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Presenting the Conditions and Outlining Priorities for Joint Cooperation on Flexible and Efficient Global Energy Markets for LNG

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This Report was prepared by:

ISSARD François, Senior International Energy Consultant
LIU Mingming, Associate Professor, China University of Petroleum (CUPB) School of Economics and Management

EU-China Energy Cooperation Platform (ECECP)
Website: http://www.ececp.eu
E-mail: info@ececp.eu

EU-China Energy Cooperation Platform was launched on 15 May 2019 to support the implementation of activities announced in the 'Joint Statement on the Implementation of EU-China Cooperation on Energy'. The overall objective of ECECP is to enhance EU-China cooperation on energy. In line with the EU's Green Deal, Energy Union, the Clean Energy for All European initiative, the Paris Agreement on Climate Change and the EU's Global Strategy, this enhanced cooperation will help increase mutual trust and understanding between EU and China and contribute to a global transition towards clean energy on the basis of a common vision of a sustainable, reliable and secure energy system. Phase II of ECECP is implemented by a consortium led by ICF, and with National Development and Reform Commission - Energy Research Institute.

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English editing: Helen Farrell
Chinese editing: Chi Jieqiao, Song Zhen

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中国石油大学(北京)
CHINA UNIVERSITY OF PETROLEUM

This Report has been prepared under the framework of the 'Joint Statement on the Implementation of the EU-China Cooperation on Energy', signed 9 April 2019, which stipulates:

> *Art. 1: 'The energy's cooperation's overarching goal is to further the global clean energy transition while … supporting fuel-switching to low-carbon energy sources traded on open and transparent global markets…'*
> *Art. 8: '…. Both sides seek to implement their energy cooperation through…. Interlinked workstreams on the energy system … to develop and support a global, flexible and efficient liquefied natural gas (LNG) market for the benefit of the EU and China…'*

Within this framework, the 'document outlining priorities for joint cooperation on flexible and efficient global energy markets for LNG' (the LNG Report) is one of the specific deliverables.

Prepared by European and Chinese experts, the LNG Report is intended to reflect the most recent business and policy developments on both the Chinese side and the European side and offer some practical recommendations to enhance the fluidity and working conditions that affect LNG Global supply and demand.

With this purpose in mind, this Report includes a general review of the natural gas market that places the LNG industry in its resource and market context.

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What is LNG?

LNG (Liquefied Natural Gas) is the liquefied state of natural gas or methane (CH_4).

Liquefying natural gas by cooling it to -162°C allows the gas to be transported to markets away from producing fields. LNG trading is realised via shipping vessels, with the regasification process occurring at a dedicated plant called a receiving terminal. These terminals may be either onshore regasification plants or floating storage regasification units (FSRUs) anchored in a harbour or in the near offshore. Once regasified, natural gas can then enter an existing or a dedicated natural gas pipeline distribution network for end-user delivery. From the receiving terminals it can also be marketed in its liquefied state.

LNG is therefore an extension and a fluidisation of a commodity which is otherwise subject to regional constraints. In this sense, LNG has joined oil as a global commodity that can travel long distances at an economic cost.

Notice on Methodology

The point of the Report is not to debate the presence or absence of the relative merits and successes of the numerous European and Chinese strategies and action plans that have resulted from long-term climate engagements by the two sides, as well as more recent evolving decisions sparked by recent critical events. Instead, it is intended to offer a view and an understanding of the differences of status and conditions prevailing in the two regions of the world with respect to LNG markets, in order to propose cooperative actions and avoid some of the market glitches and energy price peaks observed in 2022. Because of the close connection between LNG and the natural gas from which it is generated and its role in the energy mix, an understanding of the similarities and differences between the two entails a description of the entire natural gas market structure and of the respective roles of natural gas and LNG within this system.

To do so, in its first four chapters the Report provides a relatively exhaustive review of the natural gas and LNG situation in China from upstream to downstream and concludes with remarks outlining the prospects for the future of LNG in the Chinese gas market, in the light of the strategic issue of national energy security. The Report also evaluates the reforms already achieved in the natural gas market from the perspective of its planned deregulation. Natural gas and its LNG counterpart are perceived as essential contributors to China's current and future plans to transition its energy mix towards a net-zero economy by 2060.

Chapter 5 is dedicated to Europe either as 'the EU' in its strictest sense (for instance regarding policy) or more generally in its geographical situation, given that the economy and energy interdependence of European countries are not limited to

European Union Member States. The Chapter offers a review of gas supply and demand conditions, particularly in recent years, and highlights the renewed interest displayed in Europe towards LNG as a substitute for pipeline supplies from Russia. Unlike China, Europe has been integrated into global markets for many years and its energy market dynamics are not regionally limited but are playing out in a global context.

China and the EU are at very different stages of maturity in terms of gas market conditions and policies. However, with Chinese companies and state policies swiftly integrating LNG into their energy balancing supplies, there is a growing likelihood of counterintuitive and counterproductive actions in global markets by the two parties. Such actions could negatively impact their own regional economies and interests.

A final section presents the remediation actions and energy policies implemented by the EU to address the recent crisis in Ukraine, demonstrating both the quality of its crisis management system and the flexibility of its decision-making process.

Accordingly, a set of recommendations is proposed that could help China and the EU to reach a better alignment of policies and market requirements.

Executive Summary

China is the world's largest emitter of greenhouse gases (GHGs), a ranking it has held since 2006 (China was responsible for over 31% of global emissions in 2021), with more than 78% of these emissions due to the use of coal which is its main primary source of energy.

Indeed, China is by far the world's largest coal producer (52% of world production), consumer and importer. It should also be noted that despite the apparently high volume of imports, China is practically coal self-sufficient (it can meet 99% of its coal requirements with domestic production), and has the second largest reserves in the world, characteristics that are of major relevance when reviewing the country's energy security and policies.

The Chinese economy is energy-intensive, consuming large amounts of electricity, most of which is produced from coal. This coal-generated electricity, primarily produced domestically at a low cost, powers the manufacturing of various affordable goods that are exported to Europe and the US. However, given the recent and current rate of growth of emissions, if the country makes no changes to the structure of its energy mix, it risks overtaking the US as bearing responsibility for the greatest amount of greenhouse gases in the planet's atmosphere.

The destiny of the global climatic transition is therefore closely connected with the fulfilment of China's target of carbon neutrality by 2060, announced by President Xi Jinping at the United Nations in 2020.

Europe, for its part, presents itself as the most advanced and proactive region in a high-profile strategy to rapidly reduce its emissions and has set for itself extremely ambitious objectives of climate neutrality by 2050, preceded by an interim target for a 55% reduction in carbon emissions by 2030.

As far as it is concerned, Europe has already passed its peak of emissions while China hopes to reach peak emissions in 2030 at the latest.

However, a series of successive crises over the past three years (2020-2022) have hit both regions, bringing significant disruptions in historical economic trends (those on which economists and policymakers are basing their recommendations), which have impacted energy transition references and which may alter the prospects for future developments in global energy markets.

This is the case both for CO_2 emissions, and for a resource that has played a major role in the recent market adjustments, particularly in 2021 and 2022: liquefied natural gas (LNG).

The past three years of global economic turmoil were sparked first by the Covid-19

pandemic and its aftermath, and then by the Russia-Ukraine conflict, which erupted in 2022. These have offered stark reminders of the vital role played by LNG in ensuring global energy security, while in Europe the natural gas alternative has helped ensure the region's economic and social stability. This energy resource, of which the public was barely aware until relatively recently, assisted the rebound of China's economy in 2021 and helped meet the gap left by the suspension of Russian fossil fuel imports into the EU in 2022.

Chinese emissions decreased in 2020, reflecting the effects of the Covid epidemic and a resulting widespread reduction in economic activity. Emissions also declined in the rest of the world (2020-21) but in 2021 they rebounded in China as economic activity resumed, partly triggered by the implementation in the West of huge economic stimulation and support packages to protect citizens, industries and services. Globally and in absolute terms, the increase in emissions observed in 2021 was even greater than the decrease of 2020 (carbon brief data compiled by the authors).

Over the same period, the global LNG market reacted with sharp fluctuations in both volume and destinations, in response to changes in the quantitative and geographical adjustments of global energy demand, led by sanctions on exports of oil and natural gas from Russia to Europe.

These observations highlight the leading role that China and its macroeconomic decisions play and will continue to play in the outcomes of global climate policies in the coming years. They also demonstrate the complex interconnections of global economies in the current setting of value chains.

They also highlight the need in the EU, and more widely Europe, to secure longer term LNG supply strategies, rather than simply relying on the LNG spot market.

In addition to the development of renewable energy, which has made astonishing progress in China (China has become the world leader in wind and photovoltaics in less than 10 years on the back of intensive upscaled developments, investments and subsidies), the substitution of coal by natural gas to produce electricity or heat has in the past been part of a panoply of measures and policies adopted by China to try to mitigate both its GHG emissions and its notorious air pollution.

In this complex scenario, it is important to present the historical role of natural gas and of its derivative, liquefied natural gas (LNG) in China's energy mix, and what the outlook is for the coming years. These considerations are key to proposals for ambitious forms of cooperation between the two parties, within the framework of the overall EU-China Cooperation Project.

This Report aims to review the situation of natural gas and LNG firstly in China and secondly in Europe. Acknowledging their differences and interactions, the Report offers suggestions for an orderly development of energy policies directly or indirectly concerning both the LNG market and its correlated natural gas market.

- Total annual gas consumption declined slightly in 2022 for the first time in more than five years. This was caused for the most part by the impact of the Covid-19 pandemic and its related zero Covid policy on the country's economy.

Table 1: A Snapshot of Natural Gas and LNG in China in 2022		
Total domestic production:	220.1 (bcm)	+6 % y-o-y
Total import of pipeline gas and LNG:	151.9 (bcm)	-10 % y-o-y
Of which, pipeline gas:	63.7 (bcm)	+8.0 % y-o-y
Of which, LNG:	88.2 (bcm)	- 19.6 % y-o-y
Total gas consumption:	366.3 (bcm)	-0.7 % y-o-y

- Imports of pipeline gas/LNG represented 42% of the total national gas consumption.

- Total LNG imports (88.2 bcm or roughly 63 million tons) fell by 20% in 2022 due to a weak domestic market and a decline in purchases of LNG spot cargos.

