



ENERGYQUEST



Domestic Gas Market Interventions International Experience - 2020 Update

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1. Key Points

- This report reviews government interventions in the formation of domestic wholesale gas prices in 20 countries, that in 2020 produced 74 per cent of the world's natural gas.
- The international experience provides useful indicators for Australian policy. International experience is that government interventions to reduce domestic wholesale gas prices are often unsustainable, and have numerous negative side-effects in terms of economic, energy and environmental policy.

Developed countries

- Of the five developed OECD countries reviewed, none have made material use of government interventions in their gas markets.
- The U.S. and Canadian export controls have not been used in practice to restrict gas exports. The U.S. has a total LNG export capacity in operation, or under construction, of 114 Mtpa, with a further 22.4 Mtpa approved, but yet to reach Final Investment Decision (FID) (EIA, 2020). This will be the largest national LNG export capacity in the world. Canada has been exporting gas to the U.S. for almost 60 years, and has approved 26 licences to export gas and propane, including up to 40 Mtpa of LNG.

Developing countries

- Of the 15 developing countries reviewed, seven were net exporters of gas (Qatar, Oman, Egypt, Algeria, Russia, Peru and Malaysia), and eight were net importers of gas (United Arab Emirates (UAE), Brazil, Argentina, Mexico, China, India, Indonesia and Thailand).
- Governments in these 15 developing countries, all intervene in domestic price setting for natural gas.
- While these policies may produce low headline domestic prices, the experience is that they artificially stimulate demand and tend to restrict supply, leading to gas shortages and imports of gas from other countries at higher prices. There is little incentive for energy efficiency and often governments must decide on the allocation of scarce gas to particular industries, picking winners on political grounds.
- The regulatory policies are often associated with government ownership, or control of downstream industries, and controls on exports to avoid leakage of the subsidies provided by regulated gas prices.
- Many of these countries are experiencing upward pressure on domestic gas prices, in some cases to import parity. However, it is typically politically difficult to increase prices once they are regulated.
- Regulation does not necessarily produce low gas prices in these countries. According to the International Gas Union (IGU) survey of wholesale gas prices in 2019 (IGU, 2020), five of the countries reviewed in this report (Brazil, China, India, Malaysia and Thailand) had higher average gas prices than Australia.
- The other ten countries (Qatar, UAE, Algeria, Egypt, Mexico, Argentina, Peru, Oman, Indonesia and Russia) have particularly low prices due to tight regulations and government intervention.
- Peru is the only country identified that exports gas and has domestic gas reservation. Investment in exploration has collapsed in recent years and raises doubts about the country's ability to replace reserves in the medium to long term.



2. Summary

This report reviews government interventions in the formation of domestic wholesale gas prices in 20 countries, that in 2020 produced 74 per cent of the world's natural gas.

Government intervention most commonly takes the form of price regulation, often combined with government monopoly provision but there is also some quarantining of acreage for domestic use and/or export controls.

Developed OECD Countries (U.S., Canada, Netherlands, Norway and UK)

- Of the developed OECD countries reviewed, none have government intervention, except for export approval requirements in the case of the U.S. and Canada. Otherwise the U.S. and Canada have free markets, which have facilitated the phenomenal growth of shale gas and produced sustainably low gas prices.
- The U.S. and Canadian export controls have not been used in practice to restrict gas exports. The U.S. has a total LNG export capacity in operation, or under construction, of 114 Mtpa, with a further 22.4 Mtpa approved, but yet to reach Final Investment Decision (FID) (EIA, 2020). This will be the largest national LNG export capacity in the world. Canada has been exporting gas to the U.S. for almost 60 years, and has approved 26 licences to export gas and propane, including up to 40 Mtpa of LNG.
- Norway is the largest European gas producer. Most of Norway's gas is exported. Norway has not encouraged through policy interventions gas intensive industry, but rather has leveraged its strength in oil and gas to develop an internationally competitive oil and gas services industry.
- Neither the Netherlands nor the UK, the other two significant European gas producers, have domestic gas policies to favour local industry, even though they are now moving from being large exporters of gas to net importers.
- Overall the developed OECD countries have sustainable gas prices, avoid gas shortages and are able to meet high environmental standards in gas development and use.

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- The other ten countries (Qatar, UAE, Algeria, Egypt, Mexico, Argentina, Peru, Oman, Indonesia and Russia) have particularly low prices due to tight regulations and government intervention.
- Many of the countries with heavily regulated gas prices need to import gas or consider developing other expensive forms of energy. They then have the challenge of reconciling expensive imports with low regulated domestic gas prices and under investment in gas exploration and development. Examples include:
 - Indonesia buys gas from its own LNG plants at high prices.
 - Thailand, Malaysia, Argentina, Mexico, India and China, import LNG.



E N E R G Y Q U E S T

- The UAE imports pipeline gas (from Qatar) and LNG, and is building nuclear power generation.

Russia

- In Russia, there is a high level of government intervention, ownership and control of the whole petroleum industry. State-run Gazprom has dominated the gas industry in the post-Soviet era, but competitors such as Rosneft and Novatek have become increasingly significant since 2013. Gazprom sells gas at low, regulated prices to residential and industrial customers and provides subsidised gas to countries in the former Soviet Union (FSU). Gazprom effectively subsidises the industrial economy and households with gas inherited from the Soviet Union, which it funds by having the exclusive right to export gas by pipeline to premium markets in Europe. Cross subsidies are under threat from Gazprom's weakening market power in Europe.

Asia

- China is the largest energy consumer in the world. Gas demand has rapidly overtaken domestic production, leading to the first imports of LNG in 2006 and pipeline imports from 2010, including the first gas from Russia in 2019. China is on the cusp of becoming the world's largest importer of LNG. The government has taken steps towards market based pricing, but gas prices are still regulated. Prices are not particularly low (higher than Australia's) because imported gas has incurred heavy losses for China's state-owned oil companies, even with tax subsidies.
- India has an elaborate system of regulated subsidised prices and government allocation of gas, with shortages and misallocation of resources. It is increasingly a gas importer and has to reconcile low regulated prices with expensive imports. The high level of regulation makes India challenging for foreign investment.

Middle-East and North Africa (MENA)

- MENA countries have particularly low gas prices, but due to regulation rather than market forces. Gas prices are kept low as a form of economic redistribution to the population. Gas shortages are common and/or there are problems of keeping up with demand. LNG exports may be cut to meet domestic demand, and there is little incentive for energy efficiency, with the result that the economic value of their gas resources is not necessarily maximised. Low domestic gas prices are a barrier to attracting foreign capital investment due to the lower returns, and perceived associated sovereign risks.
- Algeria has some of the world's cheapest gas prices, below the marginal cost of production. Production declined in 2019, but there was no easing of the strong growth in domestic consumption that has characterised the past decade. Notwithstanding its low energy prices, Algeria ranks in the fourth quintile for competitiveness of its economy, and attracting foreign investment is a challenge.
- Egypt has historically subsidised domestic gas prices together with other forms of energy and even food. These subsidies are a major drain on the state budget, and triggered necessary gas market reforms which have rejuvenated Egypt's gas industry. Prices are still regulated for large volumes of production, but rapid progress is being made towards a liberalised market in which private companies can market and sell their own gas. An increase in gas prices in 2014 attracted new exploration investment from international oil companies and preceded a wave of major offshore discoveries, including the super-giant Zohr field, which moved quickly into production by 2017. Subsidies for energy consumption (liquid fuels, electricity and gas) are being reduced or eliminated, which is containing growth in gas demand and contributing towards a return to significant gas exports.



E N E R G Y Q U E S T

- Oman's wholesale gas prices have increased from below the cost of production at about US\$1.50/MMBtu in 2013 to US\$3.39/MMBtu in 2019. This has encouraged foreign investors, who have also been attracted by multi-Tcf onshore gas discoveries. A combination of improved prices and favourable geology has reversed shortages of gas created by low regulated prices and allowed Oman to encourage gas-intensive industries.
- Qatar is one of the world's major oil and gas producers. It has the third largest gas reserves and is the second-biggest LNG producer. Qatar Petroleum (QP), the government owned national oil company dominates all aspects of petroleum (including downstream industries), but is market-oriented. Most gas is exported as LNG but Qatar does also use low domestic prices (set by QP at amongst the lowest in the world) to develop gas intensive industries. With a small population and huge oil and gas reserves, Qatar is an exception to the general pattern in other MENA countries, having so far been able to pursue a strategy of large scale LNG production, low domestic gas prices and development of energy-intensive industry without the problems that have afflicted many other countries.
- The UAE has the world's ninth largest gas reserves and relatively small LNG exports but is a net gas importer due to rapid economic growth and very low energy prices. Wholesale gas prices, which are around US\$2.50/MMBtu, have been at or below the cost of production for many years. Regulated electricity tariffs are also very low, stimulating consumption. Development of new gas projects has not been able to keep up with domestic gas demand, but the UAE is investing heavily in nuclear power, clean coal and large scale solar to replace domestic gas demand for generation.

South-East Asia

- Indonesia was the world's largest LNG exporter until 2005, but since 2006 the government has prioritised domestic needs over exports. LNG exports have fallen sharply. Production has been in an accelerating decline over the past decade, but consumption has been flat and there is still a significant (although shrinking) gas surplus. Gas prices are regulated but were brought up to import parity a few years ago. The government of Indonesia is now seeking to discount gas prices once again to boost economic activity. Overall domestic gas policy in Indonesia, combined with a high level of regulatory uncertainty, is creating a drought of foreign investment. Ageing fields are in decline, and state-owned Pertamina is being forced to take over a growing number of expired production sharing contracts.
- Malaysia is a major gas producer and exporter. It has a history of low regulated prices for almost 20 years, which boosted demand from the power sector and industry, creating a hefty subsidy cost and discouraging exploration and development by international oil companies. Malaysia has gas shortages in Peninsular Malaysia that necessitate imports of pipeline gas and LNG. It is making slow progress towards liberalising its gas market to address the issues of low domestic prices, and a lack of competition. Prices are now higher than Australia's. A new system of third party infrastructure access, which underwent a trial phase in 2019, will allow new market players to import and supply liquefied natural gas (LNG) using existing facilities.
- Thailand has a long history as a gas producer, but reserves have been depleted by a lack of exploration and development over the past decade and a heavy reliance on gas to generate electricity for a rapidly expanding economy. National oil company PTT controls the price of all gas and implements a regulated gas price. Gas prices are relatively high (higher than Australia's) by the standards of other countries, but the PTT monopoly prevents price competition and does not allow the most effective allocation of resources.



Central and South America

- Mexico has a substantial degree of intervention in the oil and gas sector generally. The linking of Mexican gas prices to U.S. gas prices is effectively a form of price control. The lower U.S. based gas price is encouraging demand and discouraging supply in Mexico. Gas consumption is rising strongly, with the widening gap between domestic consumption and demand largely met by U.S. producers, who now account for almost two-thirds of Mexico's gas supply.
- Argentina is a large gas producer but has also imports pipeline gas and LNG. Prices are heavily regulated and are set below cost, which has discouraged investment in exploration and led to growth in consumption. The country has very large shale gas resources, but growth in production was affected by a gas price freeze in 2019 and an economic recession, even before the arrival of COVID-19. The country is unable to raise funding to develop its shale gas as the basis of a return to large-scale gas exports. Domestic gas market intervention has led to gas shortages and resource misallocation.
- Brazilian gas use is low in international terms, but the country is still a significant importer of gas by pipeline from Bolivia and via LNG. The volume of LNG imports is falling, reflecting a decline in consumption since 2015. Wholesale gas prices are relatively high, due in part to a near-monopoly held by Petrobras. The country's anti-trust regulator ruled in 2019 that Petrobras must divest its natural gas pipeline and distribution assets by the end of 2021, which will increase competition and is likely to reduce prices. Government policy is to encourage greater use of gas, which is being affected by steps to increase competition and price transparency. Brazil does not have a domestic reservation policy.
- Peru commissioned South America's first and (so far) only LNG plant in 2010 to capitalise on the discovery of the giant Camisea field in the Amazon. Camisea also spurred rapid growth in domestic gas consumption in power generation and the mining industry, which has boomed in Peru. Protests in 2010 led the government to reserve part of the Camisea's gas for the domestic market. Gas use is encouraged by low, regulated prices. The country continues to enjoy a large surplus of production over consumption, but investment in exploration has collapsed in recent years and raises doubts about the country's ability to replace reserves in the medium to long term. A multi-billion dollar pipeline project to deliver Camisea gas reserved by the government to households, the electricity sector and industry in the south of Peru stalled mid-construction in 2015, which has alleviated pressure on reserves.
- Overall, the non-OECD countries typically have significant government control over domestic gas prices. In many countries the low regulated prices are not sustainable, under pressure from strong demand, rising costs and the need to import expensive gas to meet gas shortages. Low prices generally deter foreign investment or strain government budgets and discourage efficient energy use. Despite low energy costs, a number of these countries also rate poorly in the competitiveness of their economies.
- As the IEA, OPEC, OECD and World Bank (2010) note in a joint report to the 2010 meeting of the G-20:

"Energy subsidies could create distortive price signals and result in higher energy consumption or production, or barriers to entry for cleaner energy services. Subsidies to consumption, by lowering end-use prices, can encourage increased energy use and reduce incentives to conserve energy efficiently. Thus, Former Soviet Union (FSU) countries, where electricity prices are much lower than their cost, are characterized by very high consumption per capita and lowest energy efficiency...Energy subsidies can put societies onto inefficient consumption and production paths. Fossil-fuel subsidies to consumers can create dependencies and discourage users from shifting



to cleaner sources of energy. Similarly, subsidies to specific energy technologies undermine the development and commercialization of other technologies that might ultimately become more economically (as well as environmentally) attractive. As such, subsidies can —lock-in technologies to the exclusion of other, more promising ones.”

3. Background

In 2013 EnergyQuest prepared an independent, high-level report for the Australian Petroleum Production and Exploration Association (APPEA) on major government wholesale domestic gas market interventions internationally. The most common forms of intervention are controls over gas prices, subsidies and government monopoly provisions, but may also include volume reservation, quarantining of acreage and export controls. This report updates the original report to 2020.

The focus of this report is on major gas-producing countries, which in aggregate produced 72 per cent of global gas production in 2019 (BP, 2020).

- North America: Canada, Mexico, United States
- Europe: Netherlands, Norway, United Kingdom
- Russia
- Asia: China, India
- Middle East /North Africa: Algeria, Egypt, Oman, Qatar, the United Arab Emirates (UAE)
- South East Asia: Indonesia, Malaysia, Thailand
- Central and South America: Argentina, Brazil, Mexico, Peru

The report draws on reports of the International Gas Union (IGU), the US Energy Information Administration (EIA), the International Energy Agency (IEA) and research published by the Oxford Institute for Energy Studies (OIES). The OIES in particular is the leading global research centre studying international gas markets and policy. We have also drawn on the CIA Factbook for an economic snapshot of each country, the BP Statistical Workbook, the EIA Country Profiles, World Economic Forum’s ranking of country competitiveness and the Fraser Institute’s ranking of attractiveness for petroleum investment. Numerous other sources have also been used and are cited in the references.

4. Introduction

The size and nature of any country’s gas sector depends on a range of factors including the natural endowment of gas and other fuels, the size and nature of energy demand (both local and export), the ability of a country to mobilise investment to develop energy resources and government policy.

Government energy policies generally reflect the type of government: democratic or not, free market or not. Where a country sits in the economic development ranking is also relevant.

Energy policies usually reflect a number of objectives including energy security, energy affordability, economic development, income redistribution, environment and safety.

The degree to which these goals form part of the energy policy mix varies between countries. For example, income redistribution is often a goal of energy policy in emerging economies. In Australia it is generally accepted that the taxation and social security systems are the most efficient means of achieving distributional objectives.



Similarly, in some countries governments seek to achieve their energy and other objectives through government ownership, regulation and control. However, since the 1980s, developed OECD countries like Australia have placed greater reliance on the market to provide an optimum economic outcome, particularly in terms of economic development, but with regulation in areas of market failure, including prevention of adverse environmental impacts.

In many other countries government ownership of all aspects of energy production is the norm, including exploration and production, refining, LNG processing, downstream energy intensive industries and electricity generation and distribution.

Environment is an area of important difference between emerging and developed OECD economies. Some emerging economies encourage consumption of fossil fuels through subsidising energy prices. Some OECD economies actively discourage fossil fuel consumption to limit greenhouse gas emissions.

While fossil fuels are increasingly taxed in OECD economies, they are often subsidised in emerging economies, either directly from government budgets or indirectly through national oil companies. Subsidies for transport fuel are widespread, but gas and electricity are often also subsidised for economic development and distributional reasons. Of the countries surveyed here, natural gas consumption was subsidised in 2019 in Argentina (US\$1.0 billion), Algeria (US\$2.3 billion), Egypt (US\$0.4 billion), India (US\$0.9 billion), Russia (US\$10.4 billion) and the UAE (US\$5.0 billion)¹.

Energy policies also vary depending on the size and nature of a country and its economy. The policies that are most appropriate in, for example, Qatar, a country of 2.8 million people with a single resource, are likely to be different from those most appropriate in a large, developed, economically diverse OECD country.

There are also important differences between OECD countries that affect energy policies. For example, large economies like the United States and the European Union (EU) with large internal markets are less reliant on free trade than a smaller economy like Australia, which is highly dependent on its ability to trade with other countries. Australia has long been an advocate of free trade internationally, both as an exporter and as an importer, significantly reducing protection since the 1970s. In most cases Australian exports do not require government approval and Australia is open to foreign investment, which is necessary in a country like Australia with a comparatively small population.

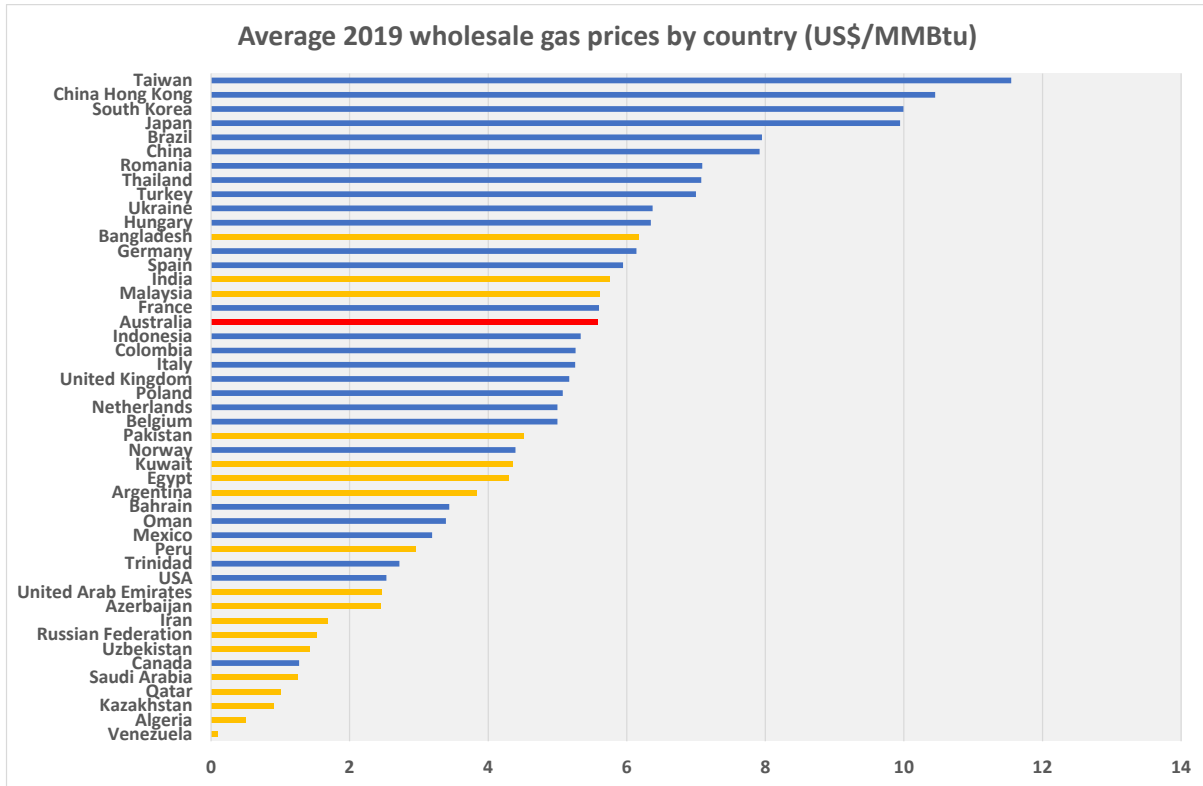
Australian pro-market and pro-trade reforms over the last thirty years have underpinned strong economic growth and rising living standards, particularly in a country of high costs requiring high environmental standards of new developments.

Discussions about government domestic gas policies are essentially about price. Wholesale gas prices vary significantly between countries. Figure 1 shows average 2019 gas prices for a range of countries surveyed by the IGU. These are average prices, not the prices for new contracts. In many countries, including many south-east Asian countries, prices under new contracts are considerably higher. The orange bars denote countries where natural gas prices are subsidised by government, based on the IEA database of fossil fuel subsidies for gas consumption (IEA, 2020), or provided below cost (e.g. Qatar) or heavily regulated (e.g. Peru). Very low gas prices often reflect subsidisation or regulation and are unsustainable, economically inefficient and poor outcomes environmentally.

¹IEA (2020)



Figure 1 Average 2019 wholesale gas prices by country US\$/MMBtu



Source: IGU (2020), EnergyQuest research.

The 2013 report contained a similar table, based on 2010 prices. Those that have moved up the table ranking are: Taiwan, Brazil, China, Romania, Thailand, Ukraine, Bangladesh, India, Malaysia, Australia, Indonesia, Pakistan, Kuwait, Egypt, Argentina, Bahrain, Oman, UAE and Iran. Other countries that have moved up the ranking and still subsidise gas are: Bangladesh, India, Pakistan, Kuwait, Egypt, Argentina, UAE and Iran. The relative increase in prices most likely reflects reductions in subsidies. Those that have moved down are: Japan, Turkey, Hungary, Germany, Spain, France, Italy, UK, Poland, Netherlands, Belgium, Mexico, USA, Azerbaijan, Russia, Uzbekistan, Canada and Venezuela. This includes nine countries in Europe with a liberalised gas market and the three countries in North America with a free market and benefitting from the shale gas revolution.

Allsopp and Stern (2012) note that with the growth in international gas trade, many countries and regions are facing increasing tensions between the domestic and international pricing of gas. They note that for economic efficiency, gas prices 'should' reflect opportunity costs at the margin. In gas markets not open to international trade the gas price should equal the long run marginal cost of producing additional gas (including an allowance for depletion or scarcity rent). For countries that engage in international trade, the opportunity cost is the price that can be obtained from additional exports, or the price that must be paid for additional imports (export or import parity).

Government interventions to reduce prices below cost in markets not open to trade or below import or export parity prices in importing or exporting countries respectively effectively create subsidies for domestic consumers (IEA, OPEC, OECD, World Bank, 2010).

Natural gas is a non-renewable resource and subsidising current consumption is not the most economically efficient or prudent means of maximising the value of such a resource for a country. The government fiscal system is likely to be a more efficient way of capturing and efficiently using



resource rents. Energy subsidies favour particular consumers and particular industries (indiscriminately picking winners) while the government fiscal system is better at targeting distribution of benefits, whether it might be through the tax system generally or assistance to particular industries, which might be gas-users or might be completely different industries.

Subsidies can be sustained for longer in some countries, particularly countries with small populations and wealth from significant petroleum production, and may be a means of redistributing wealth to the population. Other countries with large populations (e.g. Egypt) have tried to simultaneously build an LNG industry, subsidise gas and electricity for industry and households and develop energy intensive industries like petrochemicals. This is generally unsustainable and leads to domestic gas shortages and reductions in LNG exports.

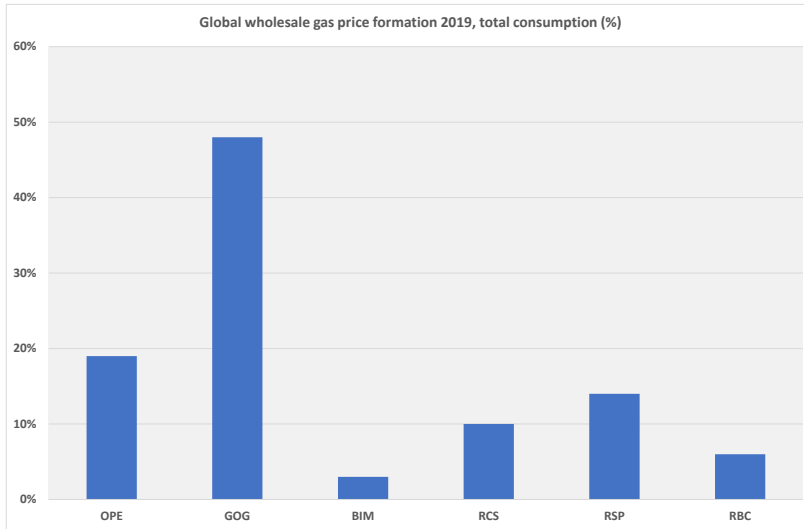
In the U.S. on the other hand high, domestic gas prices stimulated the shale gas revolution.

The IGU (2020) has done pioneering research into the basis for wholesale gas prices in different countries. This work identifies seven categories of wholesale gas price formation:

- Oil Price Escalation (OPE): The price is linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil and/or fuel oil. In some cases coal prices can be used as can electricity prices.
- Gas-on-Gas Competition (GOG): The price is determined by the interplay of supply and demand – gas-on-gas competition – and is traded over a variety of different periods (daily, monthly, annually or other periods). Trading takes place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK). There are likely to be developed futures markets (NYMEX or ICE). Not all gas is bought and sold on a short term fixed price basis, and there will be longer term contracts but these will use gas price indices to determine the monthly price, for example, rather than competing fuel indices. Spot LNG is also included in this category.
- Bilateral Monopoly (BIM): The price is determined by bilateral discussions and agreements between a large seller and a large buyer, with the price being fixed for a period of time – typically this would be one year. There may be a written contract in place but often the arrangement is at the government or state-owned company level.
- Netback from Final Product (NET): The price received by the gas supplier is a function of the price received by the buyer for the final product the buyer produces. This may occur where the gas is used as a feedstock in chemical plants, such as ammonia or methanol, and is the major variable cost in producing the product.
- Regulation: Cost of Service (RCS): The price is determined, or approved, by a regulatory authority, or possibly a Ministry, but the level is set to cover the “cost of service”, including the recovery of investment and a reasonable rate of return.
- Regulation: Social and Political (RSP): The price is set, on an irregular basis, probably by a Ministry, on a political/social basis, in response to the need to cover increasing costs, or possibly as a revenue raising exercise.
- Regulation: Below Cost (RBC): The price is knowingly set below the average cost of producing and transporting the gas often as a form of state subsidy to its population.

Figure 2 shows the incidence of different types of gas price formation globally. Gas-on-gas competition is most common, followed by oil price escalation but 29 per cent of gas is consumed at regulated wholesale prices.

Figure 2 Global wholesale gas price formation 2019

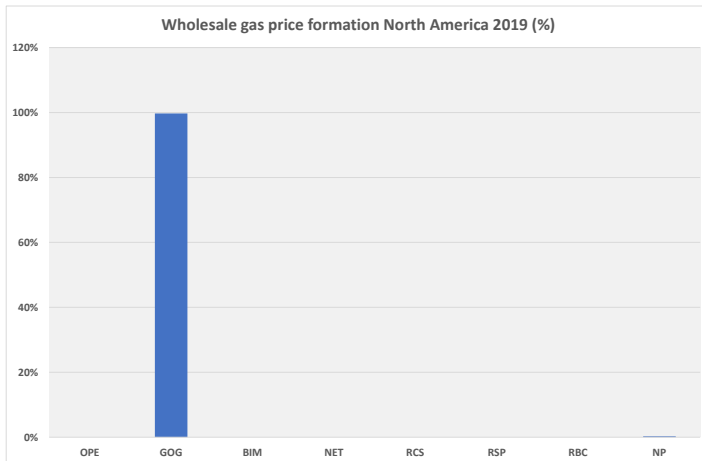


Source: IGU (2020)

5. North America

Unlike many countries, wholesale gas prices in the United States result from gas-on gas competition rather than regulation (Figure 3).

