LNG Insights

China LNG Forecast

October 2017

Chinese LNG imports over the first eight months of 2017 were 44% higher than the same period last year. Full year imports could exceed 34 million tonnes (26 million tonnes in 2016). In 2018 China is likely to overtake Korea to become the second largest LNG importer. How much will China import in 2025? Will it overtake Japan? This LNG Insights forecasts China's LNG imports out to 2030.

Boom time

- Domestic gas consumption over the first eight months of 2017 increased by 17.8% year-on-year to reach 150.4 Bcm
- Domestic gas production up 10.8% to 97.8 Bcm
- Natural gas imports Jan-Aug up 24.8% to 57 Bcm
- LNG imports in first eight months up 44% year on year.
- LNG sales within China surged by 45% year on year in H1 2017, to 8.11 million tonnes as a result of stronger demand from the transport and industrial sectors.
- Transportation sector returns to growth – LNG significantly cheaper than diesel
- Government outline substantial expansion of LNG terminal capacity, gas storage facilities and pipelines
- Major coal to gas conversion programme launched to convert industrial boilers and district heating plants to gas in major cities. *This campaign becomes the major driver in gas demand growth*

Scene setter

The 13th Five-Year Plan for natural gas development (2016-2020) that was issued in January 2017 revised downward its estimates for gas demand in 2020, stating that gas will account for 8.3-10% of the energy mix. Officials acknowledged that their previous goal of 10%, which is estimated to translate to 350 Bcm, was overly ambitious. According to the new plan, Beijing aims to produce 207 Bcm of gas by 2020, including 120 Bcm of conventional gas, 30 Bcm of shale, 37 Bcm of tight gas and 16 Bcm of coal-bed methane, with an additional 10 Bcm unallocated.

A key objective in the five-year plan is the conversion of industrial boilers and district heating plants from coal to gas throughout four major urban areas: the greater Beijing region, northeast China, the Yangtze River Delta around Shanghai and the Pearl River Delta in Guangdong province. Local governments are supporting the efforts with measures including subsidized gas connections and boiler replacements.

This campaign is expected to generate about half of the gas demand growth over the next five years.

We are energy consultants who also issue **Insights -** periodic thought-pieces about key issues in gas and LNG markets.

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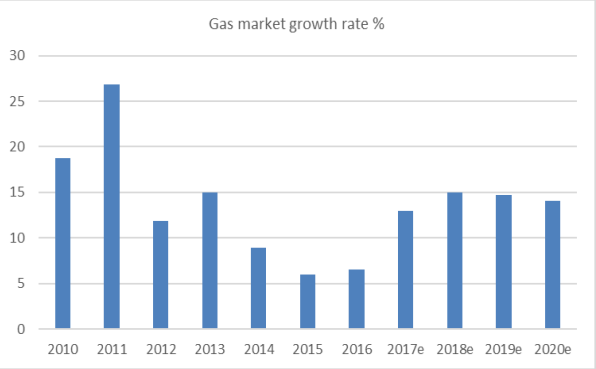
The Big Re-think

Within six months officials revisited these targets and decided that the previous goal of gas having a 10% share of the energy mix by 2020 may be attainable after all. The very strong performance of both demand and supply over the first half of 2017 banished the nervousness shown last year and suggested that the gas market had returned to the double-digit growth rates of 2010-2013.



Domestic gas consumption over the first half of 2017 increased by 15.2% compared with the same period last year, to 114.6 Bcm. Supply also increased substantially. Natural gas imports in the first six months of the year were up 15.9% year-on-year at 31.1 million tonnes. Domestic gas production grew by 7.2% in the first half of the year compared with the same period last year and totalled 74.1 Bcm.

A PetroChina research institute forecast that China's gas demand could surge by a record 30 Bcm this year driven mainly on the back of preferential policies. That substantially exceeds the 23.7 Bcm increase recorded in 2011 and would be equal to annual growth of 14.6% based on China's gas consumption of 205.8 Bcm in 2016.

