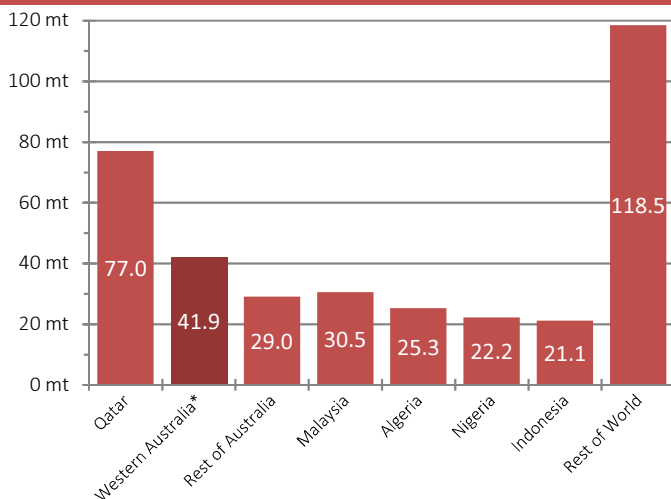




- Western Australia has an established and reliable liquefied natural gas (LNG) export industry. The State’s first LNG project, the North West Shelf, will celebrate 30 years of LNG exports in 2019.
- Western Australian LNG projects are located close to Asia, the region with the largest consumption of LNG.
- As foundation investment partners and customers, Japanese utility companies helped establish Western Australia’s LNG industry. Japan remains the destination for most of Western Australia’s LNG exports.
- In 2006, Western Australia became the first jurisdiction in the world to export LNG to China. Western Australian LNG projects also have long-term contracts signed with customers in South Korea and India.
- High gas prices in the 2000s prompted major investment in Western Australia’s LNG industry. Western Australia currently has four operating LNG export projects: the North West Shelf, Pluto, Gorgon and Wheatstone. By the end of 2018, the State will have five operating LNG export projects with a total capacity of close to 50 million tonnes per annum (mtpa).
- Perth hosted the 18<sup>th</sup> International Conference and Exhibition on LNG (LNG18) in April 2016.

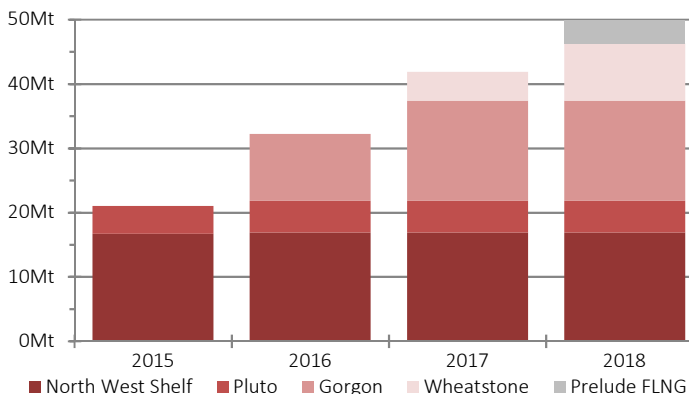
**Global LNG export capacity: 2017**



Source: International Group of LNG Importers (GIIGNL); WA Department of Jobs, Tourism, Science and Innovation (DJTISI) estimates (based on public company announcements).

- The International Group of LNG Importers estimates that at the end of 2017, global LNG export capacity was 365 mtpa.
- Australia’s capacity at the end of 2017 was 70.9 mtpa, which included the:
  - North West Shelf, Pluto, Gorgon and Wheatstone (train 1) projects in Western Australia (totalling 41.9 mtpa);
  - Darwin project in the Northern Territory (3.7 mtpa); and
  - Queensland Curtis, Gladstone and Australia Pacific projects in Queensland (25.3 mtpa).
- The second train at Wheatstone began production in June 2018. If the remaining projects under construction commence as scheduled (Prelude in Western Australia; and Ichthys in the Northern Territory), Australia’s total LNG production capacity will be 88 mtpa by early 2019.
- Australia will then have the largest LNG export capacity of any country, surpassing Qatar’s 77 mtpa.

