Gas

Resources and Energy Quarterly June 2018

LNG is natural gas cooled to

–162°C

2nd

largest LNG exporter in the world

52 million tonnes

41%

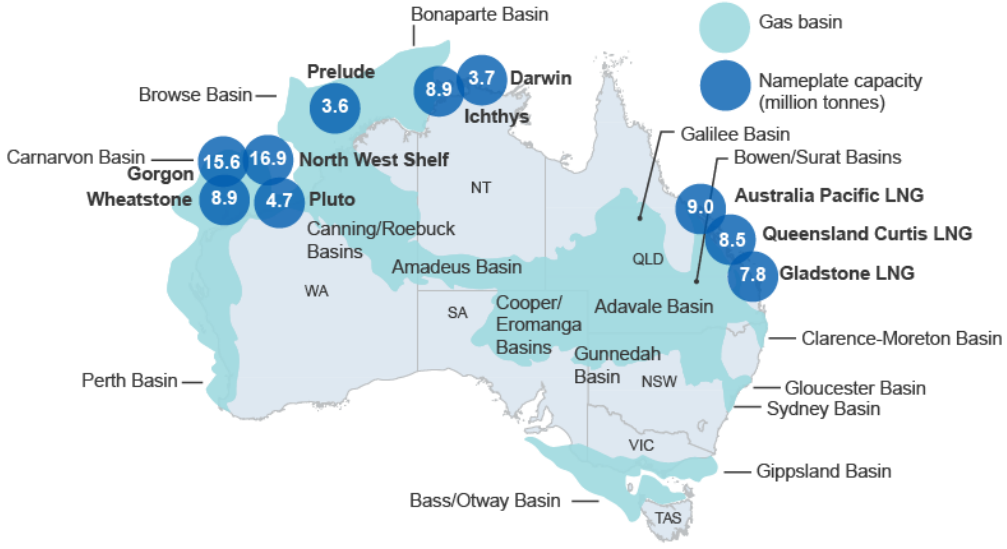
rise from 2015–16 export volumes

Combined nameplate capacity of Australia's 10 LNG projects is

88 million tonnes per annum

Most Australian LNG is sold on oil-linked contracts

Australia's LNG projects and gas basins



Australia's LNG key export destinations, 2016–17

48%	29%	11%	7%	3%	3%
Japan	China	South Korea	Singapore	India	Rest of the world

Global share of LNG exports in 2017

27%	20%	9%	7%	6%	31%
Qatar	Australia	Malaysia	Nigeria	Indonesia	Rest of the world

Global share of LNG imports in 2017

28%	13%	13%	6%	6%	34%
Japan	South Korea	China	India	Taiwan	Rest of the world

7.1 Summary

- The value of Australia's LNG exports is forecast to increase from $30.8 billion in 2017–18 to $42.4 billion in 2019–20, driven by higher volumes and higher prices. LNG is forecast to overtake metallurgical coal as Australia's 2nd highest resource export by value in 2018–19.
- The completion of the final three Australian LNG projects by the end of 2018 will underpin the strong growth in export volumes and bring total export capacity to 88 million tonnes. LNG exports are projected to reach 77 million tonnes in 2019–20.
- LNG contract prices — at which most Australian LNG is sold — are projected to increase, in line with oil prices. The average price of Australian LNG is expected to increase to $10.5 a gigajoule in 2019–20, up from $8.1 a gigajoule in 2016–17.
- Spot prices in Asia have recovered from their lows of 2016, but are expected to moderate and then decline, as new capacity enters the global LNG market over 2018 and 2019.

7.2 Prices

LNG contract prices follow oil prices upwards

Oil-linked pricing has been the dominant pricing mechanism in Asia since Japan began importing LNG (in the late 1960s) as a substitute for oil in power generation. Prices in US$ per MMbtu are generally set by applying a scaling factor (of around 14 per cent) to the Japan-Customs-cleared Crude oil price index (JCC) in US$ per barrel, with a lag of three to four months.

The JCC has been increasing steadily from a low of US$41.9 a barrel in 2016 to US$54.1 a barrel in 2017. It is expected to reach an average of US$69.4 a barrel in 2018, before easing to US$65.9 a barrel by 2020. This will support a significant increase in LNG contract prices in the second half of 2018 and into 2019.