The National Energy Administration has forecast that China's natural gas demand growth will expand by 20% in 2017. This is substantially more than the expectations from PetroChina. Whilst the NEA target may not be achieved, it does suggest significant policy support is available and that further incentives/subsidies may be forthcoming. Measures by the government to stimulate gas demand with incentives for LNG vehicle purchases, subsidises for coal-to-gas conversion of boilers, and downstream distribution tariff cuts, have all served to stimulate demand and the NEA forecast suggests further support could be available.

Still a stretch

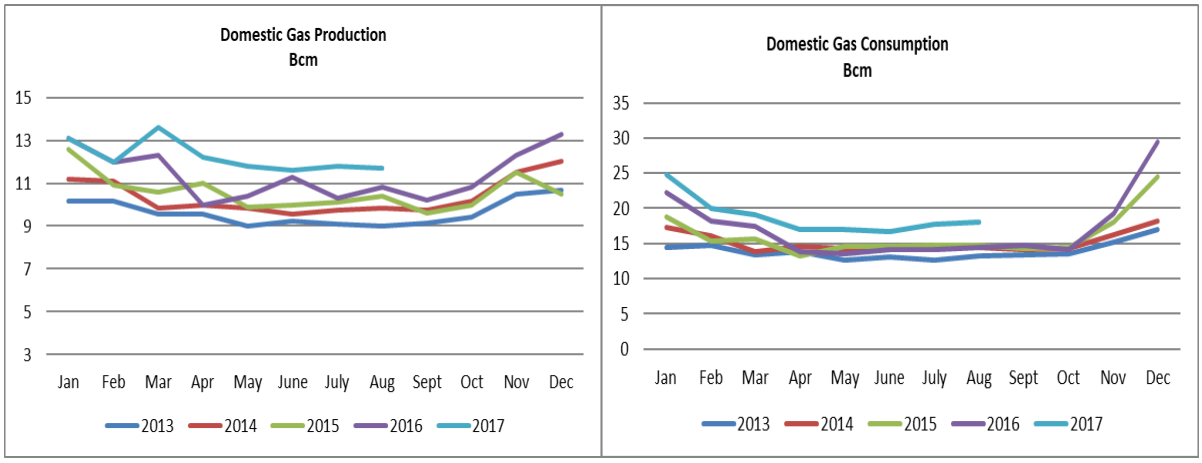
The goal of getting as much as 10% of its energy from gas by 2020 and 15% by 2030, up from 6% in 2016, is still a stretch. To achieve this, demand will have to grow by about 15% a year through the rest of the decade. If China succeeds, it will raise its natural gas demand from 206 Bcm last year to about 360 billion in 2020 – an increase in four years equivalent to its total demand growth in the past 10.

The National Development Reform Commission backed the directive with calls for strengthened pollution controls and a broad effort to encourage domestic use of natural gas, encourage the participation by private companies in overseas gas investments, expanding LNG import terminals, underground gas storage capacity and pipelines. Key parts of the expansion plan were:

- Expansion of natural gas pipeline networks to 104,000 km by 2020 (from 64,000 km in 2015) and ensuring all cities with a population of more than half a million residents will have access to pipeline natural gas. Pipeline network to reach 163,000 Bcm by 2025.
- LNG receiving capacity increasing by 8.6% a year to 100 million tonnes by 2025
- Increasing domestic storage capacity (excluding LNG receiving terminals) for natural gas, including domestic LNG, by 17% a year from 2015 to 2025 to reach 40 Bcm,
- Increasing pipeline capacity for natural gas imports by 7.6% a year from 2015 to 2025 to hit 150 Bcm.
- Encouraging the use of gas as a transportation fuel