- In spite of the rise in imported pipeline gas volumes in 2022, China faces growing challenges to its attempts to secure long term stable supplies from Central Asian countries (Turkmenistan and Kazakhstan): their domestic demand is also growing and their reserves are not replenishing on par.

- It is expected that the China gas market and therefore LNG imports will likely rebound in 2023 due to the sudden end of the zero Covid policy in early December 2022, however the momentum and intensity of this rebound remain uncertain at the time of writing.

1. Status of the Natural Gas Industry in China

Natural gas is recognised as a high-quality, efficient, clean and low-carbon fuel, and is the focus of particularly high expectations in China. It is worth noting that coal has long accounted for more than 60% of the energy needed to sustain China's rapid and intense economic development. This coal-based energy mix has regrettably brought with it serious environmental problems, represented by irregular but recurrent periods of smog in the Beijing-Tianjin-Hebei region and more widely in China's north-eastern provinces. Consequently, accelerating the development of the natural gas industry and increasing the proportion of natural gas in primary energy consumption are seen as important steps in China's green and low-carbon development. In September 2013, the Chinese government issued its Action Plan for the Prevention and Control of Air Pollution, which advocated a rise in the use of natural gas and other clean energy sources. In the clean air action plans subsequently issued by local governments, 'replacing coal with gas' and 'replacing oil with gas' have been seen as important measures to prevent and control air pollution. In addition, China has formulated a series of policy documents covering the whole industrial chain and market, driving the natural gas industry into a golden period of development. China's natural gas consumption exceeded 100 bcm in 2010, 200 bcm in 2016, and 300 bcm in 2019, and it is now the fourth largest natural gas market in the world. At the same time, despite being the world's fourth-largest natural gas producer, China has also become the world's largest importer of natural gas because of its own insufficient domestic reserves.

1.1 China's Natural Gas Reserves

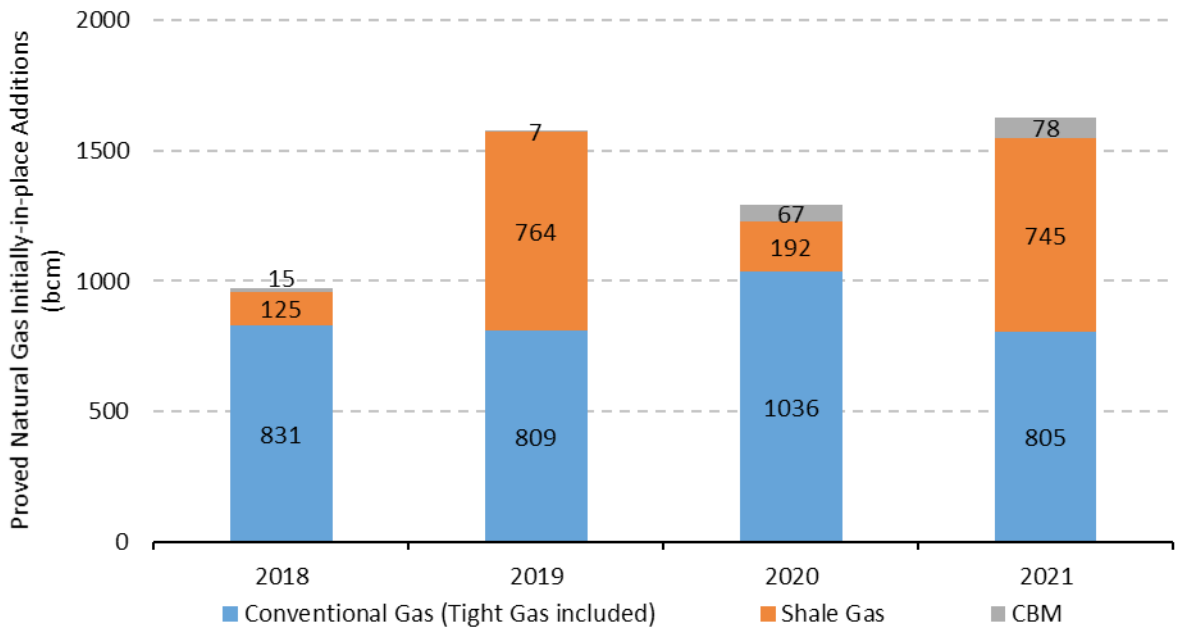
The magnitude of actual oil and gas reserves in China has been a matter of debate between experts. China's 'toolbox' to define the various kinds of reserves is different from the standards used internationally.

According to 'China Mineral Resources (2022)', the country's residual proven and technically recoverable reserves of conventional natural gas (including tight gas) are 6 339 bcm; coalbed methane reserves (CBM and CMM, i.e. Coal Mine Methane) total 544 bcm; and shale gas[1] reserves total 366 bcm. In recent years, China has made continuous efforts in exploration and development, and the country's additions of proven natural gas initially-in-place remain at a high level, reaching 1 628 bcm in 2021.

These reserve numbers and annual additions appear to have the capacity to guarantee sustainable production in the future, but they are referred to as technically recoverable, not economically recoverable, and therefore may be somewhat inflated.

1 Shale is a type of sedimentary rock formed of very fine-grained, or small, particles, such as clay, that have been compacted to form a layered rock. Tight gas refers to natural gas found in low permeability reservoir rocks that are most often sandstone, but also include low permeability carbonate rocks.

Figure 1: Annual additions of proven natural gas initially-in-place



Source: Ministry of Natural Resources, China.

1.2 Domestic Production

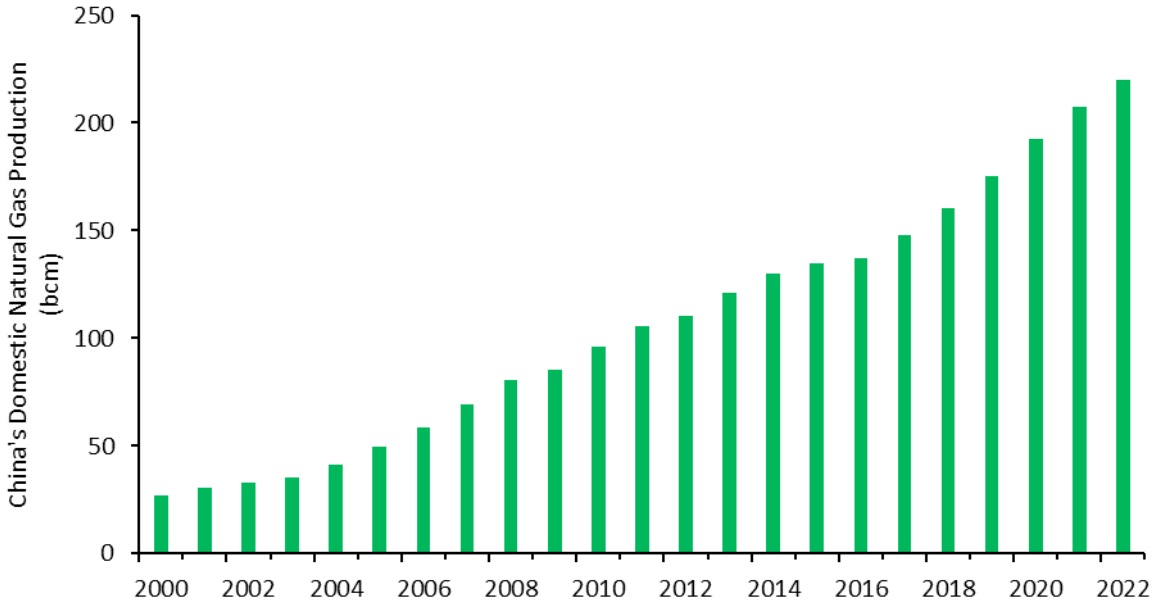
In 2022, China produced 220.1 bcm of natural gas, an increase of 6% over the previous year and up more than 10 bcm for the sixth year in a row[2]. Conventional natural gas is still the main source of gas supplies, accounting for more than 80%. Despite the high hopes for unconventional gas such as shale gas and coalbed methane, the total production of such sources is still limited. In 2022, shale gas production reached 24 bcm, an increase of 122% over 2018. Coal bed methane production was 11.5 bcm, of which 83.2% came from a single region the Shanxi Province.

In 2016, the '13th FYP on Natural Gas Development' was released, calling for an increase in natural gas production to 207 bcm by 2020, with an annual growth rate of 8.9%. In 2017, the 'Opinions on Accelerating the Utilisation of Natural Gas' further indicated that the proportion of natural gas in primary energy consumption should reach about 10% by 2020. At the same time, some local policies such as the '2017 Air Pollution Prevention and Control Plan for Beijing, Tianjin, Hebei and Surrounding Areas' were released. According to these policies, the government should speed up the work to reduce coal consumption and to promote the industrial and civil 'coal to gas' project. All these activities have resulted in an increased domestic demand for natural gas, triggering in response the rapid growth of natural gas production. China further improved the domestic supply capacity after the gas shortages experienced in the winter of 2017. In 2019, the NEA officially implemented the 'Seven-year Action Plan to Increase Oil and Gas Reserves and Production'. Domestic oil companies increased

2 http://www.gov.cn/xinwen/2023-02/28/content_5743623.htm

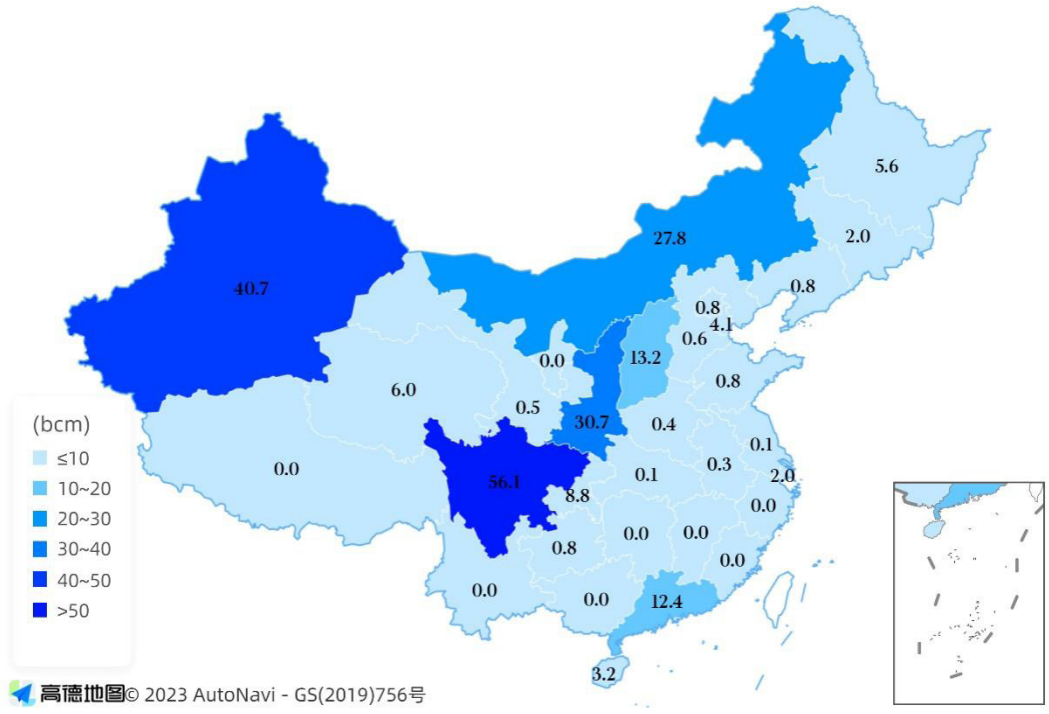
their investment in exploration and development and science and technology, resulting in successful upstream exploration results, resulting in incremental natural gas annual production of more than 10 bcm for six consecutive years.