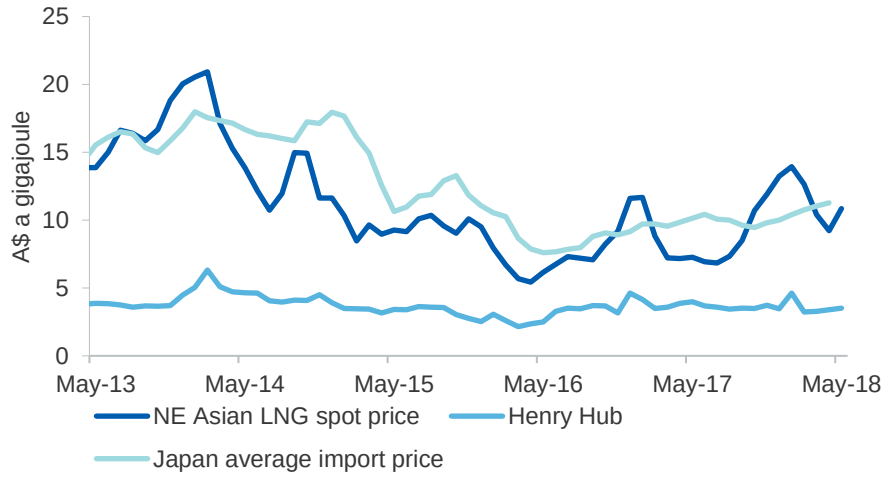
On this basis, prices for Australian LNG exports (FOB) are projected to rise from $8.1 a gigajoule in 2016–17 to $10.5 a gigajoule in 2019–20.

US LNG contracts offer an alternative to oil-linked pricing. Prices are indexed to the Henry Hub pricing point in Louisiana, plus shipping and liquefaction tolling fees. The Henry Hub index averaged US$2.49 per MMbtu in 2016 and US$2.96 per MMbtu in 2017. In an environment of rising oil prices, US LNG exports will become increasingly attractive for buyers. However, the limited capacity of the Panama Canal (the fastest route from the US east coast terminals to Asia) could potentially limit growth in US exports to Asia.

Volatile LNG spot prices expected to ease

North East Asia spot prices have recovered from the lows of 2016, and reached seasonal highs of over US$10 per MMbtu (A$12.3 a gigajoule) in the March quarter 2018. The recent peak in spot prices was related to unplanned outages at some overseas LNG plants, and strong winter heating demand in Asia, particularly in China and South Korea.

Figure 7.1: Gas and LNG prices, monthly

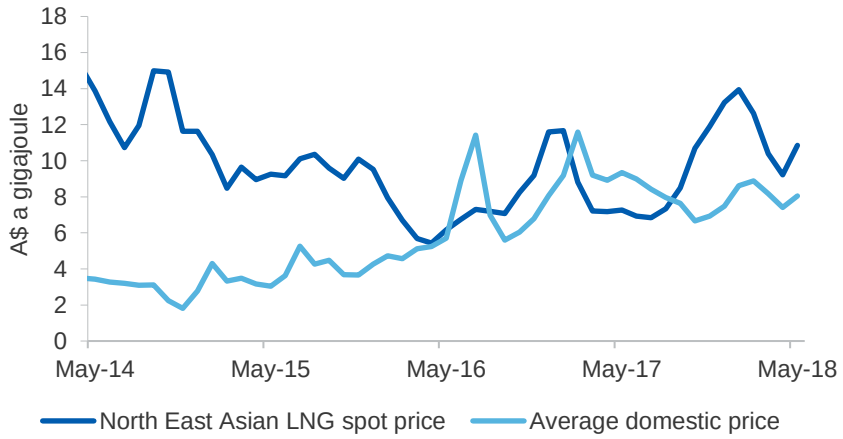


Notes: Henry Hub is the US domestic gas reference price.
Source: Argus (2018); Bloomberg (2018)

Spot prices have retreated recently following the passing of the northern hemisphere winter, but seasonal peaks driven by winter heating demand are expected to continue over the forecast period. The combination of rapid demand growth in China, coupled with insufficient facilities for seasonal gas storage, is expected to maintain upward pressure on spot prices during the northern winters.

The North East Asia spot price is expected to trend down over 2018 and 2019, as significant new LNG capacity enters the market from Australia and the US, outpacing growth in global demand. The new US projects offer more flexible contract arrangements than traditional suppliers, creating a more liquid and responsive spot market. The market is not expected to tighten again until after 2020, when supply and demand rebalance.

Figure 7.2: Domestic and Asian spot prices



Note: The domestic price is the average of the Wallumbilla and east coast capital spot prices.
Source Argus (2018); AEMO (2018)

East coast domestic prices and LNG spot prices

East coast domestic prices have not followed the sharp movements in LNG spot price netbacks over the last six months. Asian LNG spot prices have more than doubled, rising from $6.84 a gigajoule in July 2017 to $13.93 a gigajoule in January 2018, before falling back to $9.22 a gigajoule in April 2018. However, wholesale spot prices in eastern Australia have been relatively stable, showing a steady decline over 2017 after peaking in the March quarter 2017.

The reasons for this disconnect are unclear, but may include logistical difficulties in arranging spot sales, the difficulties in varying production from coal seam gas fields in response to short term sales opportunities, and low summer demand on the east coast.