Perhaps not such a stretch after all

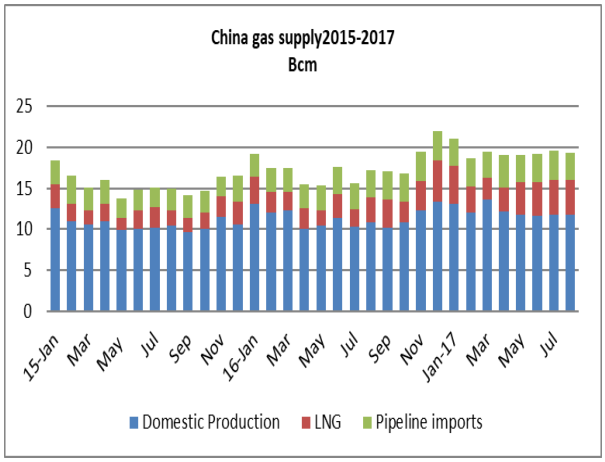
Two months on, the 2020 targets look much more achievable. Natural gas demand in China rose 17.8% y.o.y. in the first eight months of 2017 with strongest demand coming from industry and the transportation sector. Demand grew by a staggering 30% y.o.y. in August as the aggressive campaign to switch industrial boilers and district heating schemes from coal to gas in the major cities bore fruit. Demand hit 18.1 Bcm in August. If that can happen in a summer month what will happen when the district heating systems get turned on in October?



Domestic gas production grew by 10.8% in the first eight months of the year compared with the same period last year and totalled 97.8 Bcm. Whilst respectable and well ahead of the 7.6% growth rate for 2016, it will still be a stretch to ensure the 2020 production target of 207 Bcm will be met. There had been a perception that the growth potential of conventional resources is limited and that unconventional resources may be the main growth area, particularly shale. However conventional production costs are, in most cases, lower than the cost of imported gas and the two major producers, PetroChina and Sinopec, are investing to grow conventional gas production.

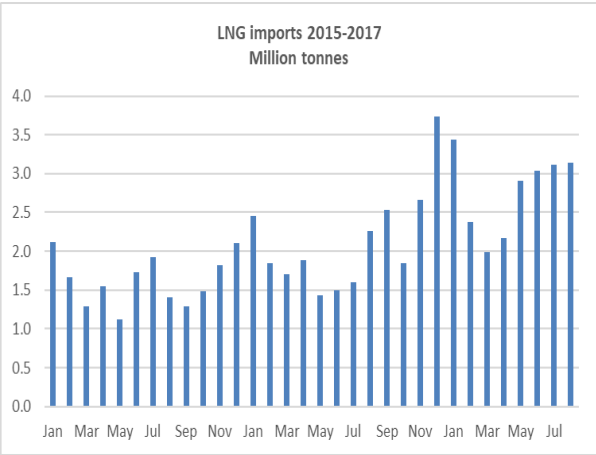
Shale gas is significantly more expensive to develop but its development is a government priority. The Five-Year Plan assumes production of 30 Bcm of shale gas in 2020. 7.9 Bcm was produced in 2016 and Sinopec, has said its Fuling shale gas field, China's first shale gas commercial production program launched in 2014, will reach an annual output of about 10 Bcm by the end of this year.

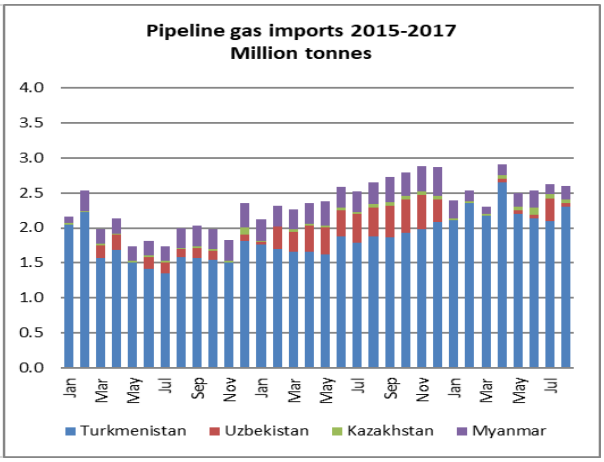
Natural gas imports in July spiked almost 45% year-on-year to 5.76 million tonnes and then rose 20% y.o.y. in August to 5.66 million tonnes.



Piped gas imports for the first eight months were 42.5 million tonnes, 28% higher than the same period last year.

LNG imports were 22.2 million tonnes, up 44% compared with the same period last year as new contracts at AP LNG and Gorgon in Australia ramp up.