Figure 2: China's domestic natural gas production 2020-22



Source: National Energy Administration, China; National Bureau of Statistics, China.

Figure 3: China's natural gas production by province



Source: National Bureau of Statistics, China.

Figure 4: China's CBM production by province

Source: National Bureau of Statistics, China.

PetroChina (the listed arm of state-owned China National Petroleum Corporation - CNPC) is the largest producer of natural gas in China, producing 145.3 bcm in 2022, and accounts for 66% of national output. Shaanxi, Sichuan and Xinjiang are major natural gas producing provinces, and the main producing hubs and gas fields are distributed in the following geological basins: Ordos Basin, Sichuan Basin and Tarim Basin.

Table 2: China's Natural Gas Production by Company

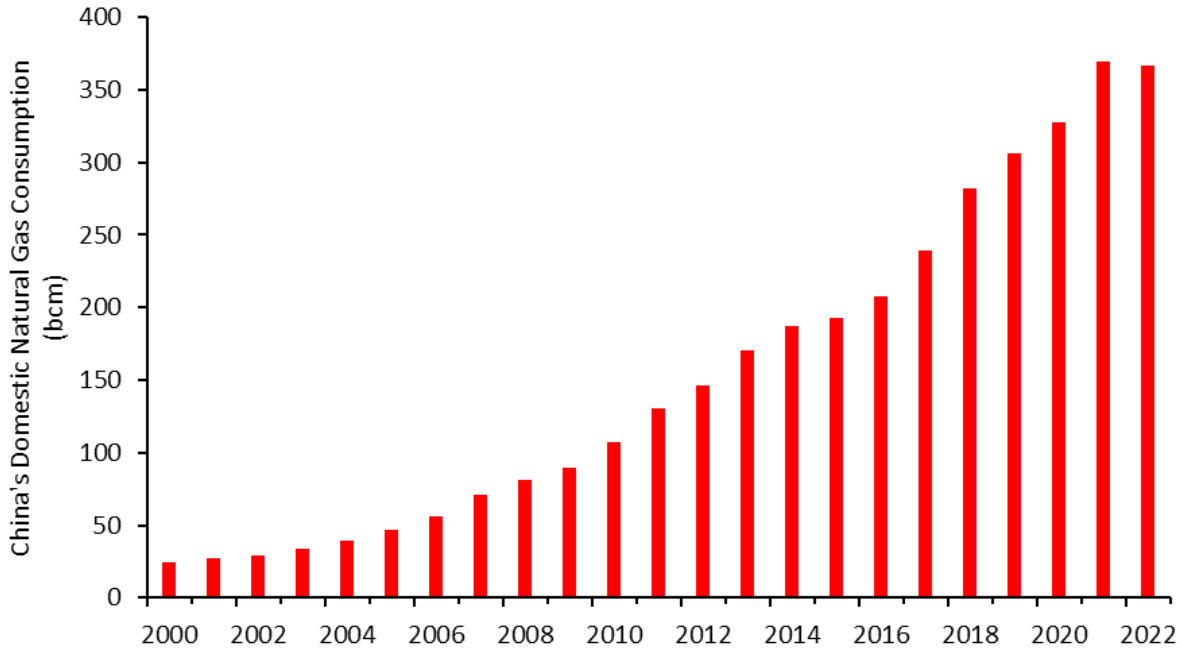
Company (bcm)	2016	2017	2018	2019	2020	2021	2022
CNPC	98.1	103.3	109.4	118.8	130.6	137.8	145.3
Changqing	36.5	36.9	38.8	41.3	44.9	46.5	50.6
Xinan	19.0	21.0	22.6	26.9	31.8	35.4	37.6
Tarim	23.6	25.3	26.6	28.6	31.1	31.9	32.3
Qinghai	6.1	6.4	6.4	6.4	6.4	6.2	6.0
Daqing	3.8	4.0	4.3	4.6	4.7	5.0	5.5
Xinjiang	2.9	2.8	2.9	2.9	3.0	3.5	3.8
Sinopec	21.6	25.7	27.6	29.6	30.3	33.6	33.6
Xinan	5.5	6.1	6.2	6.6	6.7	8.0	8.4
Jianghan	5.2	6.1	6.1	6.4	6.8	7.3	7.3
Zhongyuan	4.0	6.0	6.6	7.1	6.4	6.9	6.0
Huabei	3.5	3.7	4.1	4.4	4.8	5.1	5.0
CNOOC	13.5	14.3	16.0	17.3	19.9	22.6	25.3
Shanxi Yanchang	2.0	2.6	3.4	4.8	5.7	7.1	7.6
Total	**136.9**	**148.0**	**160.2**	**175.4**	**192.5**	**207.6**	**220.0**

Source: https://www.cubeoil.com/

1.3 Consumption

China's natural gas consumption has kept growing, with a compound annual growth rate of nearly 12% from 2010 to 2021. In 2022, statistics from the National Development and Reform Commission showed that the consumption of natural gas in China was 366.3 bcm, down 1.7% year on year[3], in the first recorded decline in nearly two decades. Much of the decline has been due to slower domestic economic growth and high international gas prices, but gas consumption is expected to pick up in 2023 as China's economy recovers.

Figure 5: China's natural gas consumption 2000-22

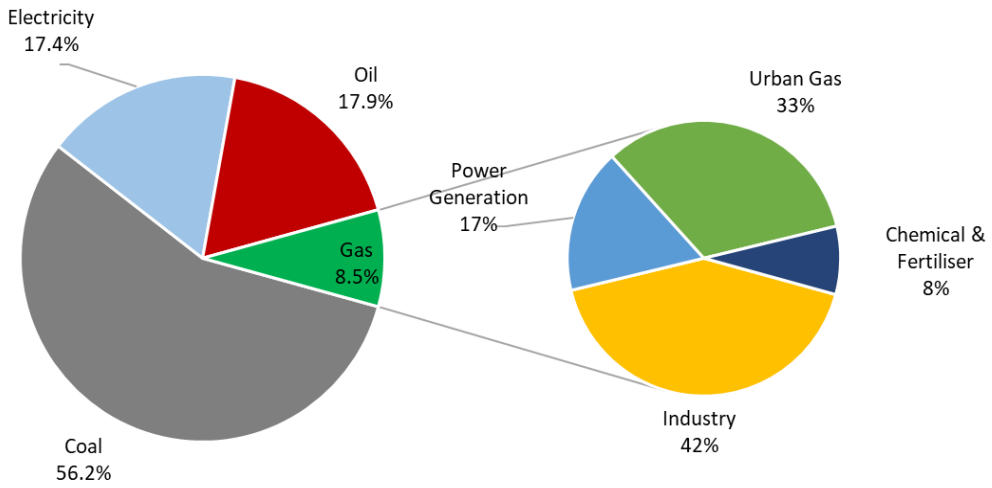


Source: National Bureau of Statistics, China.

In 2022, China's total energy consumption reached 5.4 billion tons of coal equivalent, 2.9% higher than in 2021. The share of non-fossil energy in total energy consumption increased by 0.8% over the previous year, coal increased by 0.3%, petroleum decreased by 0.6% and natural gas fell by 0.4%, which was also the first decrease in recent years. Industrial and urban gas are the largest areas of natural gas consumption, accounting for 42% and 33% of total natural gas consumption respectively. Gas for power generation accounted for 17%, while gas for chemical industry accounted for 8%. Guangdong, Jiangsu, Sichuan, Shandong and Hebei ranked the top five provinces in terms of consumption.

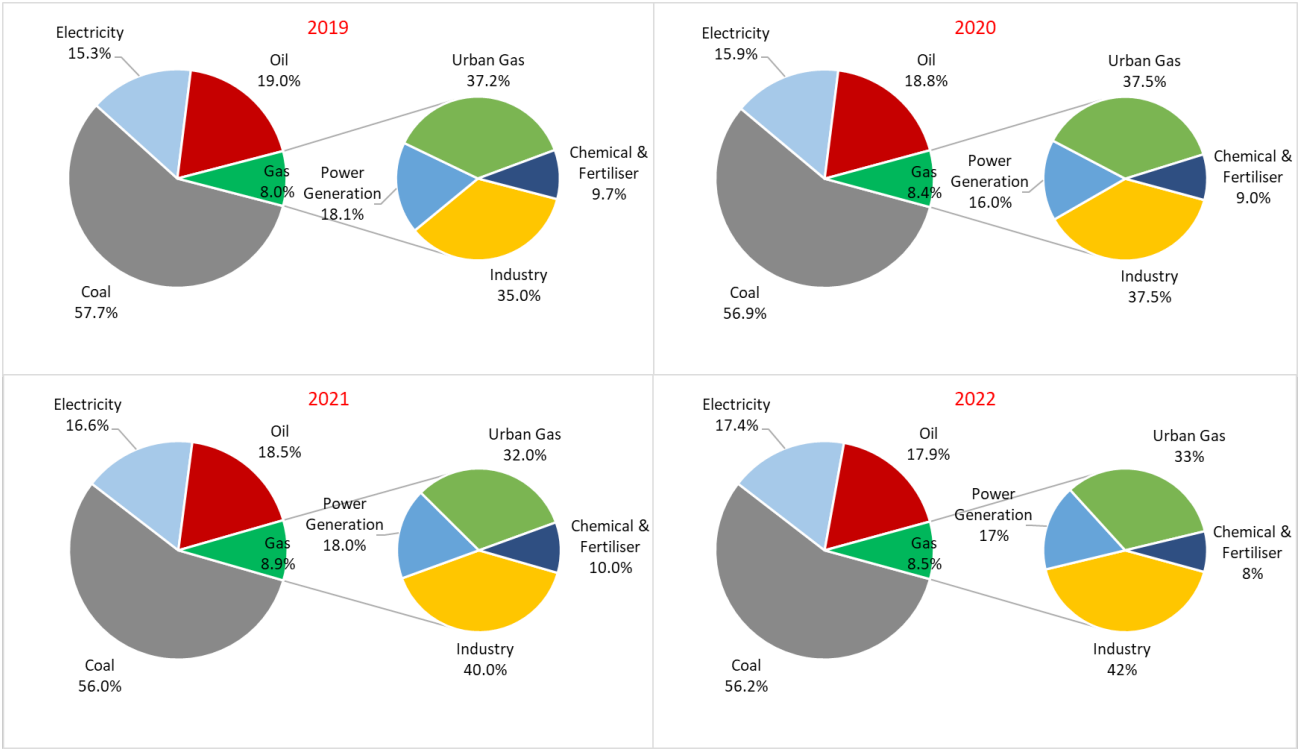
3 https://www.ndrc.gov.cn/fggz/jjyxtj/mdyqy/202301/t20230131_1348023.html