7.3 World trade

Strong growth in global demand led by China

After a period of relatively low growth in the LNG market between 2012 and 2016, world LNG imports grew rapidly at around 10 per cent from 2016 to 2017 to reach approximately 290 million tonnes. About half of this expansion in trade arose from a 40 per cent gain in China's annual LNG imports, but there was also strong growth in Europe and a number of emerging Asian markets.

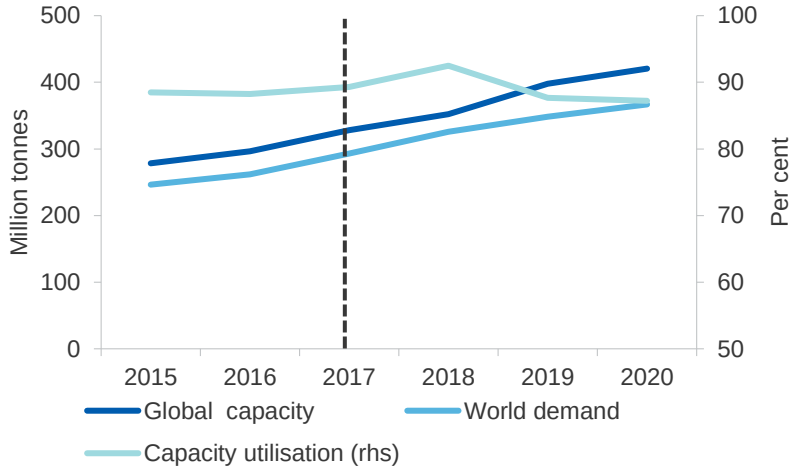
Import growth is expected to continue at a similar rate over 2018, before moderating over 2019 and 2020. LNG demand will be increasingly affected by nuclear restarts in Japan, increased pipeline imports into China, and more subdued conditions in emerging markets which are more sensitive to movements in LNG prices. Global trade is expected to reach over 360 million tonnes in 2020, 25 per cent higher than in 2017.

Global LNG liquefaction capacity increased in 2017 — though at a slower rate than demand — as a number of new projects came online in Australia, the US, Malaysia and Russia. Capacity is expected to continue to expand over 2018 and 2019, as the Australian plants currently under construction enter service, and as another four US projects reach completion.

The rapid rate of demand growth over 2017 and 2018 has postponed the arrival of over-capacity in the LNG market. However, given the expected moderation in growth rates after 2018, and the continued expansion of

committed liquefaction capacity, excess capacity is expected to emerge in 2019 and 2020, taking some pressure off spot prices. The market is expected to rebalance after 2020, as demand growth absorbs the available capacity, prompting investment in new supply capacity. This will require final investment decisions (FID) on new projects within the next few years, given the typical 4–5 year period between FID and production.

Figure 7.3: Global nameplate liquefaction capacity and LNG demand



Notes: Global liquefaction capacity is global nameplate capacity (the combined nominal maximum annual production capacity of the world's LNG plants).

Source: Nexant (2018); Department of Industry, Innovation and Science (2018)

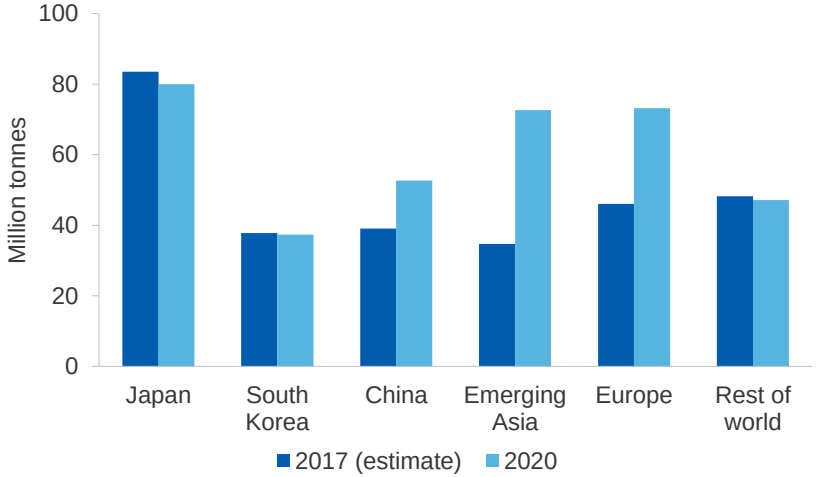
7.4 World imports

Global LNG imports to grow rapidly over 2018

Post-Fukushima, global LNG imports grew at a modest annual rate of 2.5 per cent between 2012 and 2016. However, growth accelerated to 10 per cent in 2017, as pent-up demand took advantage of additions to global LNG liquefaction capacity, and buyers responded to low spot and oil-linked LNG prices. Growth in imports came mainly from China and Europe, but there was also a significant expansion in non-traditional Asian markets.

This high growth rate is expected to continue over 2018, particularly in emerging Asian markets. Import growth is expected to moderate in subsequent years, as competition from alternative fuels begins to weigh on gas demand, and higher oil prices flow through into higher LNG prices.