Figure 3 Wholesale gas price formation North America 2019

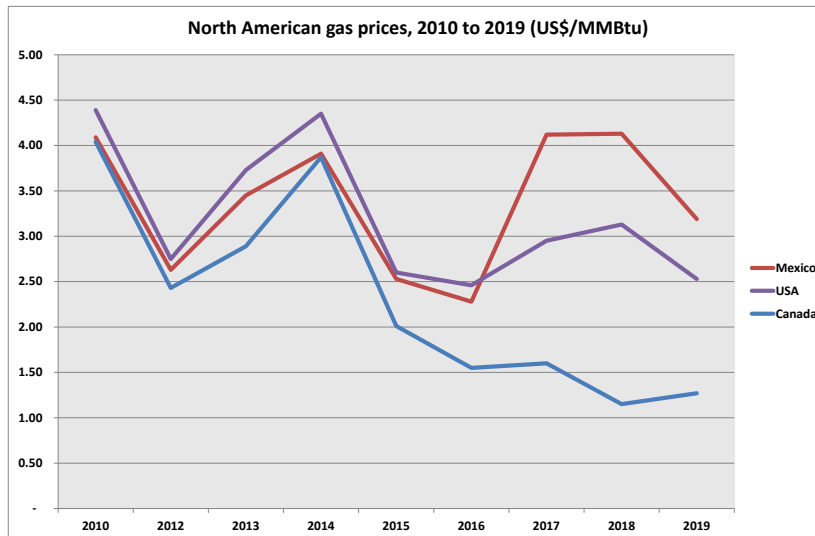


Source: IGU (2020)

Prices in Canada and Mexico are heavily influenced by U.S. prices (Figure 4). Canadian prices are now significantly lower than US prices due to the growth in US shale gas production and export pipeline infrastructure constraints. Mexican prices increased relative to Henry Hub in 2017. Mexico converted to a liberalised natural gas market on 1 July 2017 and the cap on prices PEMEX could charge for natural gas was removed.



Figure 4 North American gas prices, 2010 to 2019 (US\$/MMBtu)



Source: IGU (2020)

The United States

Main points

- The U.S. is the world's largest gas producer. It became a net exporter of gas as recently as 2017 and is already the world's third largest exporter of LNG, behind Australia and Qatar.
- Wholesale gas prices are set by the market.
- U.S. gas reserves and production have grown rapidly based on a revolution in shale gas production technology. As a result, U.S. gas prices fell in the decade beginning in 2008 from around US\$9/MMBtu to below US\$4/MMBtu, and have subsequently reached below US\$2.50/MMBtu.
- The U.S. has total LNG capacity in operation or under construction of 114 Mtpa, with a further 22.4 Mtpa approved but yet to reach FID (EIA, 2020).
- The U.S. has Free Trade Agreements (FTAs) with 20 countries (Office of the US Trade Representative, 2020) including Canada, Mexico, Australia and Korea, the world's third largest LNG importer.
- The only market intervention with domestic implications is that projects planning export to non-FTA countries require export approval. Exports of gas to, and imports of gas from countries without an FTA with the U.S. are permitted provided they are not inconsistent with the public interest.
- As of August 2020, the DOE had issued 43 long-term non-FTA authorisations to export domestically produced gas from the lower-48 states—each with an export term of 20 years. These authorisations had a total volume of 46 Bcf/d or about 16.7 Tcf per year.



Economy

According to the CIA Fact Book (CIA), the U.S. has a population of 333 million (July 2020 estimate). Gross Domestic Product (GDP) is US\$19.5 trillion (2017 estimate) and GDP per capita is US\$59,800, ranking 19 in the world.

The U.S. ranks highly at 2 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

The U.S. is the second largest energy consumer in the world, ranking behind China but well ahead of India and Russia (BP, 2020). It ranks third globally in oil production and ninth in proven reserves. The U.S. is the world's largest gas producer and has proven gas reserves of 455 Tcf (ranking fifth globally). Proven reserves are equivalent to 14 years of production, based on 2019 production of 32.5 Tcf. The U.S. has had a good average rate of proven reserves replacement of 176 per cent over the past decade.

Gas comprises 32 per cent of primary energy consumption. Gas consumption is 30 Tcf. The U.S. is at the centre of the highly liquid North American gas market and trades large volumes of gas with Canada and Mexico. It did not become a net exporter of gas until 2017, but exports are rising sharply with the growth of volumes to Mexico by pipeline and the start-up of a number of LNG export terminals. In 2019, the US exported a total of 4.3 Tcf, up from 3.4 Tcf in 2018. Total imports in 2019 were 2.6 Tcf, with 98 per cent of imports via pipeline from Canada and the balance of 0.05 Tcf (1 Mt) as LNG.

Sector organisation

The U.S. gas supply sector is essentially a free market, with numerous buyers and sellers. Gas producers and marketers are not directly regulated. Gas prices at the wellhead were deregulated in 1989. In 1992 the transmission and merchant services of pipelines were unbundled. Interstate pipeline companies are regulated in the rates they charge, the access they offer for their pipelines, and the siting and construction of new pipelines. Local distribution companies are regulated by state utility commissions, which oversee their rates, construction issues, and ensure proper procedure exists for maintaining adequate supply to their customers.

The growth in unconventional gas in the United States has been facilitated by the free market.

The United States is generally open to foreign investment and it is generally an attractive place for oil and gas investment.

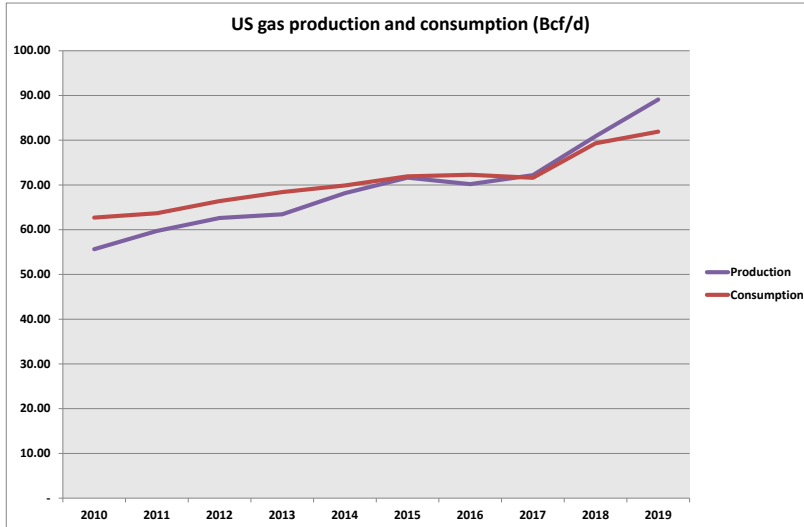
The U.S. was ranked at the top of the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

U.S. gas production has grown strongly over the past decade due to the shale gas boom (Figure 5). Consumption has also increased. In particular gas-fired generation has become competitive and low gas prices have revived energy-intensive industries such as petrochemicals.

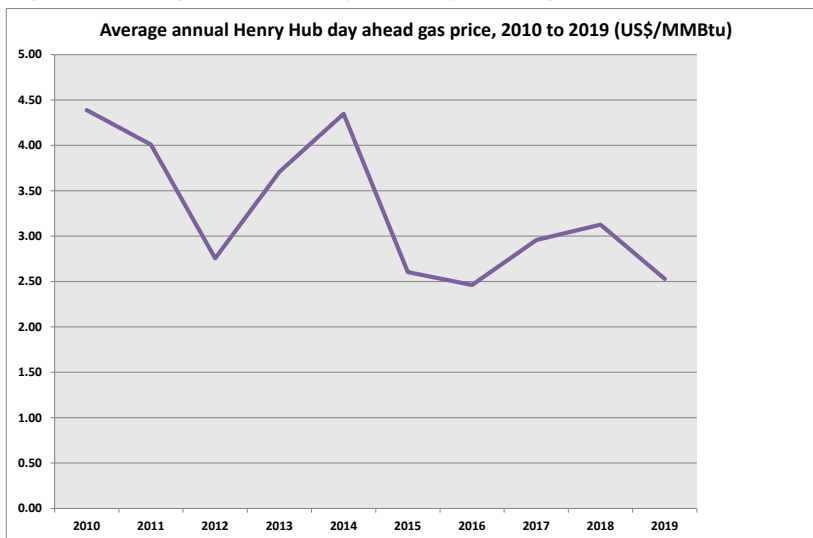
Figure 6 shows average annual U.S. Henry Hub gas prices from 2010 to 2019. The average annual price fell from US\$4.37/MMBtu in 2010 to US\$2.56/MMBtu in 2019. Prices fell sharply through the first half of 2020 as a result of the global demand shock from measures to slow the spread of COVID-19, which came on top of seasonally weak gas demand in 2019. The Henry Hub price hit a 20-year low of US\$1.38/MMBtu in June, but had recovered to US\$2.75/MMBtu in October.

Figure 5 US gas production and consumption (Bcf/d)



Source: (BP, 2020)

Figure 6 Average annual Henry Hub day ahead gas price, 2010 to 2019



Source: BP (2020)

Policy issues

The U.S. gas industry was highly regulated from the 1930s to the 1980s. Wellhead gas prices were deregulated in 1989. Transmission pipeline services were unbundled in 1992, with regulation remaining on tariffs and access.

In 1992 Congress deemed that exports to countries with which the U.S. has an FTA “shall be deemed to be consistent with the public interest and applications for such importation or exportation shall be granted without modification or delay.” (USC, 2011). The U.S. has FTAs with 20 countries, 11 of which are in Central and South America. This was to bring the U.S. into line with the provisions of the North America Free Trade Agreement (NAFTA) providing for gas imports from Canada and exports of



significant volumes of pipeline gas to Mexico. NAFTA was superseded by the United States-Mexico-Canada Agreement (USMCA) in March 2020. The agreement protects oil, gas and refined products from the imposition of tariffs, which had become a source of anxiety for producers after the U.S. in 2019 imposed tariffs on structural steel from Mexico.

The only current market intervention with domestic implications is that projects planning export to non-FTA countries require export approval. Current restrictions on U.S. LNG exports appear to be an historical hangover. Under provisions first enshrined in the National Gas Act 1938, it is illegal to export or import gas without a permit from the DOE. A permit is to be issued “unless the proposed exportation or importation will not be consistent with the public interest” (USC, 2011). The criteria for determining public interest include domestic need for the gas proposed for export, adequacy of domestic supply, U.S. energy security and the impact on the U.S. economy, including the impact on domestic gas prices (US Department of Energy, 2017).

In August 2020, the Department of Energy (DOE) issued a policy statement that extended the term of authorisations to export gas to non-FTA countries (DOE, 2020). Authorisations are now valid until 31 December 2050, replacing a standard term for export licences of 20 years. As of August 2020, DOE had issued 43 long-term non-FTA authorisations to export domestically produced gas from the lower-48 states—each with an export term of 20 years. These authorisations had a total volume of 46 Bcf/d or about 16.7 Tcf per year. The extension of export term to non-FTA countries followed a relaxation of reporting rules in 2018, which means gas exporters need only report the country of delivery, not the country of end use.

The DOE issued a set of Policy Guidelines in 1984 setting out the criteria it employs in evaluating applications (DOE, 2011). The goals of the Policy Guidelines are to minimize federal control and involvement in energy markets and to promote a balanced and mixed energy resource system. The Guidelines provide that “the market, not government, should determine the price and other contract terms of imported (or exported) natural gas. The federal government’s primary responsibility in authorizing imports (or exports) will be to evaluate the need for the gas and whether the import (or export) arrangement will provide the gas on a competitively priced basis for the duration of the contract while minimizing regulatory impediments to a freely operating market”.

The DOE’s review of export applications focuses on the domestic need for the natural gas proposed to be exported, whether the proposed exports pose a threat to the security of domestic natural gas supplies and any other issue determined to be appropriate, including whether the arrangement is consistent with DOE’s policy of promoting competition in the marketplace by allowing commercial parties to freely negotiate their own trade arrangements (DOE, 2011).

Canada

Main points

- Canada is a major gas producer. Proven gas reserves are 70.1 Tcf (ranking 17 globally), equivalent to 11.5 years of production, based on 2019 production of 6.1 Tcf. Gas consumption was 4.2 Tcf in 2019.
- Gas prices are set competitively in the market. The free upstream market has facilitated the development of shale gas, which has ultimately reduced Canadian and U.S. gas prices.
- Canada has been exporting gas to the U.S. for almost 60 years. Exports were a net 1.8 Tcf in 2019. It is due to export its first gas via LNG in 2024.



E N E R G Y Q U E S T

- Canada Energy Regulator (CER) approval is required under section 118 of the National Energy Board Act, to assess export applications on the basis of whether the proposed export volume is surplus to Canadian requirements.
- CER has approved 26 licences for export of gas and propane, including a decision in December 2019 to allow Chevron Canada to increase the volume of gas allowed to be exported from Kitimat LNG from 10 Mtpa over 20 years to about 18 Mtpa over 40 years.

Economy

According to the CIA Factbook (CIA, 2020):

- Canada has a population of 37.7 million (July 2020 estimate). GDP is US\$1.8 trillion (2017 estimate) and GDP per capita is US\$48,400 (2017 estimate), ranking 34 in the world.
- Canada resembles the U.S. in its market-oriented economic system, pattern of production, and high living standards. Since World War II, the growth of the manufacturing, mining, and service sectors has transformed the nation from a largely rural economy into one that is primarily industrial and urban. The 1989 US-Canada Free Trade Agreement (FTA) and the 1994 North American Free Trade Agreement (NAFTA) (which includes Mexico) touched off a dramatic increase in trade and economic integration with the U.S. its principal trading partner.
- Canada ranks highly at 14 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Based on 2019 statistics from BP (BP, 2020), Canada is the sixth largest energy consumer in the world. Energy consumption by fuel type is led by oil (32 per cent), but gas is increasingly important and accounted for 30 per cent of energy consumed in 2019, followed by hydroelectricity (24 per cent), nuclear energy (6 per cent), coal (4 per cent) and renewables (4 per cent).

Canada is a superpower in terms of proven oil reserves, ranking third globally when tar sands are included, and is the world's fourth largest oil producer, behind only the U.S., Russia and Saudi Arabia (BP, 2020). Most of Canada's crude is heavy oil and nearly all of it is sent to the U.S. for refining. Canada's crude oil exports to the US grew strongly between 2010 and 2019 to fill a gap created by declining production from other key sources of heavy crude, namely Venezuela and Mexico. Canada accounted for 48 per cent of U.S. crude oil imports in 2018 (EIA, 2020).

Proven gas reserves are 70.1 Tcf (ranking 17 globally), equivalent to 11.5 years of production, based on 2019 production of 6.1 Tcf. Gas consumption was 4.2 Tcf in 2019. Canada has had an average rate of proven reserves replacement of 106 per cent over the last decade.

Canada has been exporting gas via pipelines to the U.S. for almost 60 years. The country's first exports via LNG are expected in 2024 with the commissioning of the Shell-operated Canada LNG project.

New technology from the U.S. shale gas boom has been used by explorers over the past decade to show the potential to unlock hundreds of Tcfs of unconventional gas in Canada. This was followed by proposals for 18 LNG projects (13 in British Columbia, 2 in Quebec and 2 in Nova Scotia) with a total export capacity of 216 Mtpa. Since 2011, 24 projects have been issued export licences, but only the Shell-operated Canada LNG has achieved FID. More than a dozen LNG projects had been delayed or cancelled even before the COVID-19 pandemic.



Sector organisation

Canada has a privatised oil and gas sector that includes participation of many domestic and international oil companies. The Investment Canada Act stipulates that any large investment in Canada must be of "net benefit" to Canada, indicating possible limits on foreign control of strategic commodities, but actual limits have been infrequent (EIA, 2020).

The U.S. shale oil and gas boom starting in 2008 quickly spilled over to Canada. This attracted an influx of new players and foreign investment in exploration, particularly in the Western Sedimentary Basin.

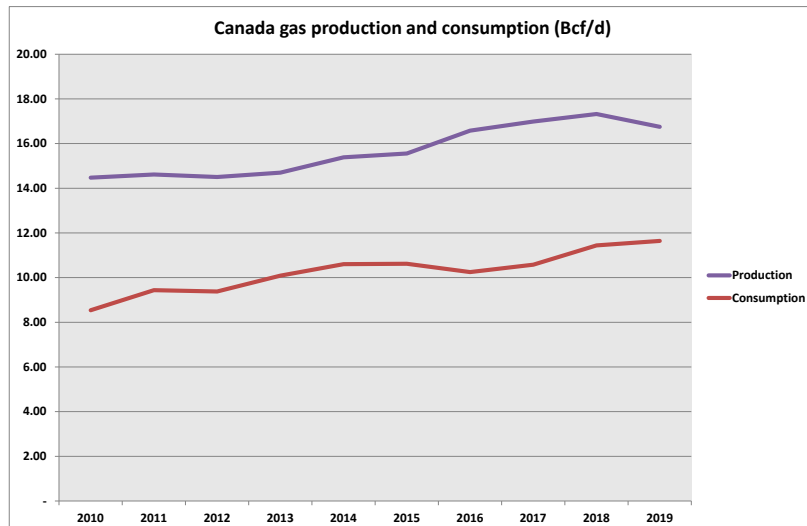
Canada ranks well in the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018), but since that time the imposition of a federal carbon tax (increasing by C\$10/tonne every year to C\$50/tonne by 2022) has led to forecasts of significant exits from Canada's oil and gas industry (Fraser Institute, 2019).

Gas production, consumption and prices

Canada has been a substantial gas exporter for many years as seen in Figure 7. Natural gas exports occur at several major export points along the Canada/U.S. border. The volume exported depends upon market supply and demand as well as available pipeline capacity. Net pipeline exports were 1.8 Tcf in 2019 and have trended downwards from 2.2 Tcf in 2016. Total exports were 2.7 Tcf in 2019. (Canada also imports pipeline gas from the US.)

Figure 7 shows US Henry Hub prices and Alberta spot prices. Canadian wholesale gas prices are set by the market and heavily influenced by U.S. production and prices. Canadian prices are now significantly lower than U.S. prices due to the growth in U.S. shale gas production and export pipeline infrastructure constraints.

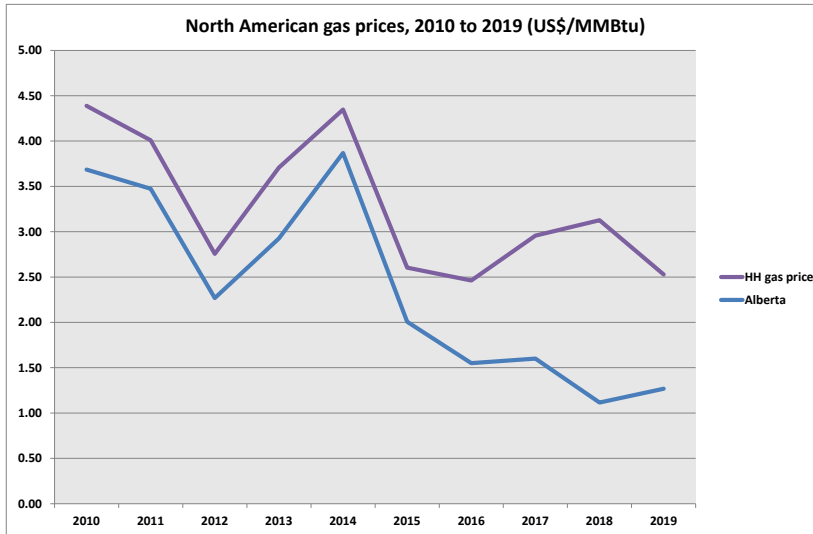
Figure 7 Canada gas production and consumption (Bcf/d)



Source: BP (2020)



Figure 8 U.S. and Canadian gas prices 2010 to 2019



Source: BP (2020)

Policy issues

National regulation of energy projects in Canada was taken over by the CER in August 2019, superseding the National Energy Board. The CER Act emphasises safety and environmental protection, reconciliation with Indigenous peoples and improving Canada’s global competitiveness. CER regulates 73,000 km of pipelines, 85 international power lines, energy exports and imports, oil and gas exploration and drilling in certain northern and offshore areas as well as offshore renewable energy. Provincial bodies also regulate energy, the largest and most influential of which is the Alberta Energy Resources Conservation Board (ERCB).

The only gas market intervention with domestic implications is that export projects require approval. CER approval is required under section 118 of the National Energy Board Act to assess export applications on the basis of whether the proposed export volume is surplus to Canadian requirements. Each application is viewed individually, without taking account of the cumulative total of licenced export volumes. The CER “believes market forces will ultimately determine which proposals move forward. Since deregulation of Canadian gas markets in 1985, gas markets in North America have functioned efficiently and the Board believes they will continue to do so in the future.”

CER has approved 26 licences for export of gas and propane, including a decision in December 2019 to allow Chevron Canada to increase the volume of gas allowed to be exported from Kitimat LNG from 10 Mtpa over 20 years to about 18 Mtpa over 40 years.

Mexico

Main points

- Proven gas reserves were only 6.3 Tcf at the end of 2019, down sharply from 12.5 Tcf at the end of 2009 and 28.4 Tcf at the end of 1999. Domestic gas consumption was 3.2 Tcf in 2019, compared to production of only 1.2 Tcf. Domestic demand was met by imports of 1.8 Tcf by pipeline (entirely from the U.S.) and a further 0.2 Tcf via LNG shipments, mostly from the U.S. (0.14 Tcf).



E N E R G Y Q U E S T

- Mexico generally has a substantial degree of intervention in the oil and gas sector. The linking of Mexican gas prices to U.S. gas prices is effectively a form of price control. The lower U.S. based gas price is encouraging demand and discouraging supply in Mexico.
- Gas consumption is rising strongly, with the widening gap between domestic consumption and demand largely met by U.S. producers, who now account for almost two-thirds of Mexico's gas supply.
- Mexico has substantial hydrocarbon resources, but oil and gas production is falling rapidly because of natural field decline and under-investment by national oil company PEMEX, which operated as a monopoly until 2014.

Economy

According to the CIA Factbook (CIA, 2020):

- Mexico has a population of 129 million (July 2020 estimate). GDP per capita is US\$19,900, ranking 90 in the world.
- Mexico's \$2.4 trillion economy, the 11th largest in the world, has become increasingly oriented toward manufacturing since the North American Free Trade Agreement (NAFTA) entered into force in 1994. Per capita income is roughly one-third that of the U.S., and income distribution remains highly unequal.
- Mexico has become the U.S.'s second-largest export market and third-largest source of imports. In 2017, two-way trade in goods and services exceeded US\$623 billion. Mexico has free trade agreements with 46 countries, putting more than 90 per cent of its trade under free trade agreements.
- Mexico ranks 48 out of 141, not particularly competitive, in The Global Competitiveness Report 2019.

Petroleum Sector

Based on 2019 statistics from BP (BP, 2020), Mexico ranks globally 15 in terms of energy consumption. Oil and gas are the dominant sources of energy, accounting for 43 per cent and 42 per cent respectively of energy consumption by fuel type, followed by coal (7 per cent) and renewables including hydroelectric (7 per cent).

Mexico has a long history as one of the world's top 10 oil producers, but natural field decline and a lack of investment by the state-owned PEMEX has seen the country slide from 8 to 13 among the world's largest producers over the decade to 2019. Oil production dropped from 2.98 million bopd in 2009 to 1.92 million bopd in 2019. Total proved reserves halved from 11.9 billion barrels to 5.8 billion barrels over the same period (BP, 2020).

Proven gas reserves were only 6.3 Tcf at the end of 2019, down sharply from 12.5 Tcf at the end of 2009 and 28.4 Tcf at the end of 1999. Domestic gas consumption was 3.2 Tcf in 2019, compared to production of only 1.2 Tcf. Domestic demand was met by imports of 1.8 Tcf by pipeline (entirely from the U.S.) and a further 0.2 Tcf via LNG shipments, mostly from the U.S. (0.14 Tcf).

Sector organisation

Mexico nationalized its oil sector in 1938, creating PEMEX as the sole oil operator in the country. PEMEX is the largest company in Mexico, and one of the largest oil companies in the world. The energy sector is regulated by the Secretaría de Energía (SENER), while the Comisión Nacional de Hidrocarburos (CNH) provides additional oversight of PEMEX and its oil and gas activities.



Mexico's natural gas industry monopoly began to relax in 1995 with the opening of gas transmission and distribution to foreign investment in 1995. In 2014, constitutional reform ended PEMEX's monopoly in every segment of the hydrocarbons economy. The major goals of this reform were to bring in competition to lower energy prices and much needed foreign capital to reverse the decline in oil and gas production. The first offshore block offering was made to foreign firms (although PEMEX still had a first option over all acreage), private companies were allowed to expand the country's gas pipeline system and began to participate in the wholesale gas market. Other key reforms included the end of PEMEX's monopoly on fuel distribution and retailing, which has seen Shell, BP, Chevron and ExxonMobil open thousands of petrol stations and gain a significant market share (Bloomberg, 20 September 2020).

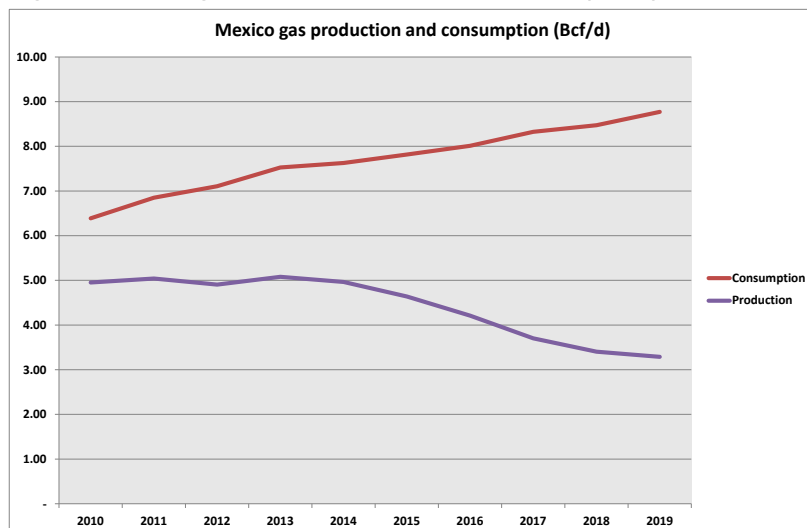
The 2018 election was won by Andres Manuel Lopez Obrador, who campaigned on a platform of "energy sovereignty," which meant reversing private sector participation in the energy sector. This included a three-year moratorium on exploration block offers and the construction of a major new refinery in the president's home state of Tobasco. The impact of COVID-19 on liquid fuel demand and oil prices has had a severe impact on PEMEX, which reported a loss of US\$24 billion in Q1 2020, following a loss of US\$18 billion in 2019.

Gas production, consumption and prices

Domestic gas production and consumption are on vastly different trajectories, with the widening gap filled by imports of gas (Figure 9). Gas production, which is mostly associated with oil production, has declined from 5.1 Bcf/d in 2010 to 3.3 Bcf/d in 2019 (BP, 2020). Gas consumption has increased over the same period from 6.3 Bcf/d to 8.8 Bcf/d.

Mexico's dependence on imports has been baked-in with the construction of a number of pipelines, which have also largely displaced LNG imports on the west and east coasts, despite all-time historical low global LNG prices.

Figure 9 Mexico gas production and consumption (Bcf/d)



Source: (BP, 2020)

Natural gas is mainly used in three sectors in Mexico – power generation, other energy sectors including consumption in oil and gas production and in industry. PEMEX is the country's single largest consumer of natural gas, representing around 40 per cent of the country's total. Most of the natural gas consumed by PEMEX is used in the upstream exploration and production sector, but significant



amounts are also used in refineries and petrochemical plants. The power sector accounts for one-third of Mexico’s natural gas consumption and demand is rising.

Mexican wholesale gas prices averaged US\$3.19/MMBtu in 2019 (IGU, 2020). Mexican prices are tied to prices (Henry Hub futures plus a transport fee).

Policy issues

Mexico has a substantial degree of intervention in the oil and gas sector generally. The linking of Mexican gas prices to U.S. gas prices is effectively a form of price control. The lower U.S. based gas price is encouraging demand and discouraging supply in Mexico.

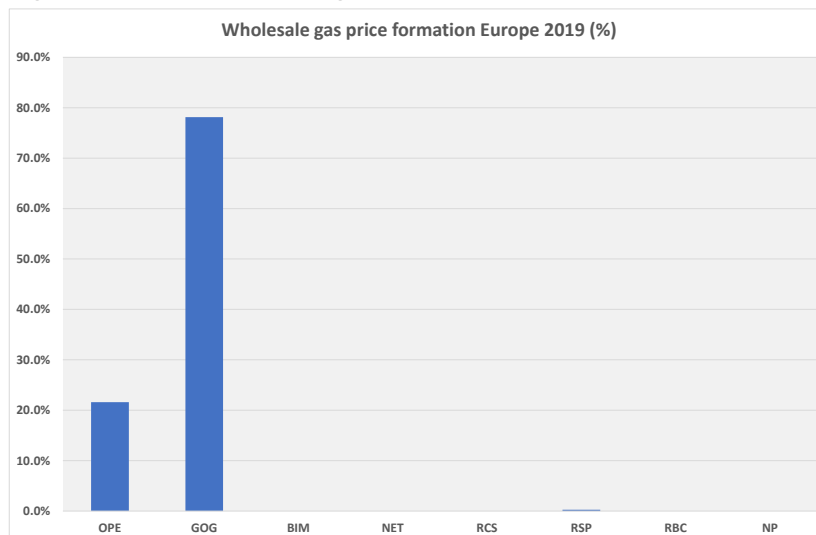
Mexico has large unconventional gas resources, part of which is found in extensions of highly productive formations in south Texas. According to the EIA (EIA, 2020), Mexico has an estimated 545 Tcf of technically recoverable shale gas resources – the sixth largest of any country in the global study. The large increase in pipeline capacity to bring in low-priced gas has undermined the incentive to invest in what is regarded as Mexico’s best hope of reducing its import dependency.