**Western Australia’s LNG export capacity**

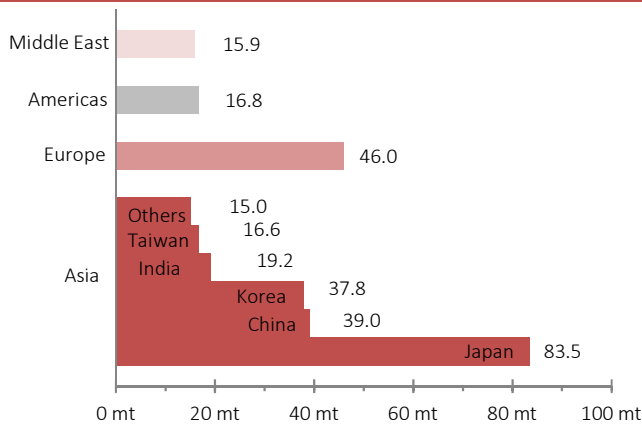


Note – Additions to LNG export capacity reflect the start-up of LNG trains during a particular year; however not all the export capacity of a new LNG train may be available in the same year.  
Source: WA DJTISI estimates based on public company announcements.

- The North West Shelf project originally comprised two trains in 1989. A third, fourth and fifth train were developed in 1992, 2004 and 2008, raising total capacity to 16.9 mtpa.
- The Pluto project (single 4.9 mtpa train) began exporting in May 2012.
- The Gorgon project (15.6 mtpa, three trains) began exports from its first train in March 2016 and production from its second and third trains in October 2016 and March 2017.
- The Wheatstone project (8.9 mtpa, two trains) commenced production from its first train in October 2017 and second train in June 2018.
- The remaining LNG development in Western Australia is the Prelude floating LNG project (3.6 mtpa).
- By the end of 2018, when development of all projects is scheduled to be completed, Western Australia’s total LNG export capacity will be 49.9 mtpa.



Regional LNG imports: 2017



Source: International Group of LNG Importers (GIIGNL).

- In 2017, global LNG trade was 289.8 million tonnes, with the five largest importers – Japan, South Korea, China, India and Taiwan – located in Asia. There are also emerging LNG markets in Pakistan and Southeast Asia.
- Asia accounted for 73 per cent (211.2 million tonnes) of global LNG imports in 2017.
  - Japan and South Korea together accounted for 42 per cent of LNG imports in 2017.
  - China and India together accounted for 20 per cent of LNG imports in 2017, with this proportion expected to grow as both countries increase their gas demand.
- Europe (16 per cent), the Americas (6 per cent) and the Middle East (5 per cent) made up the balance of global LNG imports.

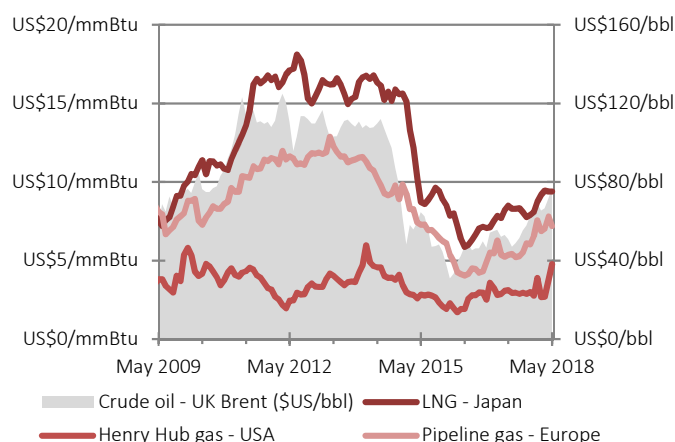
LNG transport: international shipping duration (days)

From:	To: Japan (Tokyo)	China (Shanghai)	Korea (Incheon)	Taiwan (Yung-an)	India (Gujarat)
Australia (West coast)	8	7	8	6	9
Australia (East coast)	8	9	9	8	14
Qatar	14	12	13	11	2
USA (Gulf coast)	20	22	21	22	21
South East Asia (Singapore)	6	5	6	4	6
Russia (Sakhalin)	2	3	3	4	12
Nigeria	23	22	23	20	15

Note – days shipping is based on a vessel at maximum speeds of 19.5 knots.  
Source: Shippscene; International Group of LNG Importers (GIIGNL).