Forecasting LNG demand

The key influences on LNG demand are:

- Domestic gas consumption
- Domestic gas production
- Piped gas imports
- LNG infrastructure

Domestic gas demand

Our base case for domestic demand is 350 Bcm in 2020 and 520 Bcm in 2025. Our low line assumes demand of 456 Bcm in 2025 and the high line 592 Bcm.

By far the largest gas market is industry, where gas/LNG is substantially cheaper than diesel. Industry has a 45% share of the gas market followed by power and district heating at 21%. A major programme is underway to convert industrial boilers and district heating schemes from coal to gas. In March 2017, the central government announced a detailed plan to reduce air pollutions in the Beijing-Tianjin-Hebei area, which covers Beijing, Tianjin and 26 other cities in Hebei, Henan, Shandong and Shanxi provinces (26+2). Among these cities, Beijing, Tianjin, Langfang and Baoding are required to be coal-free by October 2017. This campaign is expected to be the main driver of gas demand growth over the next five years creating about 55 Bcm of additional demand over the period 2016-2020.

The campaign is not restricted to the cities and has been extended to the rural areas where significant subsidies are available to encourage take up of gas by the rural residential sector. Rural gas penetration is expected to reach 63% in 2020, from 38% in 2016. Oil to gas switching is expected to create additional gas demand of 25 Bcm over the period 2016-2020.

Domestic LNG market

In the first half of 2017 domestically produced LNG accounted for 4.63 million tonnes of the total consumed, up by one-third year on year, but was outperformed by imported LNG, sales of which expanded by two-thirds, to 3.48 million tonnes. When delivered by truck, LNG imported at recent spot rates is competitive for delivery to industrial customers as far as 500km inland. Based on landed prices in Q2 17 of around US$6/MMBtu it was possible to truck LNG ex terminal as far as 500 km and sell to industry and transportation clients at a 30% discount to piped gas.

It is estimated that imported LNG sold via trucking as percentage of total LNG imports rose from 5% to about 30% by mid-year with several LNG receiving terminals filling over 200 trucks a day.

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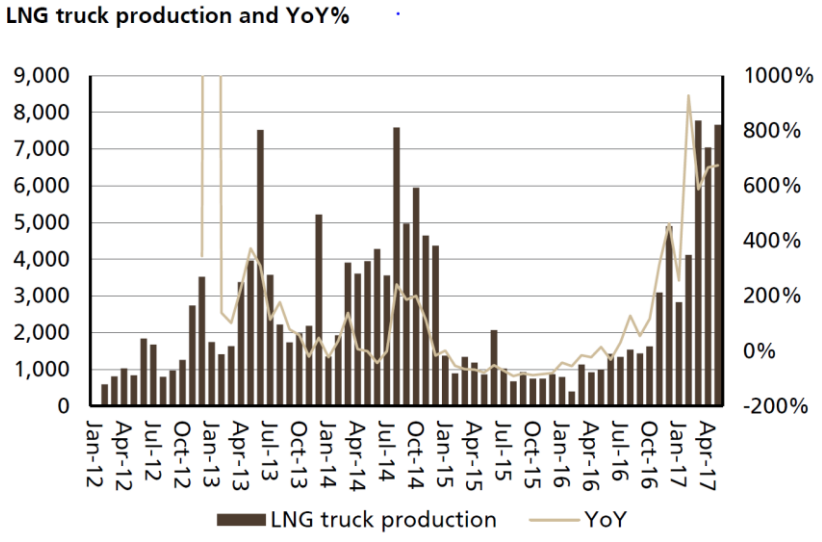
LNG containers have been introduced that can be loaded and offloaded on rail cars leading to a potential structural change in transportation of natural gas. This could allow for a longer transportation distance and deeper penetration of LNG across China when compared to traditional transportation by LNG trucks.

Domestic LNG plants—which now have an estimated capacity of 15-18 Bcm—have been running at under 50% of capacity due to high levels of maintenance, compared to 64% on average last year, with some reportedly failing to return from maintenance due to tightening credit conditions and environmental inspections, leading to stronger demand for imported LNG. There are however exceptions and a Kunlun Energy large scale LNG plant that was idled in 2016 has been operating at a near-full utilization rate in 2017. With LNG so competitive with piped gas it has been possible to raise LNG prices - in Shanxi they are 20% higher than same time last year although feedstock costs have not changed.