Figure 6: China's energy mix and gas consumption by sector in 2022



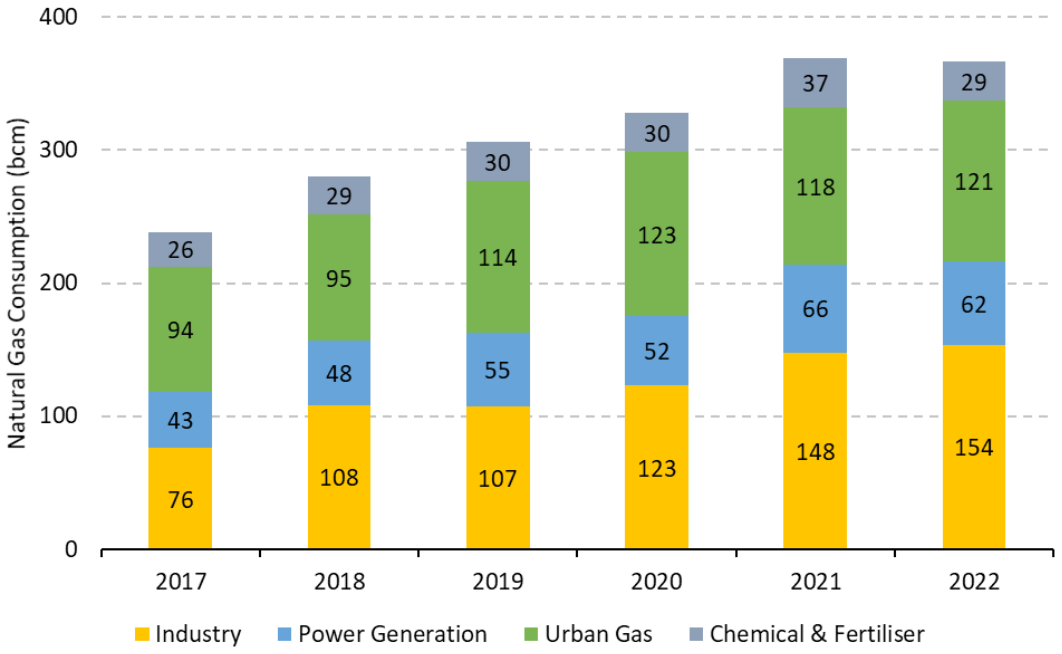
Source: National Bureau of Statistics, China.

Figure 7: China's energy mix and gas consumption by sector 2019-22



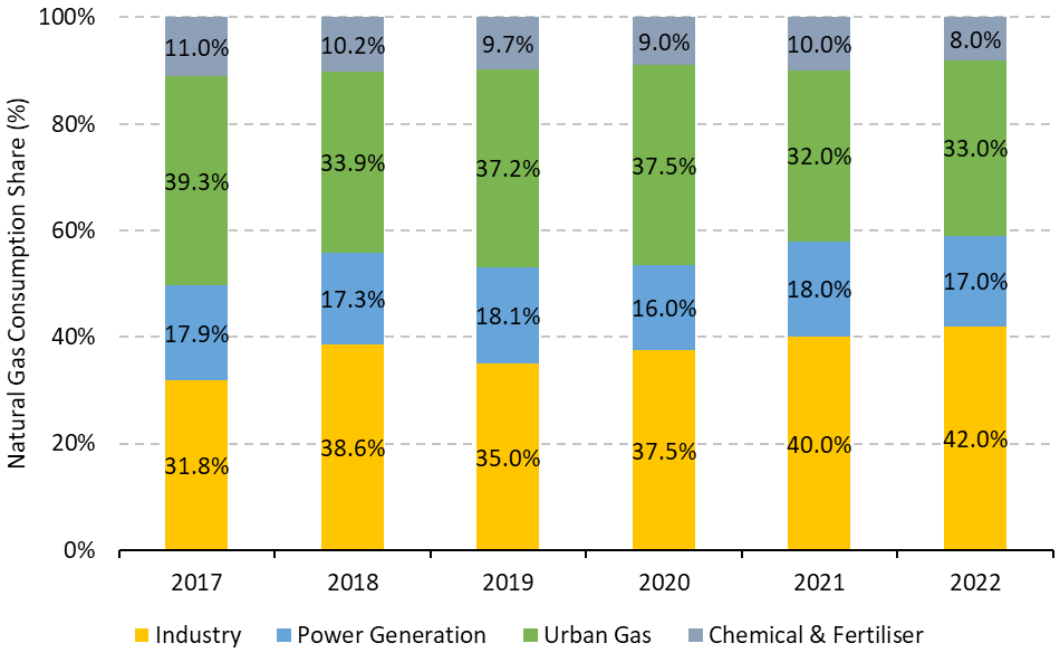
Source: National Bureau of Statistics, China.

Figure 8: China gas consumption by sector 2017-22



Source: National Bureau of Statistics, China.

Figure 9: China gas consumption by sector (%) 2017-22

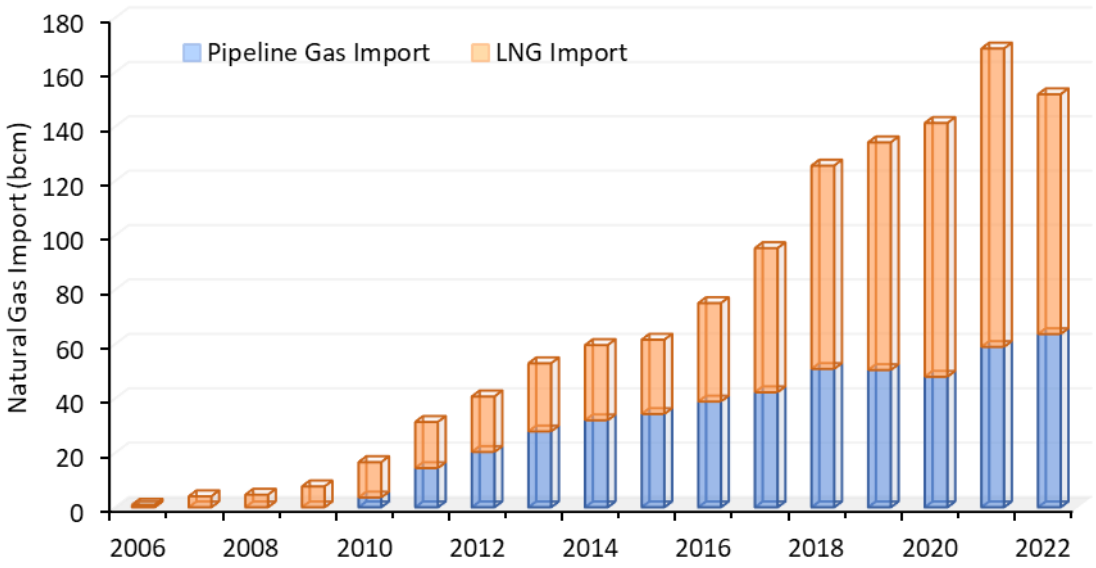


Source: National Bureau of Statistics, China.

1.4 Natural Gas Imports

Although natural gas domestic production is growing steadily, it still cannot keep up even with the lower-than-expected growth in consumption. As a result, China's natural gas market is becoming more and more dependent on foreign natural gas supplies year after year. In 2006, China began to import natural gas on a large scale, importing 0.960 bcm that year. In 2010, gas imports already exceeded 10 bcm. In 2018, imports exceeded 100 bcm, and China overtook Japan to become the world's largest natural gas importer. In 2019, it once again overtook Japan to become the world's largest LNG importer. In 2022, affected by slowing economic growth and high LNG prices, China's natural gas imports declined for the first time to 151.9 bcm, down nearly 10% from 2021. Of these import volumes, pipeline gas accounted for 88.2 bcm, up 7.8% year on year. Liquefied natural gas imports fell 19.5% year on year to 63.7 bcm, taking China back to being the world's second largest importer position of LNG[4].

Figure 10: China's natural gas imports from 2006-22



Source: General Administration of Customs, China.

1.5 Underground Natural Gas Storage

For any country, storage capacity plays an important part in ensuring the stability of natural gas supply. In order to achieve stable production and supply of natural gas in both winter (north of China) and summer (south of China), additional gas storage construction, enhanced capacity management of gas storage and peak shaving are needed. The construction of China's gas storage began in the 1990s. In order to ensure the smooth and safe operations of the Shan-Beijing Gas Line (from Ordos Basin) and the West-East Gas Pipeline (from Tarim Basin), underground gas storage was built in Dagang oil field near Beijing and Jiangsu Jintan near Shanghai, creating

4 http://gdfs.customs.gov.cn/customs/302249/zfxxgk/2799825/302274/302277/302276/4807029/index.html

more than 1 bcm of working capacity gas storage. During the 12th Five-Year Plan period, the construction of gas storage entered an accelerated stage. PetroChina and other enterprises selected depleted gas fields with good geological conditions and built a number of gas storage facilities in Sichuan, Xinjiang, Liaoning and other areas such as Chongqing Xiangguosi. By the end of 2022, China had built more than 27 underground gas storage units (clusters), with a working gas capacity of 39.83 bcm. In 2022, gas injection began at Shuangtaizi gas storage centre, with a storage capacity of 11.7 bcm and a working capacity of 6.1 bcm, making it the largest underground gas storage facility in China.