- Western Australia’s LNG projects are located relatively close to the world’s biggest LNG importers in Asia, comparing favourably to the shipping distances from Qatar (with the exception of India).
- The shipping distance from Western Australia’s LNG projects to Japan is around 3,400 nautical miles or about 8 days travel, with similar shipping durations to South Korea, China, Taiwan and India.
- The expansion of the Panama Canal, completed in late-June 2016, means that most LNG tankers can now pass through, providing a shorter trade route for LNG exports from the USA to Asian customers. However, shipping to Asian customers from the US Gulf Coast still takes more than twice the time of shipping from Western Australia.

Regional LNG/pipeline gas prices

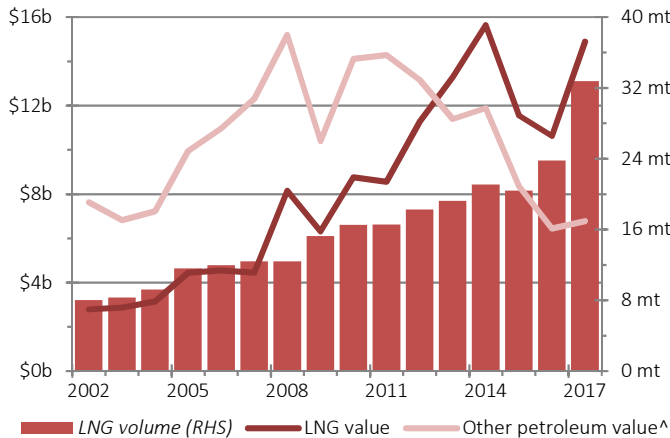


mmBtu = millions of British thermal units  
Source: World Bank

- LNG sales in Asia are made mostly through long-term contracts. According to the International Group of LNG importers, 21 per cent of Asia’s LNG imports in 2017 were through spot and short-term contracts, with the remaining 79 per cent through long-term contracts.
- Most long-term LNG contracts for supply to Asia have prices linked to the oil price, so LNG prices in Asia generally move with the oil price (with a timing lag of a few months).
- This differs from gas prices in the USA, which respond to the regional gas market. In the past, this has led to a large gap between Asian LNG prices and USA gas prices: higher oil prices led to higher LNG prices in Asia, while gas prices fell in the USA as more shale gas supply was brought to market. The large fall in the oil price in late 2014 reduced this gap.
- The average price of Japan’s LNG imports in July 2018 (based on Japanese customs data) was US\$9.9 per mmBtu, up 18 per cent on July 2017.
- The average price of Japan’s LNG imports in 2017-18 was US\$8.8 per mmBtu, up 17 per cent on 2016-17.



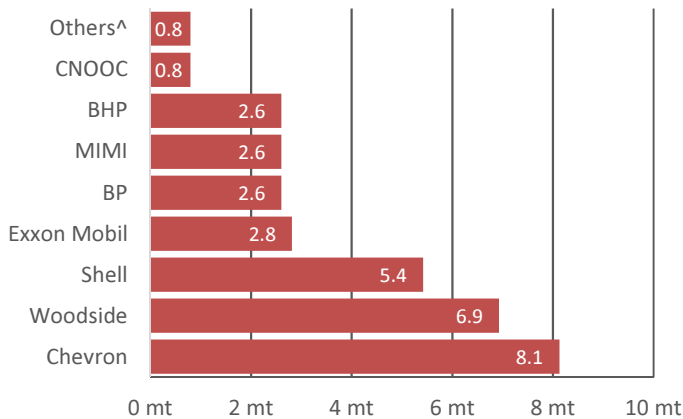
Western Australia's LNG sales (volume and value)



^ Other petroleum sales include Condensate, Crude Oil, LPG and domestic natural gas.  
Source: WA Department of Mines, Industry Regulation and Safety.

- The volume of Western Australia's LNG sales rose 38 per cent to 32.7 million tonnes in 2017. The increase in volume was mainly due to the ramp-up in production from the Gorgon LNG project during 2017.
- The value of Western Australia's LNG sales rose 40 per cent to \$14.9 billion in 2017.
- LNG accounted for 14 per cent of Western Australia's total commodity sales (\$108.8 billion) in 2017, up from a share of 11 per cent in 2016.
- LNG accounted for 69 per cent of Western Australia's total petroleum sales (\$21.7 billion) in 2017, up from a share of 62 per cent in 2016.

