HOW CHINA'S LNG MARKET WILL EVOLVE AS MORE INFRASTRUCTURE IS BUILT

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China's LNG market is booming. LNG imports grew by 41% in 2018, replacing piped import shortfalls and accommodating the high seasonality of heating demand in northern China. A new trend is the growth in moving LNG by tanker truck, which has helped overcome pipeline and regasification constraints. In 2018, trucked LNG reached 24 Mt, equivalent to 12.6% of total gas demand. LNG importers are increasingly relying on trucking to boost import capacity. This dynamic reflects a lack of pipeline interconnectivity and storage capacity (under 5% of gas demand).

China is set to expand its midstream infrastructure. Piped gas imports together with additional gas storage will play a key role in managing seasonality. At the same time, additional large-scale LNG storage tanks and satellite LNG peaking facilities will remain a crucial part of meeting peak requirements. Infrastructure additions will likely constrain and potentially reverse the need for LNG trucking.

Furthermore, as market reforms progress, third-party access and accelerated approval of new terminals will allow non-national oil companies to import more LNG directly. LNG will facilitate gas price discovery as market participants will have more balanced negotiating power than in the piped gas system. This could have potential implications for the evolution of future liquid global LNG prices.

In this paper, we explore the interplay between infrastructure and LNG demand in China and discuss LNG's prospects in the country's continuously evolving gas market.
Introduction

The rapid growth of gas demand in China from 2016 means that the country lacks sufficient gas infrastructure compared with other major gas markets that have taken decades to build up. Winter LNG demand is growing most rapidly in northern China but existing terminals are concentrated in the south of the country. Terminals in northern China have been stretched. Many counties and towns are not covered by a distribution network. Operating pipelines are increasingly insufficient for peak levels. Storage capacity for peak shaving is 5% of total gas demand, far below the 20-25% levels typically seen in Europe and the US. The lack of storage also makes China more vulnerable to supply disruptions.

Infrastructure insufficiency is increasingly a threat to long-term demand growth. Acute gas shortages occurred in winter 2017-18, although China avoided a repeat of this in winter 2018-19. But that came at the cost of restraining demand creation and the NOCs pre-buying LNG to lock in winter supplies, even if that meant overbuying.

Substantial investment in new infrastructure is now being made. This includes in gas storage, regas, and new import pipelines. The question for the market now is as substantial new infrastructure is developed, whether China’s LNG demand and market will become more flexible and better able to meet the needs of the market. Or will China still need to rely on LNG for security of supply as it has done in recent winters. This paper discusses how infrastructure – regas terminals, import pipelines, gas storage and pipeline network – will develop, and explores the implications for LNG demand and the market.

Background

China’s gas demand expanded rapidly from 206 bcm in 2016 to 277 bcm in 2018. This 16% annual growth rate was well above the average of 9.6% a year during 2010-2016. The exceptional increase was mainly driven by tougher environmental policies: the Air Pollution Prevention and Control Action Plan (APPCAP) and then the Blue Sky Defense Action Plan effective 2018-2020. As part of this, many coastal provinces set targets to curb coal consumption. The ‘2+26’ region in northern China suffers from the worst air quality, particularly during winter. As such, the region was the primary target to promote gas for winter space heating. Small and inefficient coal boilers were shut down. The government accelerated the pace to connect urban populations to the gas grid. Meanwhile, millions of rural households also switched from coal to gas. Transport gas demand increased, driven by bans on diesel trucks in some cities.

The boom has resulted not just in a change to total gas volumes but is also changing demand patterns. Winter space heating alone accounts for 20% of the incremental gas demand. That demand occurs typically in four to five months (November-March) and is concentrated in the 2+26 region. Northern China’s demand profile is becoming more seasonal.

Domestic production and pipeline imports have not been able to accommodate the recent massive increase in gas demand. Consequently, LNG has become the fastest growing source of gas. China’s LNG demand increased by 46% in 2017 and 41% in 2018, when it reached 54 Mt.
The recent exceptionally strong growth in Chinese LNG demand has postponed the global LNG supply glut (now expected in 2019) and will reduce its extent. Through 2018, China cleared its over-contracted position and has been highly active in spot markets. Chinese buyers have returned to term contracting in a significant way to improve short-term supply security for winter and to hedge long-term uncertainty in domestic production ramp-up.

**Regas capacity expansion will position China for further LNG demand growth post-2020**

Surging LNG demand outpaced the growth in regas capacity and boosted the average utilisation rate of terminals to around 80% in 2018, up from 50% in 2016. Regas constraints are most acute during winter in northern China. At their peak, Caofeidian terminal operated at 60% and Shandong terminal operated at 40% above their nominal capacity. To temporarily relieve regas constraints, CNOOC chartered an FSRU to provide additional regas capacity at its Tianjin terminal. Terminals also expanded truck-loading positions to allow LNG send-out by trucks.