There are further inefficiencies because PEMEX allocates the gas available rather than letting the market allocate gas to buyers who value it most. It also demonstrates the risks of having a monopoly supplier decide petroleum investment priorities.

6. Europe

European wholesale gas prices are largely established through gas-on-gas competition rather than regulation (Figure 10). Gas-on-gas competition is taking over from oil-linked prices. (Historically Russian exports were all oil-linked.)

Figure 10 Europe wholesale gas price formation 2019

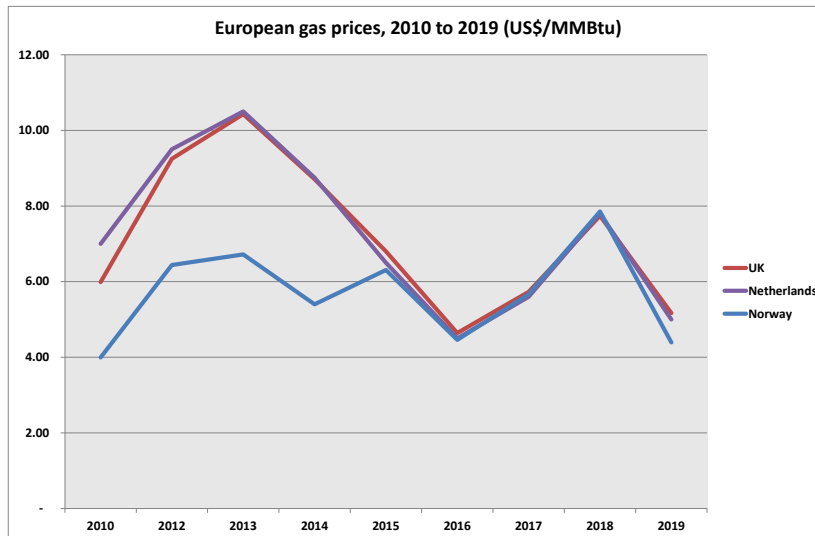


Source: IGU (2020)

Prices in different countries are increasingly closely related reflecting the high degree of gas-on-gas competition and the numerous supply linkages between countries (Figure 11).



Figure 11 European gas prices, 2010 to 2019 (US\$/MMBtu)



Source: IGU (IGU, 2020)

Netherlands

Main points

- The Netherlands' long history as a key gas producer in Europe is coming to an end with the closure of the Groningen field (which was once the largest gas field in Europe) in mid-2022. Production has been managed downwards since 2015, but demand remains stable, leading to net gas imports for the first time in 2018.
- The Netherlands is a core part of the European gas market, which is composed of interconnected national wholesale markets. The Dutch wholesale gas market has been liberalised in line with EU regulations. The Netherlands is home to the Title Transfer Facility (TTF), which is the largest gas-trading hub in Europe. Retail gas prices are not regulated.
- The government will exit its role as a major gas wholesaler with the cessation of activities by GasTerra in 2024. Gas prices are set by the market. There are no government interventions with domestic gas market implications.
- Like other members of the EU, Netherlands energy policy has been focussed on reducing greenhouse emissions, with the implication of reducing use of fossil fuels such as natural gas.

Economy

According to the CIA Factbook (CIA, 2020):

- The Netherlands has a population of 17.3 million. GDP is US\$0.9 trillion and GDP per capita is US\$53,900, ranking 23rd in the world.
- The Dutch economy is the sixth-largest economy in the EU and plays an important role as a European transportation hub. The economy is noted for its consistently high trade surplus, stable industrial relations and low unemployment. Industrial activity is predominantly in food processing, chemicals, petroleum refining and electrical machinery. A highly mechanised agricultural sector underpins the country's status as the world's second largest agricultural exporter.
- The Netherlands primary energy consumption was 3,510 PJ in 2019, and has been in slow decline over the past decade.



- The Netherlands ranks highly at 4 out of 141 in The Global Competitiveness Report (World Economic Forum, 2019).

Petroleum Sector

Based on 2019 statistics from BP (BP, 2020), the Netherlands ranks 30 in the world in terms of energy consumption. Energy consumption by fuel type is led by oil (47 per cent), followed by gas (38 per cent), coal (8 per cent), renewables (6 per cent) and nuclear energy (1 per cent).

The Netherlands has traditionally relied on gas more than any other country in the EU, reflecting an abundant supply of cheap gas following the onshore discovery of the giant Groningen field in 1959. Groningen was one of the world's 10 largest gas fields (with initial recoverable reserves of more than 100 Tcf) and began supply to the Netherlands, Germany, Italy, Belgium and France in the 1960s.

Since 1991, Groningen production has resulted in earthquakes that have increased in frequency and intensity, leading to community demands to end production. Production caps mandated by government since 2014 were replaced by a new mining law in 2018 that gave government unilateral control of Groningen production. A year later, the Dutch government brought forward the field closure date from 2030 to 2022 (Reuters, 2019). This led to a sharp reduction in national proven gas reserves to 6.1 Tcf (ranking 43 globally), which covers the country's gas needs for only five years, based on 2019 consumption of 1.3 Tcf. From 2013 to 2018, domestic gas production fell by 55 per cent but demand remained steady. This resulted in a sharp increase in energy import dependency from 29 per cent to 72 per cent. The Netherlands became a net gas importer for the first time in 2018.

Sector organisation

NAM (50 per cent Shell and 50 per cent ExxonMobil) is the largest gas producer and operates the Groningen field, but production levels have been controlled by government since 2018. Several other oil and gas producers operate small fields onshore and offshore in the North Sea.

GasTerra, which is half owned by the State (10 per cent directly and 40 per cent through EBN, a state-owned company) and half by Shell and Exxon (25 per cent each), is the sales office for Groningen gas and buys gas from domestic and foreign producers on the open market.

GasTerra is also obliged to buy gas from small domestic fields under reasonable conditions and at market rates if a producer so wishes. GasTerra was by far the dominant player in the wholesale market, with a share exceeding 70 per cent (OECD, 2020). Engie and Gazprom are also active in the wholesale market.

With the end of gas production at Groningen, GasTerra announced in 2019 it would wind up its operations and cease activity at the end of 2024. The government is also seeking to remove the legal requirement to buy gas from small fields (the "small fields policy"). An as-yet-undetermined legal entity will take responsibility for GasTerra's long-term commitments, which includes import contracts from Norway and Russia.

Gasunie, a Dutch infrastructure company fully owned by the state, owns and operates the gas transportation network. Since 2011, Gasunie and tank storage company Vopak have owned and operated the Netherlands' only import facility, the Gas Access to Europe or GATE terminal. It has since expanded to act as a break-bulk and re-export facility and has become an LNG hub for Europe. GATE has a throughput capacity of 8.1 Mtpa. The facility has a long history of under-utilisation but imports have increased significantly since 2018 to offset the decline in supply from Groningen. Most of the deliveries are short-term or spot sales.

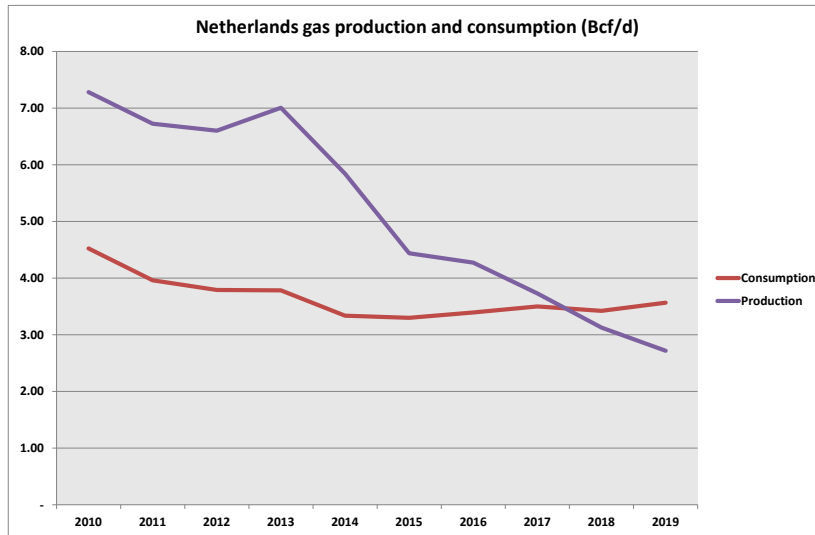
The Netherlands ranks well at 22 out of 80 in the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).



Gas production, consumption and prices

The Netherlands has been a stable market for natural gas consumption for decades (Figure 12), and is the most gas intensive energy economy in Europe. Gas use is spread almost equally between residential, power and other sectors. Within the power sector, gas generation accounted for 59 per cent of total electricity generated (BP, 2020).

Figure 12 Netherlands gas production and consumption (Bcf/d)



Source: (BP, 2020)

Based on the IGU's latest study (IGU, 2020), average wholesale gas prices in the Netherlands in 2019 were US\$5.00/MMBtu, almost double average prices in the US (US\$2.53/MMBtu) but slightly less than the UK (US\$5.17/MMBtu) and Australia (US\$5.58/MMBtu).

The Netherlands is a core part of the European gas market, which is composed of interconnected national wholesale markets. The Dutch wholesale gas market has been liberalised in line with EU regulations. The Netherlands is home to the Title Transfer Facility (TTF), which is the largest gas-trading hub in Europe. Retail gas prices are not regulated. However, suppliers must submit all prices to the Authority for Consumers and Markets for review, and the ACM has the power to oblige price changes. It is intended that this ex-ante price monitoring will be ended under the new Energy Law in 2021 (IEA, 2020).

The industry gas price was the sixth-lowest among IEA member countries. In contrast, Dutch households paid the second-highest price among IEA member countries (IEA, 2020). The high household price is a result of high taxation, which at 55 per cent of the total price was the second-highest tax rate among IEA member countries in 2019 (IEA, 2020). Dutch prices follow similar trends as in neighbouring countries, reflecting the interconnected markets in the region. Differences in price between the countries are mostly due to different taxation policies, especially for households.

Policy issues

The Netherlands has a liberalised gas market, as part of the European Union market, to which it is an important supplier.

The closure of the Groningen field in 2022 creates security of supply concerns for the Netherlands given its heavy reliance on gas, but the risks are low because of the country's LNG import infrastructure and position as a gas trading hub in Europe.



ENERGY QUEST

By far the bigger policy issue for gas in the Netherlands is the country's aggressive targets to reduce greenhouse gas (GHG) emissions. The 2019 Climate Act set targets to reduce GHG emissions by 49 per cent by 2030 and 95 per cent by 2050 (versus 1990 levels).

Emission reductions will be driven by the Stimulation of Sustainable Energy Production (SDE+) support scheme, which uses competitive auctions to award subsidies to renewable energy projects. From 2011 to 2020, SDE+ allocated EUR 60 billion of subsidies, payable over a period of up to 15 years. To encourage industrial emissions reductions, a carbon levy will be introduced in 2021 on emissions above a certain threshold, which will be reduced annually through to at least 2030. The largest electricity emissions reductions are expected to come from a ban on coal-fired generation, which requires coal plants to cease operating, or convert to alternative fuels, by 2030.

The government foresees natural gas will be an important part of the energy system through at least 2030, but is actively encouraging reduction of gas demand with policies such as the Natural-gas Free Districts Programme, which supports the transition of 1.5 million homes from gas to low-carbon district heating and electric heat pumps by 2030 (with a goal of switching all buildings – 7.7 million houses and 1 million other buildings – by 2050). The Gas Act was amended in 2018 to change the existing obligation to connect new homes and buildings to the gas network into a ban on new gas connections.

The government is also accelerating the production and use of low-carbon gases. These policies promote the use of gas infrastructure to transport and use of low-carbon gases such as hydrogen and biomethane and enable carbon capture and storage (CCS) by supporting transport and storage of CO₂.

Other policies affecting the gas industry are a ban on shale gas exploration and production, introduced in 2018.

Norway

Main points

- The petroleum industry dominates Norway's economy and its exports. Norway is a major producer of gas, almost entirely for export by pipeline, and is Western Europe's largest producer of crude oil.
- Norway does not have a gas reservation scheme, and the export market determines gas prices despite the high level of state involvement in the petroleum industry.
- Norway's abundance of hydro power and ambitious targets for reducing greenhouse emissions, with the implication of reducing use of fossil fuels, limits the scope for other than minimal domestic gas consumption.

Economy

According to the CIA Factbook (CIA, 2020):

- Norway has a population of 5.5 million (July 2020 estimate). GDP is US\$382.1 billion (2017) and GDP per capita is US\$72,100, ranking 11 in the world.
- Norway has a stable economy with a vibrant private sector and a large state sector. The government maintains large ownership positions in key industries including oil and gas (Equinor, 67 per cent), hydropower (Statkraft, 100 per cent), aluminum (Norsk Hydro, 34 per cent) as well as banking and telecommunications. Norway opted out of the EU during a referendum in 1994. However, as a member of the European Economic Area, Norway partially participates in the EU's single market and contributes sizably to the EU budget.



E N E R G Y Q U E S T

- The country has modest domestic energy needs and nearly all electricity production relies on hydropower. Rising electricity imports from Denmark and Sweden have created debate about whether Norway needs to build gas-fired power stations.
- Norway ranks highly at 4 out of 141 countries in The Global Competitiveness Report 2019 (World Economic Forum, 2020).

Petroleum Sector

Norway is one of the world's leading petroleum producers, ranking eight for gas production and 15 for oil production (BP, 2020). Nearly all of Norway's oil and gas production is exported, making petroleum the country's most important export. Most gas production is exported by pipeline to countries in the EU (mainly Germany, Belgium, the UK and France) and meets between 20 per cent and 25 per cent of EU demand. LNG exports began in 2007 but account for only about 5 per cent of gas exports.

Norway oil production represents about 2 per cent of the global market and was valued at US\$26.5 billion in 2019, or 27 per cent of the total external trade in goods. Norway is the world's third largest gas exporter, ranking behind only Russia and Qatar. Norway exported 4.0 Tcf in 2019, valued at US\$18.3 billion and representing 19 per cent of Norway's external trade in goods (Norwegian Petroleum Directorate, 2020).

Norway ranks 43 in terms of primary energy consumption. By fuel type, energy consumption is led by hydropower (63 per cent), followed by oil (22 per cent), gas (9 per cent), renewables (4 per cent) and coal (2 per cent).

Proven oil reserves were 8.5 billion barrels in 2019, up significantly from 7.1 billion barrels at the end of 2009. Oil production in 2020 will be lower than 2019 after Norway's energy minister in April 2020 directed production cuts to help stabilise the global market in the wake of COVID-19. The cuts are believed to have extended beyond state-backed Equinor and were enacted by revisions to production permits (Financial Times, 2020). Oil production is expected to grow significantly by 2024 with the start-up of new projects, including Equinor's large Johan Sverdup field.

Proven gas reserves are 54 Tcf (ranking 19 globally), equivalent to 13 years of production, based on 2019 production of 4.0 Tcf (BP, 2020). Gas production is forecast to grow from 113.2 MMboe/d in 2019 (the lowest since 2014) to 119.9 MMboe/d in 2024 (Norwegian Petroleum Directorate, 2020).

Sector organisation

Equinor dominates natural gas production in Norway. A number of international oil and gas companies, including BP, ConocoPhillips, Total and Shell have a sizable presence in the natural gas and oil sectors in partnership with Equinor. State-owned Gassco is responsible for administering the natural gas pipeline network. The company also manages Gassled, the network of international pipelines and receiving terminals that export Norway's natural gas production to the United Kingdom and continental Europe (IEA, 2020).

The IEA considers that as a reliable and transparent supplier, Norway improves the energy security for a large number of countries. It has a consistent and predictable regulatory framework for exploration and production, and it manages both its petroleum resources and revenue in a transparent and competent manner (IEA, 2020).

Norway ranks highly in the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey. Norway (North Sea) ranked 14 out of 80 while Norway (Other Offshore) ranked 15 out of 80 (Fraser Institute, 2018).



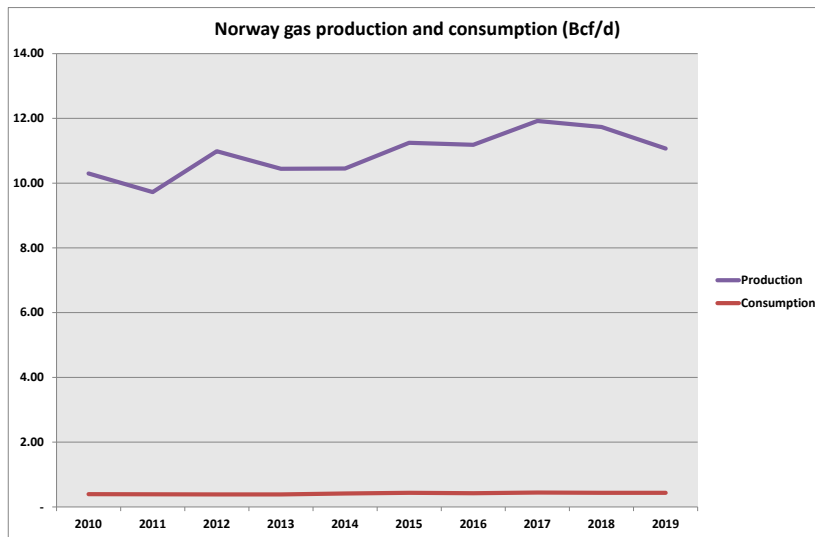
Gas production, consumption and prices

Annual gas production grew strongly between 2000 and 2010 and has been maintained at around 4 Tcf for the past decade (Figure 13). Production has declined slightly from a peak of 4.3 Tcf in 2017, with output of 4.0 Tcf in 2019 (BP, 2020). Production is forecast to grow steadily over the next few years, increasing by 5.9 per cent between 2019 and 2024 (Norwegian Petroleum Directorate, 2020).

Norway's domestic gas consumption is low due to the almost total reliance on hydropower, which accounts for about 95 per cent of total installed capacity (IEA, 2020). Increased gas penetration is limited because the government does not permit new gas-fired plants without carbon capture and storage (CCS) technology. However, Norway is taking a leading role in the development of large-scale CCS to support the EU's goal of net zero carbon by 2050. In July 2020, the state approved a Euro 2.1 billion investment to meet 80 per cent of the cost of building CCS facilities at a cement plant and a waste-to-energy power plant. Captured emissions will be stored offshore as part of the Northern Lights project, a joint venture between Equinor, Shell and Total, scheduled for commissioning in 2024.

All energy prices in Norway are determined by the market. The IGU study (IGU, 2020) lists average Norwegian wholesale gas prices as US\$4.39/MMBtu in 2019, which is the lowest in Europe and significantly less than wholesale prices in EU countries which rely heavily on Norwegian gas supply, such as France (US\$5.60/MMBtu) and Germany (US\$6.14/MMBtu).

Figure 13 Norway gas production and consumption (Bcf/d)



Source: (BP, 2020)

Policy issues

The government's main objective for the oil and gas sector is to ensure long-term value creation through sound resource management on the Norwegian Continental Shelf. The Norwegian "Ten Petroleum Commandments" (Ten Commanding Achievements, 2012) approved by the Norwegian Parliament in 1971, are still the basis of Norwegian policy.

Oil and gas activity is important to maintain high employment and create wealth in Norway. It is a key sector of the Norwegian economy and has contributed significantly to industrial development and the advancement of the Norwegian welfare society. A large part of the oil and gas revenue goes to the state in the form of taxes, dividends, and fees, and contributes to the state's strong financial position. The state's oil and gas revenue is channelled to the Government Pension Fund Global, which held assets of \$US1.1 trillion at the end of June 2020. It is the largest sovereign wealth fund in the world.



The government's priorities for Norway's domestic energy supply sector are outlined in the April 2016 White Paper Power for Change – an energy policy towards 2030 (Noweigan Ministry of Petroleum and Energy, 2016). The White Paper presents an energy policy that intends to improve the security of supply, promote industrial development and more efficient and climate-friendly energy use. One of its four priority areas is enhanced security of supply, which is primarily a question of electricity security. Government interventions with domestic gas market implications are directed towards reducing greenhouse emissions, limiting use of gas. Gas plays a minimal role in Norwegian energy consumption and use is restricted by government policies on power generation.

The government views a smoothly functioning electricity market as critical for electricity security. As far as possible, market-based solutions should be used to operate the electricity system and trading electricity. As stated in the White Paper, effective markets give the right price signals for the production, transmission, and consumption of electricity and promote the sound use of resources and innovation, as well as the security of supply.

United Kingdom

Main points

- In 2004, the UK shifted from being a gas exporter to a gas importer via pipeline and LNG.
- It has one of the most liberalised energy sectors with prices market determined, and the oldest European gas trading hub.
- The UK does not have a domestic gas reservation scheme, despite declining production which has necessitated a shift to gas imports. There are no government policies to favour domestic gas users.

Economy

According to the CIA Factbook (CIA, 2020):

- The UK has a population of 65.8 million (July 2020 estimate). GDP is US\$2.9 trillion and GDP per capita is US\$44,300 (2017 estimate), ranking 39 in the world.
- The UK is the third largest economy in Europe after Germany and France. The UK has large coal, natural gas, and oil resources, but its oil and natural gas reserves are declining and it became a net importer of gas in 2004. Services, particularly banking, insurance, and business services, account for the largest proportion of GDP, while industry continues to decline in importance.
- The UK ranks highly at 9 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Natural gas plays a crucial role in the UK's energy sector (IEA, 2020). It is used by 80 per cent of households for residential heating, and gas plays an important role in reducing the carbon intensity of the UK electricity supply as it has recently replaced larger shares of coal. Consumption in the industrial and commercial sectors, by contrast, forms a small share in gas demand.

Once a large producer of oil and gas from the North Sea, UK oil and gas production has declined significantly since the peak year of 2000. The UK became a net importer of natural gas in 2004, of crude oil in 2005, and of oil products in 2012 (IEA, 2020). The United Kingdom's energy system is characterised by a large share of natural gas and oil, which in 2019 accounted for 36 per cent and 40 per cent respectively of primary energy consumption (BP, 2020).



Proven gas reserves declined by 33 per cent between 2009 and 2019 to 6.6 Tcf. Gas production has fallen in line with the decline in reserves, down from 2.2 Tcf in 2009 to 1.4 Tcf in 2019. This provides cover for less than five more years of production. Gas consumption has remained relatively stable (2.8 Tcf in 2019). The UK imports pipeline gas from Norway and LNG, via four operating import terminals.

Sector organisation

Private companies operate the UK natural gas sector, including production, distribution, and transmission. National Grid plc is a British multinational electricity and gas utility company with activities in the UK and north-eastern U.S.. National Grid Electricity Transmission owns and operates the electricity networks and partly the interconnectors. National Grid Gas plc owns and operates the gas transmission network (from terminals to distributors), known as the National Transmission System.

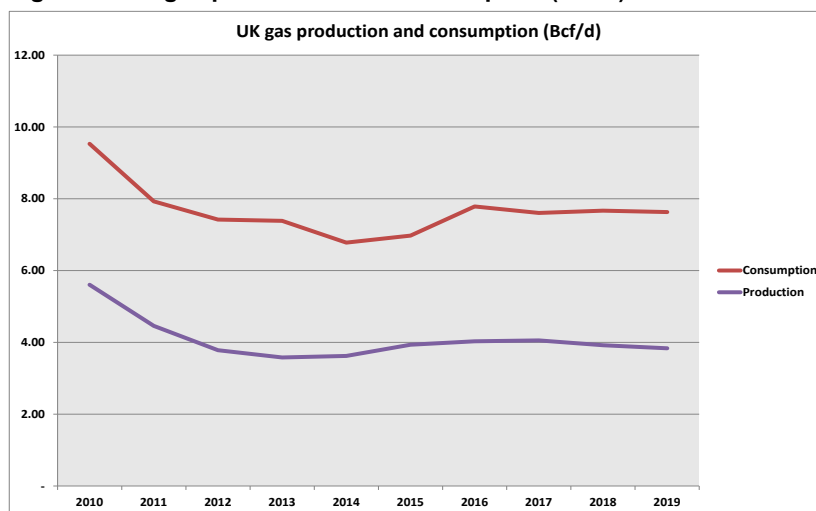
The Department of Business, Energy and Industrial Strategy (BEIS), created in 2016, has primary responsibility for secure, clean and affordable energy supply in the UK. Several companies are under the authority of the BEIS Secretary of State to deliver policy objectives. The Low Carbon Contracts Company and the Electricity Settlements Company are both private limited companies to deliver on the decarbonisation of the UK electricity sector. The Office of Gas and Electricity Markets (Ofgem) is the main regulator of the UK gas and electricity networks. Its central role is to protect the consumer interests, which include reducing GHG emissions, ensuring the security of supply, and regulating competitive markets in gas and electricity supply and retail.

The UK ranked highly in the Policy Perception Index of the Fraser Institute's Global Petroleum Survey 2018. UK (North Sea) and UK (Other offshore) ranked nine and 13 respectively out of 80 (Fraser Institute, 2018).

Gas production, consumption and prices

UK oil and gas production has declined significantly since the peak year of 2000. Gas production increased modestly after 2013, encouraged by a more favourable tax policies for the exploration and development of new offshore resources. However, the decline in production is expected to resume and the UK market will become more dependent on imports, primarily from Norway and continental Europe, and on LNG (Figure 14).

Figure 14 UK gas production and consumption (Bcf/d)



Source: (BP, 2020)



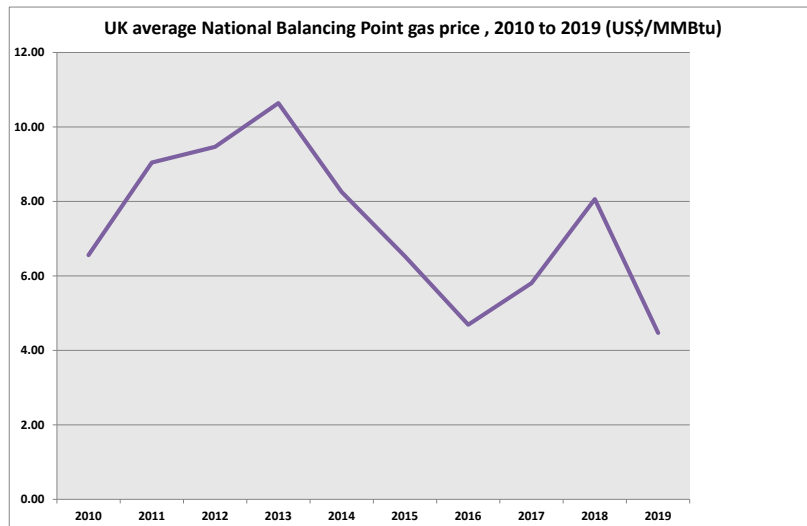
Since 2015, UK gas demand has increased due to a decrease in global gas prices, environmental regulation on coal-fired power plants, and the government's introduction in 2013 of a carbon floor price in the power sector, which favoured the operation of gas generation at the expense of coal. The largest consuming sectors are heat/power generation and the residential sector, which each account for more than a third of gas demand.

The main gas imports to the UK come through pipelines from Norway (75 per cent of total imports in 2017) and Belgium (10 per cent) (IEA, 2020). The UK also imports LNG and has three import terminals (Grain, owned by National Grid with a capacity of 14.8 Mtpa; Dragon, owned by Shell and Ancala LNG, 5.1 Mtpa; and South Hook, owned by Qatar, Exxon and Total, 15.6 Mtpa). A fourth facility at Teesside is currently idled, although Trafigura has a license to redevelop the facility. National Gas Grid's 10-year network development plan in 2017 contained 11 LNG import terminals.

Prices are determined competitively for all uses of gas and there is a single wholesale price, irrespective of where the gas comes from. The wholesale price, which is not regulated, is known as National Balancing Point (NBP) price of gas. The NBP market was established in the late 1990s and is Europe's oldest gas market. The NBP price is the most important component of end-user price. According to the IEA (IEA, 2020), wholesale costs made up 39 per cent of the gas bill, whereas network costs accounted for 25 per cent, environmental and social costs for 1 per cent, and the remainder from the supply pre-tax margin (9 per cent) and 20 per cent operating costs and other services (6 per cent).

Figure 15 shows the UK average annual NBP gas price from 2010 to 2019. Prices over the past decade have oscillated over the range US\$4.47-10.64/MMBtu. According to the IGU's wholesale gas price survey (IGU, 2020), the UK price was US\$5.17/MMBtu in 2019, which places it just inside the lowest quartile of European nations.

Figure 15 UK average National balancing Point gas price, 2010 to 2019 (US\$/MMBtu)



Source: (BP, 2020)

Policy issues

The UK does not have a domestic gas reservation scheme, despite declining production which has necessitated a shift to gas imports. There are no government policies to favour domestic gas users.

