years of continuous growth. Additionally, as is common in this type on analysis, this the result of different dynamics within the APEC region.

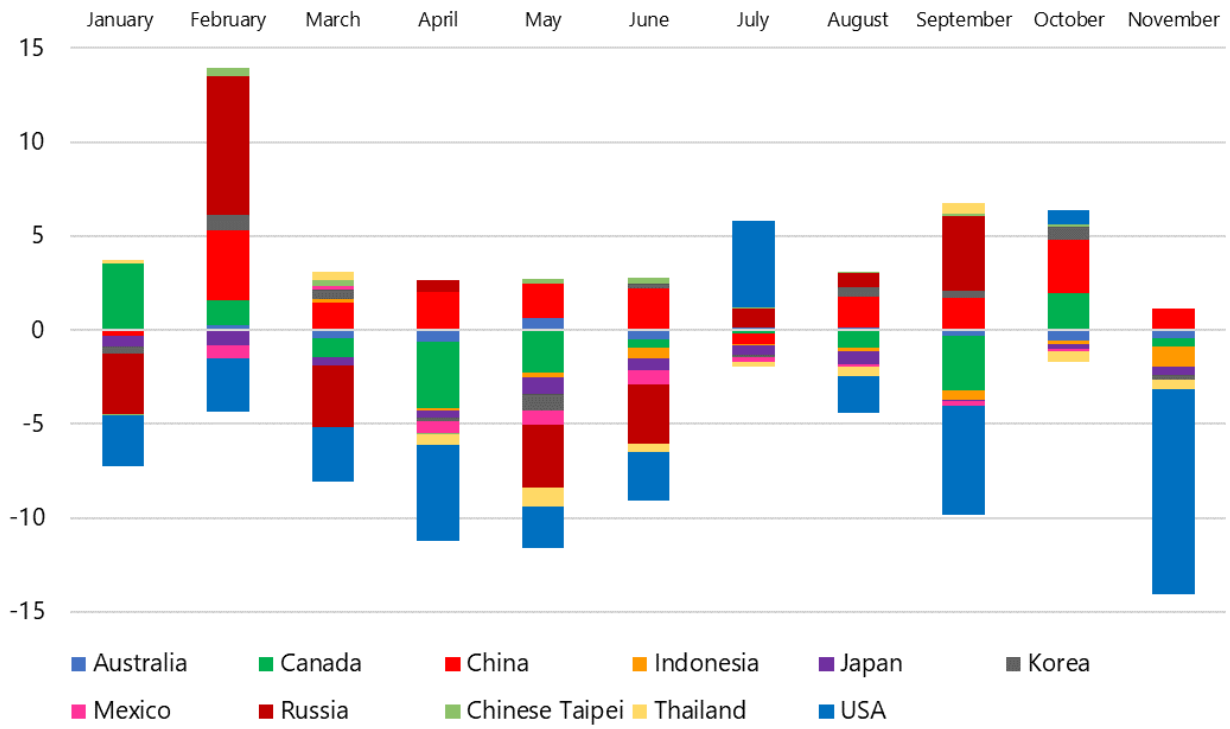
China was the first economy where lockdown measures were implemented, which meant a reduction in transportation, industry, and power demand. However, contrary to what happened in many other economies, China's gas demand actually increased by an annual 6% rate when compared to November 2019, with demand only falling by 1.1% in January on a year-on-year (y-o-y) basis and increasing every month after that. China's gas demand is estimated to increase by around 20 bcm or 6%, compared to 2020. Large potential for gas demand growth remains in China as gas currently has a low share (8%) of China's primary energy mix compared to coal and oil. Future gas demand growth is expected in the industry and buildings sectors as China's pipeline network expands.

While China led APEC demand growth in absolute terms, as of November 2020, gas demand also grew in Brunei Darussalam (4%); Chile (2%), Korea (1%), Hong Kong, China (54%); Singapore (8%) and Chinese Taipei (8%). The largest of volume gain in this group was in Chinese Taipei, with a cumulative 1.6 bcm increase

[1] Malaysia (demand only); Papua New Guinea and Viet Nam were excluded from this analysis as no monthly gas data was available.

during the same period, with imports estimated to surpass the 21 bcm, a record high. These economies share some commonalities in their demand response to the pandemic. They imposed strict lockdowns, border controls, and contact tracing measures, particularly in the second quarter of 2020, but showed some signs of economic recovery in the third and fourth quarters. The growth contributed to increased demand for power generation, as well as some gains from the industrial sector in Chile, Korea, and Chinese Taipei.

Figure 5-1 Changes in monthly natural gas demand in APEC by economy in 2020 vs 2019 (bcm)



Sources: APEC EGEDA Monthly data (2020), IEA Monthly Natural gas Statistics (2020), Secretaría de Energía (2020), Ministerio de Energía y Minas del Perú (2020).

Demand growth in these economies was overshadowed by declines in most other APEC member. Declines in most APEC economies were accentuated in the second quarter of 2020, which later saw diverse degrees of recovery across economies. Cumulatively, as of November 2020, the USA saw the largest fall by as much as 17 bcm or 2%, a sharp contrast to the 23 bcm annual growth seen in 2019. This decline was driven by steep drops in the buildings (over 20 bcm) and industry sectors (5 bcm) and was only partially offset by a 3.2% rise in the gas-fired power generation as the coal-to-gas fuel switching trend observed in the last five years continued (EIA, 2020b).

The two other North American economies, Canada and Mexico, followed a similar trend with gas consumption in each decreasing by 5%, for a combined drop of approximately 10 bcm as of October, 2020 (SENER, 2020). In Canada, this decline was driven by less heating demand in the buildings sector and own-energy consumption as oil and gas demand activity fell. In Mexico, gas consumption in the power and industry sectors slowed, however USA piped imports grew by 4% at the expense of declines in LNG imports (-63%) and domestic gas production (-6%).

Gas demand also fell in Japan by a cumulative 4 bcm or 3% as of November 2020, driven mostly by less power generation. Indonesia and Thailand also show a downward trend in their gas demand of around 3 bcm each, during the same period, accounting for 8% and 6% declines, respectively. Power generation is the main engine of both demand and growth in these two Southeast Asian economies. Other APEC economies with smaller volumes of gas consumption also saw their demand decline, representing a combined decrease of 2 bcm, including Australia (-1%), New Zealand (-1%), Peru (-17%), Philippines (-9%). Finally, data for gas demand in Russia, only available until September 2020, recorded an accumulated marginal increase on demand. However, thermal power generation fell by 11% in the first three quarters of 2020, with gas-fired capacity accounting for 70% of the total, gas consumption is estimated to have fallen in the second half of 2020 following a similar trend in total thermal power generation (SO-UPS, 2020).

5-2 Impacts of COVID-19 on APEC gas production

The pandemic has also affected gas production in the APEC region, overall APEC gas production was down an estimated 3% in 2020. Hong Kong, China and Singapore, the two only APEC non gas producers, as well as Papua New Guinea and Viet Nam (for which monthly data is not yet available), were excluded from this analysis.

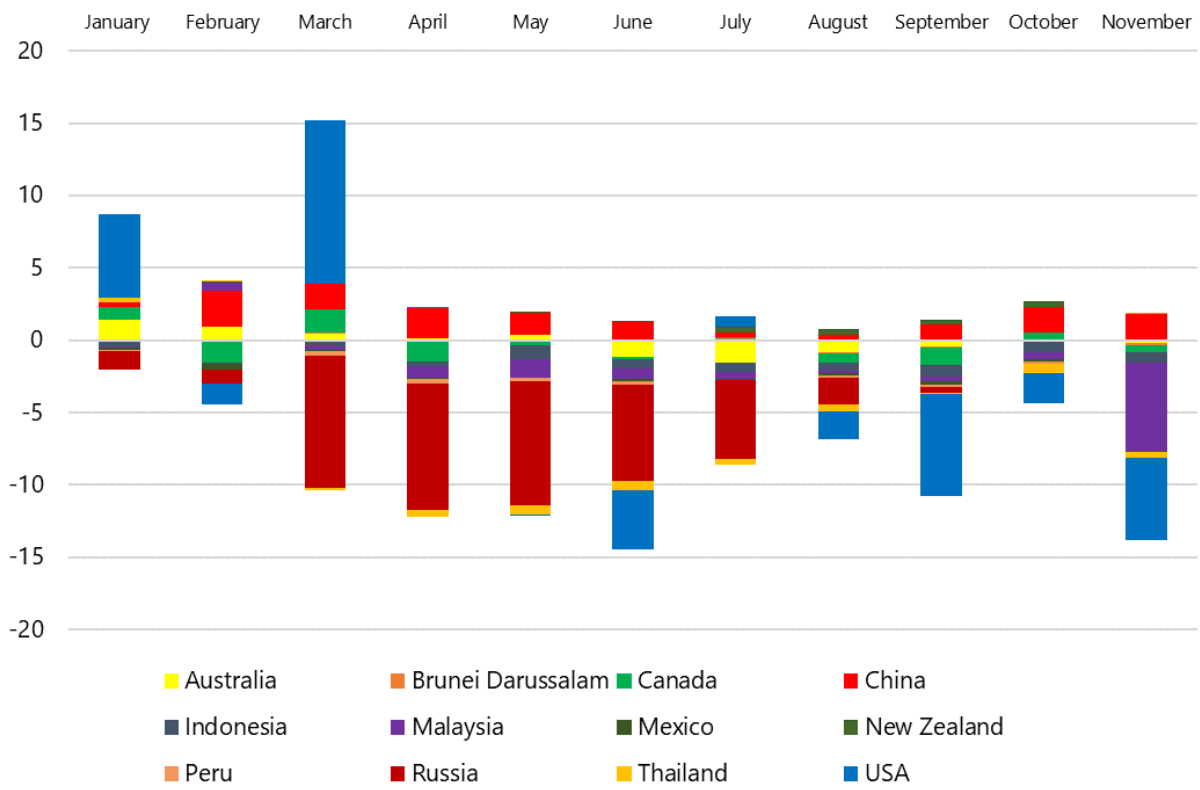
Gas production fell in all APEC economies with the sole exception of China, but nowhere did it fall more than in Russia. Cumulative data through September 2020, shows that gas production in Russia shrank by 43 bcm or 6% compared to the previous year. Reduced demand both domestically and in Europe, Russia's primary export markets, forced the production decline.