In anticipation of growing reliance on LNG, terminal expansions have accelerated. The Ministry of Transport has recently identified 35 sites suitable for expanding or adding new berths. In total, we estimate that those sites can hold around 240 mmtpa of capacity, with northern China (Bohai Rim) allocated the most capacity.

The NOCs have installed plans to expand capacity. Emerging buyers are entering as well. As of January 2019, only three terminals were operated by non-NOCs: ENN, Guanghui and Jovo. Yet more companies have shown interest, including city gas companies, power generators, trucked LNG players and oil/LPG traders. Zhejiang Energy, Shenzhen Gas and Sinoenergy are front runners given they have projects already under construction.

To guarantee returns on investment and supply efficiency, the backers of the new terminals will lock in LNG...
contracts for at least part of their capacity. But each terminal should have some excess capacity. Overtime, a continuous build of regas capacity will allow LNG requirements to be fully met. Consequently LNG capacity constraints will increasingly be overcome and a repeat of the gas shortages of the winter of 2017/2018 very unlikely.

We expect that China’s regas constraints will be gradually relieved after 2020. We forecast China will have around 140 mmtpa of capacity by 2025, providing the project pipeline progresses smoothly.

Terminal projects by company, as of January 2019

<table>
<thead>
<tr>
<th>Company</th>
<th>LNG Receiving Capacity (mmtpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNOOC</td>
<td>80</td>
</tr>
<tr>
<td>PetroChina</td>
<td>60</td>
</tr>
<tr>
<td>Sinopec</td>
<td>40</td>
</tr>
<tr>
<td>Others</td>
<td>20</td>
</tr>
</tbody>
</table>

LNG receiving capacity identified

<table>
<thead>
<tr>
<th>Region</th>
<th>Current Capacity (mmtpa)</th>
<th>Maximum Capacity Identified (mmtpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern China</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>Eastern China</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>Southern China</td>
<td>50</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: Wood Mackenzie China Gas & Power Service

Gas storage build will (slightly) moderate LNG demand seasonality

China’s gas storage capacity is limited. Consequently, peak gas demand cannot be fully met by storage. Wholesale suppliers (upstream suppliers and pipeline operators) have agreements with gas buyers for interruptible supply during winter. Chemical producers and power plants have been the usual targets of supply rationing. Yet amid supply tightening, more industrial users have been covered by interruptible agreements.

While gas storage development has always been a key goal, in 2018 it was restated and detailed. A policy was released by the Central Government in April 2018 that lists gas storage targets for various entities. The policy requires wholesale gas suppliers to have 10% of their annual sales volume, local governments to have three days of gas demand in their governing areas, and city gas distributors to have 5% of their annual sales volume as storage by 2020. Underground gas storage facilities, LNG tanks at coastal terminals and other peak-shaving CNG or LNG storage facilities are eligible to be accounted.

Seasonal peak shaving will count on underground facilities and LNG tanks at terminals. However, the economics of building this peak-shaving capacity remain challenging. They command significant upfront investment, which
requires strong price signals. However, a seasonal gas-pricing mechanism is only at an early stage of development in China. As such, the build-out of underground gas storage and LNG storage tanks may only gain momentum after 2020.

If the NOCs can increase their capex spend on gas storage and non-NOCs enter the storage business, underground storage and terminals combined could provide 44 bcm capacity by 2025. We expect this will account for 8% of forecast annual gas demand, up from 5% in 2018. While an improvement, that level would still be significantly lower than in Europe and the US today, which are nominally between 20% and 25%.

As such, we do not expect that storage additions will significantly reduce the pressure of winter supply by 2025. Instead, LNG will continue to meet the seasonal requirements of China's gas market.

*Working gas in underground gas storage*  
* LNG storage capacity at terminals*
LNG trucking and new modes of logistics will enable LNG to reach further inland
While pipelines are the main mode of transport for gas across China, LNG trucking has grown significantly. Trucked volumes increased from 8 Mt in 2014 to 24 Mt in 2018, representing 12% of total gas demand. Of the trucked LNG in 2018, 55% was from regas terminals while the rest came from inland small-scale liquefaction plants.

LNG trucking bypasses regas and pipeline constraints. Terminals have expanded their truck-loading facilities to allow more LNG offtake. In 2018, around one-quarter of LNG imports were distributed by trucks.