Figure 7.4: LNG import forecasts



Notes: Emerging Asia excludes Taiwan, China, Japan and South Korea.

Source: Nexant (2018); Department of Industry, Innovation and Science (2018)

Japanese imports to show a marginal decline

Japan sources almost all its gas from LNG imports, and has been the leading buyer of LNG in the world since the 1970s. Japan's LNG imports were stable over 2016 and 2017, at around 84 million tonnes a year. Demand picked up again in the first three months of 2018, reaching two-year highs. With two thirds of gas demand used in power generation in Japan, the outlook for LNG imports depends heavily on competition from nuclear reactors, coal and renewables.

The main factor affecting the outlook for gas demand is the rate at which moth-balled nuclear reactors are re-commissioned. Seven reactors (out of a total of around 50) had been re-commissioned as of April 2018, and

there are applications to restart an additional 17. There is considerable uncertainty about the rate and number of restarts, given public opposition and legal challenges. The outlook to 2020 is for only a minor reduction in LNG imports, to around 80 million tonnes. However, there is downside risk to this outlook if oil prices remain high, or if nuclear restarts accelerate.

Modest growth projected for South Korea's imports

Annual LNG imports to South Korea grew from 34 million tonnes in 2016 to around 38 million tonnes in 2017. Growth was strong over the last six months of 2017 and into 2018. This reflected the seasonal nature of demand in South Korea, with the recent peaks associated with a cold northern hemisphere winter. In conjunction with similar winter spikes in China and Japan, spot prices in north east Asia almost doubled.

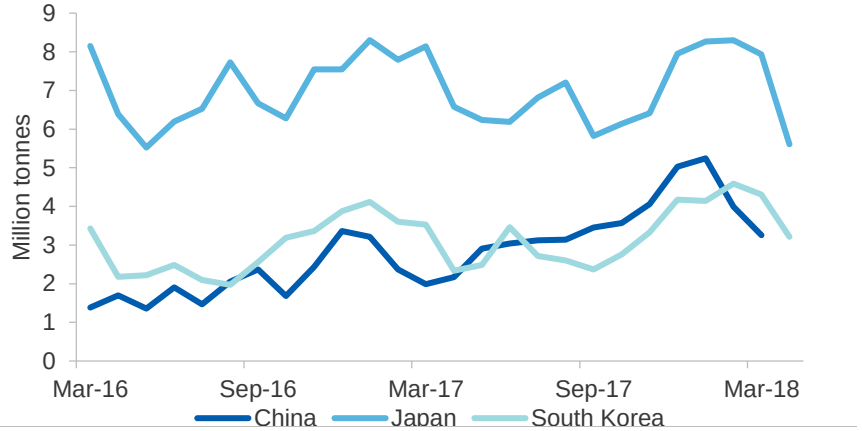
Approximately half of South Korea's gas consumption is used for power generation (although gas provides only 17 per cent of power), and demand is sensitive to competition from nuclear, coal and renewable generation. Outages and safety concerns at a number of nuclear reactors stimulated demand for LNG in 2017, although these reactors are expected to return to service during 2018, putting downward pressure on gas demand.

The long run trend in South Korea's LNG imports has been relatively stable since 2010, and imports are expected to show only modest growth over the outlook period. As is the case in China, the outlook has upside risk if concerns over air pollution at coal-fired power stations lead to constraints on coal utilisation. The South Korean energy ministry has announced plans to increase the share of natural gas and renewables in power generation, but changes are not likely to take effect until after 2022.

China overtakes South Korea as second largest importer in 2017

China's imports of 39 million tonnes of LNG in 2017 have slightly edged out South Korea as the world's second largest LNG importer. Annual growth was over 40 per cent between 2016 and 2017, making up almost half of the growth in global LNG trade. Imports grew strongly from October 2017 into the winter heating season before declining in the March quarter 2018. The surge in demand was caused by a combination of a cold winter and government policies aimed at reducing air pollution in urban areas — by converting from coal to gas for power generation and home heating.

Figure 7.5: Asian LNG imports monthly, 2016–2018



Source: Argus (2018); Department of Industry, Innovation and Science (2018)

Underground gas storage is used in many countries to balance winter heating peaks with gas stored over the summer (see box 7.1). China plans to increase underground storage capacity, but this is not expected to keep pace with demand growth, and seasonal demand will continue to put pressure on LNG spot prices in the northern winter.

China's gas demand is expected to grow strongly, supported by government targets to increase the use of gas to 10 per cent of primary energy consumption by 2020, a doubling from the energy share in 2015. Growth is expected in all sectors, including the transport sector.

The rapid expansion of LNG imports will continue over 2018, but growth is expected to stabilise by 2020, as local production continues to expand and pipeline imports increase from Central Asia and Russia. Recent trade negotiations between the US and China may impact sales of US LNG to China, but it is too early to tell how this will affect imports from Australia. Australia is a major LNG supplier to China, contributing to about 45 per cent of imports into China in 2017.