The USA experienced the largest decline in production with a cumulative drop of 11 bcm or 1% through November 2020. This drop occurred despite a year over year production increase in the first quarter of 2020. While a 1% decrease is not a large decline, this represents a substantial break from a decade of steady production growth. According to the US Energy Information Administration, USA gas production is not estimated to recover to pre-pandemic levels until 2022 (US EIA, 2021).

Malaysia, the fifth largest LNG exporter, contracted its gas production by 10 bcm or 16% during the same period, with decreases in demand in its traditional export markets. Malaysian LNG exports were down 7% in 2020. In Indonesia, gas production shrank by 6 bcm or 10%, which, unlike Malaysia, is similar to the decline seen in 2019 and continuing a downwards trend since 2015, driven mostly by natural depletion of some of its fields. Gas production in Thailand followed a pattern similar to that of Indonesia, continuing a downwards trend by falling 11% or 4 bcm through November 2020.

In North America, Canadian gas production decreased by 2% or 4 bcm in the same period, driven by demand drops both domestically and in the USA, its only *de facto* gas exporting destination. Production in Mexico, similarly to Indonesia, continued a declining trend during 2020 of an accumulated 6% or 2 bcm as of October of that year, a trend projected to increase according to preliminary data from the National Hydrocarbons Commission (CNH), the upstream regulator. (SENER, 2020).

Figure 5-2 Changes in monthly natural gas production in APEC by economy in 2020 vs 2019 (bcm)



Sources: APEC EGEDA Monthly data (2020), IEA Monthly Natural gas Statistics (2020), Secretaría de Energía (2020), Ministerio de Energía y Minas del Perú (2020).

Australia, where gas production more than doubled between 2015 and 2019 boosted by LNG exports and rising domestic demand, saw a marginal production decrease of 0.8% in 2020 (AU-DISER, 2021). This decline occurred in spite of a 2% increase on LNG exports, which reached a record high in 2020. Conversely, domestic demand fell by an estimated 1% in 2020, particularly in March and April and again from October through December, driven by less demand in the power and industry sectors.

Elsewhere in the APEC region, gas production fell as of November of 2020 in Brunei Darussalam (-2%) and Peru (-11%), both LNG exporters whose production had increased in recent years and saw this growing trend reversed as demand shrunk domestically and also in their traditional LNG exports destinations. Gas production also fell in the Philippines (-9%) in 2020, in contrast to increases in production seen in the past two years.

In contrast, gas production rose in China, where, as of November 2020, production increased by 9% or 15 bcm. Not only did Chinese gas production continue to grow even in January when COVID-19 hit gas demand the hardest, but every month registered growth and production is estimated to reach a record high of approximately 185 bcm in 2020.

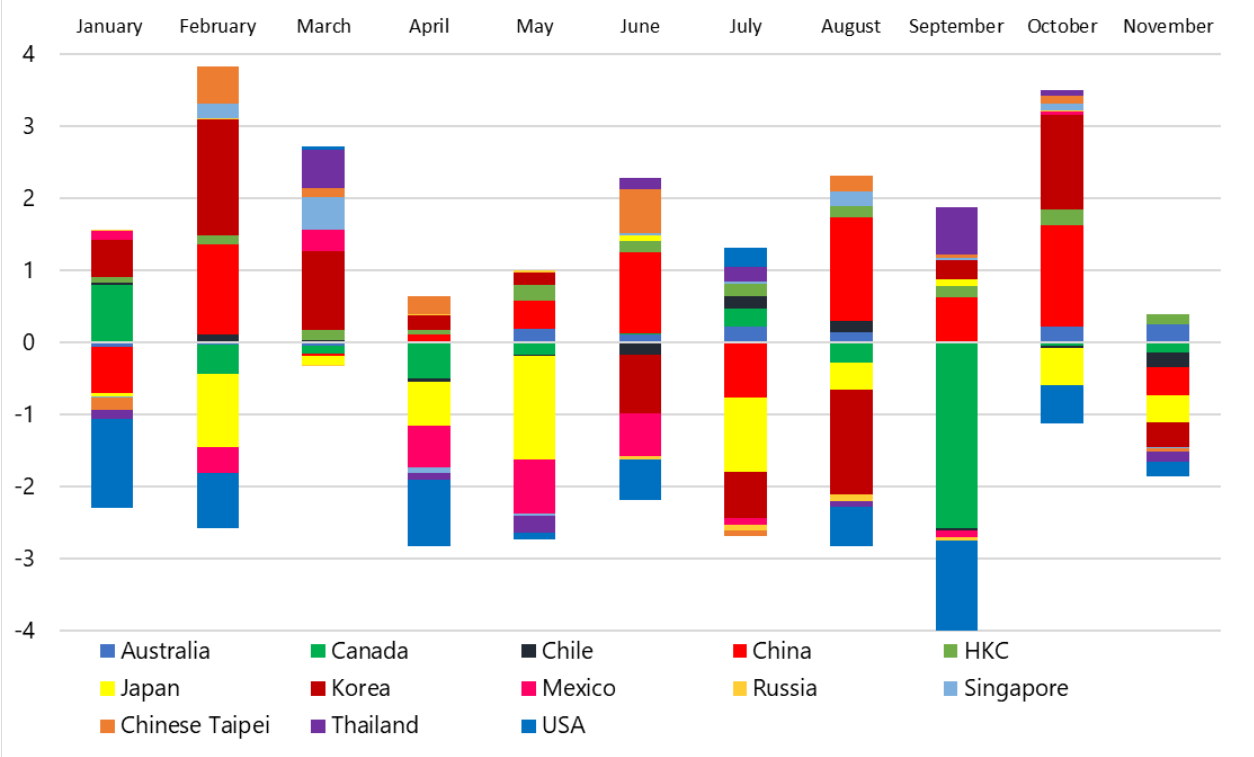
5-3 Impacts of COVID-19 on APEC gas trade

With regards to trade, overall APEC imports fell by 0.9% on an accumulated year over year basis as of November 2020. While marginal, APEC imports had been growing steadily since 2014, increasing by 1.5% per annum in 2019 and by 5.1% in 2018. This overall decrease in gas imports results from a combination of trends in major APEC importers and is intrinsically and tightly related to the impacts on gas demand described in section 5-1. Out of the 14 importing economies in APEC, gas imports decreased in six of them, with the largest decreases taking place In Japan and the US.

Japan registered the largest decline in imports in APEC, with volumes decreasing every month except for June and September and were over 5% or 6 bcm lower in 2020 compared with 2019. This is the lowest level since 2010 and steepens the downward trend on LNG imports started in 2017. Japan, however, still retains the crown as the world's largest LNG importer.

In the same period, the United States and Canada have also decreased gas imports by 7% and 8%, respectively, reflecting their interdependent and integrated grids. In these three economies, decreasing imports are mostly driven by weaker demand from power generation and the industrial sector, as a result of the restrictive measures implemented to tackle the COVID-19 pandemic. The combined decreased on imports of these two economies, amounted to around 7 bcm as of November 2020.

Figure 5-3 Changes in monthly natural gas imports in APEC by economy in 2020 vs 2019 (bcm)



Sources: APEC EGEDA Monthly data (2020), IEA Monthly Natural gas Statistics (2020), Secretaría de Energía (2020), Ministerio de Energía y Minas del Perú (2020).