The inadequacy of domestic gas volumes means the UK has a strong focus on gas security, according to the IEA (IEA, 2020). Several bodies have responsibility for security of gas supply,



including BEIS, Ofgem and National Grid Gas. The UK has a liquid gas market, robust infrastructure and a diverse supply that spans domestic production, LNG and pipeline imports. Price signals are used to ensure flexibility, to cover potential shortages and allow gas to flow to the UK.

Over the next few years, the IEA expects declining North Sea production to lead to a slight increase in reliance on imports, despite gas demand expected to decrease by about 5 per cent between 2018 and 2023. There is limited scope for growth in gas demand, with coal-to-gas switching by power generators already largely running its course (remaining coal-fired generators will be phased out by 2025).

The UK power system will move to a high share of variable renewables over the next decade under the UK's advanced plans to achieve net zero carbon by 2050. Since 2018 the government has incentivised firming generation, including gas-fired power, with the Capacity Market mechanism. The IEA says this will bring forward new gas-fired plants, but these are expected to run at low capacity (IEA, 2020).

Unlike Australia, the UK power market also has a fall-back position of interconnections with neighbouring countries, and expansion of this capacity is likely as the UK system goes through major transformation over the next decade.

The IEA says another policy issue is the evolution of retail gas and electricity markets. In 2019, the government mandated residential price caps on the average annual use of gas and electricity in response to criticism the retail market was not working well for consumers. The price caps will continue until 2023 and may continue beyond this date, based on a review by Ofgem.

The IEA cites programs to decarbonise gas for residential heating as another policy issue for gas. The government is encouraging home owners to use heat pumps, which will limit growth in residential gas demand. The IEA says decarbonisation policy should prioritise improvements in building energy performance to bring forward cost-effective results.

7. Russia

Main points

- Russia is a major gas producer and the world's largest exporter of gas by pipeline, mainly to Europe. LNG exports began in 2009 and have expanded rapidly in the past decade, elevating Russia to the world's fourth largest LNG exporter.
- The petroleum sector is highly significant in the Russian economy.
- There is a high level of government intervention, ownership and control of the whole petroleum industry. State-run Gazprom has dominated the gas industry in the post-Soviet era, but competitors such as Rosneft and Novatek have become increasingly significant since 2013.
- Gazprom sells gas at low, regulated prices to residential and industrial customers and provides subsidised gas to countries in the FSU. Gazprom effectively subsidises the industrial economy and households with gas inherited from the Soviet Union, which it funds by having the exclusive right to export gas by pipeline to premium markets in Europe.
- Cross subsidies are under threat from Gazprom's weakening market power in Europe.
- Overall Russia has a very high degree of domestic gas market intervention, which has produced resource misallocation and poor environmental outcomes and is recognised as being unsustainable. The country is trying to move towards a liberalised domestic gas market.



Economy

According to the CIA Factbook (CIA, 2020):

- Russia has a population of 142 million (July 2020 estimate). GDP is US\$4.0 trillion and US\$27,900 per capita, ranking 74 in the world.
- Russia has undergone significant changes since the collapse of the Soviet Union, moving from a centrally planned economy towards a more market-based system. However, both economic growth and reform have stalled in recent years, and Russia remains a predominantly statist economy with a high concentration of wealth in officials' hands. Economic reforms in the 1990s privatised most industry, with notable exceptions in the energy, transportation, banking, and defence-related sectors. The protection of property rights is still weak, and the state continues to interfere in the free operation of the private sector.
- Russia is one of the world's leading producers of oil and natural gas, and is also a top exporter of metals such as steel and primary aluminium. Russia is heavily dependent on the movement of world commodity prices as reliance on commodity exports makes it vulnerable to boom and bust cycles that follow the volatile swings in global prices. A combination of falling oil prices, international sanctions, and structural limitations pushed Russia into a deep recession in 2015, with GDP falling by close to 2.8 per cent. The downturn continued through 2016, with GDP contracting another 0.2 per cent, but was reversed in 2017 as world demand picked up. Government support for import substitution has increased recently in an effort to diversify the economy away from extractive industries.

Russia ranked 43 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Russia is the world's fourth largest energy consumer and relies heavily on its vast reserves of gas, which accounted for 54 per cent of primary energy consumption in 2019 (BP, 2020). Russia is also the world's largest exporter of gas by pipeline. It exported 7.7 Tcf in 2019, more than double its nearest competitor for pipeline gas exports, Norway. Russia added LNG exports to its international gas trade in 2009 and has grown in the past decade to become the world's fourth largest exporter of LNG (1.4 Tcf or 26.6 Mt in 2019). Russia imports gas by pipeline from Kazakhstan and Uzbekistan, equivalent to 4 per cent of its domestic gas production in 2019.

Given the heavy drawdown on its gas endowment every year, it is fortunate Russia has the world's largest proven gas reserves at 1,340 Tcf in 2019. This is equivalent to 55 years of production, based on 2019 output of 24 Tcf. Russia had an average rate of proven reserves replacement of 165 per cent over the past decade (BP, 2020).

Sector organisation

State-run Gazprom has dominated the gas industry in the post-Soviet era. It sells gas at low, regulated prices to residential and industrial customers and provides subsidised gas to countries in the FSU. Gazprom effectively subsidises the industrial economy and households with gas inherited from the Soviet Union, which it funds by having the exclusive right to export gas by pipeline to premium markets in Europe (and to China as of late 2019 with the commissioning of the Power of Siberia pipeline).

In 2016, Gazprom produced 65 per cent of all Russian gas (EIA, 2020), but competitors such as Rosneft and Novatek have become increasingly significant. Independent producers have benefited



from a significant increase in the regulated gas price since 2009, which Gazprom had requested to help it fund the development of new gas projects on the Yamal Peninsula (Henderson & Moe, 2019).

A number of ministries and regulatory agencies are involved in the gas sector. The Ministry of Natural Resources and Environment issues field licenses, monitors compliance with license agreements, and levies fines for violations of environmental regulations. The Ministry of Energy develops and implements general energy policy and oversees LNG exports. The Finance Ministry is responsible for hydrocarbon production and export taxes, while the Ministry of Economic Development supervises tariffs.

The Federal Antimonopoly Service is the main regulatory agency involved in the natural gas sector. This agency regulates pipeline tariffs and oversees charges of abuse of market dominance, including charges related to third-party access to pipelines.

Russia ranked 28 out of 80 in the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

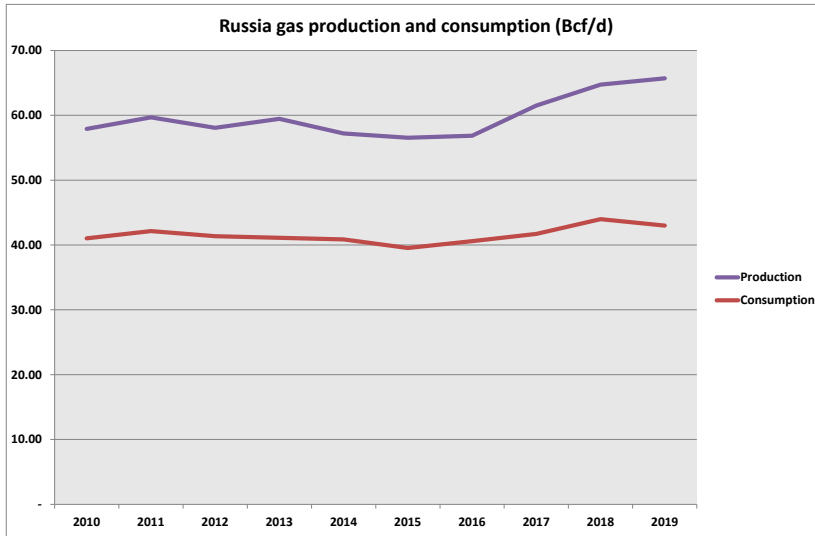
Gas production, consumption and prices

As shown by Figure 16 annual gas production has risen significantly in recent years, increasing by 16 per cent or 3.3 Tcf between 2015 and 2019. With domestic consumption relatively flat over the same period, nearly all production growth went into exports, which accounted for 38 per cent of all Russian production in 2019. A significant proportion of the production growth was absorbed by Russian LNG exports, which jumped by 170 per cent or 0.9 Tcf over the same period, but most of the export growth has been in pipeline gas. In 2019, 87 per cent of Russia's pipeline gas exports went to Europe (BP, 2020).

LNG exports began in 2009 with the start-up of Sakhalin LNG, with the majority of the LNG contracted to Japanese and South Korean buyers under long-term supply agreements. In 2013, Russia modified its Law on Gas Exports to allow Novatek and Rosneft to export LNG, breaking Gazprom's monopoly on all natural gas exports. Yamal LNG is owned by a consortium, led by Novatek with a 50.1 per cent interest. Total and CNPC each have 20 per cent interest, and the Silk Road Fund (an investment fund established by the Chinese government) holds the remaining 9.9 per cent interest in the project.

Russia began exporting gas by pipeline to China in late 2019 with the start-up of the Power of Siberia Pipeline (POS). The POS will take five years to ramp up to full capacity of 28 Mtpa. Gazprom is in talks to raise annual gas flows to China by 6 Bcm to 44 Bcm (32 Mtpa) via the POS pipeline. (In the June quarter 2020, POS delivered 0.53 Mt of gas at an average price of US\$4.73/MMBtu, compared with the average landed price of LNG of US\$6.95/MMBtu or Australian LNG at US\$7.58/MMBtu. The border price of pipeline gas is generally cheaper than the landed price of LNG, but until now most pipeline gas has entered China at the far western border, with pipeline transport of up to 8,800 km to gas customers. In contrast, the POS reaches China at the north-eastern border, closer to demand centres. (EnergyQuest, September 2020).

Figure 16 Russia gas production and consumption (Bcf/d)

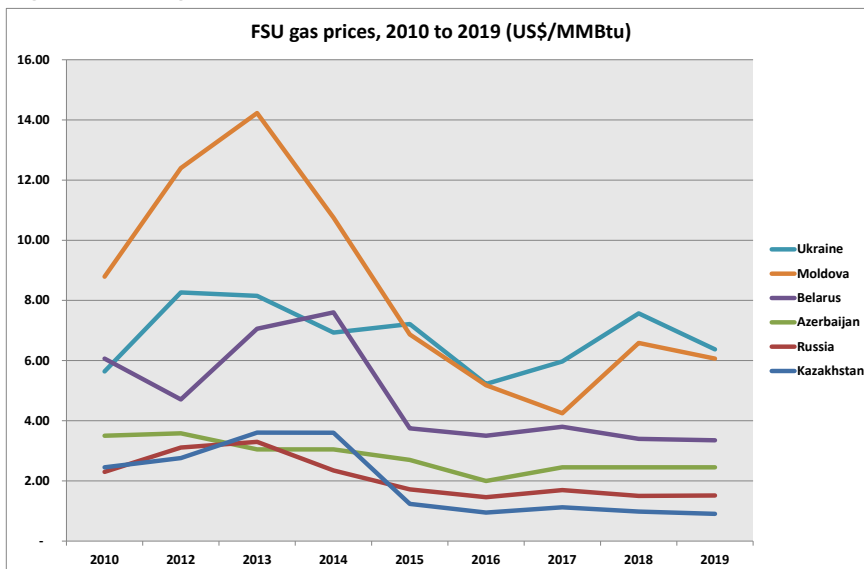


Source: BP (2020)

Average wholesale gas prices in Russia were among the lowest in the world at US\$1.52/MMBtu in 2019 (IGU, 2020). The IEA estimates that Russian gas consumption subsidies totalled US\$10.3 billion in 2019, with an additional US\$13.7 billion in subsidies attributed to electricity, which is predominantly gas-fired power generation (IEA, 2020).

As shown by Figure 17 wholesale prices have decreased since 2013, which followed several years of increases in regulated prices to help Gazprom fund the development of new projects on the Yamal Peninsula. Figure 18 also shows average wholesale prices in the FSU countries supplied by Gazprom. Prices in Kazakhstan, Azerbaijan and Belarus continue to be heavily subsidised.

Figure 17 FSU gas prices.

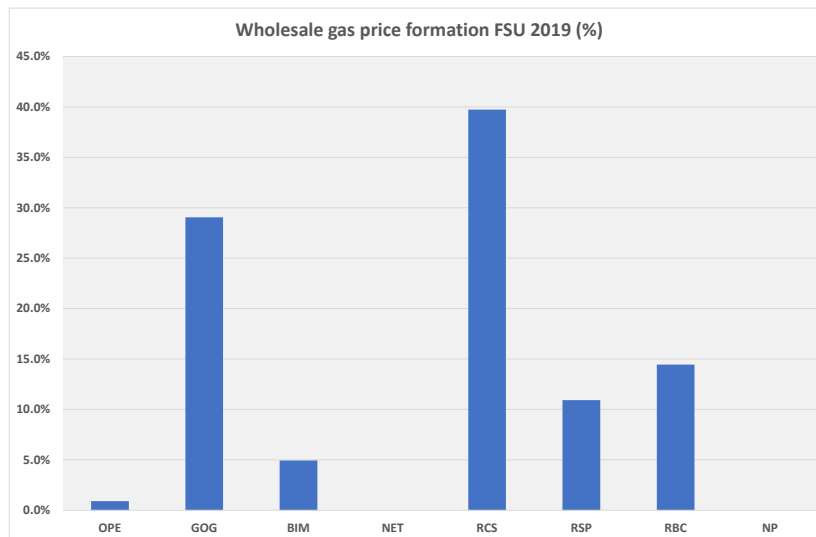


Source: (IGU, 2020)



Figure 18 shows that about 65 per cent of wholesale gas in the FSU is priced based on covering the 'cost of service' or provision at below cost (both of these probably for domestically-provided gas) with 'gas on gas' competition and oil-price linked (probably for exported gas) accounting for under 30 per cent of gas.

Figure 18 Wholesale gas price formation FSU 2019



Source: IGU (2020)

Policy issues

The response of international suppliers to the gas glut in Europe at the beginning of 2020, made worse by the demand shock of COVID-19, showed Gazprom had lost its market power, according to the Oxford Institute for Energy Studies (Oxford Institute for Energy Studies, 2020). Russia became a swing producer in Europe and accommodated most of the drop in European demand, even as Qatar and the US increased their shipments to Europe in the first half of 2020 compared to the first half of 2019. The authors concluded Russia took on this role because the sub-US\$2/MMBtu gas price did not cover its short-run marginal costs, and Russia did not want to engage in a price war.

The Oxford Institute for Energy Studies also notes that developments in the European gas market have forced Gazprom to accept gas-on-gas pricing, replacing oil indexation for the majority of Gazprom's contracts. This means Gazprom must now accept price risk as well as volume risk.

If Gazprom has lost its market power, Russia's ability to sell at high prices into the European market to cross-subsidise domestic gas prices is less certain and this raises economy-wide risks, given the reliance of many industries in Russia and the FSU on low gas prices.

Russia's gas regulators have noted the beneficial effects of competition created by Novatek, Rosneft and others and are seeking to cease price regulation and liberalise the gas market, while maintaining control of the gas sector by managing only pipeline tariffs. According to Henderson & Moe (2019), President Putin and the Federal Antimonopoly Service have been pushing for the development of a gas exchange and as of 2019, the most promising is run by SPIMEX in St Petersburg and could be a significant step towards market liberalisation.

Overall, it is becoming increasingly clear even within Russia, that intervention in the domestic gas market has negative effects for the economy and is unsustainable. Low prices have also led to wasteful use of gas, with widespread flaring of gas associated with oil production. According to the U.S. National Oceanic and Atmospheric Administration, Russia flared an estimated 850 Bcf of natural

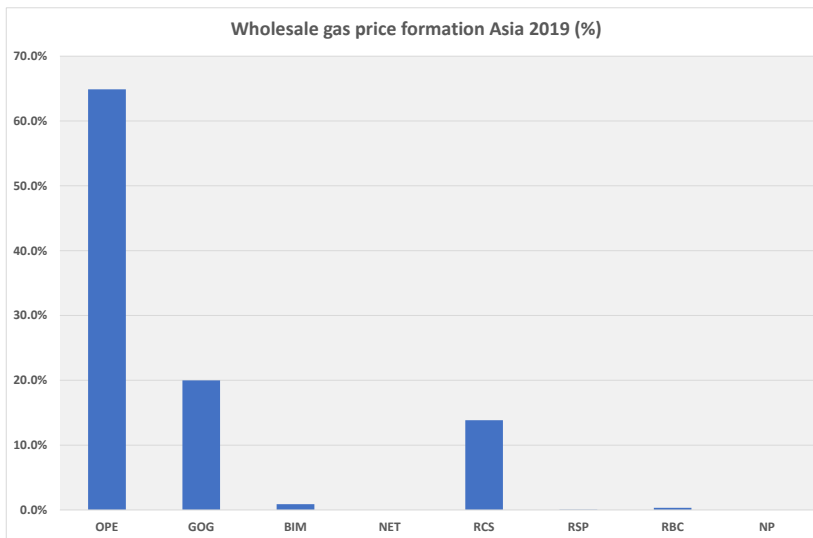


gas in 2016, the most of any country. At this level, Russia accounted for about 16 per cent of the total volume of natural gas flared globally in 2016 from upstream sources. A number of Russian government initiatives and policies have set targets to reduce routine flaring of associated gas (EIA, 2020).

8. Asia

The IGU Wholesale Gas Price report (IGU, 2020) defines Asia as Afghanistan, Bangladesh, China, India, Myanmar and Pakistan. Figure 19 shows the basis of gas price formation in the region. The price for the majority of gas is oil-linked (reflecting LNG and international pipeline imports), with some gas-on-gas competition and regulated pricing based on cost of service.

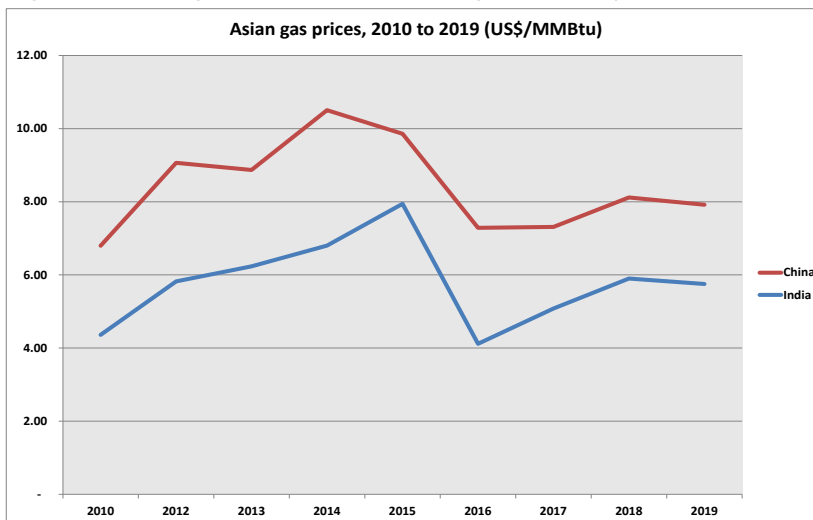
Figure 19 Asia wholesale gas price formation 2019



Source: IGU (2020)

Figure 20 shows Chinese and Indian gas prices. Prices are generally higher than Australian, North American and European prices.

Figure 20 Asian gas prices, 2010 to 2019 (US\$/MMBtu)



Source: IGU (2020)



China

Main points

- China is the largest energy consumer in the world. Gas demand has rapidly overtaken domestic production, leading to the first imports of LNG in 2006 and pipeline imports from 2010, including the first gas from Russia in 2019. China is on the cusp of becoming the world's largest importer of LNG.
- The government has taken steps towards market-based pricing, but gas prices are still regulated. Prices are not particularly low (and higher than Australia's) because imported gas has incurred heavy losses for China's state-owned oil companies, even with tax subsidies.
- Overall, China has a high degree of state ownership and regulation, including domestic gas market intervention. The policy direction is towards increasing gas use to replace coal and reduce pollution.

Economy

According to the CIA Factbook (CIA, 2020):

- China has a population of 1,394 million (July 2020 estimate). GDP is US\$25.36 trillion (2018) and GDP per capita is US\$18,200 (2018), ranking 96 in the world.
- Since the late 1970s China has moved from being a closed, centrally planned system to a more market-oriented one that plays a major global role. In 2010 China became the world's largest exporter. China has implemented reforms in a gradualist fashion. In recent years, China has renewed its support for state-owned enterprises in sectors it considers important to "economic security," explicitly looking to foster globally competitive national champions.
- The government's 13th Five-Year Plan, unveiled in March 2016, emphasizes the need to increase innovation and boost domestic consumption to make the economy less dependent on government investment, exports, and heavy industry. However, China has made more progress on subsidising innovation than rebalancing the economy. Beijing has committed to giving the market a more decisive role in allocating resources, but the Chinese Government's policies continue to favor state-owned enterprises and emphasize stability.
- Economic development has progressed further in coastal provinces than in the interior, and by 2016 more than 169.3 million migrant workers and their dependents had relocated to urban areas to find work. One consequence of China's population control policy known as the "one-child policy" - which was relaxed in 2016 to permit all families to have two children - is that China is now one of the most rapidly aging countries in the world. Deterioration in the environment - notably air pollution, soil erosion, and the steady fall of the water table, especially in the North - is another long-term problem. China continues to lose arable land because of erosion and urbanization. The Chinese Government is seeking to add energy production capacity from sources other than coal and oil, focusing on natural gas, nuclear, and clean energy development. In 2016, China ratified the Paris Agreement, the multilateral agreement to combat climate change, and committed to peak carbon dioxide emissions between 2025 and 2030. In September 2020, President Xi Jinping announced a target of net zero carbon before 2060.
- China ranks highly at 28 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).



Petroleum Sector

China is the largest energy consumers in the world. It ranks fifth globally in oil production and 13 in proven reserves (BP, 2020). Proven gas reserves are 297 Tcf (ranking 6 globally), equivalent to 17 years of production, based on 2019 production of 6.3 Tcf. China has had high average rate of proven reserves replacement of 525 per cent over the past decade. Gas consumption is 10.9 Tcf and comprises 8 per cent of primary energy consumption. The gap between domestic gas production and consumption is met by LNG imports and pipeline gas (from central Asia and now from Russia).

Sector organisation

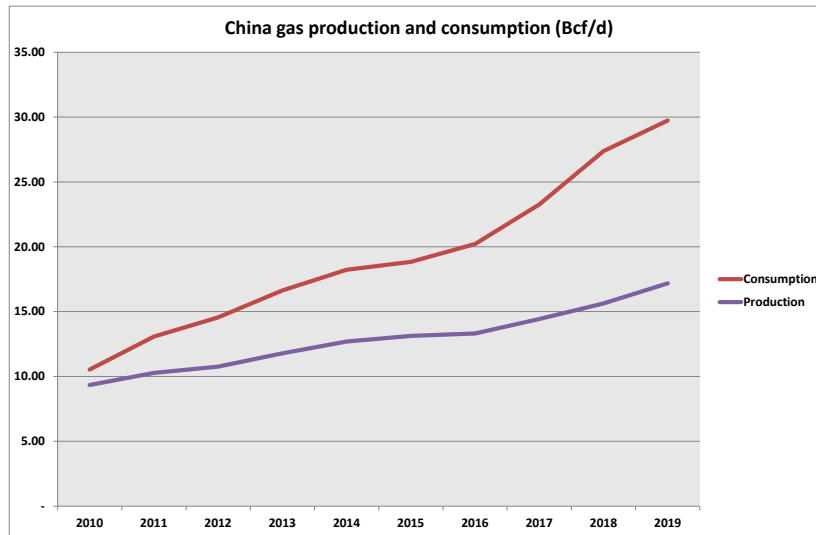
The natural gas sector is dominated by the three principal state-owned oil and gas companies: CNPC, Sinopec and CNOOC. CNPC is the country's largest natural gas company in both the upstream and downstream sectors. CNOOC typically uses production sharing contracts (PSC) agreements with foreign international oil companies (IOC's) wanting to co-develop upstream offshore projects and has the right to acquire up to a 51 per cent working interest in all offshore discoveries once the IOC recovers its development costs.

China has historically ranked poorly in the Policy Perception Index of the Fraser Institute's Global Petroleum Survey. It was excluded from the 2018 survey due to a lack of responses.

Gas production, consumption and prices

China's gas production has increased steadily over the past decade, but consumption has grown at a faster rate and dictated an increasing volume of imports as LNG and pipeline gas (Figure 21).

Figure 21 China gas production and consumption (Bcf/d)



Source: BP (2020)

China's government anticipates boosting the share of natural gas as part of total energy consumption from almost 8 per cent in 2019 to 10 per cent by 2020 and 14 per cent by 2030 to reduce high levels of pollution from the country's heavy coal use. A policy of coal-to-gas switching in the industrial sector was introduced in 2017 and was the single largest contributor to growth in gas consumption in 2019 (IEA, 2020). Although natural gas is still a small contributor to China's overall energy portfolio, China is the world's third largest gas consumer (behind the US and Russia) and is one of the fastest-growing natural gas markets in the world (EIA, 2020).



To boost domestic supply, China recently introduced financial incentives for production from unconventional gas resources. The resource tax on shale gas production has been reduced from 6 per cent to 4.8 per cent, starting in April 2018 through to March 2021. China also offers subsidies until 2023 on all unconventional gas production, which has been expanded to include tight gas (EIA, 2020).

About 40 per cent of China's gas consumption is by industrial users (fertiliser production and manufacturing, including mining and oil and gas production), although the recent growth of gas consumption in the past few years stems from the power, utilities, and residential sectors (EIA, 2020).

China's imports of LNG will likely grow to new highs in 2020 as companies buy up cheap gas supplies to meet industrial and residential demand. China's total gas use is expected to increase by 4-6 per cent this year, whereas global gas markets are set to fall by 4 per cent due to COVID-19 lockdowns. LNG imports are set to hit a record 65-67 Mt this year, analysts and Chinese traders estimate, 10 per cent more than 2019's total. China's gas demand has recovered faster than expected after the COVID-19 pandemic driven by the industrial sector, with companies taking advantage of the record-low prices seen earlier in the year. PetroChina has accommodated higher LNG imports by reducing pipeline imports from central Asian, mainly Kazakhstan (Reuters, 25 September). In fact, with rising Chinese imports and falling Japanese imports, China may overtake Japan as the world's largest LNG buyer this year, earlier than expected.

The government has taken steps towards a market-based pricing system, but prices are still regulated. According to the IGU (2020), wholesale gas prices averaged US\$7.92/MMbtu in 2019. Prices are not particularly low because they present the Chinese government with a difficult balancing act. It needs prices to remain as low as possible to encourage greater use of gas in the country's fight against pollution, but state-owned oil companies have incurred multi-billion dollar losses on imported gas sold at domestic prices, even with tax subsidies. Higher prices are also needed to stimulate investment in new domestic supply and met the policy goal of lowering the country's dependency on imports.

Policy issues

China has already made significant progress in its gas liberalisation reform, including some price deregulation, third-party access and an ongoing approach to unbundling infrastructure (IEA, 2020). China has also established pilot gas exchange centres aimed at instituting a market price index.

The price of natural gas is still heavily subject to the regulated city-gate prices, although a significant step was flagged in November 2019 when the National Development and Reform Commission deleted city-gate gas prices from its draft catalogue of Central Government Pricing. The current pricing regime remains unchanged to date.

A shake-up of the country's approach to gas pipeline infrastructure is underway with the formation of China Oil and Gas Piping Network Corporation, which has taken over the pipeline interests of the country's three state-owned oil companies. This is expected to accelerate the build-out of the country's pipeline infrastructure, which reaches only one quarter of the population and contributed to gas shortages in some regions in 2019.

Gas has benefited from China's aggressive steps to reduce air pollution, and it could potentially receive even greater support from government under the recently announced plan to achieve a national target of net zero carbon before 2060. In the short to medium term, this could see an acceleration of gas demand, although a rapid shift to renewable energy could limit the growth of gas demand in China. The government has yet to announce specifics of how China, which is currently the world's largest source of CO₂ emissions, plans to achieve net zero carbon in less than 40 years.



India

Main points

- India is the world's third largest energy consumer, but gas has so far been only a minor player in meeting the country's energy needs.
- Domestic gas production is falling and LNG imports increasing.
- State-owned companies play a predominant role in production.
- Gas prices are regulated. Gas shortages mean supply is rationed to priority sectors, which is likely to lead to economically inefficient resource allocation.
- The degree of state intervention makes foreign investment challenging. While India has achieved a good rate of reserves replacement, it is likely that a more liberalised gas sector would encourage greater development of indigenous Indian resources, including coal seam and shale gas.