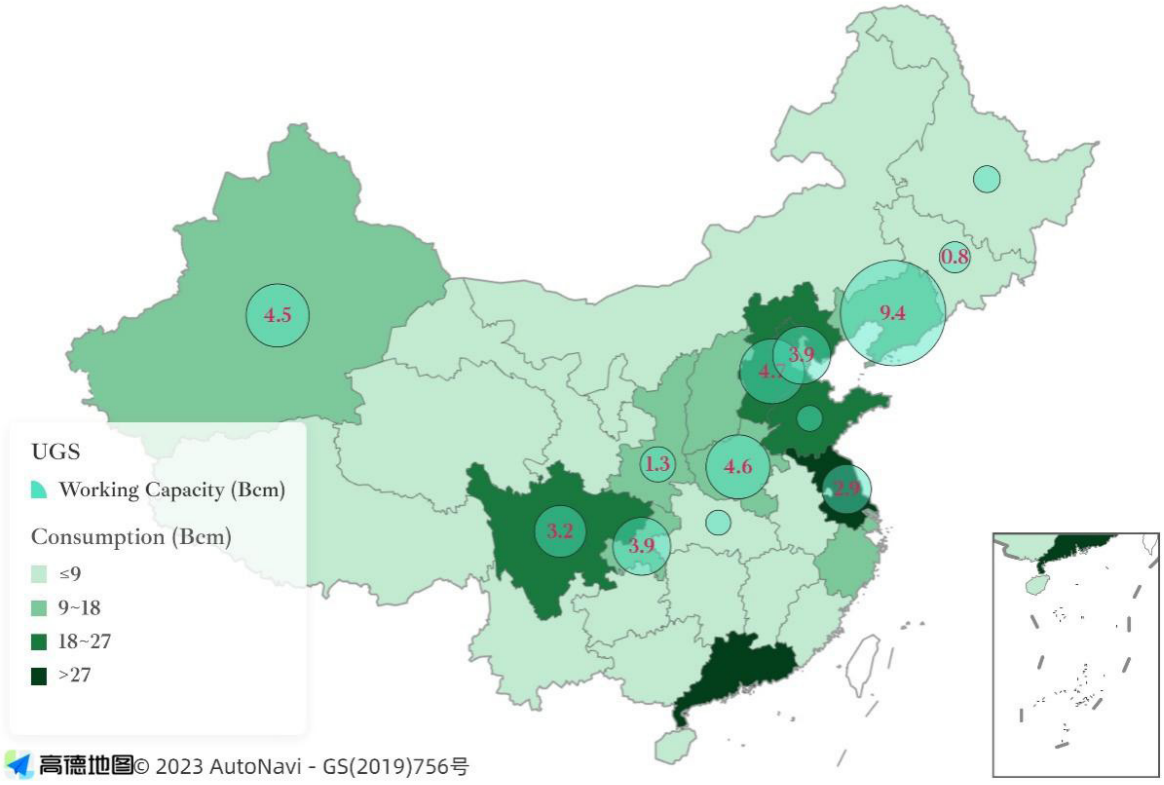
Table 3: China's Underground Natural Gas Storage Facilities

Operator	Name	Province	Type	Working Gas Volume (bcm)	Cushion Gas Volume (bcm)
CNPC	Daqing Cluster	Heilongjiang	Gas Field	0.27	0.43
CNPC	Shuang 6	Liaoning	Gas Field	3.00	5.52
CNPC	Lei 61	Liaoning	Gas Field	0.34	0.53
CNPC	Shuangtaizi	Liaoning	Gas Field	6.10	11.70
CNPC	Shuangtuozi	Jilin	Gas Field	0.51	1.12
CNPC	Daggang and Bannan Cluster	Tianjin	Gas Field	3.89	8.52
CNPC	Suqiao Cluster	Hebei	Gas Field	2.30	6.70
CNPC	Nanpu	Hebei	Gas Field	1.65	4.10
CNPC	Huabei Cluster	Hebei	Gas Field	0.75	1.87
CNPC	Changqing Shaan 224	Shaanxi	Gas Field	0.50	1.00
CNPC	Su East 39-61	Shaanxi	Gas Field	0.80	1.90
CNPC	Hutubi	Xinjiang	Gas Field	4.50	11.70
CNPC	Xiangguosi	Chongqing	Gas Field	2.30	4.30
CNPC	Tongluoxia	Chongqing	Gas Field	0.70	1.10
CNPC	Huangcaoxia	Chongqing	Gas Field	0.90	1.90
CNPC	Mujiaping	Sichuan	Gas Field	0.20	0.40
CNPC	Laowengchang	Sichuan	Gas Field	1.90	3.60
Sinopec	Huxi	Jilin	Gas Field	0.30	0.06
Sinopec	Zhongyuan	Henan	Gas Field	1.27	2.61
Sinopec	Yong 21	Shandong	Gas Field	0.20	0.50
Sinopec	Jintan	Jiangsu	Salt Cavern	0.70	1.20
Sinopec	Jianghan	Hubei	Gas Field	0.14	0.23
Sinopec	Qingxi	Sichuan	Gas Field	1.10	2.10
PipeChina	Wen 23	Henan	Gas Field	3.30	8.40
PipeChina	Jintan	Jiangsu	Salt Cavern	1.70	2.60
PipeChina	Liuzhuang	Jiangsu	Salt Cavern	0.25	0.46
Ganghua	Jintan (Town gas)	Jiangsu	Salt Cavern	0.26	0.46

Source: Sourced from online materials.

In terms of operators, PetroChina owns and operates the largest volume of gas storage capacity, with working gas volume of 30.6 bcm. According to PetroChina's 2019-2030 underground gas storage construction plan, the company intends to establish the following six regional gas storage centres: Northeast China, North China, Central and Western China, Northwest China, Southwest China and Central and Eastern China. By 2030, PetroChina will also expand the capacity of 10 gas storage centres and build 23 new gas storage centres.

Figure 11: Mainland China's natural gas consumption and underground natural gas storage working capacity by province



Source: Sourced from online materials.

However, the distribution of gas storage is not balanced and is not located in areas that will support the main consumption markets. While most working gas storage facilities currently in operation are located in Liaoning, Hebei, Henan, Xinjiang, Chongqing and other provinces, the main gas consumption provinces of Guangdong, Jiangsu, Shandong and Beijing lack gas storage and peak shaving capacity.

Another issue may lie in China's complex geological conditions which could complicate efforts to develop sufficient storage capacity that is appropriately located (even if the business conditions for it improve).

2. LNG Industry in China

China's LNG industry started in the 1990s. In 1996, construction began on the Shanghai Wuhaogou LNG Station, owned by Shenergy. It is the first LNG plant to be built in China. However, the most relevant event for the fledgling industry occurred in 1998, when the Chinese government approved CNOOC's LNG import project. This was piloted in Guangdong Province and took several years to develop. It was not until 2006 that China's first LNG receiving terminal - Dapeng LNG Terminal in Guangdong - officially began operation, marking the start of the country's LNG import industry. Since then, construction of several LNG regasification terminal projects has taken place in Guangdong, Fujian, Shanghai, Zhejiang and Hainan, all owned and operated by Chinese state-owned NOCs. In 2018, ENN's Zhoushan LNG Terminal, the first LNG receiving project invested by private enterprises, also began operation, and the industry entered a new stage of expanded, multi-player development.

2.1 LNG Industry Structure

The LNG industry chain is a complete industrial chain that runs through the whole natural gas industry, including upstream enterprises such as natural gas extraction enterprises and natural gas liquefaction enterprises, midstream enterprises such as LNG transportation enterprises and LNG receiving stations, and downstream enterprises such as gas filling stations and urban gas distribution enterprises.

At present, the upstream natural gas exploitation enterprises are still dominated by three state-owned enterprises, PetroChina, SINOPEC and CNOOC, while enterprises involved in LNG liquefaction business are somewhat more diversified. The private listed companies include Kunlun Energy, ENN Group, Guanghui Energy, Hongtong Group, among others. Midstream transportation enterprises include COSCO Shipping, China Merchants Energy Shipping, Delong Co-Energy, and more. Receiving terminal enterprises are mainly PipeChina, PetroChina, CNOOC, Sinopec, plus local state-owned and private enterprises such as ENN Group and Shenergy Group. Additional downstream enterprises connect with many city gas companies. In terms of gas filling station operators, the most significant are China Gas, Chongqing Gas and Bestsun Energy.

2.2 'Land-based' Domestic LNG Production

As mentioned earlier, China's natural gas is produced mainly in the west of China and consumed in the east. Although several natural gas pipelines have been built during the last 20 years, such as West-to-East pipeline, there is still insufficient natural gas transport capacity. Thanks to the imbalance between production capacity in the west and demand growth in the east, the LNG industry has found a niche role and enjoyed a steady development. In 2022, China's land-based LNG production reached 18.83 million tons, up 14% from 2021 with an annualised compound growth rate of nearly 20% since 2015.