Gas imports in Korea, all of them via LNG, fell by 1.8% in 2020. This represents a further decrease from the 55 bcm reached in 2018, but still higher than the 49 bcm of 2017. Korea's LNG imports actually grew during the first half of 2020 but started a steep decline during the second half of the year that more than offset those gains. As in Japan, Korea's LNG imports were tightly related to decreases on overall power generation and changes in other sources of power, particularly nuclear, coal and the increasing share of solar PV and wind.

Gas imports into Mexico, which grew by 60% from 2009 to 2019, supported by pipeline imports, decreased by 4% cumulatively basis as of October 2020 (SENER, 2020). Interestingly, pipeline imports coming from the USA actually rose by 4% during the same period but this was offset by a 74% decrease in LNG imports, which meant an overall decrease of 2 bcm in imports. This decrease in LNG imports responds on the one hand to the commissioning of the 27 bcm/y capacity Sur de Texas-Tuxpan pipeline in late 2019 which displaced LNG imports to the Altamira terminal and lower gas demand from the power sector, as economic activity slowed down affected by the COVID-18 pandemic (SENER, 2020).

Conversely, APEC gas imports increased in 6 economies, with most growth taking place in China and accounting to 4.5 bcm or 4% as of November of last year. With official numbers yet to be published, China's gas imports are slated to reach a new record-high of over 130 bcm per year in 2020, with LNG imports increasing by 12% from 2019 and remaining as the global largest natural gas importer. Pipeline gas imports from Russia are expected to grow too with the commissioning of pipelines in China allowing more flows from the Power of Siberia pipeline, but official data has not been made public at the time of writing. China's record-high gas imports highlight this economy's recovery from the pandemic has allowed a continued growth for gas demand, production, and imports.

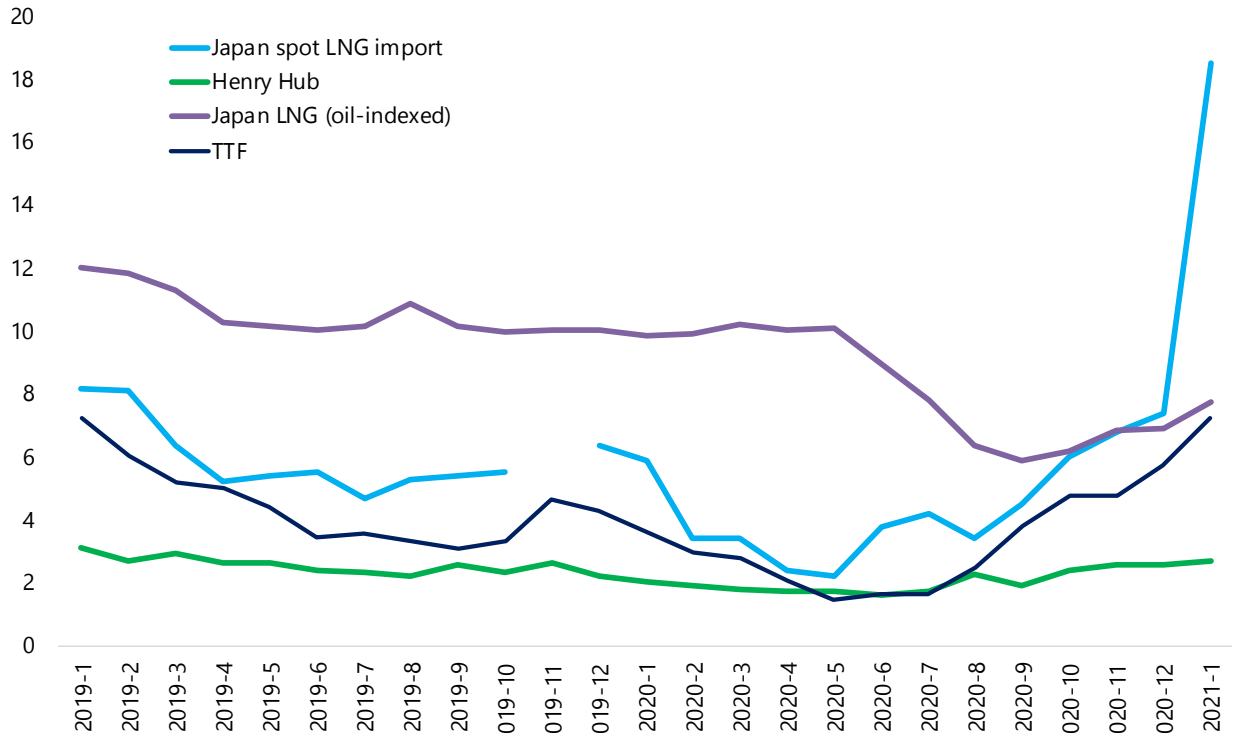
LNG imports to Chinese Taipei are set to also reach a record-high with an 8% increase as of November and imports estimated to be over 23 bcm in 2020, underpinned by an increase on the power generation share with this fuel. Hong Kong, China and Singapore had an 54% and 8% increased their gas demand, with an equal rise on its imports since all of their supply relies on foreign sources. Gas imports to Thailand, most of them via pipeline but with a rising share of LNG imports, also grew by 8% on a cumulative basis during the same period. While gas imports decrease in the second quarter of the year, imports recovered in the next two quarters. Interestingly, gas demand actually decreased in Thailand, but domestic production fell at an even faster rate, creating a supply gap that was covered with additional LNG imports. Finally, gas imports to Chile rose by a marginal 0.2% as of November of 2020, underpinned by a 10% increase on LNG imports, however provisional data for December suggest that overall imports may actually decrease, depending mostly on power generation dynamics during the austral winter.

5-4 COVID-19 and gas prices

Another unexpected development took place with respect to gas prices in 2020. The main benchmark prices for natural gas exhibited dramatically different behaviours in the two halves of the year (Figure 5-4). During the first half of 2020 and, particularly during the second quarter, gas prices touched historical lows. The Henry Hub benchmark floated below USD 2/MBtu from February to June, the TTF fell below USD 1/MBtu and the Asian spot price fell to less than USD 2/MBtu; all them historical lows. However, these benchmarks started to recover on the third quarter of 2020, remaining however still below the levels seen in the same

quarter in 2019. Nevertheless, in mid-December, Asian spot prices suddenly rose by ten-fold, reaching a record high of over USD 30/MBtu. This resulted from a complex interaction of factors, including a cold snap that drop temperatures lower than average in Northeast Asia, unavailability of most nuclear reactors for power generation in Japan due to safety revisions, record high-demand in China, limitations on coal-fired generation in Korea, lower LNG inventories and liquefaction plants outages in Australia and Norway. As cargoes from all over the world headed to Northeast Asia, the Panama Canal registered congestion and some LNG vessels coming from the USA opted for alternative and longer routes. All this contributed to a sudden rise on charter rates to almost USD 200,000/day, more than tripling the rates seen only 4 months before in August. While prices returned to levels like those of early December by late January, this temporary "perfect storm" highlighted the lack of gas storage in Northeast Asia and other infrastructure limitations in the Pacific basin gas market.

Figure 5-4 Natural gas prices in January 2019 through January 2021 (USD/ MBtu)