China's domestic LNG output is estimated to have risen by 6.25% in August compared with July, to 1.28 Bcm.

LNG fuelled trucks accelerating

The economics of gas as a transportation fuel have improved after increases in diesel prices and higher taxes on diesel. Demand for LNG as a truck fuel is growing strongly. OPEC's decision to cut crude production in November 2016 raised expectations of higher diesel prices and led to a sharp increase in demand for LNG fuelled trucks. LNG truck sales in China reached 4,900 units in December 2016, compared to a January-October average of 1,200 units/month and over the first four months of 2017 averaged over 7,000 units a month. LNG vehicle ownership is now expected to grow at about 30% per annum between 2017 and 2020.



Source: WIND

Gas demand in the transportation sector is now expected to grow at a 20% CAGR in the period 2016-20, and its share within total gas demand could rise from 11% in 2016 to 15% in 2020. If a strong policy push (e.g. through subsidies) is maintained the high line scenario has growth at a CAGR of 32% and transportation gas demand's share at 21% by 2020. The bull case suggests that the transportation sector could contribute to 44% of China's incremental gas demand growth over 2016-20. Growth is almost entirely due to increasing demand from trucks, buses and heavy plant. Gas use by light vehicles tends to be in the form of CNG and this sector is now facing strong competition from electric vehicles.

LNG as a marine fuel struggling

A protracted downturn in China's river cargo-shipping industry has dashed hopes of building 60,000 LNG-fuelled ships by 2020. China currently has just 139 LNG-fuelled ships, 102 of which are newbuilds and 37 retrofitted diesel vessels. Nearly 100 of the 139 ships are operational

Gas demand forecast

Our base case forecast assumes gas demand of 350 Bcm in 2020 (slightly lower than government forecast in 13th Five Year Plan) and 520 Bcm in 2025. Consumption doubles between 2017 and 2023.

Our low line assumes the current strong subsidy support is not sustainable and the coal to gas substitution campaign is poorly implemented at a local level. It also assumes a continuation of relatively low oil prices that lessen the attractiveness of LNG as a transportation fuel.

Gas demand						
Million tonnes	2015	2016	2017	2020	2025	2030
Low line	193	206	230	310	456	582
Mean line	193	206	233	350	520	664
High line	193	206	243	400	592	750

Our high line assumes environmental drivers remain strong resulting in a continuation of strong policy support for coal to gas substitution from both central and provincial government. Oil prices rise further encouraging the use of LNG as a transportation fuel and speeding up diesel to gas conversion by industry.

Domestic gas production

Our base case for domestic production is also broadly in line with the forecast in the 13th Five Year Plan and assumes production of 207 Bcm in 2020 and 290 Bcm in 2025.

This assumes an aai of 10.9% between 2017 and 2020 similar to ytd 2017 growth of 10.8%. This is significantly higher than the aai over the period 2012-2016 of 6.3%.

Domestic gas production						
Bcm	2015	2016	2017	2020	2025	2030
Low line	127	137	152	200	282	365
Mean line	127	137	152	207	290	375
High line	127	137	152	215	315	427

Low line

Continued good growth in production but moderated by slower ramp up of shale gas production. Shale gas production of 25 Bcm in 2020 rather than 27 Bcm assumed in the mean line. Production grows by an aai of 10% between 2017 and 2020 and 7.1% per annum between 2021 and 2025.

High case

The high case assumes that the current strong demand growth encourages faster development of domestic resources, in particular, shale gas. This results in an aai in production of 12% between 2017 and 2020 and 8% per annum from 2021-2025.

Piped gas imports

China currently imports gas from Myanmar and Central Asia and Russian supplies from eastern Siberia are due to start in December 2019. Line D, the fourth of the Central Asian pipelines feeding China, was due to be completed in 2017 allowing an additional 30 Bcm of gas to be imported. Work on this line was put on hold after CNPC and Uzbekneftegaz agreed on an indefinite postponement on work to the

Uzbek section of the route. This means Central Asian supply is capped at 55 Bcm, the capacity of Lines A-C.