LNG trucking also adds liquidity to gas markets. LNG prices have been deregulated and the LNG trucking market has many players. Due to its flexibility, LNG trucking provides opportunities for trading. For gas buyers, trucked LNG is the most flexible source to meet peak demand as piped gas contracts do not guarantee peak usage. By sourcing LNG on their own, gas buyers can diversify supply sources and circumvent pipeline monopoly.

Currently, for long-distance transport, pipeline is more economic. However, new modes of LNG logistics are under development, including inland shipping and transporting by railway. The economics of these options are better than LNG trucking and will enable LNG to reach further inland, again overcoming pipeline constraints.

Expansion of pipeline import corridors will introduce volume competition to LNG
China imported 48 bcm of gas from Central Asia and 3 bcm from Myanmar in 2018. Pipeline import additions will mainly come from Central Asia and Russia.
Central Asian gas is currently delivered to China via the Turkmenistan-China Gas Pipeline network, which consists of lines A, B and C. A fourth string, Line D, is under construction with completion expected by 2022. In addition, there are plans to expand lines A and B by 5 bcm each. Once all four strings are operational, the network will have the capacity to transport up to 95 bcm a year. After arriving at China’s northwest border, Central Asian gas is sent to the West-East pipeline system, which extends to multiple inland and coastal provinces.

The introduction of Russian gas into the Chinese market is imminent. The progress of the Power of Siberia pipeline has accelerated since 2017. Construction of the pipeline, as well as the upstream development of the Russian Chayandinskoye and Kovyktinskoye gas fields, is expensive and challenging. However, the project is critical to unlocking development in Russia’s remote regions. And the Power of Siberia pipeline will enable Russia to access the giant Chinese market. On the Chinese side, a firmer gas demand outlook and need for supply diversity will encourage the country to take Russian gas. Two other import corridors – the Far East and Altai – are at early stages. The Far East pipeline negotiations are ongoing. The Altai route, which goes from West Siberia to China’s northwest border, currently seems like a more remote option. However, as China’s gas demand grows further, it could become a viable choice after 2030.

The Russian and Central Asian pipeline projects will allow China to count on more options to meet gas demand growth, notably between 2020 and 2025. Northern China’s LNG growth will be most affected as Russian gas will arrive in the Beijing-Tianjin-Hebei region first. Unlike pipeline gas from Central Asia, the Power of Siberia supply will enter close to the key north east market. This is where gas demand has been growing quickly and where seasonality has grown due to the replacement of coal as heating fuel.

**China pipeline import capacity forecast**

As infrastructure develops, LNG’s price competitiveness will become even more important

Increasingly, infrastructure will cease to constrain LNG imports. Instead, in most cases such as LNG trucking, regas and storage, it could facilitate an expansion of LNG demand. However, just as LNG capacity will expand, so
will pipeline capacity.

Depending on the oil price, pipeline imports will test the economics of LNG in the coastal regions. Using our current 2025 expectation of an oil price of US$77/bbl and LNG contract assumption of 12%, LNG and Turkmen gas are equivalent in Beijing, while Russian gas is more competitive. However, in Shanghai, LNG remains more competitive than piped gas imports. As such, we believe that LNG will remain a preferred import option for southern Chinese markets. Piped gas will form an important baseload source of supply but due to storage constraints, LNG will remain a critical option for meeting growing winter requirements in northern China.

Given this relative competitiveness to piped imports, LNG is well placed to keep growing and fill the gap between production, gas demand and the baseload role for piped supplies. We expect LNG imports to reach just over 80 Mt by 2025 and likely grow beyond 100 Mt after 2030.

However, China’s future gas balance has many uncertainties. As the market gets bigger, small percentage changes to price or expectations of the level of domestic supply, demand and piped imports will significantly change the outlook for LNG.

*Delivered prices of pipeline imports into coastal regions*

![Diagram showing delivered prices of pipeline imports into coastal regions](source)

*China gas supply-demand balance*

![Diagram showing China gas supply-demand balance](source)

**Infrastructure will enable a more resilient and efficient gas market, leading to changes in gas pricing with potential global implications**

As more infrastructure will be developed, we expect that China will become a more resilient and efficient gas market. The demand for LNG will become more flexible and better able to respond to the needs of the market, such as ensuring winter demand is met. More regas capacity will provide buyers with increased options for when they can buy LNG, while storage and piped imports will provide additional ways to meet seasonality.
In turn, sufficient infrastructure will allow the optimisation of gas supplies to ensure the most competitive source of gas can be accessed and prioritised. Consequently, this should enable the current, largely regulated, pricing regime to transform into a market-based one. Gas and LNG price competition and transparency should mean that domestic trading develops additional momentum. If backed by adequate and transparent regulation, an accepted Asian gas trading hub could evolve in China.

1 Note: utilisation rate is calculated as annual or monthly import volume divided by nominal capacity