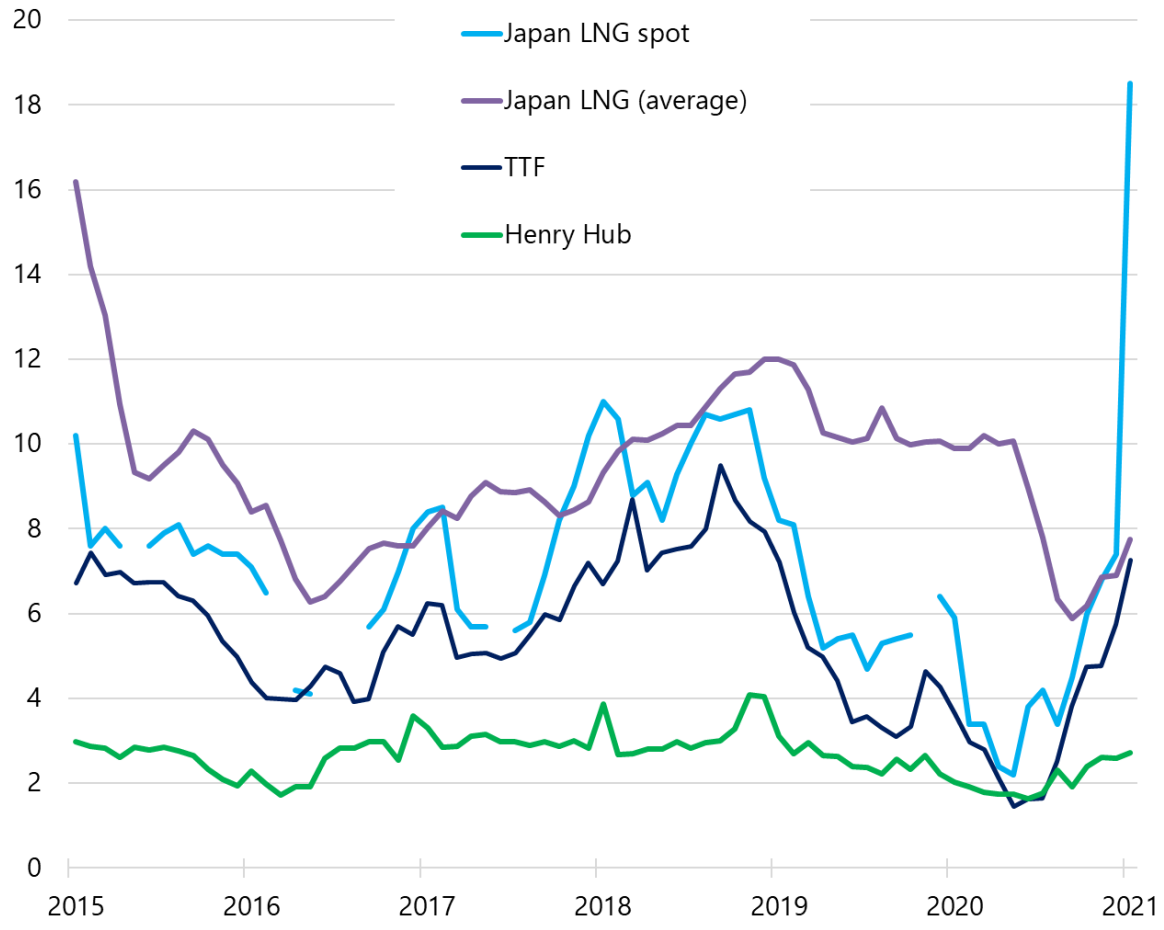


Sources: Ministry of Finance of Japan, Agency of Natural Resources of Energy of Japan, U.S. Energy Information Administration, Intercontinental Exchange, 2021.

Section 6. Gas prices

The dynamics of natural gas prices over time as reflected in the fluctuations of key regional benchmarks create a complex pattern. This pattern reflects both the long-term trend of growing liquidity and integration in the global gas market and short-term volatility related to the COVID-19 pandemic and infrastructure constraints, including limited gas storage in Asia (Figure 6-1). As described earlier in this report, natural gas consumption, production, and trade are increasing worldwide, and especially in the APEC region. This growth is increasing market liquidity and trading opportunities, but growing pains are still evident as the commissioning of large pipeline and LNG projects can still produce periods of excess supply leading to lower prices and excess demand until the next large supply project becomes operational. In the short term, gas demand is seasonal and very much affected by extreme heat and cold. The COVID-19 pandemic also dealt a large, unexpected hit to gas demand in early 2020 causing increased price volatility.

Figure 6-1 Trends in selected natural gas benchmark prices, 2015-2021 (USD/MBtu)



Sources: Ministry of Finance of Japan, Agency of Natural Resources of Energy of Japan, U.S. Energy Information Administration, Intercontinental Exchange, 2021.

The stability of gas prices at Henry Hub, the primary benchmark price in the USA, reflects the abundant resources and robust production growth in the Permian and Appalachian basins and the maturity of the pipeline infrastructure in the USA. This price stability has spurred increased domestic gas consumption in the power generation and industry sectors and created the opportunity for strong growth in gas exports, both via LNG and pipelines. Henry Hub did experience temporary price spikes in the Northern hemisphere winters of 2016/17, 2017/18, and 2018/19 as gas demand in the power and buildings sectors surged during cold snaps. But from 2015 to 2020, Henry Hub averaged only USD 2.65/MBtu and consistently remained below USD 5.00/MBtu, except for few days at the start of 2018. Moreover, Henry Hub has increased its international relevance as US LNG exports indexed to this benchmark have risen more than ten-fold in the past five years and pipeline exports to Mexico have doubled.

On the other side of the Pacific Ocean, the picture is quite different as most (67%) LNG imports are still priced via long-term contracts linked to the price of crude oil (IEA, 2021). The Japan LNG average marker weights all LNG imports into this economy and serves as proxy for LNG imports in Northeast Asia more generally. Following, crude oil's price dynamics, as opposed to gas-to-gas competition, the Japan LNG average price has remained for most of the last five years, more expensive than spot prices around the world. However, following two steep declines in crude oil prices, in 2016 and, most notably, in 2020, Japan LNG average prices have for limited periods fallen below Asian LNG spot prices. LNG spot prices in Asia show marked seasonality, especially during December and January, when cold temperatures increase demand for heating. This was particularly evident in 2018, when a cold snap in China caused spot prices to more than double. The opposite trend occurred in January 2019 and 2020, when mild winter weather caused Asian LNG spots prices to dip below USD 4.00/MBtu.

Outside the APEC region, the Title Transfer Facility (TTF), a major European spot-price benchmark, has become increasingly important for global LNG trade. With European LNG demand increasing rapidly in 2018 and 2019, accounting in fact for most of global LNG demand growth in those two years. Lower prices have prompted increased gas-fired power generation and favoured a coal-to-gas switch, which has further increased LNG demand. TTF prices and Asian spot LNG prices have increased their correlation, sharing similar trends but with TTF trading at a discount to Asian spot prices.

The unprecedented reduction in gas demand caused by the COVID-19 pandemic was clearly reflected in the movement of spot prices in Europe and Asia. At the start of 2020, when demand for heating in Northeast Asia was below average and China imposed lockdowns in major cities, Asian spot LNG prices declined steeply. After March, when the pandemic hit Europe, the TTF follow suit with a sharp drop in prices, falling even lower than Henry Hub. The first half of 2020 saw an unparalleled decline on prices across regions, with benchmarks reaching historical lows. In May, monthly average Asian LNG spot prices touched bottom at USD 2.20/MBtu while TTF fell to USD 1.45/MBtu. Henry Hub traded below USD 2.00/MBtu from February to July and fell to USD 1.63/MBtu in June. The drop in demand from industry and power generation exceeded declines in domestic gas production and very low prices held through the second quarter of 2020.

However, the low global gas prices did not last long, as the third quarter brought signs of economic recovery, demand rose while gas production declined and some LNG export plants in Norway and Australia were temporarily shutdown. TTF and Asian LNG spot prices rose in a similar trend, more than doubling and tripling in only three months, respectively. At the same time, Asian oil-indexed prices fell by 40% reflecting the lag of the extremely low crude prices seen in March and April 2020.

Finally, in mid-December 2021 extreme cold hit Northeast Asia. That weather event combined with other factors in Japan, Korea, and China, including the unavailability of other sources of power generation and

low inventories, led to daily spot prices in Asia of over USD 30.00/MBtu and a monthly average for January 2021 of USD 18.50/MBtu, almost the triple of the month before. This temporary price shock reflects the volatility of natural gas demand to extreme cold but also highlights infrastructure constraints, especially in the Pacific basin. The absence of LNG export facilities on the western coast of North America and limited gas storage capacity in Asia caused a strong disconnect between Asian and North American gas prices that signals the need to more gas infrastructure in the region.

Section 7. Conclusions and main takeaways

APEC economies played an outsized role in the growth of the world gas market over the last decade. In 2019, APEC consumed more than half (57%) of world's gas production and accounted for 67% of the year-over-year growth in global consumption. APEC economies include four of the world's five largest gas consumers: the United States of America, the Russian Federation, the People's Republic of China, and Canada.

Since 2009, APEC gas demand growth has been dominated by the USA and China. Following the rapid increase in U.S. shale gas production and the resulting gas price declines, gas demand in the US grew by 36% from 2009 to 2019. China's demand has more than tripled in the last decade. Although gas demand in Japan declined by 3% over the period, Japan is still the world's largest LNG importer,

With respect to gas production, APEC economies again played a pivotal role. APEC countries accounted for 72% of world gas production growth. Production growth was concentrated in the United States, Russia, Australia, and China. These four economies accounted for 70% of the world's gas production growth from 2009 to 2019. This growth led to an increase in the APEC's share of global gas production from 57.1% in 2016 to 60.1% in 2019.

Although most (70%) of the world's natural gas is consumed domestically, about 1,320 bcm of gas were traded internationally in 2019. International gas trade increased steadily in the past decade, except for 2014. Traded volumes grew by 48% from 2009 to 2019 (4% CAGR). Between 2014 and 2019, gas trade grew at an even faster rate (5.6%), more than double of that of the 2009-2014 period. In 2019, international trade rose by 5.2% compared to the 2018. LNG trade increased faster than pipeline trade and increased its share of total trade from 27% in 2009 to 36% in 2019. Increased LNG trade has increased regional market integration as well as enlarged the number of both gas exporting and importing economies.