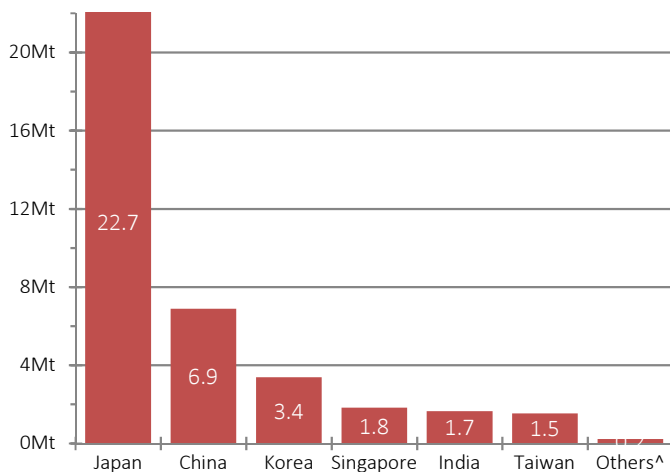
WA's LNG production by company: 2017



^ Includes Tokyo Gas, Kansai Electric, Osaka Gas, Jera, Kufpec, PE Wheatstone and Kyushu Electric.  
Source: EnergyQuest EnergyQuarterly.

- Chevron accounted for 25 per cent of Western Australia's LNG production in 2017. Chevron is the operator and largest stakeholder in the Gorgon and Wheatstone projects and its share of Western Australia's LNG production is increasing as these projects ramp-up production.
- Woodside accounted for 21 per cent of Western Australia's LNG production in 2017. Woodside has a one sixth share of the North West Shelf project and a 90 per cent share of the Pluto project.
- As large-volume, long-term contract buyers are increasingly hard to find, LNG producers have been shifting to a 'portfolio' sales strategy in which companies sell their equity share of a project's production. Aggregating sales volumes from different LNG projects allows sellers to maximise spot and short-term market opportunities.

WA's LNG sales by destination: 12 months to July 2018



^ Others include sales to Thailand and United Arab Emirates.  
Source: EnergyQuest LNG Report

- Japan was Western Australia's first LNG customer in 1989 and it remains the State's largest customer.
- Western Australia became the first exporter of LNG to China in 2006 via the North West Shelf's sales contract with Guangdong Dapeng LNG.
- In the twelve months to July 2018, Western Australia exported 38.2 million tonnes of LNG. Of this total:
  - Japan accounted for 59 per cent;
  - China accounted for 18 per cent;
  - South Korea accounted for 9 per cent;
  - Singapore accounted for 5 per cent;
  - India and Taiwan each accounted for 4 per cent.
- Japan is likely to remain Western Australia's largest LNG customer, however new contracts with buyers in China, South Korea and India and growing portfolio sales will diversify the State's LNG markets.



WA LNG PROJECT LIST (including associated infrastructure and developments) – as at 27 August 2018