In October 2017 the 10 Bcm Beineu-Bozoi-Shymkent pipeline in Kazakhstan will enter service, running west to southeast Kazakhstan, then linking into the Kazakhstan-China pipeline, part of the larger Turkmenistan-Uzbekistan-Kazakhstan-China trunk pipeline system (Lines A-C).

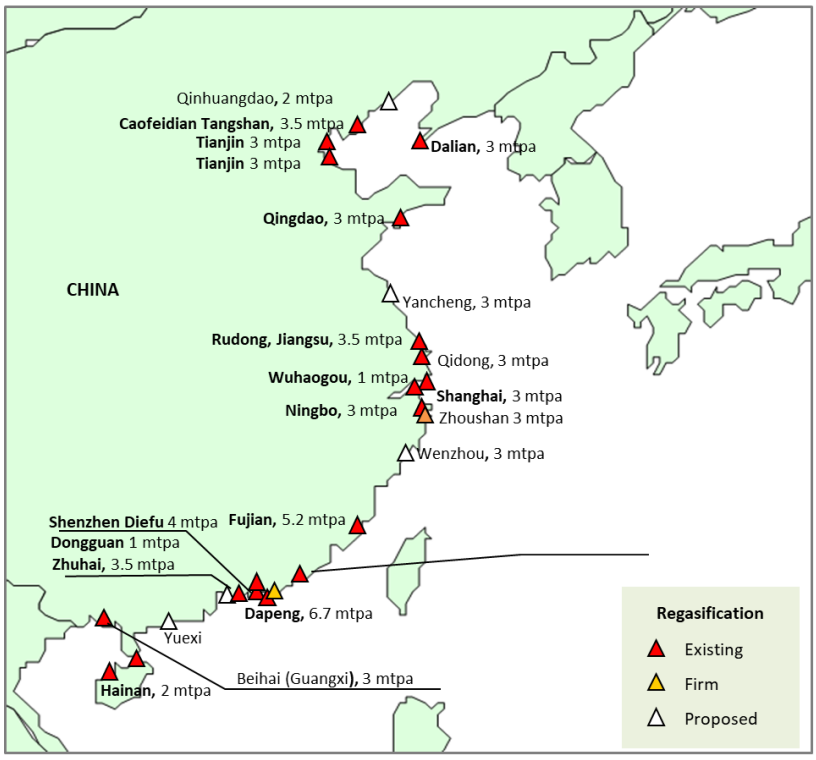
CNPC and Gazprom have reached agreement re the scheduling of Russian gas via the Power of Siberia pipeline. Delivery of gas will start in December 2019 (slightly early in the previously agreed 2019-2021 start-up window) and slowly ramp up to reach the contracted volume of 30 Bcm/annum in 2025 when the 30-year supply contract will formally start.

Piped gas imports						
Bcm	2015	2016	2017	2020	2025	2030
Low line	33	38	42	64	88	93
Mean line	33	38	42	65	108	118
High line	33	38	42	67	120	128

Our low line assumes lower volume from Myanmar (Myanmar has asked to buy back some of the gas supplied to China), Central Asian supply capped at 55 Bcm and a slow ramp up of Russian supply. Both the mean line and high line assume that Line D is eventually completed and comes into service in 2020

LNG infrastructure

China currently has 68 million tonnes of LNG receiving terminal capacity at 20 terminals and this will rise to 90 million tonnes by 2020. Expansion plans at existing terminals could add a further 40 million tonnes and 38 additional terminals have been proposed potentially adding a further 89 million tonnes of capacity. Many of these have been proposed by the new LNG buyers. Not all will go ahead but it is clear that future LNG imports are unlikely to be constrained due to a shortage of receiving terminal capacity.