The APEC region has some of the most active gas trading economies in the world, including three of the top five world exporters (Russia, the United States and Canada) and three of the top five world importers (Japan, China and the United States). APEC is, in total, a natural gas net exporter: 60% of gas exports were shipped by pipeline while the remainder was shipped as LNG. On the natural gas imports side, by contrast, 46% was pipeline gas and 54% was LNG in 2019.

COVID-19 has temporarily stalled the global gas market. Gas consumption in APEC economies is likely to decline in absolute terms in 2020, the first time this has happened since 2009. The pandemic has also affected gas production in the APEC region. Gas production fell in all APEC economies with the sole exception of China, but nowhere did it fall more than in Russia. Cumulative data through September 2020, shows that gas production in Russia shrank by 6% compared to the previous year. Reduced demand both domestically and in Europe, Russia's primary export markets, forced the production decline. Overall APEC gas production was down an estimated 3% in 2020.

COVID-19 also affected trade with APEC gas imports down by 0.9% on an accumulated year over year basis as of November 2020. While marginal, APEC imports had been growing steadily since 2014, increasing by

1.5% per annum in 2019 and by 5.1% in 2018. This overall decrease in gas imports results from a combination of trends in major APEC importers, including the effect of the pandemic on gas demand.

According to the APERC's preliminary results of the APEC Energy Outlook 8th Edition, APEC total gas demand is projected to grow at an average annual rate of 1.5% between 2019 to 2025 and the gas production in APEC will increase by 6% over the following six years.

Recent fluctuations in regional benchmark gas prices reflect both the long-term trend of growing liquidity and integration in the global gas market and short-term volatility related to the COVID-19 pandemic and infrastructure constraints. Natural gas consumption, production, and trade are increasing worldwide, and especially in the APEC region. This growth is increasing market liquidity and trading opportunities, but growing pains are still evident as the commissioning of large pipeline and LNG projects can still produce periods of excess supply leading to lower prices and excess demand until the next large supply project becomes operational. In the short term, gas demand is seasonal and very much affected by extreme heat and cold. The COVID-19 pandemic also dealt a large, unexpected hit to gas demand in early 2020 causing increased price volatility.

In mid-December 2021, extreme cold hit Northeast Asia. That weather event combined with other factors in Japan, Korea, and China, including the unavailability of other sources of power generation and low inventories, led to daily spot prices in Asia of over $ 30.00/MBtu and a monthly average for January 2021 of $ 18.50/MBtu, almost the triple of the month before. This temporary price shock reflects the volatility of natural gas demand to extreme cold but also highlights infrastructure constraints, especially in the Pacific basin. The absence of LNG export facilities on the western coast of North America and limited gas storage capacity in Asia caused a strong disconnect between Asian and North American gas prices that signals the need to more gas infrastructure in the region.

When looking at the region on the medium and longer term, the US and China have been the largest contributors to the APEC region demand growth. Overall, electricity remains the main growth driver in the APEC region, but industry is growing faster than power in some economies, most notably, in China. This report identifies three key dynamic to follow in the region:

1. The Impact of the gradual expansion on Russian exports to China via the Power of Siberia pipeline and the Yongqing-Shanghai pipeline. How much will demand grow in the industrial, power, building and even transportation sectors with increased availability of gas? To which extent will Russian piped imports displace LNG ones? How effective will PipeChina be at increasing transportation and storage infrastructure while developing a more liberalized market? Finally, what will be the role of natural gas in the 14th five-year energy plan and its importance on targeting the 2060 carbon neutrality goal?

2. Aside from China, the largest future growth natural gas consumption, and particularly LNG, is expected to come from the Southeast Asian economies, but this growth has so far been slow and with major challenges including LNG price volatility, affordability versus coal and the development of receiving infrastructure? At the same time, Thailand's LNG demand has grown fast and is developing further regasification capacity? To which extent can LNG supplant coal in other LNG importers like Malaysia

and Indonesia? Moreover, with projects under way, what will be the impact of Viet Nam and the Philippines joining the LNG importing club and how much demand will they be able to capture?

3. Major gas consuming and producing economies around the globe have made aggressive decarbonization commitments. It is unclear at this stage how these commitments will be implemented and how those implementations will affect the consumption and production of natural gas. Will natural gas, either with or without carbon capture utilization and storage (CCUS), play a greater role in the power generation and industry sectors? Will there be a reluctance to investment in new gas facilities given the risk that those assets could be stranded early in their operational life? Will natural gas be used as a backup to intermittent renewable energy sources?

APEC members have played an outsized role in the global gas markets over the last 20 years. The future energy and climate policies of the APEC economies can be expected to continue to play a pivotal role in the natural gas market in the coming 20 years.

References

Section 2. Gas demand

CENAGAS. 2020. Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural (SISTRANGAS) 2020-2024. Centro Nacional de Control del Gas Natural. https://www.gob.mx/cms/uploads/attachment/file/591600/2PQ_SISTRANGAS_2020_2024__05-11-2020_.pdf

Daiss, Tim. 2020. China's gas pipeline dream doesn't come cheap. Asia times Financial. https://www.asiatimesfinancial.com/chinas-gas-pipeline-dream-doesnt-come-cheap

Downs, Erica, и Yan Sheng. 2020. Reform Is in the Pipelines: PipeChina and the Restructuring of China's Natural Gas Market. Columbia University: Center on Global Energy Policy. https://www.energypolicy.columbia.edu/research/commentary/reform-pipelines-pipechina-and-restructuring-china-s-natural-gas-market

EIA. 2020a. Natual Gas Prices. US Energy Infromation Administration. https://www.eia.gov/naturalgas/data.php#prices

EIA. 2020b. Natural Gas Consumption. US Energy Infromation Administration. https://www.eia.gov/naturalgas/data.php#prices

Elliot, Stuart. 2020. Russia's Gazprom mulls Power of Siberia capacity expansion to 44 Bcm/year. S&P Global Platts. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/062620-russias-gazprom-mulls-power-of-siberia-capacity-expansion-to-44-bcmyear

IEA. 2020. Data and Statistics: data tables. International Energy Agency. https://www.iea.org/data-and-statistics/data-tables?country=WORLD

JNSI. 2020. Licensing status for the Japanese nuclear facilities. Japan Nuclear Safety Institute. http://www.genanshin.jp/english/facility/map/

Suga, Yoshihide. 2020. Policy Speech by the Prime Minister to the 203rd Session of the Diet. Prime Minister's Office of Japan. https://japan.kantei.go.jp/99_suga/statement/202010/_00006.html

Section 3. Gas supply

Canada Energy Regulator. 2020. Canada's Energy Future 2020. https://apps2.cer-rec.gc.ca/energy-future/?page=oil-and-gas&mainSelection=gasProduction&yearId=2020&sector=&unit=cubicFeet&view=source&baseYear=&compareYear=&noCompare=&scenarios=Evolving&provinces=YT,SK,QC,PE,ON,NU,NT,NS,NL,NB,MB,BC,AB&provinceOrder=YT,SK,QC,PE,ON,NU,NT,NS,NL,NB,MB,BC,AB&sources=ALL&sou

rceOrder=CBM,NA,SHALE,SOLUTION,TIGHTEIA. 2020. U.S. Natural Gas Gross Withdrawals and Production. US Energy Infromation Administration. www.eia.gov/dnav/ng/ng_prod_sum_dc_nus_mmcf_a.htm

Chen Aizhu, Muyu Xu. 2019. UPDATE 2-China aims to rev up shale gas drive, wean itself off imports amid U.S. trade row. Reuters, 2019. https://www.reuters.com/article/china-energy-naturalgas-idAFL3N25T0OO

Department of Industry, Science, Energy and Resources, Commonwealth of Australia, 2020. Resources and Energy Quarterly September 2020. https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/natural-gas/statistics/mrktblntrlgsprdctn2020.xlsx

EIA. 2020. EIA Dry shale gas production estimates by play. US Energy Infromation Administration. https://www.eia.gov/naturalgas/weekly/img/shale_gas_202009.xlsx

EIA. 2020. EIA Short-Term Energy Outlook January. US Energy Infromation Administration. https://www.eia.gov/outlooks/steo/archives/jan20.pdf

Federal State Statistic Service. 2017. Regions of Russia. Socio-economic indicators 2016. https://rosstat.gov.ru/bgd/regl/B17_14p/IssWWW.exe/Stg/d02/14-16.doc

Federal State Statistic Service. 2019. Regions of Russia. Socio-economic indicators 2018. https://rosstat.gov.ru/bgd/regl/B10_14p/IssWWW.exe/Stg/d02/14-18.htm

Federal State Statistic Service. 2020. Regions of Russia. Socio-economic indicators 2019. https://rosstat.gov.ru/storage/mediabank/fimgAF33/Region_Pokaz_2020.pdf

GAZPROM, 2020. Power of Siberia: inside look. https://www.gazprom.com/press/news/reports/2020/power-of-siberia-inside/