Figure 12: China LNG industry enterprises

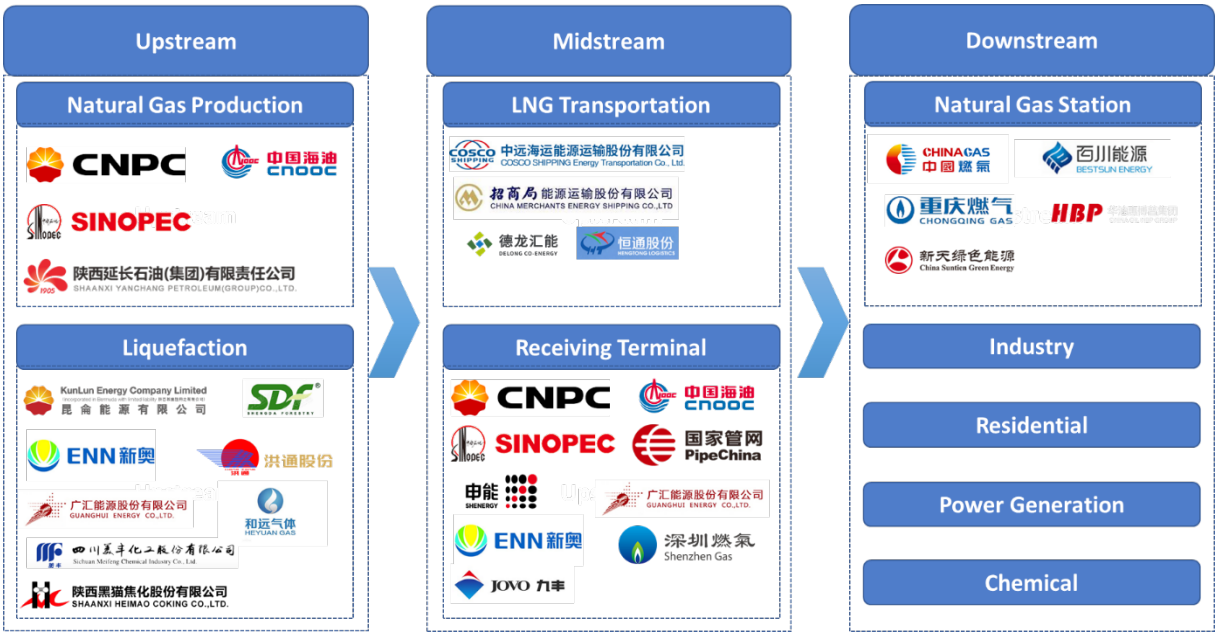
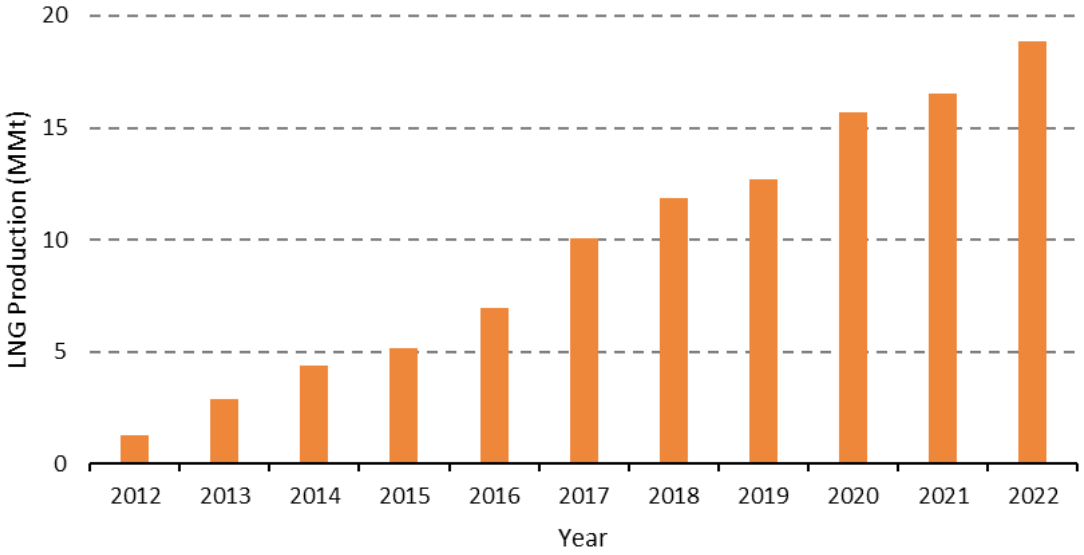


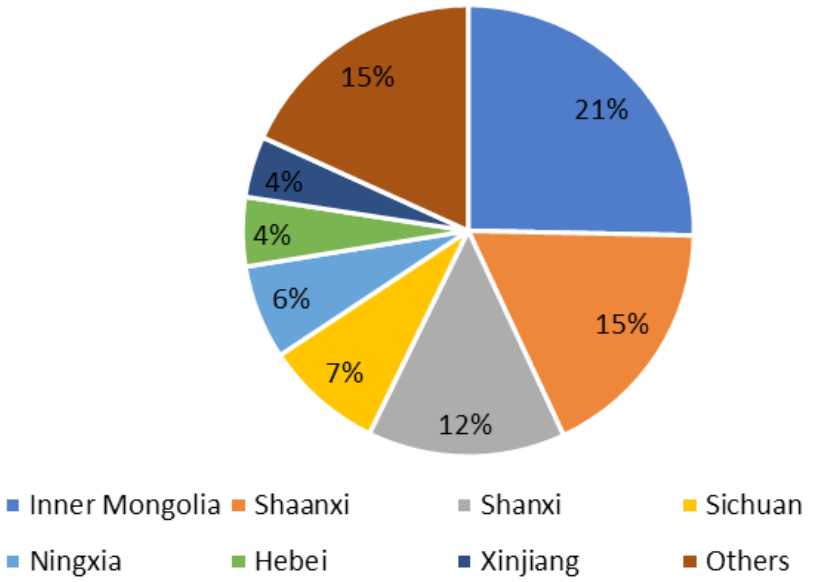
Figure 13: China's land-based domestic LNG production by year



Source: National Bureau of Statistics, China; Bloomberg.

The 'land-based' LNG production is mainly located in large provinces with abundant natural gas reserves, such as Inner Mongolia, Shaanxi, Sichuan and Xinjiang provinces. Inner Mongolia, Shaanxi and Shanxi provinces ranked the top three in terms of LNG land-based production in 2022, with output of 4.77 million tons, 3.34 million tons and 2.67 million tons, accounting for 21%, 15% and 12% of the national LNG output, respectively.

Figure 14: China land-based LNG production by province



Source: National Bureau of Statistics, China; Bloomberg.

China's land-based LNG plants have developed rapidly. In the early stages of the industry, these plants were mainly dedicated to gas storage and peak-shaving usage. But due to the persistent imbalance of supply and demand in provincial natural gas markets along with inadequate local pipeline transport capacity and inter-regional connections, the growing demand for inter-provincial natural gas trading has led to the emergence of more LNG processing plants and to the world's largest inland LNG tanker trading system. According to statistics, there are nearly 500 inland LNG processing plants in China, which are mainly distributed in Xinjiang, Sichuan, Shaanxi, Shanxi, Inner Mongolia and a few other provinces with relatively rich gas resources. Gas feedstock for this particular business includes direct gas supply from local gas fields, as well as long distance gas pipelines, coal gas and coke oven gas (see Table 4).

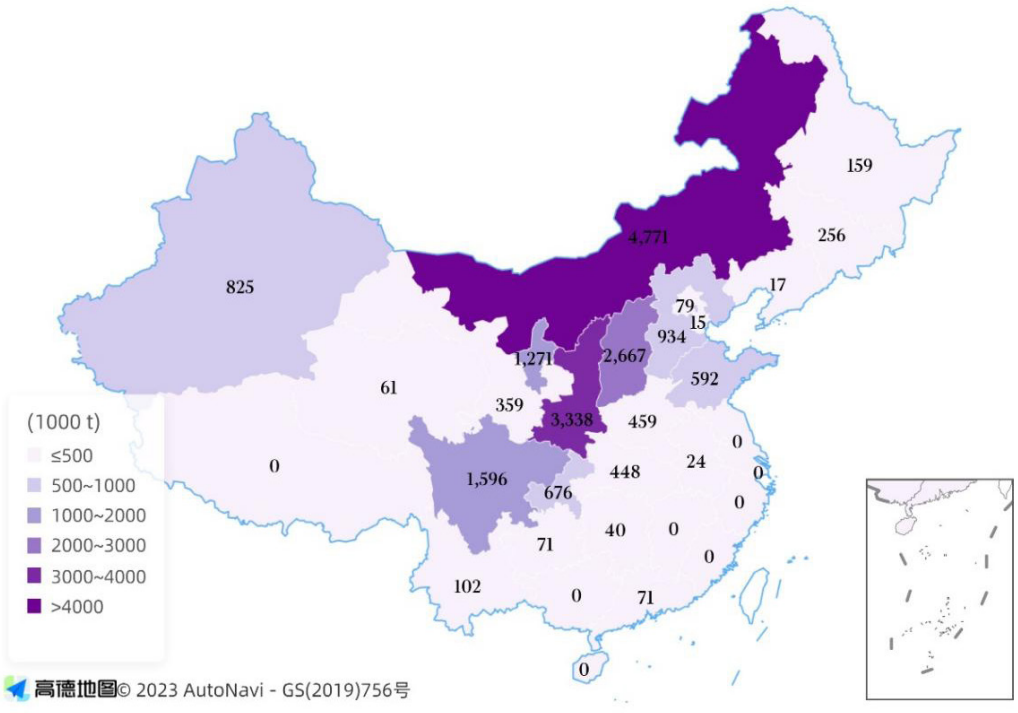
Table 4: China's LNG Plants and Production by Province

Province	LNG Plants	LNG Production (1000 tons)	Gas Source
Xinjiang	24	824.5	Gas field direct supply, long-distance pipeline gas, coke oven gas, coal to gas
Qinghai	8	60.8	Long-distance pipeline gas, coke oven gas
Ningxia	13	1271.5	Gas field direct supply, long-distance pipeline gas
Inner Mongolia	44	4771.0	Gas field direct supply, long-distance pipeline gas, coke oven gas, coal gas, by-product gas
Gansu	16	359.3	Gas field direct supply, long-distance pipeline gas
Shanxi	64	2667.5	Gas field direct supply, long-distance pipeline gas, coke oven gas, by-product gas
Shaanxi	67	3337.9	Gas field direct supply, coke oven gas, coal bed methane

Province	LNG Plants	LNG Production (1000 tons)	Gas Source
Sichuan	27	1595.8	Direct gas field supply
Chongqing	11	675.6	Direct gas field supply
Anhui	8	24.0	Long-distance pipeline gas
Guangdong	4	71.4	Coke oven gas
Guangxi	3	0.0	Direct gas field supply
Guizhou	15	71.4	Coke oven gas
Hainan	1	39.7	Direct gas field supply
Hebei	25	934.2	Long-distance pipeline gas, coke oven gas
Yunnan	19	101.7	Coal to gas, long-distance pipeline gas, coke oven gas
Henan	20	459.1	Long-distance pipeline gas, coke oven gas, coal bed gas
Heilongjiang	15	159.3	Coke oven gas
Jilin	17	255.6	Gas field direct supply, long-distance pipeline gas
Liaoning	7	17.4	Direct gas field supply
Hubei	10	447.6	Long-distance pipeline gas
Jiangsu	9	0.0	Long-distance pipeline gas, coke oven gas
Shandong	27	592.1	Long-distance pipeline gas, coke oven gas
Tianjin	4	14.6	Long-distance pipeline gas
Others	29	79.3	-
Total	**487**	**18831.1**	

Source: National Bureau of Statistics; China; www.chinagasmap.com.