Europe and emerging Asian economies to drive long-term demand growth

European LNG demand reached 46 million tonnes in 2017, growing by 20 per cent from 2016. Imports are expected to grow strongly to 2020 despite relatively flat growth in gas consumption. LNG imports are being driven by long-term declines in domestic gas production, particularly from the earthquake-prone Groningen field in the Netherlands, as well as limited prospects for growth in pipeline imports from Russia. LNG is seen as a means to diversify energy supply sources.

LNG imports to emerging Asian countries also grew strongly in 2017, to around 35 million tonnes. Growth is expected to continue to 2020, making emerging Asia the main driver of LNG import growth in the global market. This growth will be led by India and Pakistan, the largest gas consumers in this group. LNG imports in India are expected to grow by 75 per cent from 19 million tonnes in 2017 to about 33 million tonnes in 2020, whilst Pakistan will more than double imports from 5 million tonnes in 2017 to 13 million tonnes in 2020. Amongst the other emerging economies, the strongest growth prospect is Indonesia, expected to take 12 million tonnes in the west of the archipelago in 2020, despite large LNG exports from east Indonesia.

The strong growth in emerging Asia is being facilitated by the use of Floating Storage and Regasification Units (FSRUs), which provide a low cost avenue for relatively small LNG import volumes to enter a developing market. Similar technology has been proposed for LNG imports into Australia (see Chapter 15 of this publication *Asian LNG trade and Australian LNG imports*).

Oil-linked pricing is dominant in Asia, so higher oil prices could dampen LNG demand in emerging nations. The use of alternative pricing models indexed to the LNG supply and demand fundamentals has the potential to support further growth in these markets.

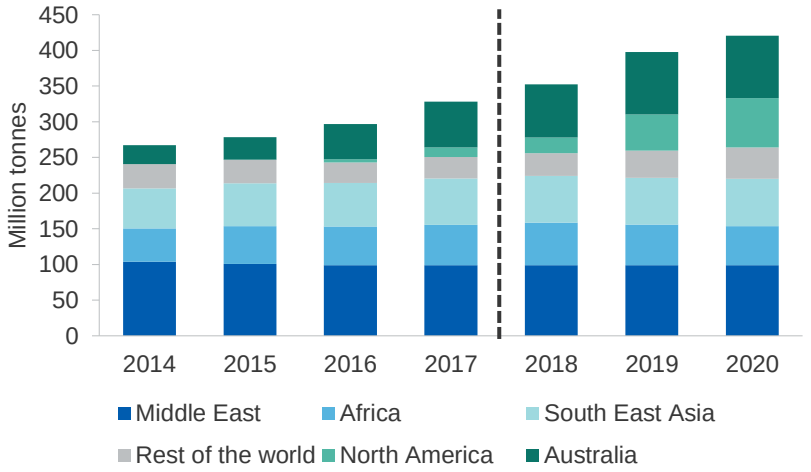
An additional emerging market for LNG is as a bunkering fuel for shipping. This could be a significant growth area for LNG, but it is not expected to make serious inroads until 2020.

7.5 World exports

A major expansion of world LNG supply capacity is underway

After relatively modest growth from 2012 to 2016, LNG liquefaction capacity is expected to grow 40 per cent from 2016 to 2020 to meet pent-up demand in Europe and Asia. The principal source of new capacity will be the US, followed by Australia and Russia.

Figure 7.6: Global LNG supply capacity



Notes: Nameplate capacity in millions of tonnes per annum
Source: Nexant (2018); Department of Industry, Innovation and Science (2018)

Qatar, currently the world's largest producer, announced plans in April 2017 to end its moratorium on new gas development in its North field, and to increase LNG export capacity by 30 per cent from the current level of 77 million tonnes. However, this is not expected to take place for at least five years and does not affect the current outlook.

In Australia, the current wave of LNG plant construction is almost over (as discussed below). In Russia, the first train at the 16.5 million tonne Yamal LNG project in the Arctic Circle began operations in late 2017. All three trains are expected to be operational by 2020.

The US is on track to have 70 million tonnes of nameplate capacity — the nominal maximum annual production capacity of an LNG plant — operational by the end of 2019. As of April 2018, four trains are operating at Sabine Pass, Louisiana (18 million tonnes) and one train at Cove Point, Maryland (5.3 million tonnes). In 2017, over 50 per cent of US sales were to Mexico, South Korea and China, and higher prices in Asia are likely to attract more sales there.

There are four more US plants under construction, plus an additional train at Sabine Pass. These plants are Elba Island, Freeport, Corpus Christi and Cameron. Approximately 30 million tonnes is expected to be operational by the end of 2018, and the remainder by the end of 2019. There are also prospects under consideration for additional trains at Sabine Pass and Corpus Christi in the US, which could take total nameplate to 79 million tonnes by the end of 2020.