Economy

According to the CIA Factbook (CIA, 2020):

- India has a population of 1,326 million (July 2020 estimate). GDP is US\$9.5 trillion (2017 estimate) and GDP per capita is US\$7,200, ranking 156 in the world.
- India is developing into an open-market economy, yet traces of its past policies of self-sufficiency remain. Economic liberalisation, including industrial deregulation, privatisation of state-owned enterprises, and reduced controls on foreign trade and investment, began in the early 1990s and has served to accelerate the country's growth, which has averaged almost 7 per cent per year between 1997 and 2017. India's diverse economy encompasses traditional village farming, modern agriculture, handicrafts, a wide range of modern industries, and a multitude of services. Slightly more than half of the work force is in agriculture, but services are the major source of economic growth, accounting for more than half of India's output, with only one-third of its labour force.
- India has middle ranking of 68 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

India is the world's third largest energy consumer (BP, 2020). Coal is the major energy source, accounting for 55 per cent of total energy consumption in India, followed by oil (30 per cent), gas (6 per cent), hydroelectric (4 per cent), renewables (4 per cent) and nuclear power (1 per cent).

Proven gas reserves are 47 Tcf (ranking 22 globally), equivalent to 52 years of production, based on 2019 production of 0.9 Tcf. India has had a good average rate of proven reserves replacement of 162 per cent over the past decade.

Sector organisation

State-owned companies play a dominant role in India's gas sector. The price of domestic gas is government regulated.

The Ministry of Petroleum and Natural Gas (MoPNG) oversees the oil and gas industry, from exploration and production to distribution, marketing and pricing. It has authority over state-owned oil and gas companies (Oil and Natural Gas Corporation and Oil India Ltd), which accounted for 71 per



cent and 9 per cent respectively of national domestic gas production in 2017-18. Private companies entered the country in the late 1990s.

The state-controlled Gas Authority of India Ltd (GAIL) owns and operates more than two-thirds of the country's gas pipeline network. The MoPNG announced the unbundling of GAIL in 2019, which should help create an independent transmission system operator to foster liquid gas trades across India. This would help bring further flexibility and transparency to the system. India has no international pipeline connections.

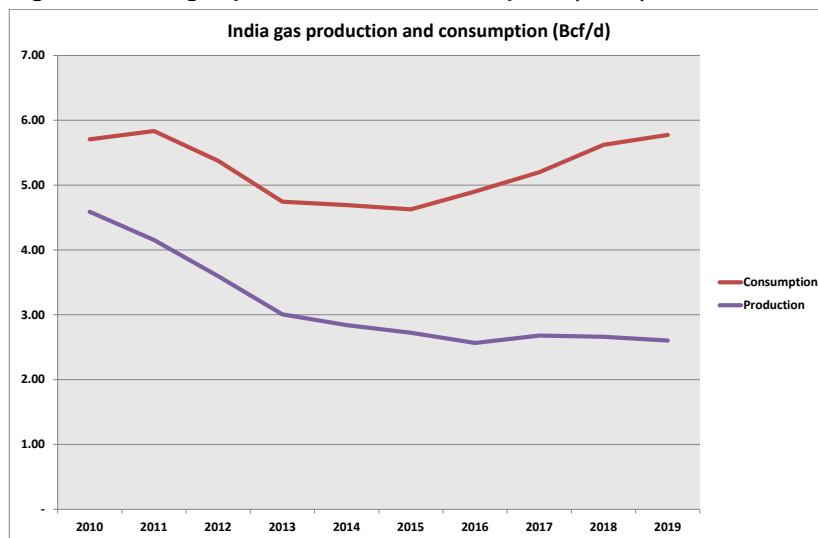
India has six LNG import terminals, with a total receiving capacity of almost 40 Mtpa. Two terminals have been commissioned in the past two years – Ennore LNG (5 Mtpa, owned by state-owned Indian Oil Corp.) and Mundra LNG (5 Mtpa, owned equally by state-owned Gujarat State Petroleum and Adani Group). Other import terminals are under development, including three floating storage and regasification (FSRU) projects. Privately owned Petronet LNG, based in India, is a key player in the country's LNG imports, operating 20 Mtpa of capacity. Shell operates the 5 Mtpa Hazira terminal.

India ranks poorly at 60 out of 80 in the Policy Perceptions Index of the Fraser Institute's 2018 Global Petroleum Survey of Barriers (Fraser Institute, 2018).

Gas production, consumption and prices

Annual gas production declined sharply between 2010 and 2015 and has since oscillated around 0.9 Tcf. Consumption has increased since 2015, with the growing shortfall of domestic supply filled by LNG imports (Figure 22). Even with rising LNG imports, the role of gas in India's fast-growing energy market has shrunk over the past decade (IEA, 2020). Gas comprised only 6 per cent of total energy consumption in 2019 (BP, 2020).

Figure 22 India gas production and consumption (Bcf/d)



Source: BP (2020)

Industry and power generation together accounted for 90 per cent of natural gas consumption in 2017, with the remainder used in transport, the residential and services sectors and in oil and gas production. Nearly three-quarters of industrial consumption stems from non-energy purposes, namely as feedstock in petrochemical and fertiliser industries. Gas-fired power generation increased from 87 TWh in 2008, to between 113 TWh and 116 TWh in the period 2009-11, before falling to around 60 TWh in 2013, corresponding to the drop in domestic gas production. Gas-fired power generation



picked up somewhat to 71 TWh in 2017, but India still has a large installed capacity of gas power that is not fully utilised (IEA, 2020).

The average Indian wholesale gas price in 2019 was US\$5.75/MMBtu (IGU, 2020).

Most of India's domestic gas production is produced by state-owned oil companies and gas prices have been regulated for decades. In 2014, the government introduced a pricing mechanism based on a consumption-weighted average basket of international natural gas prices for the US, Canada, Europe and Russia. These countries were selected to minimise links to high-price areas, notably Japan net back LNG prices. The price is reviewed every six months, based on price and volume data for the previous year. The price does not reflect supply and demand, nor the costs of discovery and production in India.

The government also intervenes in the end use of domestic gas by directing the allocation of produced gas to city gas distribution networks (for residential use and transport, with the goal of replacing oil imports), then the power sector, fertiliser producers and other sectors.

Policy issues

The government aims to increase the share of natural gas in the country's energy mix from 6 per cent to 15 per cent by 2030. Increasing domestic production is also a key government priority, as output has been below forecast levels over the past few years (IEA, 2020).

Growth in domestic production will not be achieved under existing price regulation. Domestic prices have been restricted to below the cost of production by linking them to a basket of very low international reference prices. The domestic gas selling price from conventional gas fields in India for October 2020 – March 2021 was set at \$1.79/MMBtu, one of the lowest on record and well below producers' breakeven level of around \$3.00-\$4.00/MMBtu (Platts, 15 October 2020).

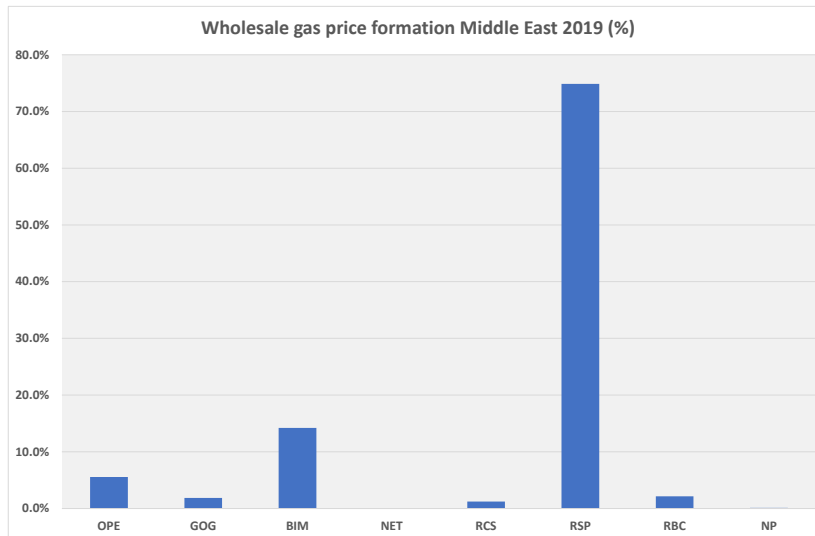
The government proposed a gas trading hub in 2018, but progress has been slow. In October 2020, an e-bidding mechanism for gas from new domestic fields was announced, but this will cover only a limited portion of domestic production.

The IEA (IEA, 2020) states that costs will have to come down for natural gas to compete in India, which should include the rationalisation of subsidies for coal and LPG and adjustment of the GST. Since natural gas does not fall under the GST, gas consumption is taxed at several state and central government levels, in addition to the gas transport tariffs. Bringing natural gas under the GST and introducing a postage stamp gas transport tariff would reduce these costs and create a level playing field with other fuels.

9. Middle East-North Africa

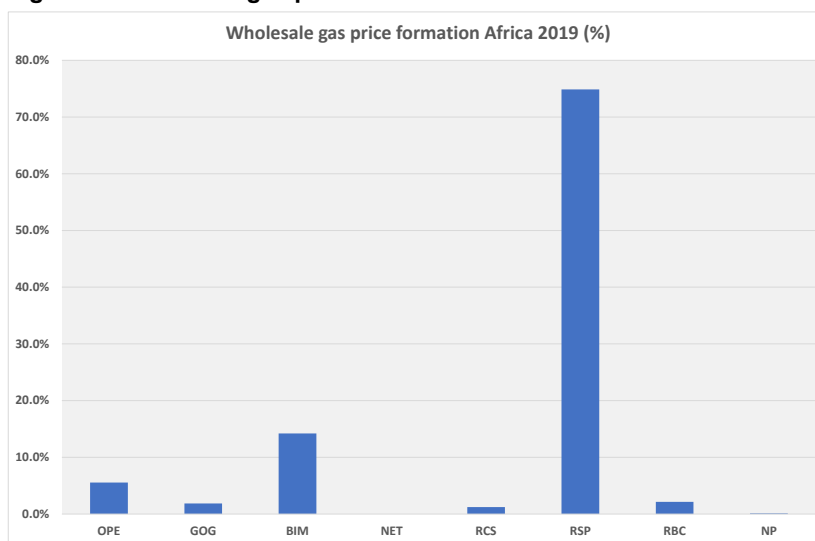
Wholesale gas prices in the Middle East and North Africa (MENA) are generally regulated for social and political purposes (Figure 23 and Figure 24).

Figure 23 Wholesale gas price formation Middle East 2019



Source: IGU (2020).

Figure 24 Wholesale gas price formation Africa 2019

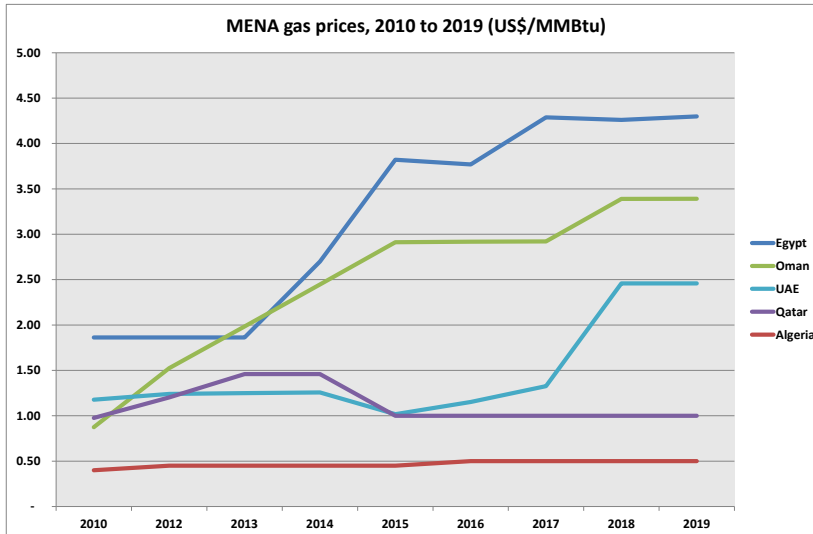


Source: IGU (2020) Also includes South Africa, the only other major African gas consuming country.

However, despite the policy settings, prices have increased in Egypt, Oman and the UAE (Figure 25).



Figure 25 MENA gas prices, 2010 to 2019 (US\$/MMBtu)



Source: IGU (2020)

The Oxford Institute for Energy Studies has undertaken substantial research on natural gas markets in the Middle East and North Africa. See particularly Fattouh and Stern (2011), Darbouche (2012 (a)) and Stern (2012). This section draws heavily on this work.

Darbouche (2012 (a)) makes a number of general points about gas markets in MENA countries:

- MENA countries hold 42 per cent of the world's proven gas reserves.
- Domestic gas demand is growing quickly (at an average rate of 6.5 per cent per annum over the last 10 years). In many of these countries demand has been growing faster than supply, leading to gas shortages, export restrictions and even imports of gas.

One of the causes of the fast growth in domestic demand is end-user gas prices at artificially low levels, below opportunity costs and below marginal costs of new supply in some instances. This reflects government intervention in price-setting.

- Energy subsidies reflect the fact that gas was often initially produced in association with oil production and considered a free good. Low gas and power prices are used by unaccountable governments to maintain the political status quo and gas is also seen as providing a comparative advantage in economic development.
- MENA countries use gas as a basis for their industrialisation strategies, which are largely based on the development of energy-intensive industries such as petrochemicals, steel, aluminium and fertilisers. However, as gas shortages have become more acute in countries such as Algeria, Egypt, Oman and Saudi Arabia, governments are considering taking, or have taken action towards increasing gas prices for energy-intensive industries, especially those that are export-oriented.
- Gas prices in the main gas producing countries in MENA are well below both international prices and the cost of new domestic gas supply (marginal cost). They vary from US\$0.75/MMBtu in Saudi Arabia, US\$0.80/MMBtu in Kuwait, US\$1.00/MMBtu in Qatar and the UAE to about US\$0.6/MMBtu in Algeria, and US\$1.25-3.00/MMBtu in Egypt.



- Most of these countries are facing gas shortages of some sort, owing in the majority of cases to growing gas demand, fuelled largely by the artificially low prices, and their inability to bring new gas supply to market under the prevailing pricing and other commercial conditions.

Anne-Sophie Corbeau of the IEA has noted that most Middle Eastern countries are struggling to develop gas fields due to increasingly difficult fields and low gas prices.

Gavin (2012) reports that the Gulf Cooperation Council states are migrating to higher gas prices. In many of these countries (excluding Qatar) the marginal cost of finding and developing gas is substantially higher than the domestic gas price. The increases include the prices of ethane and naphtha for the petrochemical industry, which are also subsidised. The U.S. with the shale gas development is becoming more attractive for petrochemicals than the Middle East.

Algeria

Main points

- Algeria is rich in both oil and gas. It is a member of OPEC and a gas exporter.
- The government plays a pervasive role in Algeria's economy. This applies in particular to the petroleum sector, which is dominated by Sonatrach, the government-owned national oil company.
- Wholesale gas prices, which are regulated, are among the lowest in the world and appear to be below marginal cost.
- Gas comprises 64 per cent of primary energy demand and is the major fuel for power generation. Gas exports are projected to decline significantly from 2030 because of lack of volumes due to growth in domestic demand.
- Over the last decade Algeria has been able to replace its gas reserves through exploration, but foreign investors have been reluctant to invest and the country is notorious for development delays of 10 to 15 years.
- Overall the domestic gas market interventions have had perverse effects and are unsustainable.

Economy

According to the CIA Factbook (CIA, 2020):

- Algeria has a population of 43 million (July 2020 estimate). GDP is US\$630 billion (2017 estimate) and GDP per capita is US\$15,200, ranking 109 in the world.
- Algeria's economy remains dominated by the state, a legacy of the country's socialist post-independence development model. In recent years the Algerian Government has halted the privatization of state-owned industries and imposed restrictions on imports and foreign involvement in its economy, pursuing an explicit import substitution policy. Hydrocarbons have long been the backbone of the economy, accounting for roughly 30 per cent of GDP, 60 per cent of budget revenues, and nearly 95 per cent of export earnings.
- Declining oil prices have reduced the government's ability to use state-driven growth to distribute rents and fund generous public subsidies, and the government has been under pressure to reduce spending. Over the past three years, the government has enacted incremental increases in some taxes (petrol, cigarettes, alcohol, and certain imported goods), but it has refrained from reducing subsidies, particularly for education, healthcare, and housing programs.
- Algeria has increased protectionist measures since 2015 to limit its import bill and encourage domestic production of non-oil and gas industries. Since 2015, the government has imposed



additional restrictions on access to foreign exchange for imports, and import quotas for specific products, such as cars. In January 2018 the government imposed an indefinite suspension on the importation of roughly 850 products, subject to periodic review.

- The government announced in 2017 that Algeria intended to develop its non-conventional energy resources. Algeria has struggled to develop non-hydrocarbon industries because of heavy regulation and an emphasis on state-driven growth. Algeria has not increased non-hydrocarbon exports, and hydrocarbon exports have declined because of field depletion and increased domestic demand.

Algeria ranks relatively poorly (89 out of 141) in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Algeria ranked 16 in proven oil reserves and production in 2019 (BP, 2020). The country is also rich in gas, with proven reserves of 153 Tcf (ranked 11 globally) and production of 3.0 Tcf (ranked 10 globally) in 2019. Algeria is an important supplier of pipeline gas to Italy and Spain and the eighth largest LNG producer. LNG exports commenced in 1964.

According to BP (BP, 2020), Algeria's proven gas reserves have been 152 Tcf ever since 2005, implying a 100 per cent reserves replacement rate, which is unlikely. Other sources such as the OPEC Annual Statistical Bulletin have similar flat estimates, implying that the government keeps the real estimates confidential and they are probably overstated. New Algerian energy minister Abdelmadjid Attar says expanding oil and gas reserves of the country is a key priority (S&P Global Platts, 2020). Algeria's large but untapped potential is a common theme. Attar also said he believes that Algeria's hydrocarbon potential is huge, both onshore and offshore. Algeria is believed to have significant shale gas potential.

Sector organisation

The government-owned Algerian national oil company, Sonatrach, has traditionally played a key role in all aspects of the oil and natural gas sectors in Algeria. In 2006, the government introduced a law that required a minimum 51 per cent participating interest for Sonatrach, forcing all foreign companies to work in partnership with the national oil company. Sonatrach accounts for around 80 per cent of Algerian hydrocarbon production. The other 20 per cent is produced by foreign companies.

Algeria ranks poorly at 57 out of 80 in the Policy Perception Index of the Fraser Institute 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

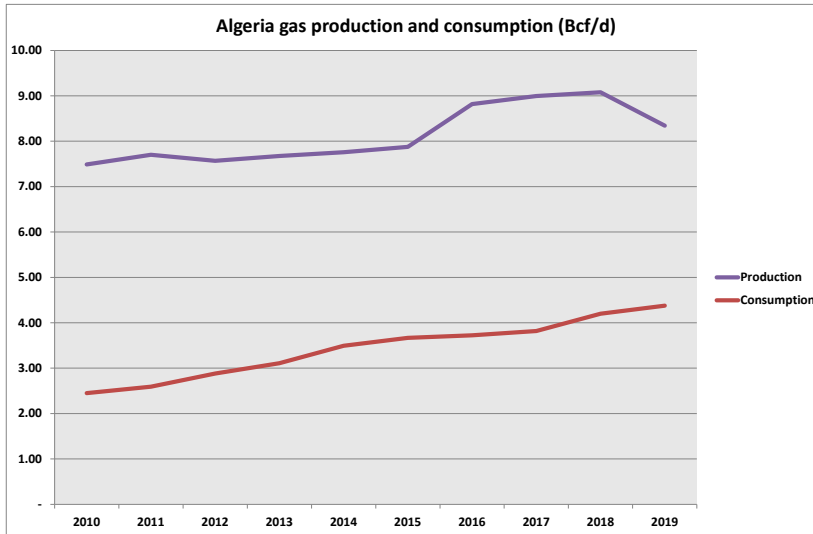
Algeria's domestic energy market relies heavily on gas, which comprised 64 per cent of the country's primary energy requirements in 2019 (BP, 2020). The power sector is almost wholly reliant on gas. Household and small business consumption of gas has grown rapidly under a 'gasification program'.

Production has declined significantly in 2019, despite the start-up of three projects with combined annual output of 320 Bcf (Reggane Nord, Timimoun and Touat) in a new southwestern hydrocarbon province. The projects faced delays of 10 to 15 years due to administrative and contracting problems and infrastructure constraints (Oxford Institute for Energy Studies, 2019).

Figure 26 shows production and consumption of sales gas.



Figure 26 Algeria gas production and consumption (Bcf/d)



Source: BP (2020)

Production declined in 2019, but there was no easing of the strong growth in domestic consumption that has characterised the past decade. Growth in domestic demand has been fuelled by heavily subsidised domestic gas prices. Between 2008 and 2018, total gas use by the domestic market increased by 70 per cent at an average annual growth rate of over 5 per cent (Oxford Institute for Energy Studies, 2019). The three main segments of Algeria's domestic natural gas consumption are power stations, the public gas distribution sector (supplying households, commercial and small/medium size industrial users) and large industry. Presently, the power sector, where natural gas represents 98 per cent of total fuel use, accounts for the largest share of total domestic gas use.

Algeria's energy minister, Abdelmadjid Attar, a former Sonatrach chief executive, recently said the country's annual gas exports may need to fall to 0.9-1.1 Tcf a year from 2030 because of the country's reserves position and growing domestic consumption (Argus Media, 2020). Total exports (pipeline and LNG) were 1.4 Tcf in 2019.

Gas prices in Algeria are among the lowest in the world at US\$0.50/MMBtu (IGU, 2020) as a result of regulation that sets the price of all gas supplied by Sonatrach to domestic customers. This is well below the cost of production, transmission and distribution when considering the weighted average wellhead cost of production was estimated at US\$0.70/MMBtu (Oxford Institute for Energy Studies, 2016). A number of other commodities have also been subsidised by government for many years, including electricity, water, milk and cereals.

Policy issues

Algeria's public finances have been severely affected by the sharp downturn in oil prices caused by national lockdowns to control the spread of COVID-19. In May, 2020, President Tebboune, who was elected only six months earlier after a wave of protests forced his predecessor's resignation, announced the national budget would be cut by 50 per cent, despite high unemployment and civil unrest. Sonatrach had already announced a 50 per cent cut in its own spending.

The current crisis in Algeria's budget position extends back to the collapse of oil prices in 2014 and can be measured by a sharp decline in the country's foreign currency reserves from a peak of US\$194 billion in April 2014 to US\$62 billion at the start of 2020. The collapse in oil prices in 2014 prompted a renewal of plans to diversify the economy, but the government failed to make progress



and left the country highly exposed to external shocks such as the global pandemic. Foreign currency reserves dropped further in the first nine months of 2020 to US\$50 billion and raised the prospect of a rescue package from the International Monetary Fund (IMF), but this has been rejected by President Tebboune.

The external shocks have highlighted longer running and unsustainable energy policy in two key areas – high taxing and unattractive terms for investment by foreign oil companies, and regulated domestic gas prices set at below the cost of production. A new petroleum law took effect in January 2020 to encourage investment by foreign companies with the capital and skills to reverse declining production. However, the prospects of new investment have been undermined by the COVID-19 pandemic.

The Algerian government will find moving away from heavily subsidised gas prices extremely difficult in the current economic and social environment. In 2018, domestic electricity and gas price subsidies in Algeria were estimated to be about US\$8 billion, representing over four per cent of the country's gross domestic product (IEA, 2020). Natural gas price subsidies alone accounted for US\$4 billion. However, without change the country will accelerate its slide into debt and further jeopardise the volumes of gas available for profitable export commitments. Overall the domestic gas market interventions have had perverse economic effects and are unsustainable.

Egypt

Main points

- Gas market reform has rejuvenated Egypt's gas industry.
- Prices are still regulated for large volumes of production, but rapid progress is being made towards a liberalised market in which private companies can market and sell their own gas.
- An increase in gas prices in 2014 attracted new exploration investment from international oil companies and preceded a wave of major offshore discoveries, including the supergiant Zohr field, which moved quickly into production by 2017.
- Subsidies for energy consumption (liquid fuels, electricity and gas) are being reduced or eliminated, which is containing growth in gas demand and contributing towards a return to significant gas exports.

Economy

According to the CIA Factbook (CIA, 2020):

- Egypt has a population of 104 million (July 2020 estimate). GDP is US\$1.2 trillion or US\$12,700 per capita (124 in world ranking).
- Despite Egypt's mixed record for attracting foreign investment over the past two decades, poor living conditions and limited job opportunities have contributed to public discontent. These socioeconomic pressures were a major factor leading to the January 2011 revolution that ousted former president Mubarak. The uncertain political, security, and policy environment since 2011 has restricted economic growth and failed to alleviate persistent unemployment, especially among the young.
- In late 2016, persistent dollar shortages and waning aid from its Gulf allies led Cairo to turn to the IMF for a 3-year, US\$12 billion loan program. To secure the deal, Cairo floated its currency, introduced new taxes, and cut energy subsidies - all of which pushed inflation above 30 per cent for most of 2017, a high that had not been seen in a generation. Since the currency float, foreign investment in Egypt's high interest treasury bills has risen exponentially, boosting both dollar



availability and central bank reserves. Cairo will be challenged to obtain foreign and local investment in manufacturing and other sectors without a sustained effort to implement a range of business reforms.

Egypt ranks poorly at 93 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Egypt ranks 25 in global oil reserves and 26 in production (BP, 2020). It is not a member of OPEC. It ranked 13 in natural gas producers in the world in 2019.

LNG exports commenced in 2005 through two facilities – Idku LNG and SEGAS Damietta LNG. Idku (Shell 35 per cent, Petronas 35.5 per cent) is a two-train project with a nameplate capacity of 7.2 Mtpa. SEGAS Damietta, operated by Eni and with a capacity of 5 Mtpa, was idled in 2012 due to Egypt's declining gas production. A restart of production is under consideration with Egypt's return to a gas surplus in 2019.

As at the end of 2019, Egypt had 75.5 Tcf of proven natural gas reserves, ranking 16 in global natural gas reserves. Over the last decade it has had an average proven reserves replacement rate of 100 per cent (BP, 2020).

Sector organisation

A new gas market law implemented in 2018 created an independent body, the Gas Market Regulatory Authority (GasReg) as part of a fundamental restructure of Egypt's domestic natural gas market. Announcing the law in 2017, the Egyptian government stated its aim was for the gas market to be fully liberalised by 2022. A key feature of this new law is that it allows private companies to procure and market their own gas supplies directly. Historically, gas marketing and sales were done through the state-owned Egyptian Natural Gas Holding Company, which had played the role of national aggregator of gas supplies to the domestic market.

International oil companies play a large role in Egypt's upstream oil sector, holding shares in producing assets in partnership with the Egyptian General Petroleum Corporation. BP, Eni and Shell are major oil and natural gas companies active in Egypt.

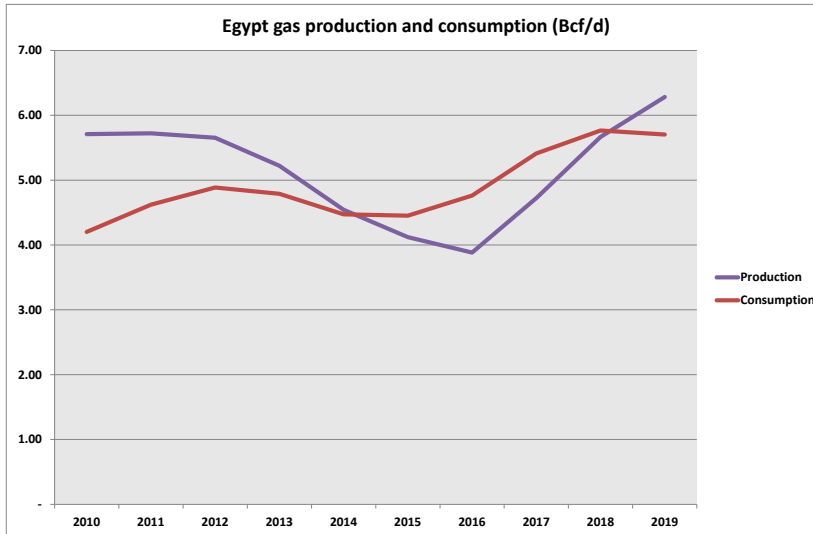
Egypt ranks poorly at 54 out of 80 in the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

Figure 27 shows Egyptian gas production and consumption over the past decade.



Figure 27 Egypt gas production and consumption (Bcf/d)



Source: BP (2020)

Production decreased by 31 per cent between 2012 and 2016, leading to net imports from 2015. Egypt had to divert its natural gas supply away from exports to the domestic market and to rely on LNG imports to address the shortfall in consumption. Egypt acquired two FSRUs in 2015. Plans for a third FSRU were cancelled in 2016 because of higher anticipated domestic production.

Much of the natural gas consumed in Egypt is used to fuel electric power plants and the government encourages households, businesses, and the industrial sector to consider natural gas as a substitute for petroleum products and coal. Gas comprised 54 per cent of primary energy consumption in 2019 (BP, 2020).

Gas production has recovered since 2016 and returned to a small surplus against consumption in 2019, but exports of gas are still highly constrained. In 2019, Egypt exported 3.0 Mt through Idku LNG, equivalent to only 25 per cent of nameplate capacity of 12.2 Mtpa. Idku shipments in 2020 have been affected by record lows in LNG spot prices and the demand-impact of COVID-19. There were no shipments between March and August (Platts, 9 October 2020).