Figure 15: China land-based LNG production by province

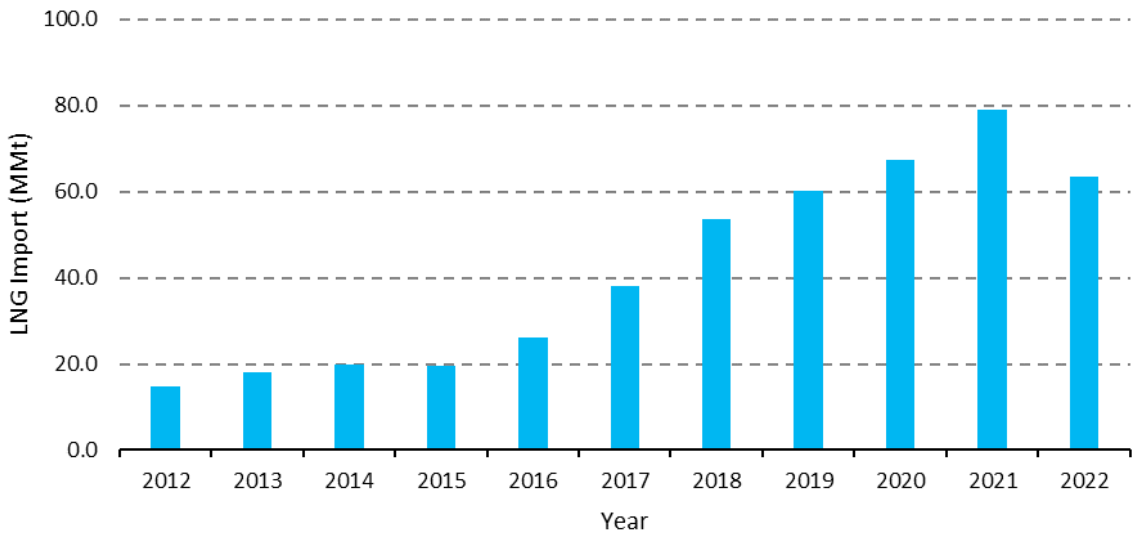


Source: National Bureau of Statistics, China; Bloomberg.

2.3 LNG Imports

In 2022, China imported 63.44 million tons of LNG, 15.49 million tons less than in 2021, down 19.6% year on year, and ending several years of rapid import growth.

Figure 16: China's LNG Imports 2012-22



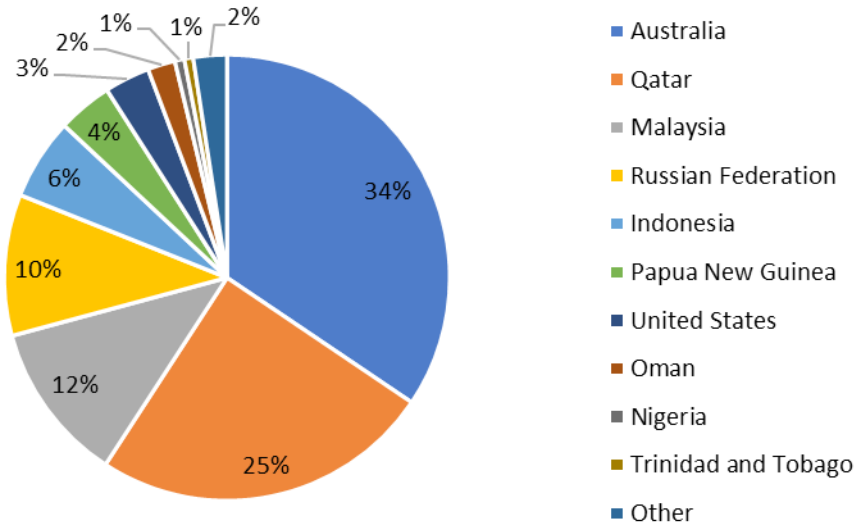
Source: National Bureau of Statistics, China.

China's LNG imports are sourced from more than 27 countries. In 2022, Australia remained China's largest source, but total imports fell by nearly 30% from 31.15 million tons in 2021 to 21.85 million tons, while Australia's share dropped from 39.5% to 34.4%. LNG imports from Qatar rose to 15.7 million tons, up 78% from a year earlier and significantly higher than the 8.98 million tons recorded in 2021, mainly due to implementation of a long-term LNG agreement between CNOOC, Sinopec and Qatar in early 2022.

China's spot natural gas imports from the US also dropped significantly in response to high spot prices, with 2.09 million tons imported from the US in 2022, down 76.7% from the previous year.

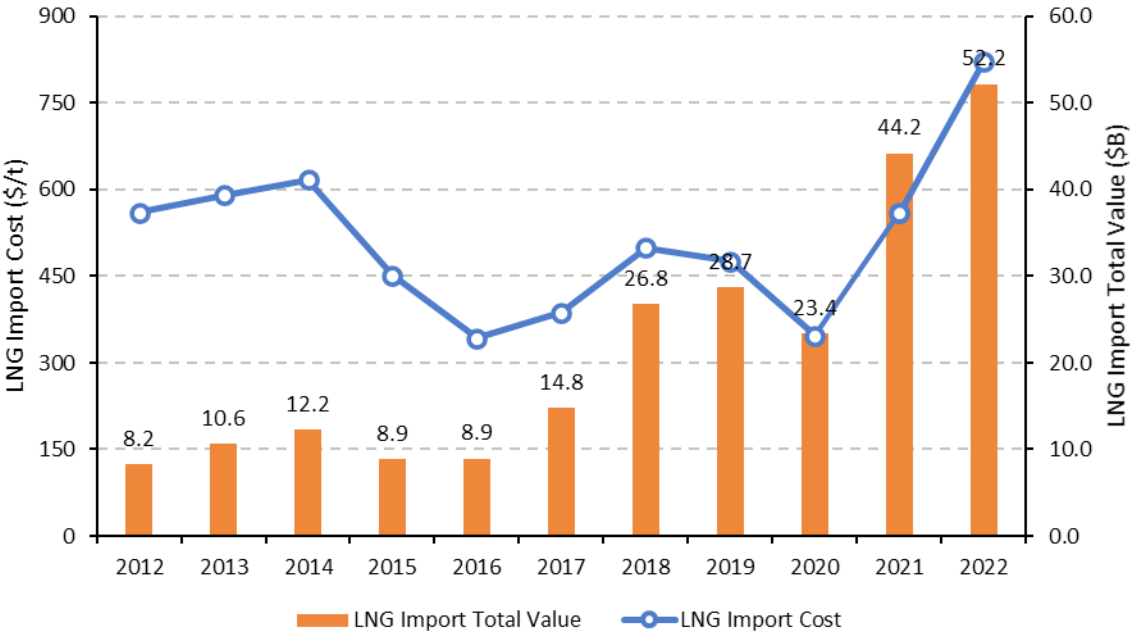
In 2022, the high global spot price of LNG had a significant impact on China's LNG import costs. On average, the cost per ton of LNG in 2022 was USD 823 (CNY 5 919), which is significantly higher than the 2021 average price of USD 560 (CNY 4 027) per ton and the highest level since 2012. While LNG imports fell 19.6%, the value of total imports reached USD 52.2 billion, its highest level since 2012.

Figure 17: China LNG imports by source in 2022



Source: General Administration of Customs, China.

Figure 18: China LNG import cost and total value



Source: General Administration of Customs, China.

The following table shows the proportion of LNG that is 'exported' out of the regasification terminals in its liquefied form. It is important to note that the gas distribution pipes from these terminals are not yet connected to the national natural gas grid, with just a few exceptions.

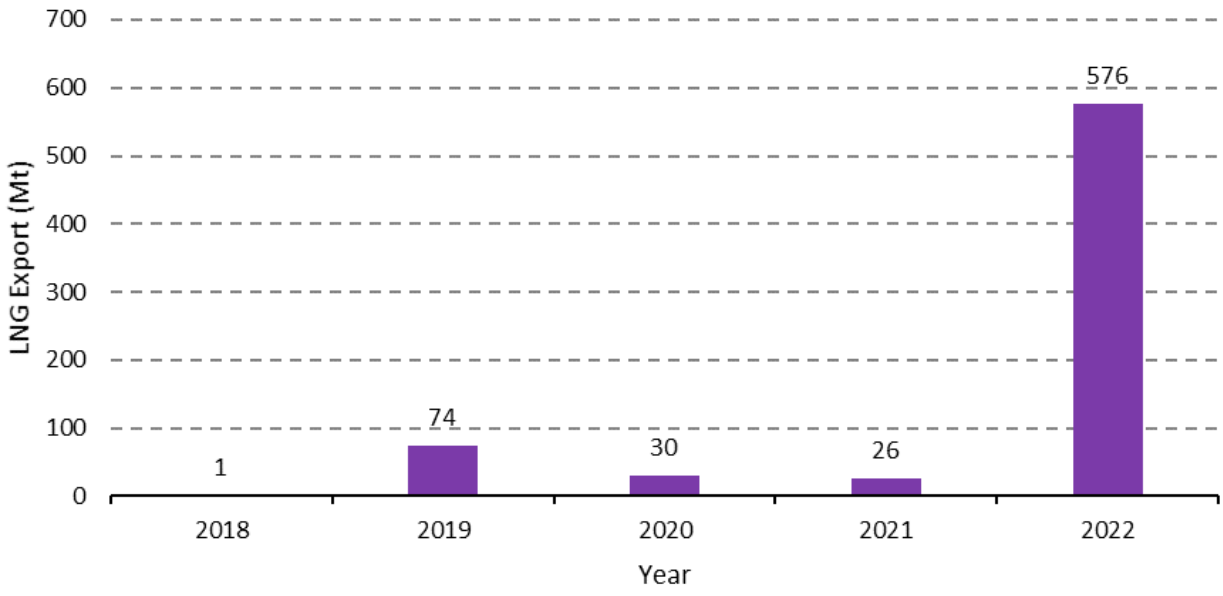
Table 5: China LNG Terminals – Trucked Ratio

Year	LNG Import mmt	Trucked LNG Import (mmt)	Ratio
2017	38.13	9.476	24.9%
2018	53.78	12.96	24.1%
2019	60.25	14.74	24.5%
2020	67.39	20.49	30.4%
2021	78.93	21.10	26.7%
2022	63.44	8.29	13.1%

2.4 LNG Re-exports

Because of the constraining destination terms of its contracts, for a long time China had not been able to re-export LNG. However, with time more flexibility was negotiated, and the re-export and trade of Chinese LNG has now become possible. For instance, between 2018 and 2021, China exported small volumes of LNG to a few countries, about 130 930 tons in four years. In 2022, high LNG spot prices and low domestic gas consumption allowed a substantial increase in total LNG re-export of about 575 540 tons, more than the previous four years combined. End-markets included Asian countries (South Korea, Japan, Thailand and Singapore), as well as European countries such as Italy.