Whilst global LNG import growth is sufficient to absorb this new capacity over 2018, slowing demand growth in 2019 and 2020 is expected to create a short period of excess supply.

Box 7.1: Meeting seasonal gas demand with underground storage

Gas consumption can be highly seasonal, particularly when there is a large heating demand in the residential market. During the winter heating season there will be large spikes in gas demand on very cold days, which can significantly exceed the average daily load. It can be very expensive to provide sufficient supply capacity to meet these extreme demand profiles, since both production, transmission and distribution assets must be sized to meet the peak day demand.

The problem is most acute in cold climates. In Victoria, where there is a significant residential heating load, the peak days can be three times higher than the summer demand. The problem is even more acute in Beijing, where the government has strongly encouraged gas heating as a means to reduce pollution from coal fired heating.

The rapid growth of gas demand in China has been matched with very high growth in winter peak demand. This has put severe pressure on the supply system, particularly over the most recent winter. The supply crunch was associated with a surge in the North East Asian spot price, which only began to abate after the northern hemisphere winter.

The most common solution to this problem in the gas industry is to include underground gas storage (UGS) in the gas supply chain. These are mainly depleted gas reservoirs, but can also include aquifers, depleted oil reservoirs and salt caverns. Gas is pumped into the underground storage during the summer when demand is low, and withdrawn into the gas network in the winter when demand is peaking. Ideally, the storages should be near the centres of demand, as this allows the investment in gas supply and transmission infrastructure to be minimised.

In Victoria, a 26 petajoule UGS has been established at Iona in the south west. This is approximately 12 per cent of total Victorian demand, consistent with the global average. However, in China the rapid growth in demand has not been matched with growth in UGS, which is currently only about three to four per cent of demand.

China is planning major investments in UGS to bring capacity to five per cent of demand by 2020. PetroChina is constructing two facilities at Chongqing and plans six more in south west China. However, unlike the US where UGS is 17 per cent of demand, China does not have an abundance of suitable geological locations. Reservoirs are deeper and more prone to faulting, which makes it more difficult to establish a sealed storage.

Until storage makes greater inroads in the gas supply chain, China is likely to experience tight conditions in the winter, meaning that the winter spikes in LNG spot prices will continue for the foreseeable future.

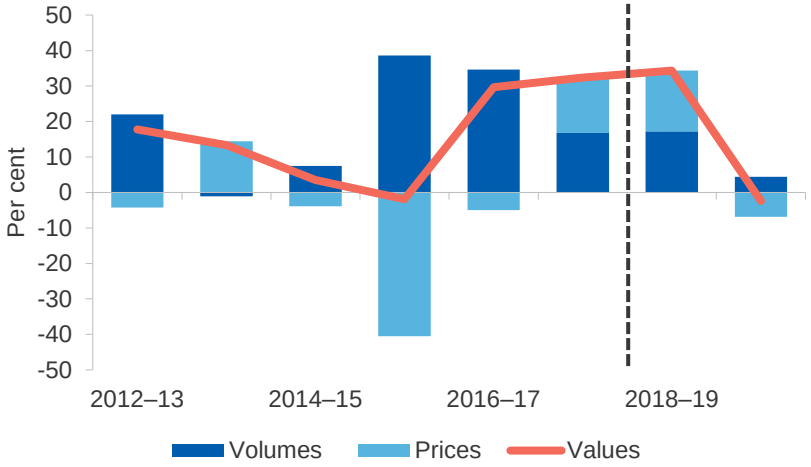
7.6 Australia

LNG export earnings driven by higher export volumes and prices

The value of Australia's LNG exports increased by 47 per cent year-on-year in the March quarter 2018, driven largely by increases in volumes as projects under construction came on-line.

Australia's LNG export earnings are forecast to increase by 37 per cent from an estimated $30.8 billion in 2017–18 to $42.4 billion in 2019–20. As Figure 7.7 shows, rising export values will be driven by both higher export volumes and higher prices.

Figure 7.7: Annual growth in Australia's nominal LNG export values, contributions from prices and export volumes



Notes: Log change is used to approximate percentage change.
Source: ABS (2018); Department of Industry, Innovation and Science (2018)