The recovery in production began in 2017 with the commissioning of the first of a series of recent offshore discoveries. By far the most significant discovery is the giant Zohr gas field, which followed a decision by the Egyptian government to revise its gas pricing policies to pay more for natural gas produced from deep-water areas.

The first of the new wave of projects is the West Nile Delta (WND) (BP 82.75 per cent, DEA Deutsche Erdoel AG 17.25 per cent). A third phase of development is due to be commissioned by the end of 2020, lifting total production to 1.2 Bcf/d. BP also commissioned in 2018 the Atoll gas project, producing 0.35 Bcf/d.

The first phase of WND was followed in late 2017 by the start of from Zohr (Eni 50 per cent, Rosneft 30 per cent, BP 10 per cent and Mubadala 10 per cent) just two years after its discovery. With an estimated reserve of 30 Tcf, Zohr is the largest gas discovery in the Mediterranean. In August 2019, production reached a target of 2.7 Bcf/d (1 Tcf/y) five months ahead of schedule.

The wave of new production allowed Egypt to cease LNG imports in 2019, with increases in Egypt's gas exports expected to follow in 2020.



Gas consumption in Egypt is dominated by power generation, accounting for more than 60 per cent of the country's total gas use. Historical price subsidies have strongly encouraged demand, which is evenly split between residential and industrial sectors (Oxford Institute For Energy Studies, 2018). In 2016, Egypt committed to phase out subsidies as part of a US\$12 billion reform package agreed with the International Monetary Fund. Substantial progress has been made, with prices increased by an average of 15 per cent in FY 2020, and zero spent on subsidies in the first half of the year (Reuters, 2020). Growth in gas demand for power generation is likely to be moderated by the price reform and the promotion of renewable energy projects in the country funded by the private sector. The government is targeting 42 per cent of electricity generation from renewables by 2035.

Wholesale gas prices in Egypt have more than doubled from US\$1.86/MMBtu in 2013 to US\$4.30/MMBtu in 2019 (IGU, 2020). The 2019 price is significantly higher than any other country in the MENA region and reflects major gas price reform by the Egyptian government to reduce or eliminate subsidies.

Gas prices paid to upstream companies were fixed at US\$2.65/MMBtu for many years until 2014, when a new pricing mechanism was introduced to reverse a decline in exploration investment. This allowed prices of up to US\$5.88/MMBtu (Oxford Institute For Energy Studies, 2018). In 2018, the overhaul of the gas market began a further phase of price reform in the first steps towards a fully liberalised market.

In October 2019, the government lowered gas prices for certain industries in response for demands from manufacturers for domestic prices to reflect weakening global gas prices. Prices for cement manufacturers were cut from US\$8.00/MMBtu to US\$6.00/MMBtu. Prices for businesses in the iron and steel, aluminium, copper and porcelain industries were reduced from US\$7.00/MMBtu to US\$5.50/MMBtu.

Policy issues

As recently as five years ago, Egypt was suffering all the usual economic problems of countries with regulated and subsidised gas prices – rapidly falling production, surging domestic demand, cuts to gas exports and ballooning public debt. Policies introduced in 2014 began a dramatic shift, helped along by world-class gas offshore gas discoveries that have created a booming gas industry in 2020.

Oman

Main points

- While Oman is not a member of OPEC, it has substantial oil and gas reserves and has been an LNG exporter since 2000.
- Wholesale gas prices have increased from below the cost of production at about US\$1.50/MMBtu in 2013 to US\$3.39/MMBtu in 2019.
- This has encouraged foreign investors, who have also been attracted by multi-Tcf onshore gas discoveries. A combination of improved prices and favourable geology has reversed shortages of gas created by low regulated prices and allowed Oman to encourage gas-intensive industries.

Economy

According to the CIA Factbook (CIA, 2020):

- Oman has a population of 4.7 million (December 2019 estimate). GDP is US\$190 billion or US\$46,000 per capita (37 in world ranking).



E N E R G Y Q U E S T

- Oman is heavily dependent on oil and gas resources, which can generate between 68 per cent and 85 per cent of government revenue, depending on fluctuations in commodity prices. In 2016, low global oil prices drove Oman's budget deficit to \$13.8 billion, or approximately 20 per cent of GDP, but the budget deficit is estimated to have reduced to 12 per cent of GDP in 2017 as Oman reduced government subsidies.
- Oman is using enhanced oil recovery techniques to boost production, but it has simultaneously pursued a development plan that focuses on diversification, industrialization, and privatization, with the objective of reducing the oil sector's contribution to GDP. The key components of the government's diversification strategy are tourism, shipping and logistics, mining, manufacturing, and aquaculture.
- Muscat has notably focused on creating more Omani jobs to employ the rising number of nationals entering the workforce. However, high social welfare benefits - that had increased in the wake of the 2011 Arab Spring - have made it impossible for the government to balance its budget in light of current oil prices. In response, Omani officials imposed austerity measures on its gasoline and diesel subsidies in 2016. These spending cuts have had only a moderate effect on the government's budget, which is projected to again face a deficit of \$7.8 billion in 2018.

Oman ranks 53 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019), reflecting a relatively open economy.

Petroleum Sector

Oman ranks 21 in global oil reserves and 20 in production (BP, 2020). It ranked 20 in global gas production in 2019 and tenth in LNG production. LNG exports commenced in 2000 and reached a record 9.5 Mt in 2019, representing 91 per cent of nameplate capacity. As at the end of 2019, Oman had 23.5 Tcf of proven natural gas reserves, ranking 27 in global natural gas reserves (BP, 2020).

Over the last decade, Oman has replaced gas production with proven reserves additions (100 per cent reserves replacement rate) (BP, 2020).

Gas accounts for a high proportion (60 per cent) of the country's primary energy consumption (BP, 2020), reflecting fast-growing consumption of gas by industrial projects. The Central Bank of Oman (2019) reported that industrial projects used 27.7 BCM (63 per cent of Oman's gas production) in 2018, up from 23.2 BCM (60 per cent) in 2017. Gas use by oil projects was the next largest category, followed by gas-fired power generation for the rest of the economy.

In 2018, the government announced it was targeting 30 per cent of electricity from renewable sources by 2030. This led to the introduction of subsidised solar photovoltaics for households, and large-scale solar projects by Petroleum Development Oman (PDO). In 2019, PDO signed a power purchase agreement with Marubeni to develop the 100 MW Amin solar project.

Sector organisation

According to the EIA (EIA, 2020), PDO, 60 per cent owned by the Oman government and 34 per cent by Shell, accounts for nearly all of Oman's natural gas supply. Smaller contributions came from US independent Occidental Petroleum, which is the largest foreign presence in Oman's petroleum sector, and Thailand's PTTEP. The state-owned Oman Gas Company (OGC) directs the country's natural gas transmission and distribution systems. The OGC is a joint venture between the Omani Ministry of Oil and Gas (80 per cent) and the state-owned Oman Oil Company (20 per cent). Oman Liquefied Natural Gas (Oman LNG) – owned by a consortium including the government, Shell, and Total – operates all LNG activities in Oman through its three liquefaction trains in Qalhat near Sur.

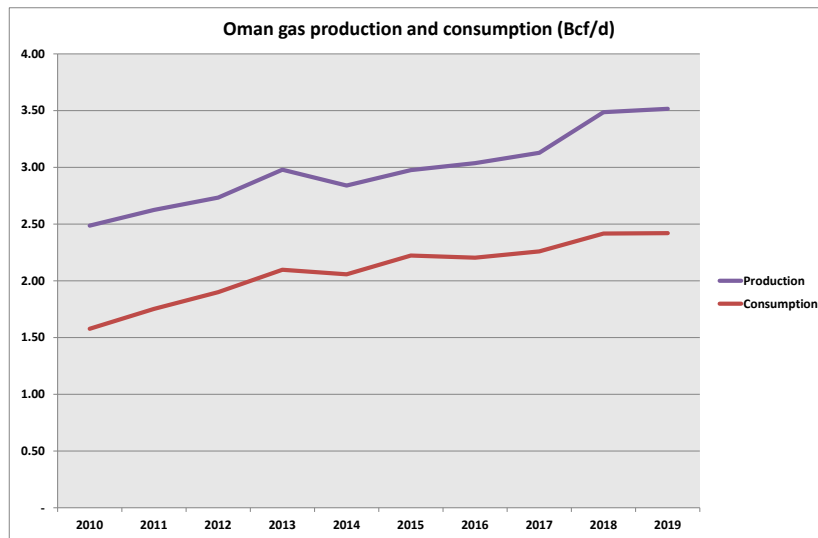


Oman ranks highly at 12 out of 80 in the Policy Perception Index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

Production of gas has risen significantly over the past decade (Figure 28). A series of major gas discoveries and developments will generate further growth over the next decade, even with natural field decline at existing projects. Gas is being earmarked for gas-to-liquids projects and gas intensive industry as part of government policy to diversify the economy from oil.

Figure 28 Oman gas production and consumption (Bcf/d)



Sources: BP (2020)

The new Khazzan-Makarem tight wet gas project (BP 60 per cent, OOC 40 per cent) is transforming domestic gas supply. A first phase reached its capacity of 1 Bcf/d in 2018. A second phase to lift production to 1.5 Bcf/d – equivalent to 60 per cent of domestic gas consumption – is due for commissioning in 2021. A total of 10.5 Tcf is expected to be produced over the life of the project.

Other multi-Tcf tight gas discoveries onshore Oman have generated strong interest and development proposals from Shell, Total and Eni. In 2018, Shell and Total began working with PDO to appraise development of tight gas in the Greater Barik region to feed a 45,000 bbl/d gas-to-liquids plant and a 1 Mtpa LNG bunkering facility.

Oman is a large exporter of gas through Oman LNG (Omani state 51 per cent, Shell 30 per cent), which began operations in 2000. The plant has three trains with a nameplate capacity of 10.4 Mtpa. Most of the gas is sold to South Korea. Although Oman is a large net exporter of gas, it has also imported gas via the Dolphin Pipeline from Qatar since 2008 under a 25-year, fixed price gas supply agreement. Oman has also been in discussions with Iran since 2014 about a potential pipeline to import up to 0.35 Tcf a year.

Under the current Dolphin contract gas costs around US\$1.30/MMBtu. However, the cost of additional volumes may be US\$5.00/MMBtu (Ledesma, 2011).

A decade ago wholesale gas prices were US\$1.50/MMBtu for the power sector and industry and US\$0.80/MMBtu for methanol and fertiliser (Ledesma, 2011). (The IGU cited an average of US\$1.25/MMBtu in 2010). According to Ledesma (2011) one factor that was holding back international and domestic companies from gas exploration and development was low domestic gas



prices. Industries were able to buy gas at US\$0.80-1.50/MMBtu but the newer non-associated reserves cost US\$2.50-5.00/MMBtu to develop and need higher gas prices. (Gavin (2012) reports the cost of developing BP's Block 61 tight gas project was possibly US\$8/MMBtu.)

According to Gavin (2012), Oman increased gas prices for fertiliser from US\$0.80/MMBtu to US\$1.50/MMBtu for 2012, rising to US\$3/MMBtu by 2015.

The IGU cites a 2019 wholesale gas price of US\$3.39/MMBtu (IGU, 2020). Prices received by Oman for LNG in the June quarter 2020 ranged from US\$9.71/MMBtu (Japan) to US\$11.49/MMBtu (South Korea), implying a substantial opportunity cost for low-priced domestic gas.

Policy issues

A decade ago, Oman was beginning to suffer the consequences of being addicted to the short-term economic and political payback of cheap gas. Natural decline from existing fields, lack of new development and surging domestic consumption were hitting the economy. There was insufficient gas to meet the needs of gas-fired power generators in seasonal peak times, and valuable gas exports were being curtailed.

In 2019, Oman is reaping the benefits of good management and good geology. A steady increase in regulated gas prices has encouraged foreign oil majors to bring their capital and skills. This has already translated into a major boost in national gas production from the Khazzan-Makarem tight wet gas project, and created the prospect of new gas-intensive projects fed by other large discoveries.

Qatar

Main points

- Qatar is one of the world's major oil producers, has the third largest gas reserves and is the second biggest LNG producer.
- Gas comprises 88 per cent of primary energy demand and is used for power generation and a range of industries controlled by Qatar Petroleum (QP).
- The government is market-oriented. QP, the government-owned national oil company dominates all aspects of petroleum (including downstream industries) but is market-oriented.
- Most gas is exported as LNG but Qatar does also use low domestic prices (set by QP and among the lowest in the world) to develop gas intensive industry. The downstream industries are all effectively controlled by QP. Qatar has encouraged foreign investment by international oil companies (in partnership with the national company) and has a competitive economy. However, it does have the world's third highest per capita greenhouse emissions.
- With a small population and huge oil and gas reserves, Qatar is an exception to the general pattern in other MENA countries, having so far been able to pursue a strategy of large scale LNG production, low domestic gas prices and development of energy-intensive industry without the problems that have afflicted many other countries.

Economy

According to the CIA Factbook (CIA, 2020):

- Qatar has a population of 2.4 million (July 2020 estimate), of which Qatari citizens are less than 300,000, the remainder being expatriates and foreign workers. GDP is US\$340 billion and US\$124,100 per capita, the second-highest in the world.



- Qatar's oil and natural gas resources are the country's main economic engine and government revenue source, driving Qatar's high economic growth and per capita income levels, robust state spending on public entitlements, and booming construction spending, particularly as Qatar prepares to host the World Cup in 2022. Although the government has maintained high capital spending levels for ongoing infrastructure projects, low oil and natural gas prices in recent years have led the Qatari Government to tighten some spending to help stem its budget deficit.
- Qatar's reliance on oil and natural gas is likely to persist for the foreseeable future, but the government has made significant gains in strengthening non-oil sectors, such as manufacturing, construction, and financial services. Non-oil GDP has risen steadily in recent years to just over half the total.
- Following trade restriction imposed by Saudi Arabia, the UAE, Bahrain, and Egypt in 2017, Qatar established new trade routes with other countries to maintain access to imports.

Qatar ranks 29 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Qatar is a major player in the oil market (ranking 14 in both global oil reserves and production), but exited OPEC in January 2019, citing its intention to focus on gas although analysts suggested the decision was designed to increase Qatar's autonomy from its Persian Gulf neighbours (New York Times, 2018). With proven gas reserves of 872 Tcf, Qatar ranks third globally behind only Russia and Iran (BP, 2020). Qatar was the third largest gas producer in the world in 2019 and shipped more LNG than any other nation except Australia. LNG exports began in 1997 and within a decade Qatar had overtaken Malaysia and Indonesia to become the world's largest LNG producer. The current production capacity of 77 Mtpa was reached in 2011. A major expansion to 110 Mtpa by 2025 was confirmed in May, and further expansion to 126 Mtpa or beyond by 2027 is being considered (The Australian Financial Review, 2020). Qatar also sends gas through the Dolphin Pipeline to the UAE and Oman, supplying 700 and 70 Bcf respectively in 2019 (BP, 2020).

Sector organisation

The state-owned QP controls all aspects of Qatar's upstream and downstream oil and natural gas sectors, including exploration, production, transport, storage, marketing, and sale of crude oil, natural gas, natural gas liquids, liquefied natural gas, gas-to-liquids, refined products, and petrochemicals and fertilisers.

Qatar often focuses its natural gas development on integrated, large-scale projects linked to LNG exports or downstream industries that use natural gas as a feedstock. These projects tend to include investment from international oil companies with the technology and expertise in integrated megaprojects, including ExxonMobil, Shell, and Total. The Qatargas Operating Company Limited (Qatargas), which operates four major LNG ventures (Qatargas I-IV), and Ras Laffan Company Limited (RasGas), which operates three major LNG ventures (RasGas I-III), lead Qatar's LNG sector. Each venture has an individual ownership structure, although QP owns at least 65 per cent of each (EIA, 2020).

Gas production, consumption and prices

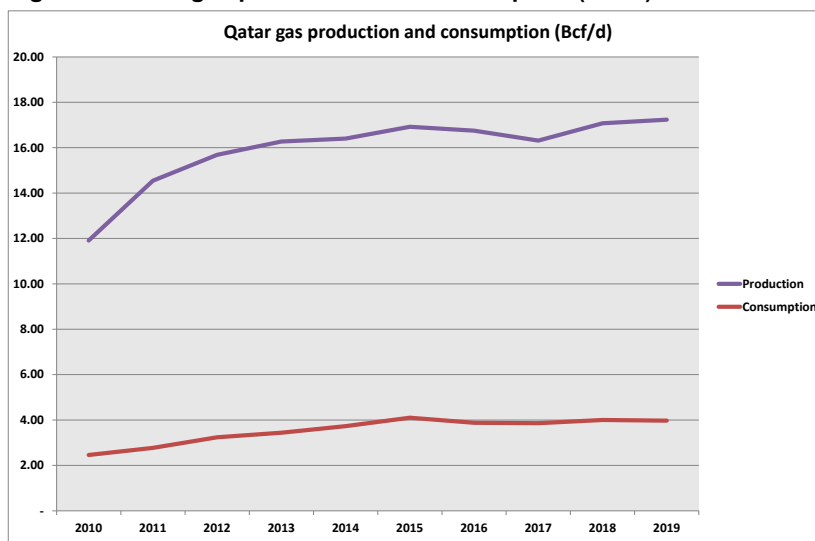
Although Qatar has a population of only 2 million people, it consumed more gas in 2019 than the Netherlands (population 17.3 million) (BP, 2020). Domestic gas demand is significant because the country relies entirely on gas to generate electricity, which powers the nation's energy-hungry LNG facilities. Gas comprised 88 per cent of Qatar's primary energy requirement in 2018 (IEA, 2020). The



government has set a target of 20 per cent of electricity from solar by 2030 (Olawuyi, 2018). This includes 100 per cent renewables to power the venues for 2022 World Cup. In January 2020, Marubeni (51 per cent) and Total (49 per cent) won the country's solar first tender with a proposal to build Qatar's first large scale solar project, Al Kharsaah, with 350 MW of capacity due on line by 2021 and a total of 800 MW by 2022 (Total, 2020).

Historically, both consumption and production of gas (Figure 29) have been closely correlated with national production of LNG, but consumption growth can be expected to moderate if Qatar meets its target for large production of renewable energy.

Figure 29 Qatar gas production and consumption (Bcf/d)



Source: BP (2020)

Wholesale gas prices are regulated and fixed at prices below the cost of production. The IGU listed Qatar's wholesale price at US\$1.00/MMBtu in 2019, which is unchanged since 2015 when the price was reduced from US\$1.46/MMBtu (IGU, 2020). Qatar has a long history of subsidising oil, gas and electricity prices (water and power are free for Qatari citizens), but the total value of subsidies has substantially reduced in 2019 (US\$511 million, down from US\$2.2 billion in 2018) (IEA, 2020).

Cheap gas has been used by the government to create a large base of gas-intensive industries, including fertilisers, chemicals, petrochemicals and steel.

Policy issues

While the Qatari petroleum sector and ancillary industries are effectively state-run, they are efficient and technically capable. Qatar also has a small population and substantial gas resources, making it easier to balance domestic and export demands.

Any value created in the associated gas-using industries such as petrochemicals is largely captured by Qatar through the state investments in these industries. However, it is relevant to ask whether these industries have been selected on a commercial basis as providing the highest returns to the state. A related consideration is that commercial practice in a vertically integrated company is that transfer prices are based on market rates. Selling gas at \$1.00/MMBtu is well below the opportunity cost of LNG sales and is likely to lead to resource misallocation in the downstream industries.

Policy issues for Qatar include lowering its GHG emissions, which were the third highest per capita in the world in 2018 (EU Science Hub, 2020), and ensuring economic growth after the country's fossil



fuel reserves are exhausted. The acceleration of activity in solar projects will help Qatar achieve both. That said, a series of upward revisions since 2017 in the country's LNG expansion plans suggests the government believes the super-giant North gas field will not be running out of gas any time soon.

United Arab Emirates

Main points

- The UAE has the world's ninth largest gas reserves and relatively small LNG exports, but is a net gas importer due to rapid economic growth and very low energy prices.
- Wholesale gas prices, which are around US\$2.50/MMBtu, have been at or below the cost of production for many years. Regulated electricity tariffs are also very low, stimulating consumption.
- Gas comprises 57 per cent of primary energy demand and is used almost exclusively for power generation.
- Development of new gas projects has not been able to keep up with domestic gas demand, but UAE is investing heavily in nuclear, clean coal and large scale solar to replace domestic gas demand for generation.

Economy

According to the CIA Factbook (CIA, 2020):

- The UAE has a population of 10.0 million (July 2020 estimate). GDP is US\$696 billion (2017 estimate) or US\$68,600 per capita, the 13th highest in the world.
- The UAE has an open economy, with a high per capita income and a sizable annual trade surplus. Successful efforts at economic diversification have reduced the portion of GDP from the oil and gas sector to 30 per cent.
- Since the discovery of oil in the UAE nearly 60 years ago, the country has undergone a profound transformation from an impoverished region of small desert principalities to a modern state with a high standard of living. The government has increased spending on job creation and infrastructure expansion and is opening up utilities to greater private sector involvement. The country's free trade zones - offering 100 per cent foreign ownership and zero taxes - are helping to attract foreign investors.
- The UAE's dependence on oil is a significant long-term challenge, although the UAE is one of the most diversified countries in the Gulf Cooperation Council. Low oil prices have prompted the UAE to cut expenditures, including on some social programs, but the UAE has sufficient assets in its sovereign investment funds to cover its deficits. The government reduced fuel subsidies in August 2015, and introduced excise taxes (50 per cent on sweetened carbonated beverages and 100 per cent on energy drinks and tobacco) in October 2017. A five-percent value-added tax was introduced in January 2018. The UAE's strategic plan for the next few years focuses on economic diversification, promoting the UAE as a global trade and tourism hub, developing industry, and creating more job opportunities for nationals through improved education and increased private sector employment.

The UAE ranked highly at 25 out of 141 countries in the 2019 Global Competitiveness Report (World Economic Forum, 2019).

Petroleum Sector

The UAE is a member of OPEC and ranks sixth in global oil production and eighth in proven oil reserves. It also has large reserves and production of gas, ranking ninth and 15th globally (BP, 2020).



BP's proven gas reserve figure of 209.7 Tcf has not changed in the past decade, which suggests a significant degree of uncertainty about the actual reserves position.

The UAE became the first Middle East country to export gas as LNG with the commissioning in 1981 of the Abu Dhabi LNG facility on Das Island, 160 kilometres off the coast from the mainland. The project is majority owned by state oil company Abu Dhabi National Oil Company (ADNOC), with minority stakes held by Mitsui, BP and Total. The project has a nameplate capacity of 5.8 Mtpa but has shipped about 5 Mtpa in recent years.

Rapid growth in domestic gas demand has made UAE a net importer of gas since 2008. Most of the imports are pipeline gas from Qatar. In 2014, the UAE started importing liquefied natural gas (LNG) from Dubai's Floating Storage and Regasification Unit (FSRU). The UAE secured a second FSRU-based import terminal in Abu Dhabi, which has been operational since September 2016.

Sector organisation

Abu Dhabi's natural gas sector is dominated by the Abu Dhabi National Oil Company (ADNOC). Abu Dhabi Gas Liquefaction Limited (ADGAS) controls the production and export of LNG.

UAE natural gas production and regulation falls to the individual emirates. International oil companies are present as minority partners in upstream and downstream projects, including Shell, BP, Occidental and Total. China National Petroleum Company took a 40 per cent stake in Al Yasat Petroleum, a new state-owned exploration company.

The UAE was not included in the Fraser Institute's 2018 Global Petroleum Survey due to a lack of responses, but the country has ranked highly in previous surveys. In 2017, UAE was a clear leader in the Policy Perception Index among countries in the Middle East and North Africa region and ranked 16 out of 98 globally (Fraser Institute, 2017).

Gas production, consumption and prices

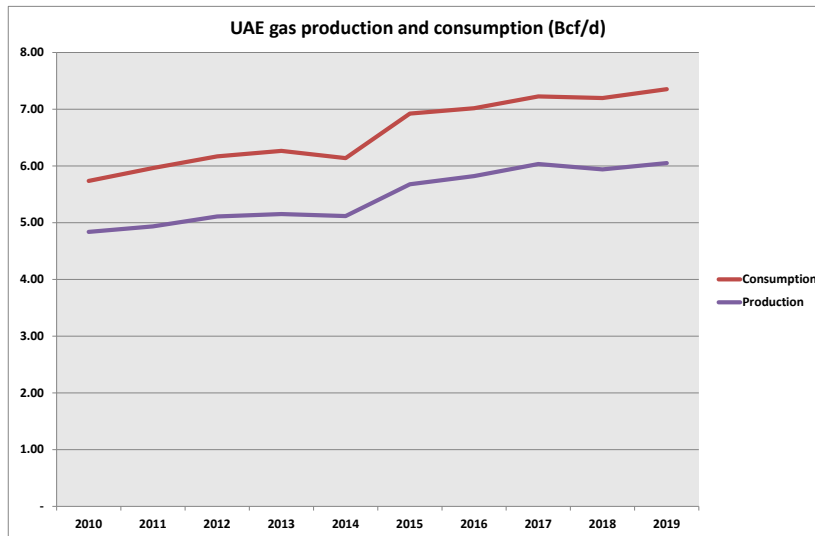
UAE relies heavily on gas, which accounted for 57 per cent of its primary energy consumption in 2019 (BP, 2020). Oil makes up nearly all of the balance (40 per cent).

Figure 30 shows UAE gas consumption has been consistently more than production for the past decade. According to the EIA (EIA, 2020), the UAE became a net importer of gas in 2008, despite steady growth in domestic production. Gas demand in the country is high because of an almost exclusive reliance on gas for electricity generation, rapid economic and population growth and the injection of large volumes of gas (estimated by EIA in 2012 to be up to 30 per cent of gas produced) into oil reservoirs as part of a large enhanced oil recovery program.

Most UAE natural gas imports come from Qatar through the Dolphin Energy pipeline project, a 3.2 Bcf per day subsea pipeline, which also connects to the other emirates and Oman. Flows through the Dolphin pipeline have remained relatively constant at about 2 Bcf/d because Qatar's compression facilities and contracted export volume limits the flows. The pipeline supplies all seven emirates and meets about 26 per cent of the country's natural gas demand (EIA, 2020).

UAE gas prices are low by global standards. IGU listed the average wholesale gas price at US\$2.46/MMBtu in 2019, unchanged from the previous year but well up from US\$1.02/MMBtu in 2015 (IGU, 2020).

Figure 30 UAE gas production and consumption (Bcf/d)



Source: BP (2020)

Policy Issues

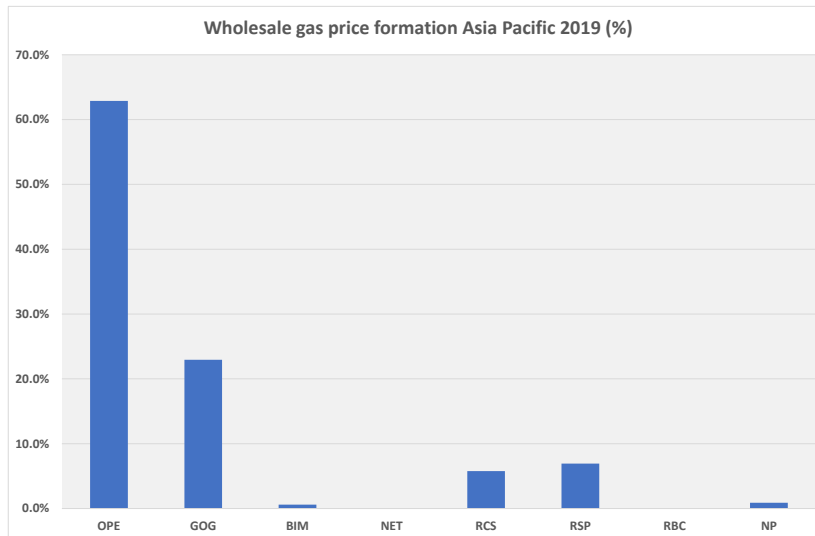
The UAE has taken bold steps under its Energy Strategy 2050 to reduce its reliance on gas and could even re-emerge as a net gas exporter in the long term. In August 2020, UAE became the first Arab country to produce nuclear energy with the commissioning of the first of four generators in the 5.6 GW Barakah nuclear complex. At full capacity in 2024, Barakah could free about 1 Bcf/d of gas demand and meet up to 25 per cent of domestic power demand (Energy Intelligence, 2020).

Gas will also be displaced in power generation by the 2.4 GW construction Hassyan clean coal power project in Dubai and multi-GW solar projects. These could potentially reduce the need for some of the costlier gas schemes planned by ADNOC to develop sour (high sulphur) and unconventional gas, particularly if forecasts for domestic power demand growth are downgraded in response to the coronavirus pandemic.