Project	Stakeholders	Capex (A\$b)	Capacity (mtpa)	Start-up	Other Project Information
<b>North West Shelf</b> <i>Trains 1-5</i>	Woodside (16.67%) BHP (16.67%) BP (16.67%) Chevron (16.67%) MIMI (16.67%) Shell (16.67%)	27.0	16.9	1989	Trains 1 and 2 began in 1989. Train 3 began in 1992. Train 4 began in 2004. Train 5 began in 2008.
<b>Pluto</b> <i>Train 1</i>	Woodside (90%) Tokyo Gas (5%) Kansai Electric (5%)	15.0	4.9	2012	Pluto exported its first LNG cargo in May 2012. Xena 1 field commenced production in June 2015. Woodside plans to backfill and expand the Pluto LNG facilities with additional gas sourced from the Scarborough fields. FEED is targeted for early 2019, FID 2020, and start up 2024.
<b>North Rankin</b> <i>Redevelopment</i>	see North West Shelf	5.0	n/a	2013	North Rankin Platform B will recover about 5 trillion cubic feet of gas from the North Rankin and Perseus fields.
<b>Greater Western Flank (Phase 1)</b> <i>Development</i>	see North West Shelf	2.5	n/a	Dec 2015	Phase 1 will recover 1.1 trillion cubic feet of gas to maintain North West Shelf output, via subsea tie-back to the existing Goodwyn A platform. Target fields in Phase 1 include Goodwyn GH and Tidepole.
<b>Gorgon</b> <i>Trains 1-3</i>	Chevron (47.3%) ExxonMobil (25%) Shell (25%) Osaka Gas (1.25%) Tokyo Gas (1%) JERA (0.417%)	55.0	15.6	Mar 2016	Gorgon exported its first LNG cargo in March 2016. Train 2 began production in October 2016. Train 3 began production in March 2017. Chevron is considering increasing Gorgon capacity by debottlenecking existing trains.
<b>Julimar-Brunello</b> <i>Development</i>	Woodside (65%) KUFPEC (35%)	1.4	n/a	Oct 2016	The Julimar and Brunello fields will feed 2.1 trillion cubic feet of gas to the Wheatstone LNG project. Phase two of the project to tie-back the Julimar field to the existing Brunello subsea infrastructure will enter FEED in 2018, with FID targeted for 2019.
<b>Persephone</b> <i>Development</i>	see North West Shelf	1.2	n/a	Jul 2017	The Persephone Development will maintain Karratha Gas Plant output via subsea tie-back to the existing North Rankin complex.
<b>Wheatstone</b> <i>Train 1 &amp; 2</i>	Chevron (64.14%) KUFPEC (13.4%) Woodside (13%) PE Wheatstone (8%) Kyushu Electric (1.46%)	40.0 <sup>^</sup>	8.9	Oct 2017	Train 1 commenced LNG production in October 2017. Train 2 commenced LNG production in June 2018.
<b>Ichthys</b> <i>Train 1 &amp; 2</i>	Inpex (62.245%) Total (30%) CPC (2.625%) Tokyo Gas (1.575%) Osaka Gas (1.2%) Kansai Electric (1.2%) JERA (0.735%) Toho Gas (0.42%)	19.0 <sup>1</sup>	n/a <sup>2</sup>	Sep 2018	Gas production started in July 2018 and LNG will be produced and exported from September 2018. <sup>1</sup> Western Australia has an estimated 50 per cent share of the project's total capital expenditure of A\$38.0 billion. <sup>2</sup> The project will have two LNG trains with a total capacity of 8.9 mtpa, all of which is attributed to the Northern Territory.
<b>Prelude</b> <i>FLNG vessel</i>	Shell (67.5%) Inpex (17.5%) KOGAS (10%) CPC (5%)	12.6	3.6	Dec quarter 2018	The floating LNG vessel arrived at the Prelude gas field in the Browse Basin in July 2017. Start-up is expected in the fourth quarter of 2018. In addition to LNG, Prelude will produce 1.3 mtpa of condensate and 0.4 mtpa of LPG. The vessel will operate at the Prelude gas field for 25 years.
<b>Greater Western Flank (Phase 2)</b> <i>Development</i>	see North West Shelf	2.8	n/a	Dec 2019	Construction is 85 per cent complete at the end of April 2018. Phase 2 will recover 1.6 trillion cubic feet of gas to maintain North West Shelf output, via subsea tie-back to the Goodwyn A platform. Target fields in Phase 2 include Dockrell, Kreast, Lady Nora, Pemberton and Sculptor-Rankin.
<b>Gorgon Stage 2</b>	see Gorgon	5.1	n/a	2019	In April 2018, Chevron announced investment in the second stage of the Gorgon project, which will help maintain supply to the project for the next 30 years. Drilling is expected to start in 2019.

Capex = capital expenditure; mtpa = million tonnes per annum (export capacity addition); FEED = front-end engineering and design; FID = final investment decision; FLNG = Floating LNG; n/a = not applicable.

Note: <sup>^</sup> DJTSI estimate of Wheatstone capital expenditure in Australian dollar terms, taking into account the profile of capital expenditure and movements in the exchange rate across the construction period.

Sources: Deloitte Access Economics 'Investment Monitor', EnergyQuest 'Energy Quarterly', WA Chamber of Commerce and Industry 'Resources and Energy Projects Service', project proponent websites, reports, presentations and media.