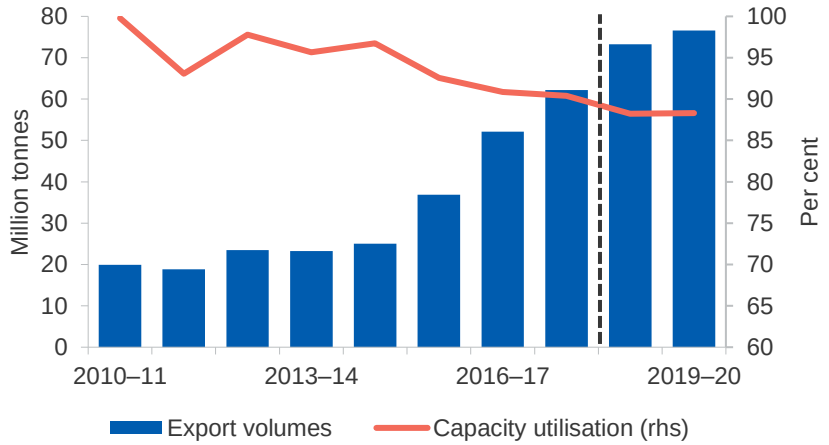
Export volumes are expected to increase by 24 per cent from 62 million tonnes in 2017–18 to 77 million tonnes in 2019–20, as the remaining LNG plants currently under construction come on-line. Prices will rise by 11 per cent from $9.5 a gigajoule to $10.5 a gigajoule over the same period, as higher oil prices flow through to LNG contract prices.

Current wave of LNG projects to be completed by the end of 2018

The remaining LNG projects currently under construction in Australia — Wheatstone (train 2), Ichthys and Prelude — are expected to be completed by the end of this year. This will bring export nameplate capacity to 88 million tonnes.

Train one of Chevron's Wheatstone project in Western Australia is already operational. Train two is expected to commence operations by the end of June 2018, with total nameplate capacity reaching 8.9 million tonnes over the third quarter 2018.

Figure 7.8: Australia's LNG exports and LNG plant capacity utilisation



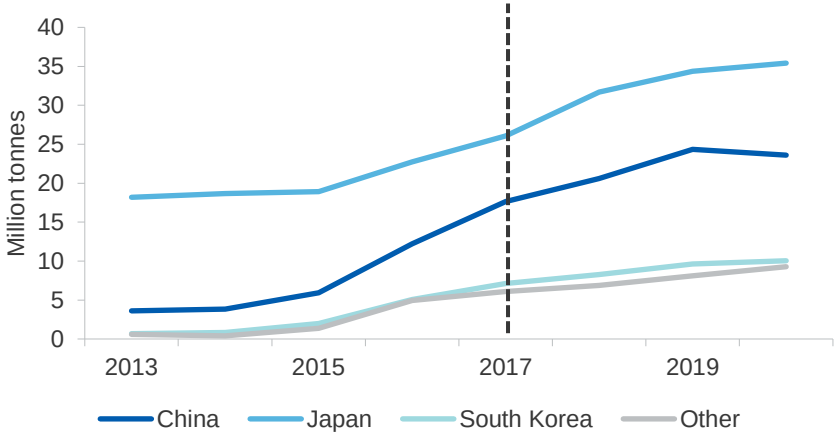
Notes: Utilisation as a share of nameplate capacity.
Source: Department of Industry, Innovation and Science (2018)

The Ichthys project, with a nameplate capacity of 8.9 million tonnes, is on track to commence production from the Darwin plant early in the September quarter of 2018. The Prelude project in offshore Western Australia, with a capacity of 3.6 million tonnes, is the world's second Floating LNG project (the first being Petronas FLNG in Malaysia) and the largest floating vessel in the world. A cooldown cargo was delivered in April 2018 to chill the storage tanks, and the project is expected to be exporting LNG by the fourth quarter of 2018.

The prospects for further capacity expansions at existing plants are limited over the outlook period. The entry of new US LNG capacity over 2018 and 2019 is expected to create a period of excess supply, which will dampen incentives for additional brownfields expansions at Australian plants.

However, debottlenecking — the optimisation of plant operations in the light of operational experience — is a standard procedure after construction of new plants. Additional capacity could be added depending on the state of the LNG market.

Figure 7.9: Asia to remain main destination for Australian exports



Source: Nexant (2018); Department of Industry, Innovation and Science (2018)

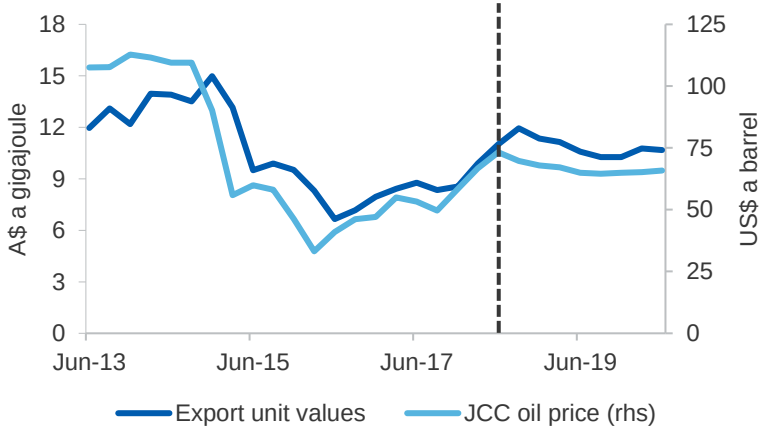
Japan has traditionally been the main destination for Australian LNG, but exports to China and South Korea have increased significantly since the current wave of capacity expansion began. Japan currently takes around 45 per cent of Australia's exports, whilst China's market share has risen to almost one third. These shares are expected to be unchanged out to 2020.