10. South East Asia

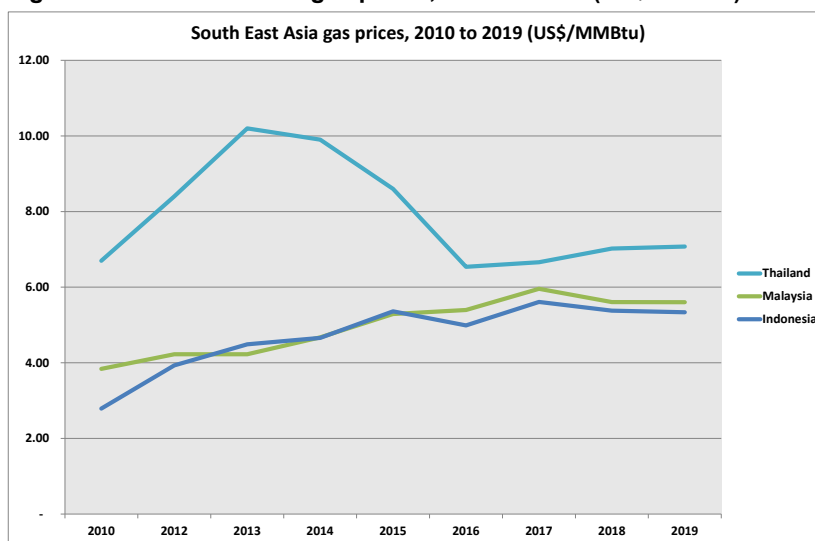
Domestic gas policies in South East Asia often try to control domestic gas prices. This is generally proven to be unsustainable, and gas prices under new contracts are generally higher than in Australia. In Indonesia the government is increasing gas prices as a quid pro quo for reserving gas for domestic purposes. While better than the previous system, this (along with other considerations) does not make Indonesia an attractive place to invest. Malaysia and Thailand have regulated prices that are under pressure in the face of the need to import LNG. With the growth of LNG imports into these countries, the market price of gas in South East Asia is increasingly at import parity.

Figure 31 Wholesale gas price formation Asia Pacific 2019 (%)



Source: IGU (2020)

Figure 32 South East Asia gas prices, 2010 to 2019 (US\$/MMBtu)



Source: IGU (2020)

Indonesia

Main points

- Indonesia was the world's largest LNG exporter until 2005, but since 2006 the government has prioritised domestic needs over exports. LNG exports have fallen sharply.
- Production has been in an accelerating decline over the past decade, but consumption has been flat and there is still a significant (although shrinking) domestic gas surplus.
- Gas prices are regulated but were brought up to import parity a few years ago. The government of Indonesia is now seeking to discount gas prices once again to boost economic activity.



E N E R G Y Q U E S T

- Overall domestic gas policy in Indonesia, combined with a high level of regulatory uncertainty, is creating a drought of foreign investment. Ageing fields are in decline, and state-owned Pertamina is being forced to take over a growing number of expired production sharing contracts.
- The economic and gas demand shocks of COVID-19 have exacerbated the situation, and uncertainty hangs over the country's proposed LNG projects.
- Indonesia ranks very poorly (71 out of 80) in the policy and perceptions index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Economy

According to the CIA Factbook (CIA, 2020):

- Indonesia has a population of 267 million (July 2020 estimate) and is the largest economy in Southeast Asia, with GDP of US\$3.25 trillion (2017 estimate) and GDP per capita of US\$12,400, ranking 127 in the world.
- During the global financial crisis, Indonesia outperformed its regional neighbours and joined China and India as the only G20 members posting growth. Growth has slowed since 2012, mostly due to the end of the commodities export boom. Indonesia's annual budget deficit is capped at 3 per cent of GDP, and the Government lowered its debt-to-GDP ratio from a peak of 100 per cent shortly after the Asian financial crisis in 1999 to 34 per cent today. In May 2017, Standard & Poor's became the last major ratings agency to upgrade Indonesia's sovereign credit rating to investment grade.

Poverty and unemployment, inadequate infrastructure, corruption, a complex regulatory environment, and unequal resource distribution among its regions are still part of Indonesia's economic landscape. President Joko Widodo - elected in July 2014 – seeks to develop Indonesia's maritime resources and pursue other infrastructure development, including significantly increasing its electrical power generation capacity. Fuel subsidies were significantly reduced in early 2015, a move which has helped the government redirect its spending to development priorities. Indonesia, with the nine other ASEAN members, will continue to move towards participation in the ASEAN Economic Community, though full implementation of economic integration has not yet materialized.

Indonesia ranks well at 50 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Indonesia largely relies on coal and oil to provide energy, with each fuel accounting for 38 per cent of primary energy consumption. Gas satisfies 18 per cent of the country's energy needs. Indonesia is a large energy user (ranking 13 globally), which means gas domestic use is relatively large at 1.5 Tcf in 2019 (BP, 2020).

Indonesia was historically a large oil producer and a member of OPEC for several decades, but a downturn in production and rising domestic demand saw the country become a net oil importer in 2004. Indonesia exited OPEC in 2009, rejoining temporarily in 2016 as part of efforts to secure more supply and attract greater investment from Middle East members in downstream projects. In 2019, Indonesia ranked 24 in oil production and 31 in proved oil reserves.

Indonesia has proven gas reserves of 50.5 Tcf (ranking 21 globally), equivalent to 34 years of production. According to BP (BP, 2020), proven gas reserves suffered a large decrease in 2019 (down 50 per cent compared to 2018). This dragged down the average rate of proven reserves replacement over the past decade to -119 per cent.



Indonesia was a pioneer of the LNG industry and the world's largest LNG exporter until 2005 (BP, 2020), thanks to the 12.5 Mtpa Arun LNG project in northern Sumatra, and the Bontang LNG project in East Kalimantan, which now operates at 11.5 Mtpa, but once had almost double this capacity.

Both projects were commissioned in 1977. Arun LNG shipped its last cargo in 2014 and converted to an import terminal. Indonesia's total gas exports have declined sharply over the past decade (down from 1.1 Tcf in 2010 to 0.6 Tcf in 2019), despite the start-up of Tangguh LNG (7.6 Mtpa) in West Papua in 2009 and Donggi Senoro in Sulawesi (2 Mtpa) in 2011.

This reflects declining gas supply, closure of old trains at Bontang and the introduction of government policy in 2006 to prioritise gas for domestic needs.

Proposed expansion of Indonesia's LNG industry is uncertain. Construction of a third train at Tangguh was postponed earlier this year. Inpex-operated Abadi LNG, with capacity of 9.5 Mtpa, had suffered delays even before the impact of COVID-19, and 35 per cent partner Shell is reportedly seeking to exit the project.

Although the majority of Indonesia's natural gas exports are transported as LNG, Indonesia sends about a fourth of its gas exports to Singapore and Malaysia through two pipeline connections: one from its offshore fields in the West Natuna Sea and the other from the Grissik gas processing plant in South Sumatra (EIA, 2020).

Sector organisation

According to the OECD (OECD, 2020), the upstream oil and natural gas sector has been regulated by the Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas) since 2012. SKK Migas is a temporary special task force operating under the purview of the Energy and Mineral Resource Ministry (MEMR), until the government amends the 2001 Oil and Gas Law. The downstream oil and natural gas sector is regulated by BPH Migas.

The state-owned power utility company, Perusahaan Listrik Negara (PLN), has a near vertical monopoly over Indonesia's electricity sector. The company currently owns and operates about 69 per cent of the country's generating capacity through its subsidiaries, and has complete market control over the transmission and distribution of power.

International oil companies such as Chevron, Total, ConocoPhillips ExxonMobil and BP are the major players in the upstream gas sector, while natural gas transmission, distribution and marketing activities are carried out by Perusahaan Gas Negara (PGN). Any gas produced has essentially to be sold to PGN or to PLN, the electricity authority.

Indonesia ranks very poorly (71 out of 80) in the policy and perceptions index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

Figure 33 shows gas production and consumption. Production decreased to 2.4 Tcf in 2019, down 7.2 per cent compared to 2018, and quickening of the rate of decline over the past decade. Annual consumption has been flat at about 1.5 Tcf over the past decade.

Gas-fired power generation accounted for 17 per cent of gas use in 2018 (IEA, 2020). The volume of gas used in power generation has been steady since 2010, leading to a decline in gas use as a proportion of all power generation from 19 per cent since 2010. Rising energy demand has largely been met by coal.

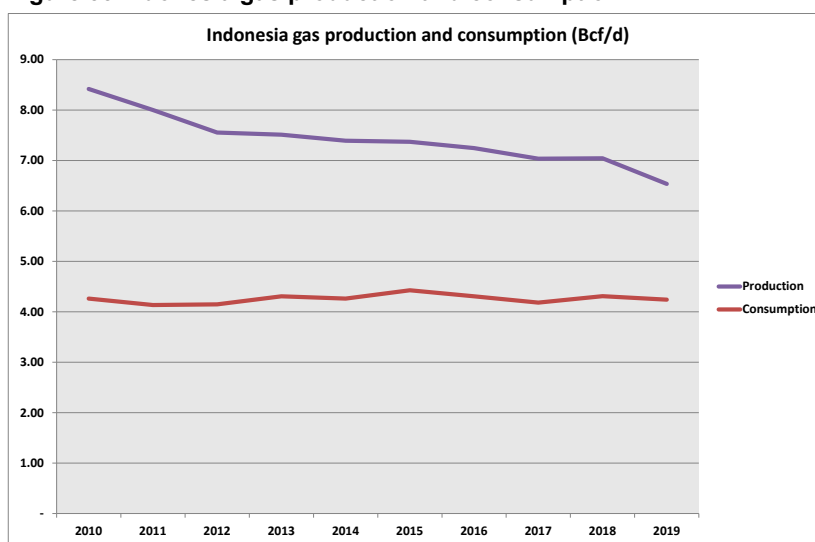
Growth in gas demand for generation is likely to be modest based on current policy settings. The Indonesian government is targeting an increase in the share of "new and renewable energy" in



primary energy supply to 23 per cent by 2025 and 31 per cent by 2050. “New” energy is defined as nuclear, hydrogen, coal bed methane (or coal seam gas), liquefied and gasified coal (IEA, 2019). IEA projects that three quarters of its forecast 60 per cent rise in electricity demand by 2040 to be met in roughly equal shares by coal-fired generation and renewables.

Looking across the 10 countries in the Southeast Asian region, the IEA expects only modest growth in annual gas production from 7.4 Tcf in 2019 to 8.8 Tcf by 2040. Indonesia is likely to account for most of this growth as new resource developments broadly kept pace with demand. Southeast Asia as a whole is projected to become a net gas importer in the late 2020s, a major turnaround for a region that is home to some of the major traditional names in LNG export (IEA, 2019).

Figure 33 Indonesia gas production and consumption



Source: BP (2020)

Residential and industrial gas prices are regulated but not particularly low. According to the IGU (IGU, 2020), the average wholesale gas price in Indonesia in 2019 was US\$5.32/MMBtu, and has been steady around this level since 2015.

In March 2020, the government announced plans for a large cut in the price of gas sold to power generators to US\$6.00/MMBtu. PLN currently pays an average of US\$8.40/MMBtu. The government is also working on a plan to lower the cost of gas for manufacturers from US\$8.00-9.00/MMBtu to about US\$6.00/MMBtu.

Policy issues

Indonesia has a long history of creating barriers to investment in its upstream sector, including regulated prices and domestic market obligations (DMOs) that require producers of coal, oil, and natural gas to sell a portion of their output (usually between 15 per cent and 25 per cent) on the domestic market at discounted prices (OECD, 2020). The quality and size of the country’s oil and gas resources had helped to overcome these disincentives, but Indonesia is struggling to gain new investment in a more competitive global market. Regulatory instability and an uncertain investment climate have also caused investors to lose interest (PwC, 2019).

A draft amendment to Law No. 22 released in 2018 removed the 25 per cent maximum on DMO’s and stated only that production must be prioritised for the domestic market, suggesting producers will have less control over the export of oil and gas products (PwC, 2019). State-owned Pertamina is taking over the operation of expiring production sharing contracts (“PSCs”) from international oil and



gas companies, which still produce the majority of the country's oil and gas. PwC says the investors adopted a “wait and see” approach to the “Gross Split Scheme” introduced in 2017 to revive investment because the many uncertainties inherent in the scheme.

Malaysia

Main points

- Malaysia is a major gas producer and exporter.
- It has gas shortages in Peninsular Malaysia that necessitate imports of pipeline gas and LNG.
- Malaysia has a history of low regulated prices for almost 20 years, which had the predictable result of boosting demand from the power sector and industry, creating a hefty subsidy cost and discouraging exploration and development by international oil companies.
- Malaysia is making slow progress towards liberalising its gas market to address the issues of low domestic prices, and a lack of competition. A new system of third party infrastructure access, which underwent a trial phase in 2019, will allow new market players to import and supply liquefied natural gas (LNG) using existing facilities.

Economy

According to the CIA Factbook (CIA, 2020):

- Malaysia has a population of 33 million (July 2020 estimate). GDP is US\$933 billion (2017 estimate) and GDP per capita is US\$29,100, ranking 71 in the world.
- Malaysia, an upper middle-income country, has transformed itself since the 1970s from a producer of raw materials into a multi-sector economy. An Economic Transformation Program begun by former prime minister Najib Razak set out a series of projects and policy measures intended to accelerate the country's economic growth. The government has also taken steps to liberalize some services sub-sectors. Malaysia is vulnerable to a fall in world commodity prices or a general slowdown in global economic activity.

Malaysia ranks highly at 27 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Malaysia had proven gas reserves of 33.4 Tcf in 2019, ranking 26 globally. Proven reserves were equivalent to 12 years of production based on 2019 country output of 2.78 Tcf (BP, 2020). Malaysia had an average rate of proven reserves replacement of 73 per cent over the last decade.

Fossil fuels dominate Malaysia's energy mix. Oil comprises 37 per cent of primary energy consumption, followed by gas (36 per cent) and coal (21 per cent).

Malaysia was one of the pioneers of the LNG industry, with first cargoes from the Malaysia LNG facility shipped in 1983. As recently as 2014, Malaysia was the world's second largest producer of LNG (behind Qatar), but has since been overtaken by Australia, Russia and the U.S.

Malaysia began LNG imports in 2013 and also imports gas by pipeline from Indonesia.

Sector organisation

Malaysia's state-owned Petronas dominates the natural gas sector, and is the sole supplier of gas. The company has a monopoly on all upstream natural gas developments, and also plays a leading



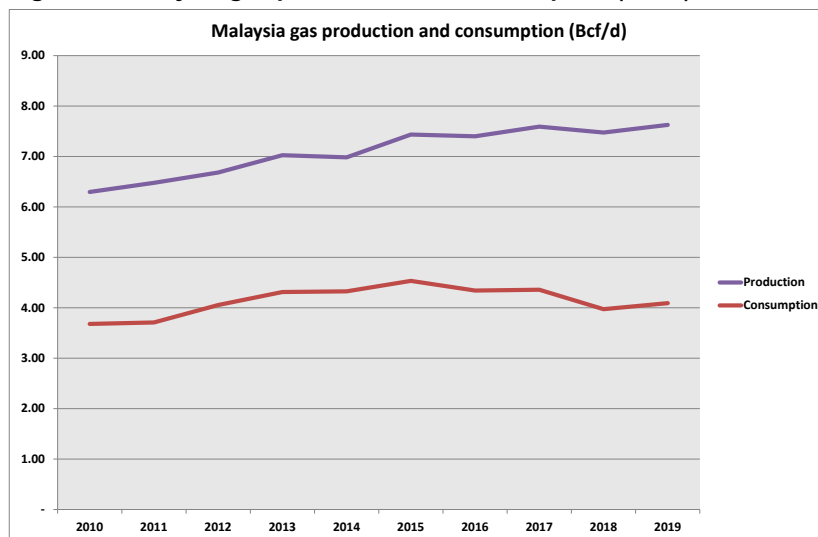
role in downstream activities and the LNG trade. Most natural gas production comes from production sharing agreements operated by foreign companies in conjunction with Petronas.

Malaysia ranks poorly at 50 out of 80 in the policy perceptions index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

As Figure 34 shows, Malaysian gas production has risen steadily over the past decade and exceeds domestic consumption by a wide margin. However, domestic consumption plus Malaysia's significant volume of LNG exports (27.3 Mt in 2019) have created an indigenous supply deficit since 2009 (Oxford Institute for Energy Studies, 2020). Malaysia has supplemented domestic supply with LNG imports since 2013 (2.2 Mt in 2019) and pipeline gas from Indonesia since 2002 (21 Bcf or 0.4 Mt in 2019) (BP, 2020).

Figure 34 Malaysia gas production and consumption (Bcf/d)



Source: BP (2020)

Domestic consumption has trended down from a peak of 1.65 Tcf in 2015 to 1.5 Tcf in 2019. Sales gas is distributed to all major demand centres in Peninsular Malaysia (the main area of domestic demand) via a comprehensive pipeline grid known as the Peninsular Gas Utilisation (PGU) pipeline built and owned by Petronas. Peninsular Malaysia accounts for about 90 per cent of domestic demand and electricity generation is the single largest component of demand (OIES, 2019). Gas has been the mainstay of power generation in Malaysia for decades until recently. In 2008, the country began a major program of adding coal-fired generation capacity to reduce its dependence on gas. By 2016, coal had overtaken gas to become the leading fuel for power generation and accounted for 45 per cent of all generation by 2018. The share of gas reduced from 64 per cent in 2008 to 37 per cent in 2018, although expansion of Malaysia's power grid meant consumption of gas-fired electricity had still increased slightly over the same period (IEA, 2020).

According to the IGU, average wholesale gas prices were US\$5.60/MMBtu in 2019, unchanged from the previous year (IGU, 2020).

Before the Asian Financial Crisis in 1997-98, the gas price was set at a level intended to reflect the costs of Petronas plus a profit. Regulated prices at low levels were introduced in 2002 to assist economic recovery and were intended as a temporary measure. Subsidies are still in force, although efforts have been made to phase them out since 2014.



Gas prices in Peninsular Malaysia are set according to either a regulated piped gas price or an unregulated LNG gas price (also known as the discounted LNG market price). Price regulations also differentiate between power and non-power customers.

The regulated wholesale price for piped gas for the power sector was set at US\$6.96/MMBtu for volumes up to 1000 MMscf/d as of October 2019. For non-power sector volumes up to 300 MMscf/d, the price is capped at US\$7.41/MMBtu.

Any gas volumes consumed above 1,000 MMscf/d (power) and 300 MMscf/d (non-power) are charged at the unregulated piped gas price. As of October 2019, the unregulated gas price for the power sector was about US\$7.69/MMBtu and US\$8.20/MMBtu for non-power. The unregulated pricing formula includes costs of production, shipping, regasification and transmission (Oxford Institute for Energy Studies, 2020).

Policy issues

Malaysia has a history of low regulated prices for almost 20 years, which had the predictable result of boosting demand from the power sector and industry, creating a hefty subsidy cost and discouraging exploration and development by international oil companies. Without the levels of new investment needed to replace depleting domestic gas reserves and grow indigenous production, Malaysia has been forced to import increasing volumes of more expensive gas in the form of LNG.

Total gas production is projected to decline until 2023, with some growth subsequently due to an increase in production from Sarawak with further development of offshore fields (Evans 2019). However, Peninsular Malaysia's production is projected to decline much faster and new gas reserves will be technically and commercially challenging and costly to develop due to location, water depth and high CO₂ content.

Malaysia is making slow progress towards liberalising its gas market to address the issues of low domestic prices, and a lack of competition. The Gas Supply (Amendment) Act 2016, which came into force in 2017 sets out the legal framework for a system of third-party access (TPA) to infrastructure for gas markets in Peninsular Malaysia and Sabah. The new system, which underwent a trial phase in 2019, will allow new market players to import and supply liquefied natural gas (LNG) using existing facilities.

Thailand

Main points

- Thailand has a long history as a gas producer, but reserves have been depleted by a lack of exploration and development over the past decade and a heavy reliance on gas to generate electricity for a rapidly expanding economy.
- Proven reserves now cover only five years of domestic consumption, leading to an expansion of LNG import capacity from 2021.
- Expansion of renewable energy is planned to reduce the share of gas in the national grid, but overall gas demand is still projected to grow.
- National oil company PTT controls the price of all gas and implements a regulated gas price. Gas prices are relatively high by the standards of other countries, but the PTT monopoly prevents price competition, and restricts effective allocation of resources.

Economy

According to the CIA Factbook (CIA, 2020):



- Thailand has a population of 69 million (July 2020 estimate). GDP is US\$1.236 trillion and US\$17,900 per capita, ranking 99 in the world.
- With a relatively well-developed infrastructure, a free-enterprise economy, and generally pro-investment policies, Thailand is highly dependent on international trade, with exports accounting for about two thirds of GDP. Thailand's exports include electronics, agricultural commodities, automobiles and parts, and processed foods. The industry and service sectors produce about 90 per cent of GDP. The agricultural sector, comprised mostly of small-scale farms, contributes only 10 per cent of GDP, but employs about one third of the labor force.

Thailand ranks highly at 40 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Oil is the dominant source of energy in Thailand, accounting for 48 per cent of primary energy consumption, followed by gas (33 per cent) and coal (13 per cent) (BP, 2020). Domestic oil reserves are declining and the country is increasingly reliant on imports.

Thailand had proven gas reserves of 6.3 Tcf in 2019, equivalent to only five years of production, based on 2019 production of 1.3 Tcf. Thailand has had an average rate of proven reserves replacement of 72 per cent over the last decade (BP, 2020).

Thailand began importing gas by pipeline from Myanmar in 2000 and received its first LNG imports in 2011.

Sector organisation

Thailand's gas industry is heavily regulated by the Energy Regulatory Commission within a policy framework set by the National Energy Policy Council. Thailand's national oil company PTT controls the price of all gas, including LNG and its transmission, and takes lead in business and commercial activities along the petroleum and gas value chains, including trading, refining and marketing. Exploration and production activities are concentrated in the subsidiary company PTTEP. PTT exercises monopoly rights in gas transmission and separation (Batista de Toledo, 2012).

Chevron, Mitsui, Total, Shell, and PTT hold sizeable shares in Thailand's natural gas fields. Chevron's Erawan and PTTEP's Bongkot fields, located in the Gulf of Thailand, are the country's largest producing natural gas fields. In addition to private investment, Thailand's partnership with Malaysia to jointly develop hydrocarbon blocks in the Malay Basin has contributed significantly to Thailand's natural gas production since 2008 (EIA, 2020).

Thailand ranks 35 out of 80 countries in the policy perceptions index of the Fraser Institute's 2019 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

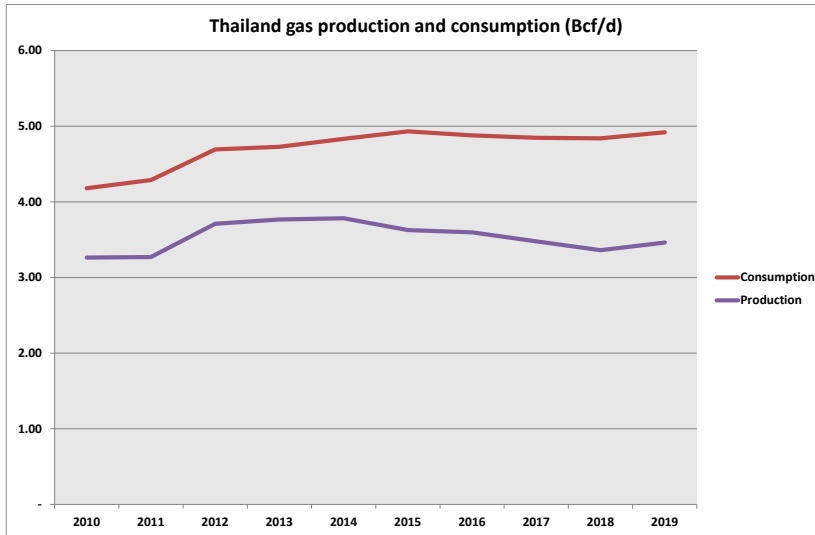
Figure 35 shows Thailand uses more gas than it produces and the shortage of domestic supply has steadily increased over the past decade. LNG imports began in 2011 through PTTEP's Map Ta Phut terminal and have grown almost every year since to a record 4.5 Mt in 2019 (BP, 2020). Thailand also imports gas by pipeline from Myanmar, with 0.25 Tcf imported in 2019.

Thailand's power grid relies heavily on gas, which accounted for 65 per cent of power generation in 2019 (BP, 2020). Coal is the next largest fuel source for power generation (18 per cent). Under its 2018 Power Development Plan, Thailand is targeting investment in renewables to reduce the share of gas to 53 per by 2037. However, the volume of gas needed will continue to grow, given a projected 67 per cent increase in total generation capacity (The Diplomat, 2019)



The Map Ta Phut import terminal can import up to 11.5 Mtpa, which leaves significant capacity to increase volumes. PTTEP has also begun construction of a second import terminal (Nong Fab) with capacity of 7.5 Mtpa. Start-up is scheduled for 2021.

Figure 35 Thailand gas production and consumption (Bcf/d)



Source: BP (2020)

According to the IGU (IGU, 2020), average wholesale gas prices were US\$7.07/MMBtu in 2019, and have been steady for the past four years. With the looming expansion of LNG imports, the Energy Regulatory Commission is seeking to change the natural gas price formula to encourage competition. It proposes a new price pool for LNG gas imports beyond the volumes imported by PTT for the Electricity Generating Authority of Thailand.

Policy issues

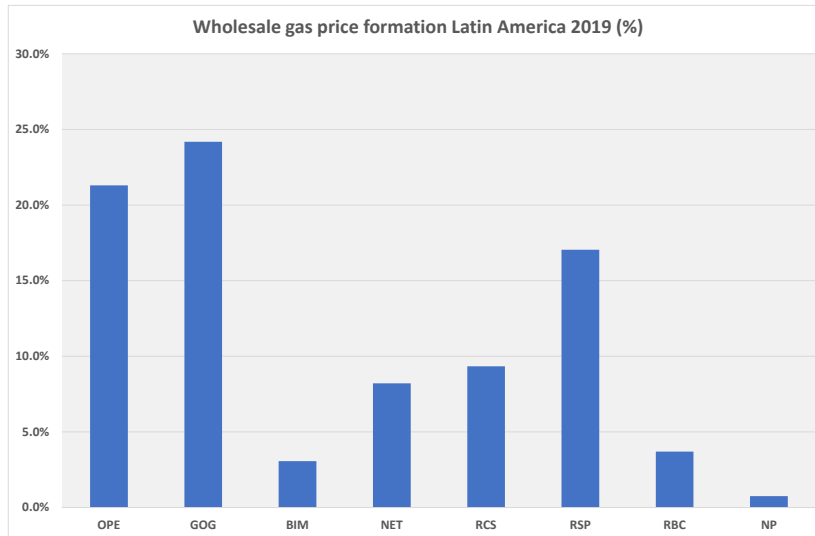
The major issue for Thailand is the running down of its domestic gas reserves, forcing it to rely on increasing volumes of more expensive LNG. Given projections for gas to retain a dominant role in electricity generation, higher gas prices will feed through to electricity prices across the economy and will increase pressure for the government to reintroduce electricity subsidises.

Import dependency could increase more quickly than anticipated because of a dispute with Chevron over the Erawan block, which delivers about 25 per cent of Thailand's domestic gas supply. Chevron's concession to operate the block is about to expire after almost 50 years, with the field due to handed to PTTEP in 2022. Chevron is in dispute with the government about decommissioning costs, which could lead to a slowdown in development drilling and an accelerated decline in production (Nikkei Asia, 2020).

11. Central and South America

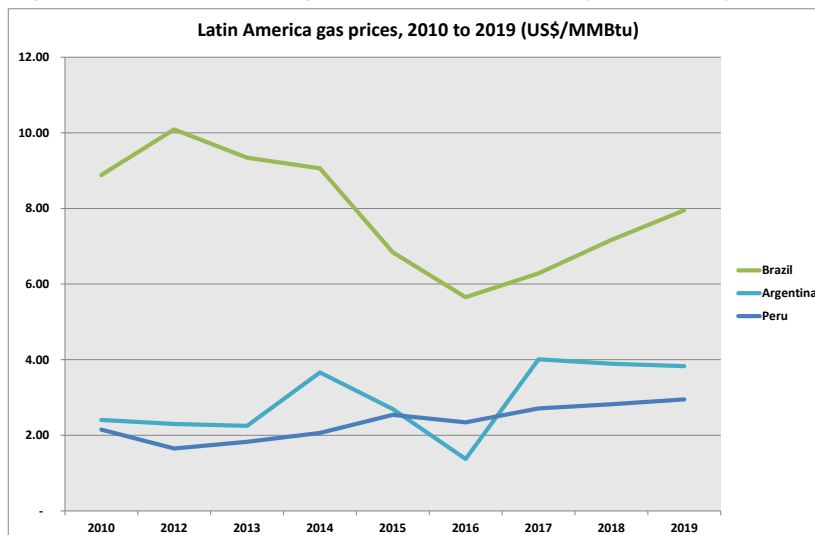
Figure 36 shows that wholesale gas prices in Latin America are mainly regulated on a social/political basis, and on a generally upward trend (Figure 37)

Figure 36 Wholesale gas price formation in Latin America 2019



Source: IGU (2020)

Figure 37 Latin American gas prices, 2010 to 2019 (US\$/MMBtu)



Source: IGU (2020)

Argentina

Main points

- Argentina is a large gas producer but has also imports pipeline gas and LNG.
- Prices are heavily regulated and are set below cost, which has discouraged investment in exploration and led to growth in consumption.