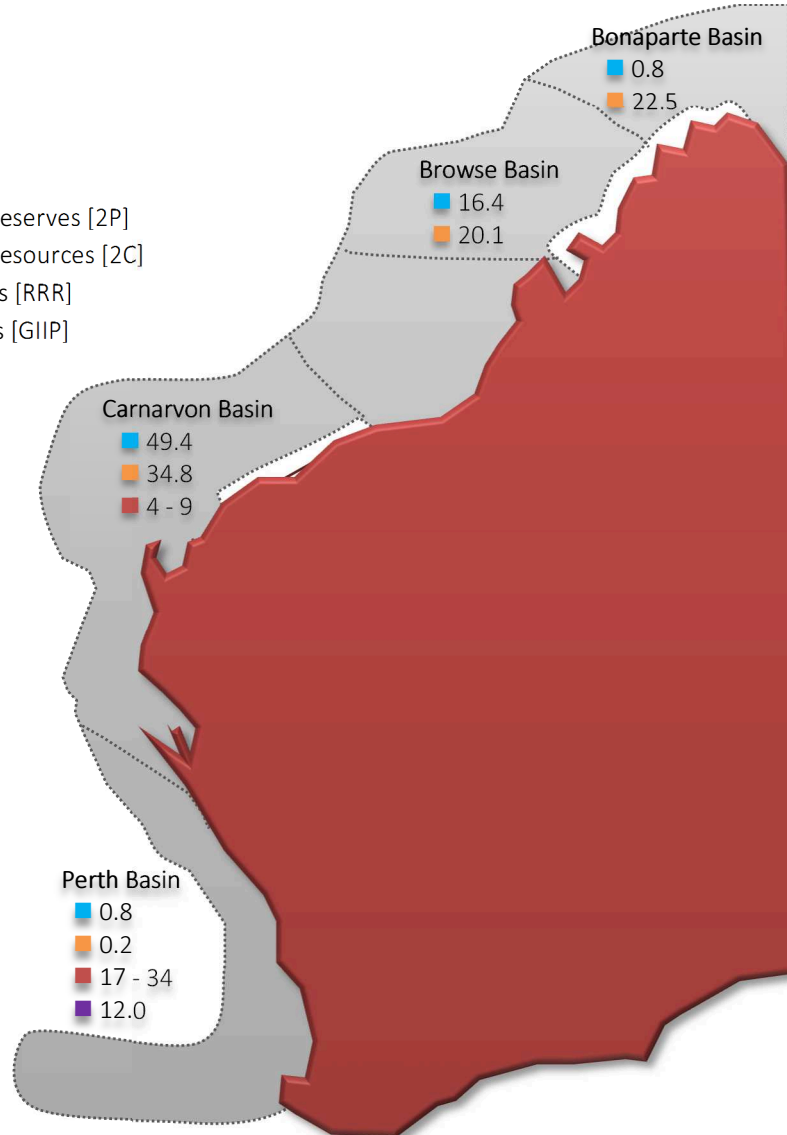
Western Australia's natural gas reserves and resources

- Western Australia's current and committed LNG projects source gas from offshore in the Carnarvon and Browse basins.
- The State's domestic gas needs are supplied through production facilities located in the Carnarvon and Perth basins.
- The State also has onshore shale and tight gas resources in the Canning, Carnarvon and Perth basins.

Map of WA's gas reserves and resources (trillion cubic feet) – as at May 2018

LEGEND

- Gas pipeline
- ⋯ Gas basin
- Conventional gas reserves [2P]
- Conventional gas resources [2C]
- Shale gas resources [RRR]
- Tight gas resources [GIIP]



Reserves are categorised by probability or likelihood of recovery  
*2P* = reserves that are proved (90%) + probable (50%).

Contingent resources are known and recoverable, however are considered sub-economic at this point in time  
*2C* = contingent resources.

Resources can be assessed against the geologic and technical likelihood of success plus the amount that is technically able to be produced now  
*RRR* = DMIRS's current, best estimates of risked, recoverable resources.

*GIIP* = Gas-initially-in-place, referring to the estimated total amount of gas contained within the basin, including volumes that are deemed sub-economic, and which may never be recovered

Reserves and resources for the Bonaparte Basin show the net entitlement to Australia.

**Note – map is indicative only.** For more information on reserves and resources classification, see the Society of Petroleum Engineers' *Petroleum Resources Management System*.

Sources: EnergyQuest EnergyQuarterly; and WA Department of Mines, Industry Regulation and Safety.