Oil prices drive Australian LNG prices higher

The majority of Australian LNG is sold to Asian customers under contracts linked to the Japan Custom-Crude (JCC) price, which tends to track the Brent crude oil price. JCC oil prices have been rising steadily, from a low of US$41.9 per barrel in 2016 to a forecast high of US$69.4 per barrel in 2018, but are forecast to fall to US$65.4 per barrel in 2020.

On the basis of these price forecasts, the average LNG price for Australian exports is projected to rise from $8.1 a gigajoule in 2016–17 to $10.5 a gigajoule in 2019–20. LNG spot prices in north east Asia are expected to track downwards from current seasonal highs, as new capacity enters the market from Australia, the US and Russia.

Figure 7.10: Australian LNG export prices and the JCC price



Notes: Export prices are export unit values. JCC forecast derived from Brent oil forecast.
Source: ABS (2018); Department of Industry, Innovation and Science (2018)

Uncertainties remain in the outlook for Australia's LNG exports

Australia's LNG exports are forecast to reach 77 million tonnes a year by 2019–20, which is approximately 88 per cent of nameplate capacity, down from 91 per cent in 2016–17. The modest decline in capacity utilisation is related to the excess global capacity expected over 2019 and 2020, and the option in some LNG contracts for buyers to reduce offtake to 'take-or-pay' levels to take advantage of low spot prices. However, as the last year has shown, both demand and LNG prices can change significantly in response to multiple global influences. In the face of this volatility, there are significant upside and downside risks for the outlook period.

Table 7.1: Gas outlook

						Annual percentage change		
	Unit	2017	2018[f]	2019[f]	2020[f]	2018[f]	2019[f]	2020[f]
World								
JCC oil price[a]								
– nominal	US$/bbl	54.1	69.4	65.4	65.9	28.4	–5.8	0.8
– real[h]	US$/bbl	55.3	69.4	64.0	63.3	25.5	–7.8	–1.0
Gas production[t]	Bcm	3 726.1	3 836.3	3 878.5	3 940.1	3.0	1.1	1.6
Gas consumption[t]	Bcm	3 739.0	3 825.1	3 884.7	3 937.2	2.3	1.6	1.4
LNG trade[d]	Mt	289.6	322.1	344.6	362.8	11.2	7.0	5.3
	Unit	**2016–17**	**2017–18[s]**	**2018–19[f]**	**2019–20[f]**	**2017–18[f]**	**2018–19[f]**	**2019–20[f]**
Australia								
Production[b]	Bcm	105.3	121.3	140.6	143.0	15.2	15.9	1.6
– Eastern market	Bcm	54.3	56.6	59.9	56.9	4.2	5.8	–5.1
– Western market	Bcm	49.6	63.3	71.9	73.4	27.5	13.6	2.0
– Northern market[c]	Bcm	1.3	1.4	8.8	12.7	4.5	530.9	44.2
LNG export volume[d]	Mt	52.1	61.7	73.3	76.6	18.3	18.8	4.6
– nominal value	A$m	22,308	30,842	43,481	42,446	38.3	41.0	–2.4
– real value[e]	A$m	22,745	30,842	42,482	40,519	35.6	37.7	–4.6
LNG export unit value[g]								
– nominal value	A$/GJ	8.1	9.5	11.2	10.5	16.9	18.6	–6.6
– real value[e]	A$/GJ	8.3	9.5	11.0	10.0	14.6	15.9	–8.8
– nominal value	US$/MMBtu	6.5	7.8	9.3	8.7	20.2	19.5	–6.2
– real value[e]	US$/MMBtu	6.6	7.8	9.1	8.3	17.9	16.7	–8.4

Notes: **a** JCC stands for Japan Customs-cleared Crude; **b** Production includes both sales gas and gas used in the production process (i.e. plant use) and ethane. Historical gas product ion data was revised in the June quarter 2017 to align with Australian Petroleum Statistics published by the Department of Environment and Energy; **c** Gas production from Bayu-Undan Joint Production Development Area is not included in Australian production. Browse basin production associated with the Ichthys project is classified as Northern market; **d** 1 million tonnes of LNG is equivalent to approximately 1.36 billion cubic metres of gas; **e** In 2017–18 Australian dollars; **f** Forecast; **g** 1 MMBtu is equivalent to 1.055 GJ; **h** In 2018 US dollars; **s** Estimate; **t** 2017 is an estimate.

Source: ABS (2018) International Trade in Goods and Services, Australia, Cat. No. 5368.0; Department of Industry, Innovation and Science (2018); Company reports; Nexant World Gas Model (2018)