CNOOC
- Dapeng, Guangdong
- Fujian
- Shanghai
- Ningbo, Zhejiang
- Tianjin
- Zhuhai, Guangdong
- Yangpu Hainan
- Yuedong Jieyang, Guangdong
- Diefu, Shenzhen, Guangdong

PetroChina
- Rudong, Jiangsu
- Dalian, Liaoning
- Caofeidian, Tangshan, Hebei
- Haikou Hainan

Sinopec
- Qingdao, Shandong
- Beihai, Guangxi
- Tianjin
- Lianyungang, Jiangsu

Shenergy Group
- Wuhaogou, Shanghai

JOVO
- Dongguan, Guangdong

Guanghui New Energy
- Qidong

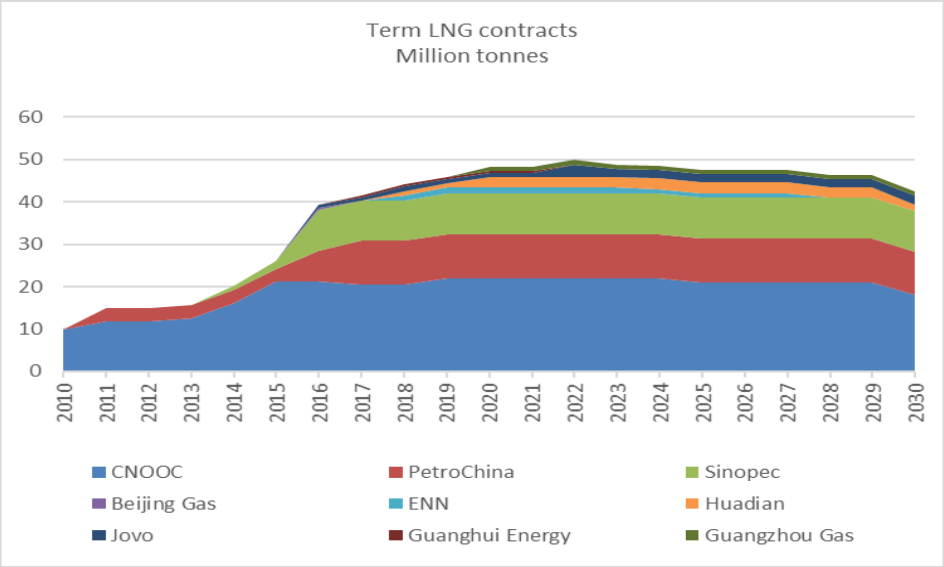
ENN
- *Zhoushan, Zhejiang (2018)*

Mill tonnes	CNOOC	PetroChina	Sinopec	Others	Total
Existing	32.6	19.5	12.0	3.7	67.80
U construction	1.0	0.0	6.0	7.3	14.30
Expansion	26.7	4.0	5.0	3.8	39.50
Proposed	23.1	9.0	6.5	49.9	88.50
	83.4	32.5	29.5	64.7	210.1

LNG contracts

China is currently slightly over contracted limiting its ability to take in cheaper spot cargoes (despite that it has imported over 30 spot cargoes this year).

	Term LNG contract volme (incl HOA's)					
	2015	2016	2017	2020	2025	2030
Million tonnes	26.2	39.2	41.4	48.4	47.6	42.4



Chinese LNG buyers currently have term supply contracts for 41.4 million tonnes which is substantially more than they currently need. They already have contacts for 49 million tonnes in 2022 (and HOA's for 1 million more). Our base case LNG demand forecast suggests China will import between 68 and 78 million tonnes of LNG in 2022 suggesting that further term commitments might be made in the next couple of years. First movers are likely to be the 12 new LNG buyers who have not yet entered into a supply commitment.

Adequate supply is available suggesting that future Chinese imports are not going to be constrained by insufficient supply.