E N E R G Y Q U E S T

- The country has very large shale gas resources, but growth in production was affected by a gas price freeze in 2019 and an economic recession, even before the arrival of COVID-19. The country is unable to raise funding to develop shale gas as the basis of a return to large-scale gas exports.
- Domestic gas market intervention has led to gas shortages and resource misallocation.

Economy

According to the CIA Factbook (CIA, 2020):

- Argentina has a population of 45 million (July 2020 estimate). GDP is US\$922.1 billion (2017 estimate) and GDP per capita is US\$20,900, ranking 88 in the world.
- Argentina benefits from rich natural resources, a highly literate population, an export-oriented agricultural sector, and a diversified industrial base. It suffered during most of the 20th century from recurring economic crises, persistent fiscal and current account deficits, high inflation, mounting external debt, and capital flight.
- With the election of President Mauricio Macri in November 2015, Argentina began a historic political and economic transformation, as his administration took steps to liberalize the Argentine economy, lifting capital controls, floating the peso, removing export controls on some commodities, cutting some energy subsidies, and reforming the country's official statistics. Argentina negotiated debt payments with holdout bond creditors, continued working with the IMF to shore up its finances, and returned to international capital markets in April 2016. In 2017, Argentina's economy emerged from recession with GDP growth of nearly 3.0 per cent. The government passed important pension, tax, and fiscal reforms.

Macri lost power in October 2019 after modest pension reform and cuts to public utility subsidies made him deeply unpopular with voters. His successor, Alberto Fernandez, won on a platform of reversing Macri's reforms.

Argentina ranks 83 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Argentina's proven gas reserves were 12.7 Tcf (ranking 32 globally) in 2019 (BP, 2020). Proven reserves were equivalent to 9 years of production, based on 2019 production of 1.5 Tcf. Replacement of reserves appears to have been good, with an average rate of reserves replacement of 127 per cent over the past decade according to the BP statistics but Argentina remains a net gas importer of LNG and pipeline gas. Gas comprised 49 per cent of primary energy consumption in 2019. Gas consumption in 2019 at 1.7 Tcf was significantly more than production.

The discovery of large gas and oil resources in about 2013, particularly the Vaca Muerta shale, has been transformative for Argentina's petroleum sector, but production costs will need to be significantly reduced if shale gas is to realise its full potential.

Sector organisation

The upstream industry is relatively deregulated, although Argentina's national oil company YPF continues to dominate oil and gas production. In 2012, Argentina renationalised YPF by forcing Repsol to hand back a 51 per cent stake in the company. Downstream natural gas transportation and distribution is heavily regulated by the Energy Secretariat.



Argentina ranks favourably in the Policy Perceptions Index of the Fraser Institute's 2018 Global Petroleum Survey, with unconventional oil and gas in the Neuquen Basin ranking 31 out of 80 world petroleum regions (Fraser Institute, 2018).

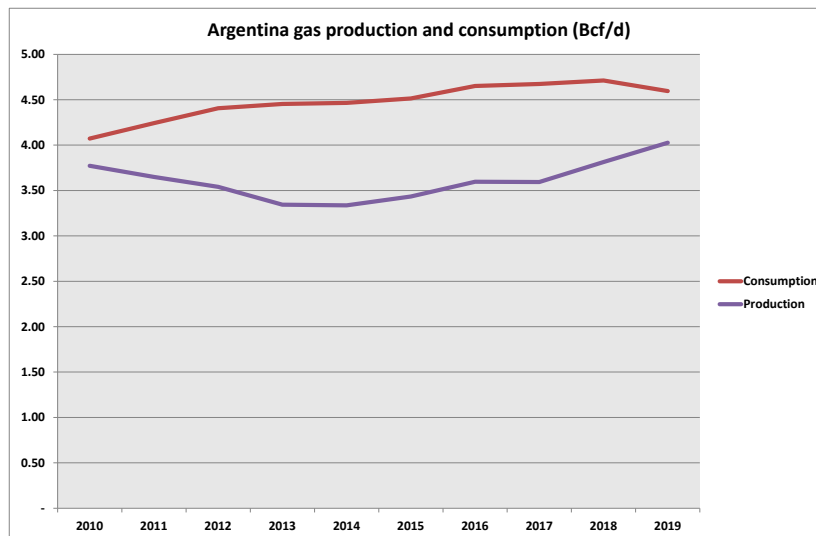
Gas production, consumption and prices

Argentina has been the largest gas producer in South America for many decades (BP, 2020). Gas is the main source of heating for buildings and the residential sector accounts for the largest share of consumption at 26 per cent. Gas comprises 49 per cent of primary energy consumption.

Gas production steadily declined in the first half of the past decade but has increased every year since 2014 to 1.5 Tcf in 2019 (BP, 2020). Consumption decreased slightly to just less than 1.7 Tcf, down 2.5 per cent compared to 2018. The shortfall in domestic gas supply has been filled by imports as LNG and pipeline gas (Figure 38).

The history of gas in Argentina over the past two decades is one of rolling economic crises and low regulated prices that have discouraged investment in exploration and development, yet created steady growth in domestic demand. This led Argentina in 2008 to become a net importer of gas with the commissioning of its first LNG receiving terminal located in Bahia Blanca, followed by an FSRU near Buenos Aires, the LNG Escobar, commissioned in 2011. The LNG terminals were not sufficient to meet the highly seasonal winter gas demand, prompting the solution of sending gas imported as LNG in Chile over the Andes in pipelines that previously carried Argentina's gas exports to Chile.

Figure 38 Argentina gas production and consumption (Bcf/d)



Source: BP (2020)

Unconventional gas production grew strongly in 2018 and 2019, creating hope Argentina could become a large gas exporter. But with the arrival of economic recession in 2018, a 60 per cent currency devaluation and high inflation rates, Argentina struggled to secure multi-billion dollar funding to solve pipeline capacity constraints from the Vaca Muerta shale and build a proposed 5-10 Mtpa export terminal. The demand and price shocks created by COVID-19 in 2020 create even more uncertainty for development of Argentina's shale gas resources. Vaca Muerta development is not economical below US\$40-50/bbl (Oxford Institute for Energy Studies, 2020).

According to the IGU, average wholesale gas prices in 2019 were US\$3.83/MMBtu (IGU, 2020).



Prices are regulated and subsidised for end users. The government also introduced price incentives for unconventional gas producers in 2012, which were coupled with reforms to gradually decrease the subsidies paid to end users. The subsidies to end-users resulted in a combination of higher supply prices, caused by high LNG and liquid fuels imports and frozen/below-cost prices for residential, commercial and industrial consumers (Oxford Institute for Energy Studies, 2020). According to the Ministry of Energy, prices paid by end-users represented only 10 per cent of the actual cost of supply in 2015. Subsidies have been progressively reduced but in 2019 still represented 52 per cent of the end user price of US\$6.60MMBtu.

At the end of 2019, the newly elected government froze prices in a bid to slow inflation, prompting a sharp downturn in drilling activity in the Vaca Muerta shale even before the global pandemic.

The reduction in end-user subsidies was achieved by increasing gas prices for residential and commercial consumers from US\$0.20-1.20/MMBtu in 2015 to US\$2.10-3.70/MMBtu in 2019. Industrial consumers have not had price increases, paying around US\$ 3.9-4.1/MMBtu (Oxford Institute for Energy Studies, 2020).

Policy issues

Low prices have led to gas shortages and resource misallocation. Reforms by former President Macri, including cuts to energy subsidies, were deeply unpopular and a key factor in his loss of office in October 2019. His successor has frozen gas prices and appears to be locked into continuing subsidies on gas consumption, which is a drain on the government's budget. This is unsustainable, with Argentina already facing a third year of economic recession in 2020 before the arrival of COVID-19.

Brazil

Main points

- Brazilian gas use is low in international terms, but the country is still a significant importer of gas by pipeline from Bolivia and via LNG. The volume of LNG imports is falling, reflecting a decline in consumption since 2015.
- Wholesale gas prices are relatively high, due in part to a near-monopoly held by Petrobras. The country's anti-trust regulator ruled in 2019 that Petrobras must divest its natural gas pipeline and distribution assets by the end of 2021, which will increase competition and is likely to reduce prices.
- Government policy is to encourage greater use of gas, which is being affected by steps to increase competition and price transparency. Brazil does not have a domestic reservation policy.

Economy

According to the CIA Factbook (CIA, 2020):

- Brazil has a population of 212 million. GDP is US\$3.2 trillion (2017 estimate) and US\$15,600 per capita, ranking 108 in the world.
- Brazil is the eighth-largest economy in the world. Having successfully weathered a period of global financial difficulty in the late 20th century, Brazil was seen as one of the world's strongest emerging markets and a contributor to global growth. The awarding of the 2014 FIFA World Cup and 2016 Summer Olympic Games, the first ever to be held in South America, was seen as symbolic of the country's rise. However, from about 2013 to 2016, Brazil was plagued by a sagging economy, high unemployment, and high inflation, only emerging from recession in 2017. Former President Dilma Rousseff was removed from office in 2016 by Congress for having



committed impeachable acts against Brazil's budgetary laws. The economy has been negatively affected by multiple corruption scandals involving private companies and government officials. Sanctions against the firms involved — some of the largest in Brazil — have limited their business opportunities, producing a ripple effect on associated businesses and contractors but creating opportunities for foreign companies to step into what had been a closed market. In October 2018, Jair Bolsonaro won the presidency with 55 per cent of the vote and assumed office on 1 January 2019.

Brazil ranks 71 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).

Petroleum Sector

Brazil is the eighth largest energy consumer in the world, ranking just behind Germany and ahead of South Korea.

The nation is oil-rich following large offshore discoveries in the so-called pre-salt layers, but is not well endowed with gas. Brazil ranks 15 globally in proved oil reserves and 10 in oil production, which has grown rapidly since 2014 with commissioning of the first pre-salt projects. Proven gas reserves are only 13.3 Tcf, which ranks Brazil outside the top 30 nations. Proven reserves replacement has averaged 100 per cent over the past decade (BP, 2020).

Gas is only 10 per cent of primary energy consumption. Annual gas consumption is 1.3 Tcf, which is well in excess of domestic production of 0.9 Tcf (BP, 2020).

Sector organisation

State-controlled Petrobras plays a dominant role in Brazil's oil and gas sector, accounting for 94.9 per cent of total oil and natural gas produced. Production of other oil companies is growing, thanks in part to a divestment program by Petrobras that aims to raise US\$20-US\$30 billion between 2020 and 2024. Planned asset sales include a 51 per cent interest in Gaspetro, the Petrobras gas holding company, which has participating interests in 19 local distribution companies, as well as non-core onshore and offshore fields in a number of basins (Thomson Reuters, 2020).

Brazil's oil and gas sector is regulated by the National Agency of Petroleum, Natural Gas and Biofuels, which is an agency of the Ministry of Mines and Energy. In 2009, Brazil passed a new Natural Gas Law that created a separate regulatory framework for natural gas. Bill No. 6407/2013, which will revoke the current Gas Law, is currently under debate in the Senate. It is expected to be approved in 2020. The new bill aims to foster the development of gas transportation activities in Brazil through the creation of a friendly market environment for investments in the construction of natural gas transportation systems.

One of the main government policy objectives provided under the Petroleum Law is to increase the contribution of natural gas to the Brazilian energy mix, but Brazil does not have a domestic reservation policy. The Gas to Grow Programme by the Ministry of Mines and Energy (MME) aims to improve the legal and regulatory framework for the natural gas sector in Brazil and encourage the entry of new players.

Brazil ranks towards the middle of the Fraser Institute's Policy and Perceptions Index in its 2018 Global Petroleum Survey – onshore concession contracts (34 out of 80), offshore pre-salt contracts (37 out of 80) and other offshore contracts (48 out of 80) (Fraser Institute, 2018).



Gas production, consumption and prices

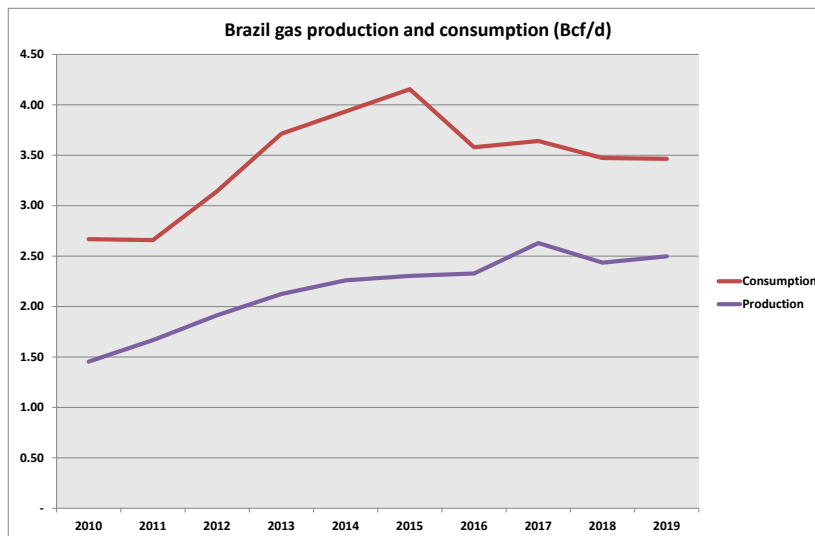
Brazil's domestic gas consumption continues to run well ahead of local production, although the gap has narrowed since 2015 (Figure 39). Production has been on steady upward trend over the past decade. Annual consumption increased rapidly from 2011 to a peak of 1.5 Tcf in 2015, but has since moderated to 1.3 Tcf (BP, 2020).

The improvement in the domestic supply-demand balance has allowed Brazil to reduce its gas imports from 0.67 Tcf in 2015 to 0.35 Tcf in 2019. Most of the gas imported in 2019 arrived by pipeline from Bolivia (0.23 Tcf), with the balance imported as LNG (0.11 Tcf). LNG imports have decreased by 53 per cent since the peak in domestic consumption in 2015 (BP, 2020).

Gas accounted for only 10 per cent of Brazil's primary energy consumption (BP, 2020), which reflects the dominance of hydropower and biofuels in the nation's energy mix. According to the EIA (EIA, 2020), hydropower fuelled 61 per cent of Brazil's total electricity generation in 2017, followed by biomass (9 per cent), wind and solar (8 per cent) and gas (8 per cent).

In 2016, the government invested heavily in coal and gas-fired power generation to drought proof the electricity grid. A drought from 2012 to 2015 depleted hydropower reservoirs to only 10 per cent of their capacity and led to widespread power rationing. An increasing role for gas in electricity generation is not guaranteed, given the government is rolling out a massive expansion of large-scale solar projects, up from 2.5 GW in February 2019 to a targeted 8.6 GW by 2027 (EIA, 2020).

Figure 39 Brazil gas production and consumption (Bcf/d)



Source: BP (2020)

Brazil's natural gas prices are also among the highest in the world. In 2018, Brazil's energy ministry reported industrial users were obliged to pay almost \$14/MMBtu, compared to an average European price of just over \$8.80/MMBtu and a US price of under \$3.90/MMBtu (Petroleum Economist, 2019).

Average wholesale gas prices in Brazil have risen by more than 40 per cent since 2016 to US\$7.95/MMBtu in 2019 (IGU, 2020). Data on gas prices in Brazil has been obscure for decades, but ANP is pushing to create transparency with new fuel and gas price rules that oblige gas distributors to publish price information in captive markets (Argus Media, 2019).



Policy issues

Lack of competition and high prices are key issues. As of 2019, Petrobras controlled about 77 per cent of gas production, 100 per cent of imports, 99 per cent of processing and 67 per cent of gas transport, as well as 20 of the nation's 27 gas distributors (Petroleum Economist, 2019).

In July, Brazilian President Jair Bolsonaro inaugurated the New Gas Market programme, aimed at cutting the domestic price of gas 40 per cent within two years, guaranteeing participation of new entrants and attracting greater investment to the natural gas sector (Petroleum Economist, 2019).

This coincided with a ruling by Brazil's anti-trust regulator, Cade, that required Petrobras to divest its gas transport and distribution assets by the end of 2021. In a related step, Petrobras in March 2020 reduced by 33 per cent its gas offtake under a long-term contract with state-owned YPFB of Bolivia. The gas released under the revised agreement will be made available to Petrobras competitors in domestic gas distribution.

Peru

Main points

- Peru commissioned South America's first and (so far) only LNG plant in 2010 to capitalise on the discovery of the giant Camisea field in the Amazon. Camisea also spurred rapid growth in domestic gas consumption in power generation and the mining industry, which has boomed in Peru.
- Protests in 2010 led the government to reserve part of the Camisea's gas for the domestic market. Gas use is encouraged by low, regulated prices.
- The country continues to enjoy a large surplus of production over consumption, but investment in exploration has collapsed in recent years and raises doubts about the country's ability to replace reserves in the medium to long term.
- A multi-billion dollar pipeline project to deliver Camisea gas reserved by government to households, the electricity sector and industry in the south of Peru stalled mid-construction in 2015, which has alleviated pressure on reserves.

Economy

According to the CIA Factbook (CIA, 2020):

- Peru has a population of 31.9 million (July 2020 estimate). GDP is US\$430 million or US\$13,500, per capita, ranking 120 in the world.
- The Peruvian economy grew by an average of 5.6 per cent per year from 2009-13 with a stable exchange rate and low inflation. This growth was due partly to high international prices for Peru's metals and minerals exports, which account for 55 per cent of the country's total exports. Growth slipped from 2014 to 2017, due to weaker world prices for these resources. Peru's rapid expansion coupled with cash transfers and other programs have helped to reduce the national poverty rate by over 35 percentage points since 2004.
- Peru has pursued a free trade policy since 2006 that has led to agreements with all its key trading partners, including the US, Canada, Singapore, China, Korea, Mexico, Japan, the EU, the European Free Trade Association, Chile, Thailand, Costa Rica, Panama, Venezuela and Honduras. A free trade agreement with Australia came into force in February 2020.

Peru ranks 65 out of 141 in The Global Competitiveness Report 2019 (World Economic Forum, 2019).



Petroleum Sector

Peru has modest oil reserves and production, ranking 41 and 37 in the world respectively in 2019 (BP, 2020). Crude oil production in Peru has been declining since the mid-1990s, but the country's total liquid fuels production has been bolstered by increased output of natural gas liquids associated with the giant Camisea field in the Amazon (EIA, 2020).

Proven gas reserves stood at 10.2 Tcf at the end of 2019, largely attributed to the Camisea field, which began production in 2004. Block 88 at Camisea is Peru's largest gas field, with proven reserves of 8.76 Tcf (Argus Media, 2020). Proven reserves cover production for 35 years, based on 2019 production of 0.37 Tcf (BP, 2020).

Peru's reserves replacement ratio has averaged 100 per cent over the past decade (BP, 2020), despite significant annual gas production of 0.4-0.5 Tcf. However, reserves started declining from 2018.

Peru has been a gas exporter since commissioning Peru LNG in 2010, which has a nameplate capacity of 4.45 Mtpa and is privately owned by Hunt Oil, SK Innovation, Shell and Marubeni. In 2010, the government issued a decree that all gas from Block 88 of the Camisea field must be used in the domestic market, over-riding a 2006 decree that allowed gas from Block 88 to be exported if Block 56 did not have sufficient reserves. Peru LNG's partners have an agreement with government to export 4.2 Tcf over the next 20 years (LNG Industry, 2010). The tightening of domestic gas requirements followed violent protests against gas exports, which included workers being taken hostage (Reuters, 2010).

Sector organisation

Petroperu, the state oil company, negotiates, signs, and supervises license agreements for the exploration and production of hydrocarbons in Peru, in accordance with the objectives, policies, and strategies of the Ministry of Energy and Mines.

Pluspetrol of Argentina is the largest oil and gas producer in Peru and operates the Camisea gas and condensate field in the Amazon jungle (using an "offshore inland" operating model, which means there is no road access to the project). In October 2019, Pluspetrol bought SK Energy's 17.6 per cent stake in the project for US\$1.1 billion, lifting its interest to 44.8 per cent. Other partners are Hunt Oil, Tecpetrol, Repsol and Sonatrach. Gas and condensate is produced from Blocks 88 and 56.

Peru ranks poorly at 63 out of 80 in the policy and perceptions index of the Fraser Institute's 2018 Global Petroleum Survey (Fraser Institute, 2018).

Gas production, consumption and prices

Figure 40 shows the rapid growth in Peruvian gas consumption and production.

Peru's natural gas production began rising rapidly in 2004 with first gas from the giant Camisea field. Production hit a new level in 2010 with the start of exports by Peru LNG. Export growth came on top of accelerating domestic demand due to rapid economic growth, fuelled by energy-intensive mining projects, and government programs such as "massification" to switch households from LPG to gas.

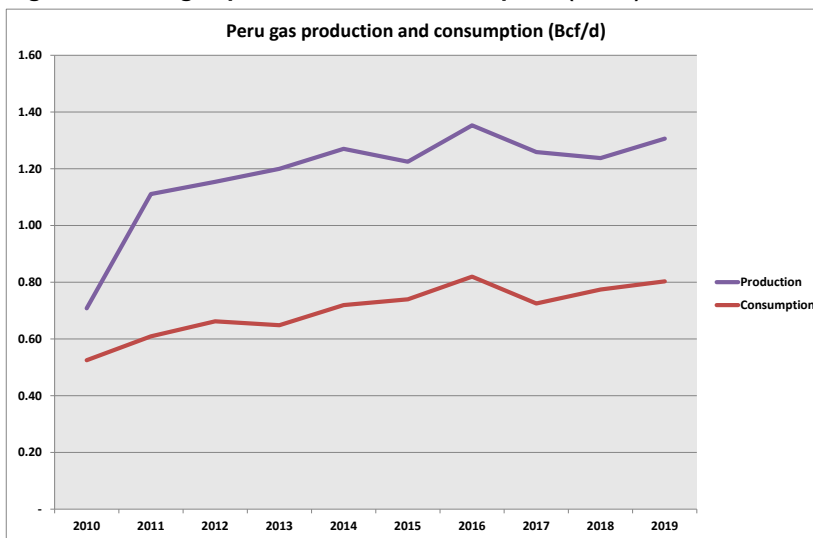
Oil accounts for the largest share of primary energy consumption (44 per cent), followed by gas (26 per cent) and hydropower (24 per cent) (BP, 2020). The role of gas in electricity generation grew rapidly in the decade following the start-up of Camisea production from 10 per cent in 2004 to 46 per cent in 2014. The share of gas in power generation has since eased to 38 per cent by 2019, with gas displaced by a higher contribution from hydropower and growth in wind and solar PV (IEA, 2020).



Peru has been able to maintain a large surplus of production over consumption, despite the start-up of Peru LNG in 2010. Gas exports have been relatively steady and close to Peru LNG's capacity since production began.

Peru's gas prices are set by government at levels significantly below those in Brazil and comparable with prices in Argentina. According to the IGU (IGU, 2020), average wholesale prices in 2019 were US\$2.95/MMBtu. The IEA does not list Peru as a country in its fossil fuel subsidies database (IEA, 2020).

Figure 40 Peru gas production and consumption (Bcf/d)



Source: BP (2020)

Policy issues

COVID-19 and its impact on oil prices and worker movements have compounded an already challenging outlook for petroleum exploration and development in Peru. Exploration investment collapsed from US\$785 million 2012 to only US\$17 million in 2017 (Oxford Business Group, 2020), reflecting uncompetitive fiscal terms, delays of up to three years in obtaining permits and protest groups seeking greater protection for the environment and indigenous communities in the Amazon.

The government has sought since 2018 to address these challenges with reforms to the 1993 Organic Hydrocarbons Law (Oxford Business Group, 2020), although it is unclear how much progress has been made. Protest activity has increased over the past year and included violence and threats to sabotage key infrastructure. Several indigenous protestors were killed and six police officers were injured earlier this year in a clash near Block 95, operated by Canadian independent PetroTal (Argus Media, 2020).

Given the challenges for gas exploration and development, it could be fortuitous the government's ambitious plans for a major pipeline from Camisea to the country's southern region have been stalled since 2015, with only 34 per cent of the project completed. The initial annual capacity of the Southern Peru Pipeline was set at 0.17 Tcf and the government had allocated 1 Tcf from Block 88 to be used by industry and new gas-fired power generators in the south (Oxford Business Group, 2020). Ministry of Mines and Energy spokesman, Miguel Incháustegui, said in October 2020 the government was conducting a 35-year assessment of Peru's available natural gas reserves as a prelude to launching a tender in early 2021 for the completion of the pipeline. Mott MacDonald released a feasibility study a



few weeks earlier with a price tag of US\$4.5 billion to complete the project (Global Energy Monitor, 2020).



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Abbreviations

1P	proved reserves
2P	proved and probable reserves
3P	proved, probable and possible reserves
2C	best estimate contingent resources
3C	high estimate contingent resources
ADGAS	Abu Dhabi Liquefaction Limited
ADNOC	Abu Dhabi National Oil Company
bbl	barrel (159 litres or 35 imperial gallons)
bbl/d	barrels per day
Bcf	billion cubic feet (10 ⁹ or a thousand million)
Bcf/d	billion cubic feet per day
Bcm	billion cubic metres
BIES	The Department of Business, Energy and Industrial Strategy (UK)
boe	barrels of oil-equivalent
bopd	barrels of oil per day
Btu	British thermal unit (1.055 kilojoules)
CCGT	combined cycle gas turbine
CCS	carbon capture and storage
cf/d	cubic feet per day
CIF	cost, insurance and freight
CO ₂	carbon dioxide
CSG	coal seam gas
EIA	Energy Information Administration
EIS	environmental impact statement
EPC	engineering, procurement and construction
EU	European Union
FEED	front-end engineering and design
FID	final investment decision
FLNG	floating liquefied natural gas
FOB	free on board
FPSO	floating production storage and offtake
FSRU	floating storage and regasification unit
FSU	former Soviet Union
GAIL	Gas Authority of India Ltd
GDP	gross domestic product
GHG	greenhouse gas
GJ	gigajoule (1 billion joules or 10 ⁹)
GL	gigalitre (1 billion litres or 10 ⁹)
GLNG	Gladstone LNG
GSA	Gas sales agreement
GW	gigawatt
GWh	gigawatt hour
Ha	hectare
HOA	heads of agreement



E N E R G Y Q U E S T

Hp	horsepower
IEA	International Energy Agency
IMF	International Monetary Fund
IOC	international oil company
JCC	Japanese crude cocktail
JV	joint venture
Kboe	thousand barrels of oil-equivalent
KJ	kilojoule (one thousand joules)
km	kilometre
kt	thousand tonnes
KTA	key terms agreement
LNG	liquefied natural gas
LPG	liquefied petroleum gas (propane and butane)
kbbbl	thousand barrels
kbbbl/d	thousand barrels per day
Mcf	thousand cubic feet
Mcf/d	thousand cubic feet per day
MENA	Middle-east and North Africa
MEMR	Energy and Mineral Resource Ministry (Indonesia)
MJ	million (10 ⁶) joules
ML	million litres (6290 barrels or 796 tonnes)
mm	millimetre
MMbbl	million barrels
MMbbl/d	million barrels per day
MMboe	million barrels of oil-equivalent
MMboe/d	million barrels of oil-equivalent per day
MMBtu	million British thermal units
MMBtu/d	million British thermal units per day
MMcf	million cubic feet
MMcf/d	million cubic feet per day
MMcm	million cubic metres (35.31 million cubic feet)
MMscf/d	million standard cubic feet per day
MoPNG	Ministry of Petroleum and Natural Gas (India)
MOU	memorandum of understanding
MPa	megapascal
Mt	million tonnes
Mtpa	million tonnes a year
MW	megawatt
MWh	megawatt hour
NBP	National Balancing Point
NGL	natural gas liquids (condensate and LPG)
OCGT	open cycle gas turbine
OECD	Organisation for Economic Co-operation and Development
OGIP	Original gas in-place
OPEC	Organization of the Petroleum Exporting Countries
OSMR	optimised single mixed refrigerant
Pa	pascal
PDO	Petroleum Development Oman



PGN	Perusahaan Gas Negara
PLN	Perusahaan Listrik Negara
PJ	petajoule (one thousand terajoules)
PJ/a	petajoules a year
PSC	production sharing contract
PV	photovoltaic
qoq	quarter on quarter
QP	Qatar Petroleum
SAP	system average price
T	metric tonne
Tcf	trillion cubic feet (10^{12} or one thousand billion)
therm	100,000 Btu
TJ	terajoule (one thousand gigajoules)
TJ/d	terajoules per day
UAE	United Arab Emirates
WND	West Nile Delta (Egypt)
WTI	West Texas Intermediate
yoy	year on year



E N E R G Y Q U E S T

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