GAZPROM, 2020. Gazprom instructed to proceed to pre-investment phase in Power of Siberia 2 project. https://www.gazprom.com/press/news/2020/march/article502475/

National Bureau of Statistics, China, 2019. The 7th series of reports of the Fourth National Economic Census. http://www.stats.gov.cn/tjsj/zxfb/201912/t20191209_1716475.html

Norton Rose Fulbright. 2021. Global LNG Outlook 2021. https://www.nortonrosefulbright.com/en/knowledge/publications/89977412/global-lng-outlook-2021

Sebastian Lewis. 2020. Insight from Shanghai: Can shale gas secure China's energy security? S&P Global Platt, 2020. https://www.spglobal.com/platts/en/market-insights/blogs/natural-gas/042820-insight-from-shanghai-can-shale-gas-secure-chinas-energy-security

Section 4. Gas trade

ArgusMedia. 2020. «PipeChina outlines LNG terminal access plans for 2021.» https://www.argusmedia.com/en/news/2166910-pipechina-outlines-lng-terminal-access-plans-for-2021?backToResults=true

CENAGAS. 2020. Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural (SISTRANGAS) 2020-2024. Centro Nacional de Control del Gas Natural. https://www.gob.mx/cms/uploads/attachment/file/591600/2PQ_SISTRANGAS_2020_2024__05-11-2020_.pdf

CPC. 2020. Projects and Plans. https://en.cpc.com.tw/cp.aspx?n=2720

CTCI. 2020. CTCI Wins EPC Contract for Taipower Taichung LNG Receiving Terminal Regasification Project. https://www.ctci.com/e-newsletter/(X(1)S(hbraecejcft2zs45vzxngkvn))/page.aspx?L=EN&no=465&cat=hot-news&article=05&AspxAutoDetectCookieSupport=1

Daiss, Tim. 2020. China's gas pipeline dream doesn't come cheap. Asia times Financial. https://www.asiatimesfinancial.com/chinas-gas-pipeline-dream-doesnt-come-cheap

Dela Cruz, Enrico. 2020. Philippine energy chief says 4 LNG projects still on track despite virus delays. Reuters. https://www.reuters.com/article/philippines-lng-idUSL4N2FT1MW

DoE. 2018. Philippine Energy Plan 2018-2024. https://www.doe.gov.ph/sites/default/files/pdf/pep/pep-2018-2040-as-of-01052020.pdf

ECALNG. 2020. «ECA Liquefaction Project.» https://ecalng.com/about-theproject/

Gazprom. 2020. «Power of Siberia: The largest gas transmission system in Russia's East.» https://www.gazprom.com/projects/power-of-siberia/

Huang. 2020. EIA controversy, Concord Natural Gas Terminal shrinks reclamation. United Daily News. https://udn.com/news/story/121691/4886880

IGU. 2020. 2020 World LNG Report. International Gas Union. https://www.igu.org/resources/2020-world-lng-report/

LNG Canada. 2020. «About LNG Canada.» https://www.lngcanada.ca/uploads/subpages/downloads/LNG-Canada-Project-Overview-2018_Web-Version-AWv4.pdf

ME. 2018. Natural Gas Management Plan 2018-2037. Thailand's Ministry of Energy. http://www.eppo.go.th/images/Infromation_service/public_relations/PDF/Gasplan2018.pdf

MEM. 2019. National Electricity Supply Business Plan (RUPTL) 2019-2028 (ESDM Decision No. 39 K/20/MEM/2019). https://jdih.esdm.go.id/index.php/web/result/1887/detail

MFA. 2020. «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.» https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1817098.shtml

MOEA. 2020a. Energy Transition Promotion Scheme. Ministry of Economic Affairs. Energy Transition Promotion Scheme. https://www.moea.gov.tw/MNS/english/Policy/Policy.aspx?menu_id=32904&policy_id=19

MOEA. 2020b. Taiwan's CNPC reiterated that the third LNG receiving station project has avoided the area of algal reefs and will implement environmental protection measures in accordance with the EIA commitment. Ministry of Economic Affairs. https://www.moea.gov.tw/Mns/populace/news/News.aspx?kind=1&menu_id=40&news_id=90727

MOIT. 2017. «Viet Nam Gas Industry Master Plan.» http://www.jccp.or.jp/country/docs/4_CPJ-5-18_MOIT.pdf

OGJ. 2020. First Gen selects three Batangas FSRU finalists. Oil & gas journal. https://www.ogj.com/pipelines-transportation/lng/article/14189533/first-gen-selects-three-philippines-fsru-finalists

Yep, Eric. 2020b. Analysis: Vietnam's gas-fired power projects see flurry of interest from US LNG exporters. S&P Global Platts. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/082720-analysis-vietnams-gas-fired-power-projects-see-flurry-of-interest-from-us-lng-exporters

Yep, Eric. 2020a. Vietnam's first LNG terminal Hai Linh to conduct test run late 2020. S&P Global Platts. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/061020-vietnams-first-lng-terminal-hai-linh-to-conduct-test-run-late-2020

Section 5. The impact of COVID-19 on gas markets

AU-DISER. 2021. Australian Petroleum Statistics 2020. Canberra: Department of Industry, Science, Energy and Resources, Commonwealth of Australia. https://www.energy.gov.au/publications/australian-petroleum-statistics-2020

EIA. 2020b. Natural Gas Consumption. US Energy Information Administration. https://www.eia.gov/naturalgas/data.php#prices

IEA. 2020. World Energy Outlook 2020. Paris: International Energy Agency. https://www.iea.org/reports/world-energy-outlook-2020

SENER. 2020. Prontuario Estadístico 2020. Mexico City: Secretaría de Energía. https://www.gob.mx/cms/uploads/attachment/file/613809/Prontuario_enero_2021__accesibilidad_Lul_.pdf

SO-UPS. 2020. Analysis of indicators of power and capacity balances in 3Q 2020. Moscow: System Operator of the United Power System. https://so-ups.ru/fileadmin/files/company/reports/ups-review/2020/ups_balance_analysis_2020q3.pdf

EIA. 2021. Annual Energy Outlook 2021. US Energy Information Administration. https://www.eia.gov/outlooks/aeo/

Section 6. Gas prices

IEA. 2021. «Gas Market Report, Q1-2021.» https://www.iea.org/reports/gas-market-report-q1-2021

Annex

Table A-1 Natural gas demand in APEC and the world, 2009-2019 (bcm)

Economy	Natural Gas Production Consumption by Economy (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
APEC Total	**1657**	**1808**	**1867**	**1933**	**1996**	**1961**	**1994**	**2022**	**2059**	**2249**	**2282**
Australia	31.2	32.0	32.4	33.9	36.7	36.0	37.1	38.1	39.2	40.5	47.2
Brunei Darussalam	2.7	3.2	3.8	3.7	3.5	2.9	2.9	3.3	3.1	3.3	3.3
Canada	94.0	97.4	107.5	106.6	115.6	111.4	114.9	112.1	114.4	121.8	121.4
Chile	3.3	5.3	5.7	4.9	4.1	4.9	4.4	4.8	5.0	5.3	6.5
China	89.5	125.1	131.3	147.2	184.3	167.5	191.8	207.9	237.8	279.6	303.8
Hong Kong, China	3.4	4.1	3.4	3.1	2.9	3.0	3.6	3.6	3.6	3.5	3.3
Indonesia	38.8	43.5	41.0	40.8	42.9	41.9	42.9	41.6	39.8	44.5	43.7
Japan	105.5	111.3	129.7	134.7	119.3	118.4	113.6	115.8	113.2	108.2	102.6
Korea	34.4	43.2	46.5	50.2	47.4	52.6	44.3	47.0	48.8	54.1	51.1
Malaysia	37.7	36.8	37.3	38.1	45.4	45.0	44.4	42.3	38.1	45.9	47.3
Mexico	67.5	70.0	72.7	76.2	75.0	72.9	77.8	80.3	81.5	84.6	83.9
New Zealand	4.3	4.7	4.3	4.5	5.4	4.8	5.1	5.1	5.2	4.6	4.5
Papua New Guinea	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.9
Peru	4.2	5.7	6.7	6.9	8.1	6.5	7.9	8.3	7.3	7.5	8.1
Philippines	3.9	3.7	4.0	3.8	3.7	3.5	3.5	4.0	3.9	4.4	4.5
Russia	426.4	465.8	476.2	471.1	464.6	465.9	445.4	444.1	463.0	498.5	484.8
Singapore	7.3	7.8	8.1	8.7	10.4	9.8	10.5	10.7	10.9	11.0	10.9
Chinese Taipei	10.7	13.4	14.6	15.3	16.4	15.6	17.6	18.4	20.3	20.2	19.8
Thailand	37.0	42.1	39.4	45.0	48.4	48.4	48.1	47.2	44.5	45.7	46.7
United States	646.8	683.1	693.0	728.3	750.5	739.4	767.1	776.7	769.8	856.0	878.2
Viet Nam	8.6	9.8	9.1	9.9	11.0	10.3	10.6	10.6	9.4	9.5	9.7
World Total	**3059**	**3331**	**3385**	**3456**	**3492**	**3487**	**3543**	**3628**	**3737**	**3929**	**3987**
APEC Share, %	54.2	54.3	55.1	55.9	57.1	56.2	56.3	55.7	55.1	57.2	57.2

Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Table A-2 APEC Natural gas demand by sector, 2009-19 (bcm)

Economy	Natural Gas Consumption by Sector (bcm)									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total gas demand	**1670**	**1785**	**1870**	**1929**	**1990**	**2034**	**2031**	**2079**	**2113**	**2287**
Energy industry own use	173	174	184	192	203	206	205	205	201	223
Power	634	700	732	801	793	790	831	843	818	880
Industry	324	385	390	413	422	435	428	446	482	520
Transportation	67	76	78	76	81	82	84	89	92	103
Buildings	376	380	385	354	395	418	403	403	424	481
Heating plants	72	77	83	84	70	69	54	53	56	51

Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Table A-3 APEC member economies natural gas production (marketed). 2009-2019

Economy	Natural Gas Production by Economy (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
APEC Total	**1719**	**1839**	**1910**	**1927**	**1977**	**2020**	**2048**	**2066**	**2160**	**2326**	**2458**
Australia	49.5	52.7	56.4	54.0	63.0	64.8	68.1	81.4	103.6	117.9	142.4
Brunei Darussalam	11.5	12.3	12.8	12.6	12.2	11.9	11.3	10.9	11.9	11.8	12.2
Canada	162.1	156.3	157.7	156.3	157.5	164.1	165.0	177.0	181.1	183.2	176.7
Chile	1.8	1.8	1.5	1.2	1.0	0.8	1.0	1.2	1.2	1.2	1.5
China	85.3	95.8	105.3	110.6	120.9	130.2	134.6	136.9	148.0	161.7	177.5
Indonesia	76.9	85.7	81.5	77.1	76.5	75.3	75.0	74.0	71.6	71.7	66.5
Japan	3.8	3.5	3.5	3.2	2.9	2.9	2.8	2.9	2.9	2.2	2.6
Korea	0.5	0.5	0.5	0.4	0.5	0.3	0.2	0.2	0.3	0.3	0.2
Malaysia	61.6	60.5	62.4	61.0	69.0	69.7	68.6	67.8	66.5	70.1	72.0
Mexico	50.6	51.0	49.0	47.0	45.8	44.8	41.6	36.7	31.6	30.6	27.0
New Zealand	4.5	4.8	4.4	4.6	4.8	5.2	5.0	5.1	5.0	4.4	4.5
Papua New Guinea	0.1	0.1	0.1	0.1	0.1	4.8	9.8	10.4	11.1	10.0	12.2
Peru	4.2	7.9	12.2	12.4	12.9	13.6	13.1	14.6	12.9	12.7	13.8
Philippines	3.9	3.7	4.0	3.8	3.5	3.7	3.5	4.0	3.9	4.4	4.5
Russia	582.5	657.3	672.8	658.1	674.5	646.5	638.0	644.2	695.1	738.2	749.9
Chinese Taipei	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2
Thailand	27.4	31.6	28.1	33.5	36.3	37.0	33.0	32.3	30.2	29.2	30.0
United States	584.3	603.9	648.8	680.8	685.7	733.4	766.5	755.3	773.3	866.5	954.8
Viet Nam	8.6	9.8	9.1	9.9	10.3	11.0	10.6	10.6	9.4	9.6	9.8
World Total	**3062**	**3281**	**3377**	**3435**	**3493**	**3543**	**3572**	**3619**	**3760**	**3957**	**4089**
APEC Share, %	56.2	56.1	56.6	56.1	56.6	57.0	57.3	57.1	57.5	58.8	60.1

Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020.

Table A-4 APEC member economies natural gas production outlook. 2019, 2025

Economy	Natural Gas Production (bcm)		2019-2025	
	2019	2025	Change	%
Australia	142.4	126.5	-15.8	-11%
Brunei Darussalam	12.2	12.2	0.0	0%
Canada	176.7	186.8	10.1	6%
Chile	1.5	1.3	-0.2	-13%
China	177.5	230.6	53.0	30%
Indonesia	66.5	89.9	23.3	35%
Japan	2.6	1.6	-1.0	-37%
Korea	0.2	0.2	0.0	-21%
Malaysia	72.0	70.4	-1.6	-2%
Mexico	27.0	28.6	1.6	6%
New Zealand	4.5	4.3	-0.3	-6%
Papua New Guinea	12.2	3.6	-8.6	-71%
Peru	13.8	15.0	1.2	9%
Philippines	4.5	7.0	2.5	55%
Russia	749.9	822.0	72.0	10%
Chinese Taipei	0.2	0.1	0.0	-26%
Thailand	30.0	24.6	-5.4	-18%
United States	954.8	977.1	22.3	2%
Viet Nam	9.8	11.3	1.5	15%
APEC Total	2458	2613	154.6	6%

Sources: IEA, Natural Gas Information 2020; APEC EGEDA, Energy Balance Table, 2020, APERC, 2020.

Table A-5 Natural gas trade. 2009-2019 (bcm)

	Natural Gas World Trade (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gas trade	894	984	1029	1017	1036	1007	1037	1103	1204	1255	1320
APEC	421	444	474	443	453	427	450	502	566	605	652
Non-APEC	473	540	555	574	582	580	587	601	637	650	668
- LNG	243	295	324	317	315	321	328	350	385	420	471
APEC	96	112	117	112	113	118	132	155	188	217	261
Non-APEC	147	183	207	205	202	204	196	195	196	203	210
- Pipeline	651	688	705	700	720	686	709	753	819	835	849
APEC	325	331	357	331	340	309	318	347	378	388	390
Non-APEC	326	357	348	369	380	377	390	405	441	447	459

Source: CEDIGAZ, 2020.

Table A-6 APEC Natural gas net trade, 2009-2019 (bcm)

	APEC Natural Gas Net-Trade (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Exports	196	198	222	193	206	182	188	202	228	248	275
Imports	113	128	154	173	189	187	167	153	157	172	160
Net trade	-83	-70	-68	-19	-18	+5	-21	-49	-70	-76	-115
LNG	62	74	90	105	117	114	93	76	70	71	26
Pipeline	-144	-145	-158	-125	-135	-109	-114	-124	-140	-147	-141

Source: CEDIGAZ, 2020.

Table A-7 APEC Natural gas imports, 2009-2019 (bcm)

	APEC Natural Gas Imports (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Imports	338	373	406	424	435	432	429	453	496	530	536
APEC	225	246	252	250	247	245	262	300	339	358	376
non-APEC	113	128	154	173	189	187	167	153	157	172	160
- LNG	158	187	207	217	230	232	225	231	258	288	287
APEC	93	111	113	109	111	116	127	147	175	196	210
non-APEC	64	76	95	108	118	116	98	83	83	93	78
- Pipeline	181	187	199	206	205	200	204	223	238	241	249
APEC	132	135	139	141	135	129	135	153	163	162	167
non-APEC	49	52	59	65	70	70	69	70	74	80	82

Source: CEDIGAZ, 2020.

Table A-8 APEC LNG imports, 2009-2019 (bcm)

Economy	APEC LNG Imports (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canada	1.0	1.4	3.2	1.7	1.1	0.6	0.6	0.3	0.4	0.6	0.5
Chile	0.7	3.1	3.8	3.8	3.7	3.5	3.6	4.3	3.9	4.0	3.8
China	7.6	12.5	16.3	19.5	24.0	26.4	26.2	34.8	50.7	71.6	80.1
Japan	85.9	93.5	104.4	116.2	116.4	117.7	113.1	110.8	111.2	110.2	102.8
Korea	34.3	43.4	48.8	48.1	53.0	49.5	44.4	44.5	49.9	58.6	54.2
Malaysia					2.0	2.1	1.9	1.6	1.9	1.8	3.6
Mexico	3.6	5.7	4.0	4.8	6.8	8.4	6.6	5.1	6.6	6.8	6.5
Singapore					1.3	2.6	2.9	3.0	4.0	4.2	4.9
Chinese Taipei	11.8	14.9	15.9	17.0	17.1	18.0	19.4	19.9	22.4	22.8	22.4
Thailand	0.0	0.0	1.0	1.3	1.9	1.8	3.5	3.9	5.1	5.9	6.8
United States	12.8	12.2	9.9	5.0	2.7	1.7	2.4	2.3	2.1	2.0	1.4
Total	**158**	**187**	**207**	**217**	**230**	**232**	**225**	**231**	**258**	**288**	**287**

Source: CEDIGAZ, 2020.