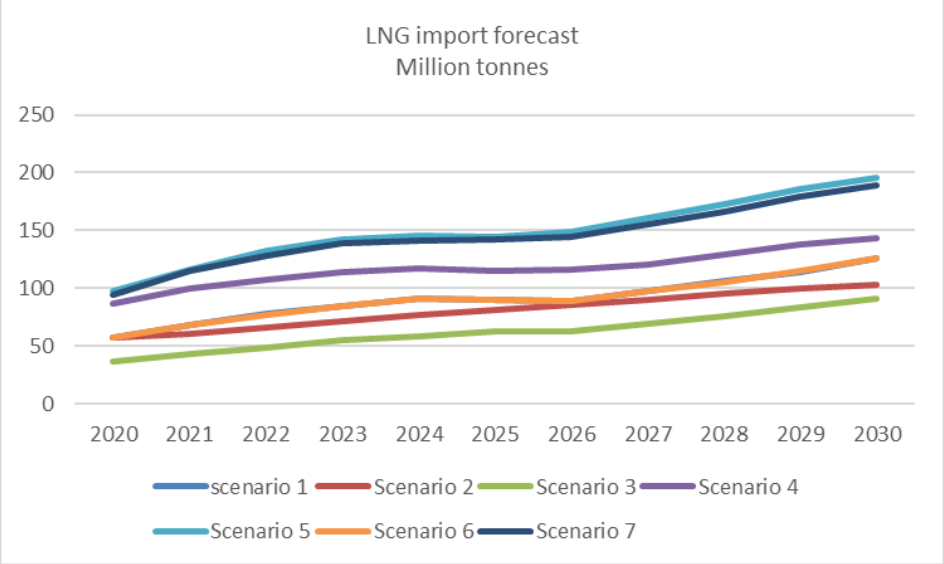
LNG demand forecast.

There are many variables that make it difficult to forecast future LNG demand. These include the oil price, government policy, GDP growth rates, domestic production (conventional, unconventional and offshore), gas demand and the level of piped gas imports. High rates of growth in gas demand depend on the continuation of the coal to gas conversion programme and a continuation of the subsidies available to encourage/facilitate the take up of gas.

Should the conversion programme be poorly implemented (and/or subsidies are withdrawn) we shall see a slower rate of growth in the gas market reaching perhaps 310 Bcm in 2020 and 456 Bcm in 2025.

However, if strong policy support continues in the 14th Five Year Plan then the currently high rates of growth can continue for longer. Our "high line" demand forecast suggests gas consumption of 592 Bcm in 2025 and 750 Bcm in 2030[1]. These variations will have a substantial impact on the level of LNG imports required.

Seven scenarios were considered when preparing this LNG forecast. Our base case forecast assumes domestic gas production of 207 Bcm in 2020 and consumption of 350 Bcm resulting in LNG imports of 57 million tonnes in 2020. LNG imports increase to 90 million tonnes in 2025 and 126 million tonnes in 2030.



In the high case LNG imports are 97 million tonnes in 2020 and 144 million tonnes in 2025.

LNG import forecasts						
Million tonnes	2015	2016	2017	2020	2025	2030
Low	20	26	30	37	63	91
Mean	20	26	34	57	90	126
High	20	26	36	97	144	196

These forecasts allow for the supply of all currently contracted piped gas. Currently about 50% of imports are in the form of piped gas but this ratio will decline going forward (and LNG increase) if there are no new piped gas supply contracts. It is probably more realistic to assume new piped gas contracts will be concluded with Russia and the Central Asian states. Russia is offering gas via the "western route". Kazakhstan has just agreed to supply 5 Bcm over 2017/18 and would like to make a

[1] To put this into context, the USA consumed 779 Bcm of natural gas in 2016, Europe (incl Russia) 910 Bcm.

long-term commitment. Additional piped gas is available and the LNG demand forecast shown below assumes that going forward 50% of natural gas imports will be LNG and 50% piped gas.

LNG import forecast assuming piped gas at 50% of imports						
Million tonnes	2015	2016	2017	2020	2025	2030
Low	20	26	30	40	64	80
Mean	20	26	34	53	85	106
High	20	26	36	74	102	119

The market won't keep to a strict 50/50 ratio but if the market continues to grow at the rate it has this year, LNG imports could double between 2017 and 2020 and possibly exceed 100 million tonnes by 2025.

There are so many influences at play dictating LNG demand, not least domestic and international oil and gas prices and domestic production. Our forecast is that China will import between 50 and 74 million tonnes of LNG in 2020 and between 85 and 100 million tonnes in 2025. China will overtake Korea to become the second largest LNG importer next year and could potentially overtake Japan to become the largest importer within five years.

Eight companies currently import LNG into China but that number could rise to twenty within 5 years.

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