Table A-9 Natural gas imports by APEC 2009-2019 (bcm)

Economy	APEC Natural Gas (pipeline) Imports (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Australia	6.6	6.0	5.6	5.5	6.5	6.3	7.7	6.9	6.2	6.3	5.8
Canada	19.9	20.9	26.5	27.5	25.8	21.8	19.8	21.8	26.0	23.8	27.5
Chile	0.84	0.34	0.12	0.04	0.02	0.01	0.04	0.00	0.00	0.20	0.63
China	0.0	3.6	14.3	20.1	27.3	31.3	33.5	38.0	41.3	49.7	49.6
Malaysia	1.5	2.9	2.0	2.3	1.2	2.5	1.3	0.6	0.7	0.6	0.6
Mexico	9.6	9.4	14.1	17.5	18.6	20.6	29.8	38.4	43.7	47.7	52.8
Russia	32.8	33.1	30.9	30.8	28.0	24.2	18.0	15.9	18.2	15.1	18.9
Singapore	8.1	8.4	8.5	10.2	10.7	9.8	9.5	9.8	9.4	10.3	9.6
Thailand	8.3	8.8	8.6	8.5	8.5	8.7	10.0	8.9	8.8	8.3	7.6
United States	93.0	93.3	88.3	83.8	78.9	74.6	74.3	82.4	83.7	79.5	76.0
Total	**181**	**187**	**199**	**206**	**205**	**200**	**204**	**223**	**238**	**241**	**249**

Source: CEDIGAZ, 2020

Table A-10 APEC natural gas exports, 2009-2019 (bcm)

	APEC Natural Gas Exports (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Exports	421	444	474	443	453	427	450	502	566	605	652
APEC	225	246	252	250	247	245	262	300	339	358	376
non-APEC	196	198	222	193	206	182	188	202	228	248	275
- LNG	96	112	117	112	113	118	132	155	188	217	261
APEC	93	111	113	109	111	116	127	147	175	196	210
non-APEC	3	2	4	3	2	2	5	8	13	22	52
- Pipeline	325	331	357	331	340	309	318	347	378	388	390
APEC	132	135	139	141	135	129	135	153	163	162	167
non-APEC	193	196	218	190	205	180	184	194	215	226	224

Source: CEDIGAZ, 2020.

Table A-11 APEC LNG exports. 2009-2019 (bcm)

Economy	APEC LNG Exports (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
APEC Total	**96**	**112**	**117**	**112**	**113**	**118**	**131**	**154**	**188**	**217**	**261**
Australia	24.3	25.4	25.2	27.4	29.5	31.1	38.6	58.2	73.5	89.5	100.8
Brunei Darussalam	8.8	8.8	9.4	8.9	9.2	7.8	8.5	8.5	8.9	8.3	8.6
Indonesia	26.0	31.0	28.5	24.2	22.0	21.3	21.0	21.7	21.2	20.2	16.2
Malaysia	29.5	30.3	32.6	31.1	33.1	33.0	33.4	32.5	35.3	32.5	33.8
Papua New Guinea						4.7	9.7	10.3	11.0	9.5	11.3
Peru		1.7	5.6	5.2	5.2	5.2	4.8	5.1	5.3	4.7	5.1
Russia	6.6	13.4	13.9	14.4	13.9	14.1	14.2	14.2	15.0	23.9	38.5
United States	0.9	1.6	1.8	0.7	0.1	0.4	0.8	4.0	17.4	28.1	46.5
World Total	**243**	**295**	**324**	**317**	**315**	**321**	**328**	**350**	**385**	**420**	**471**
APEC Share. %	**39.6**	**38.0**	**36.2**	**35.3**	**35.8**	**36.6**	**40.0**	**44.1**	**48.8**	**51.5**	**55.4**

Source: CEDIGAZ, 2020.

Table A-12 APEC natural gas (pipeline) exports. 2009-2019 (bcm)

Economy	APEC Natural Gas (pipeline) Exports (bcm)										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
APEC Total	**325**	**331**	**357**	**331**	**340**	**309**	**318**	**347**	**378**	**388**	**390**
Canada	92	92	88	84	79	75	74	82	84	80	76
Indonesia	8	10	10	11	10	10	9	9	9	9	9
Malaysia	1.3	1.5		1.6	2.3	1.8	1.6	1.7	1.5	1.5	1.5
Mexico	0.8	0.9	0.1								
Russia	193	196	218	190	205	180	184	194	214	226	224
United States	29	30	41	45	44	42	50	60	70	72	80
World Total	**651**	**688**	**705**	**700**	**720**	**686**	**709**	**753**	**819**	**835**	**849**
APEC Share, %	**49.9**	**48.1**	**50.6**	**47.3**	**47.2**	**45.1**	**44.9**	**46.1**	**46.2**	**46.5**	**46.0**

Source: CEDIGAZ, 2020.

Table A-13 Gas prices. 2015-2021 (USD per MMBtu)

Year	Month	Japan LNG spot	Japan LNG (average)	Henry Hub	TTF
2015	1	10.20	16.19	2.99	6.73
2015	2	7.60	14.20	2.87	7.43
2015	3	8.00	13.04	2.83	6.92
2015	4	7.60	10.94	2.61	6.98
2015	5	-	9.34	2.85	6.73
2015	6	7.60	9.19	2.78	6.74
2015	7	7.90	9.50	2.84	6.74
2015	8	8.10	9.82	2.77	6.41
2015	9	7.40	10.31	2.66	6.31
2015	10	7.60	10.11	2.34	5.96
2015	11	7.40	9.52	2.09	5.36
2015	12	7.40	9.08	1.93	4.98
2016	1	7.10	8.40	2.28	4.38
2016	2	6.50	8.56	1.99	4.01
2016	3	-	7.74	1.73	4.00
2016	4	4.20	6.83	1.92	3.97
2016	5	4.10	6.27	1.92	4.30
2016	6	-	6.40	2.59	4.75
2016	7	5.80	6.76	2.82	4.59
2016	8	-	7.14	2.82	3.92
2016	9	5.70	7.54	2.99	3.98
2016	10	6.10	7.65	2.98	5.09
2016	11	7.00	7.59	2.55	5.70
2016	12	8.00	7.59	3.59	5.50
2017	1	8.40	8.04	3.30	6.25
2017	2	8.50	8.42	2.85	6.19
2017	3	6.10	8.25	2.88	4.97
2017	4	5.70	8.76	3.10	5.05
2017	5	5.70	9.10	3.15	5.07
2017	6	-	8.88	2.98	4.95
2017	7	5.60	8.86	2.98	5.08
2017	8	5.80	8.92	2.90	5.51
2017	9	6.90	8.64	2.98	5.97
2017	10	8.20	8.31	2.88	5.85
2017	11	9.00	8.45	3.01	6.66
2017	12	10.20	8.65	2.82	7.20
2018	1	11.00	9.34	3.87	6.69
2018	2	10.60	9.83	2.67	7.24

Year	Month	Japan LNG spot	Japan LNG (average)	Henry Hub	TTF
2018	3	8.80	10.11	2.69	8.68
2018	4	9.10	10.09	2.80	7.02
2018	5	8.20	10.25	2.80	7.43
2018	6	9.30	10.44	2.97	7.52
2018	7	10.00	10.44	2.83	7.59
2018	8	10.70	10.88	2.96	8.00
2018	9	10.60	11.30	3.00	9.49
2018	10	10.70	11.66	3.28	8.67
2018	11	10.80	11.70	4.09	8.17
2018	12	9.20	12.00	4.04	7.94
2019	1	8.20	12.01	3.11	7.22
2019	2	8.10	11.87	2.69	6.04
2019	3	6.40	11.29	2.95	5.21
2019	4	5.20	10.27	2.65	4.99
2019	5	5.40	10.15	2.64	4.42
2019	6	5.50	10.04	2.40	3.44
2019	7	4.70	10.13	2.37	3.58
2019	8	5.30	10.86	2.22	3.31
2019	9	5.40	10.14	2.56	3.10
2019	10	5.50	9.98	2.33	3.33
2019	11	-	10.04	2.65	4.63
2019	12	6.40	10.06	2.22	4.28
2020	1	5.90	9.89	2.02	3.65
2020	2	3.40	9.89	1.91	2.96
2020	3	3.40	10.21	1.79	2.79
2020	4	2.40	10.01	1.74	2.10
2020	5	2.20	10.08	1.75	1.45
2020	6	3.80	8.97	1.63	1.62
2020	7	4.20	7.79	1.77	1.66
2020	8	3.40	6.34	2.30	2.52
2020	9	4.50	5.88	1.92	3.82
2020	10	6.00	6.18	2.39	4.76
2020	11	6.80	6.86	2.61	4.76
2020	12	7.40	6.91	2.59	5.74
2021	1	18.50	7.75	2.71	7.26

Sources: Ministry of Finance of Japan, Agency of Natural Resources of Energy of Japan, U.S. Energy Information Administration, Intercontinental Exchange, 2021.