Figure 19: China LNG re-exports 2018-22

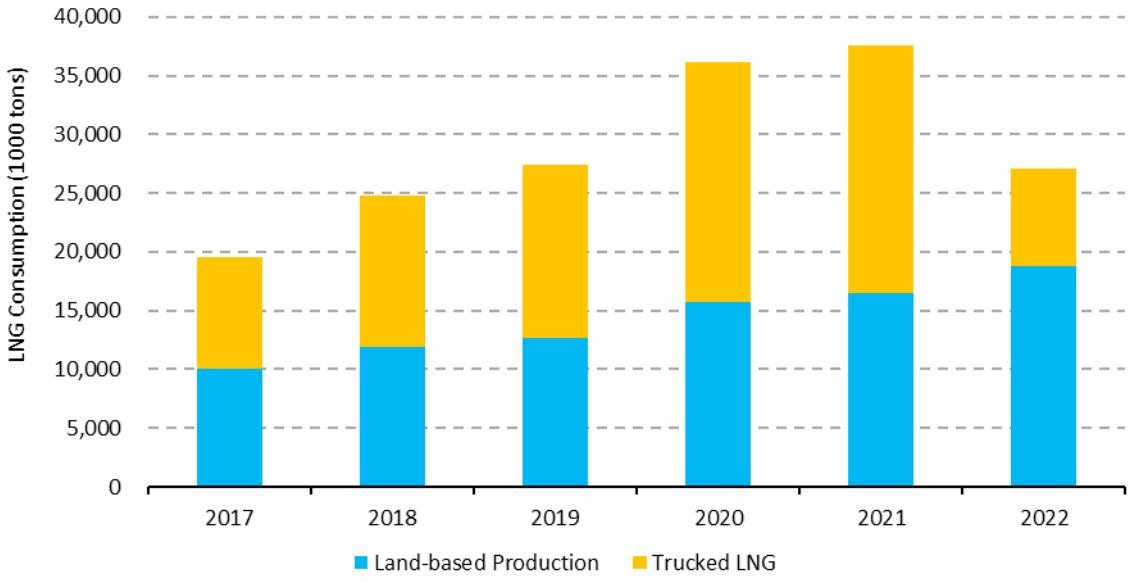


Source: National Bureau of Statistics, China.

2.5 LNG Consumption

China's LNG consumption consists of 'land-based' LNG production and trucked LNG imports from LNG receiving terminals. In response to the decline in LNG spot imports during 2022, and in order to keep pipeline gas supply stable, most LNG imports were regasified, resulting in a significant decline in trucked LNG. The final figure for the trucked LNG imports in 2022 was 8.29 million tons, down 61% year on year, while the consumption of LNG was 27.18 million tons, down 28% year on year.

Figure 20: China LNG consumption by year

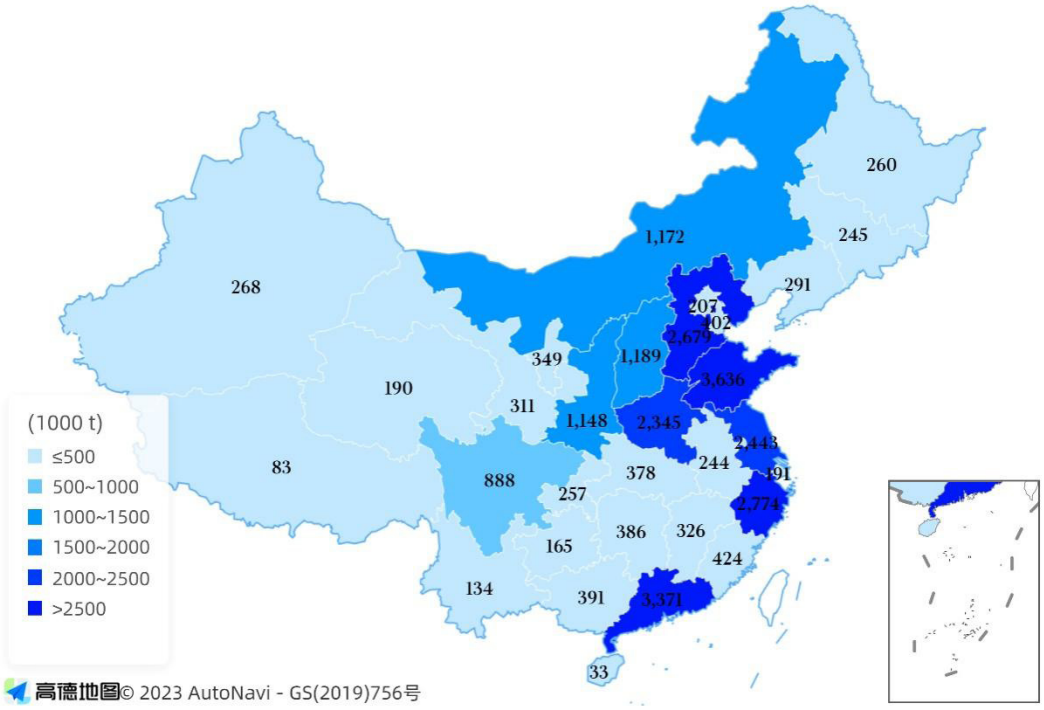


Source: National Bureau of Statistics, China; Bloomberg.

Geographically, Shandong, Guangdong, Zhejiang, Hebei, Jiangsu and Henan are the largest LNG-consuming provinces in China, among which Shandong and Guangdong exceeded 33 million tons, accounting for 13.4% and 12.4% respectively, while Zhejiang and Hebei exceeded 25 million tons, accounting for 10.2% and 9.9% respectively. The sources of LNG supply vary from province to province. Shandong, Jiangsu, Henan and Hebei depend on land-based LNG production, while Guangdong depends mainly on trucked LNG imports. Inner Mongolia, Shaanxi, Shaanxi, Sichuan and Xinjiang are the main providers of land-based LNG production.

According to Zhuochuang Information, LNG consumption in all downstream sectors, and industry in particular, declined by more than 40% in 2022. In terms of consumption, transport is the main destination for LNG, accounting for 47.98%. Urban gas consumption accounted for 20.93%, industrial consumption 29.4% and power generation consumption 1.69%.

Figure 21: China LNG consumption by province

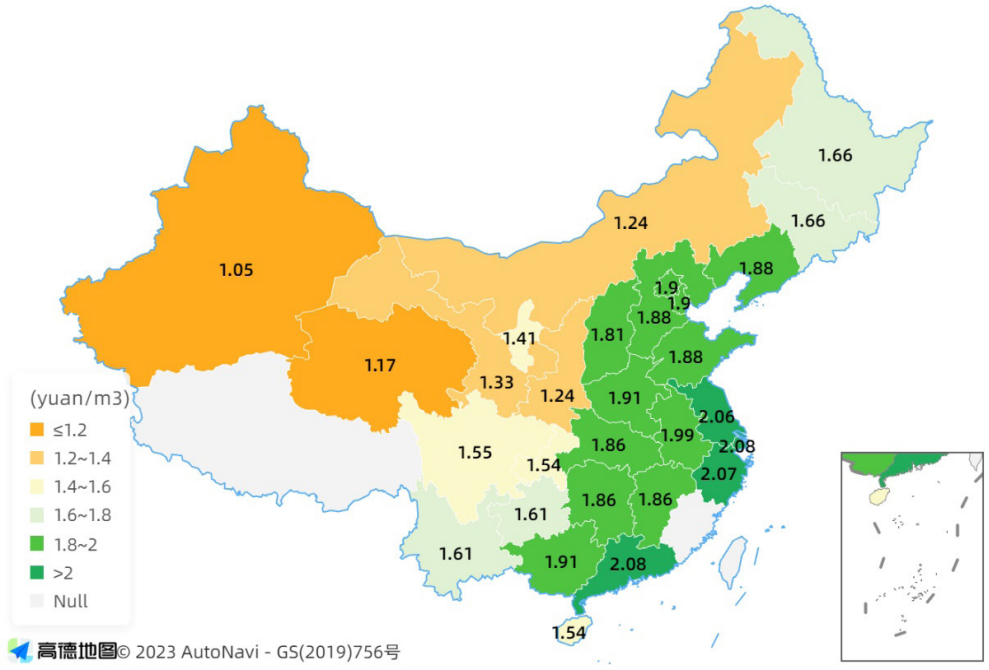


Source: National Bureau of Statistics, China; Bloomberg.

2.6 LNG Market Price

The reform of natural gas price mechanisms has long been the focus of natural gas marketisation in China. In October 2015, a paper entitled 'Several Opinions on Promoting Price Mechanism Reform' for the first time advocated natural gas price reform in accordance with the general idea of 'controlling the middle and liberalising the two ends'. Since then, the government has successively issued documents to further standardise the prices within the natural gas industry chain, such as pipeline transportation, gas storage facilities, and residential valve stations, so as to improve the marketisation conditions of natural gas. In March 2020, the new edition of the Central Pricing Catalogue was released and stipulated that the market should set the price for offshore gas, shale gas, coal-bed methane, coal-derived gas, LNG, gas for direct users, gas purchased and sold by gas storage facilities, open trading of gas on trading platforms, imported pipeline gas brought onstream after 2015, and gate and station prices for natural gas from provinces. According to the Catalogue, the gate price of other domestic onshore pipeline natural gas and imported pipeline natural gas coming onstream before the end of 2014 should be temporarily managed using the current price mechanism, with the market setting the price once the natural gas market-oriented reform process has begun.

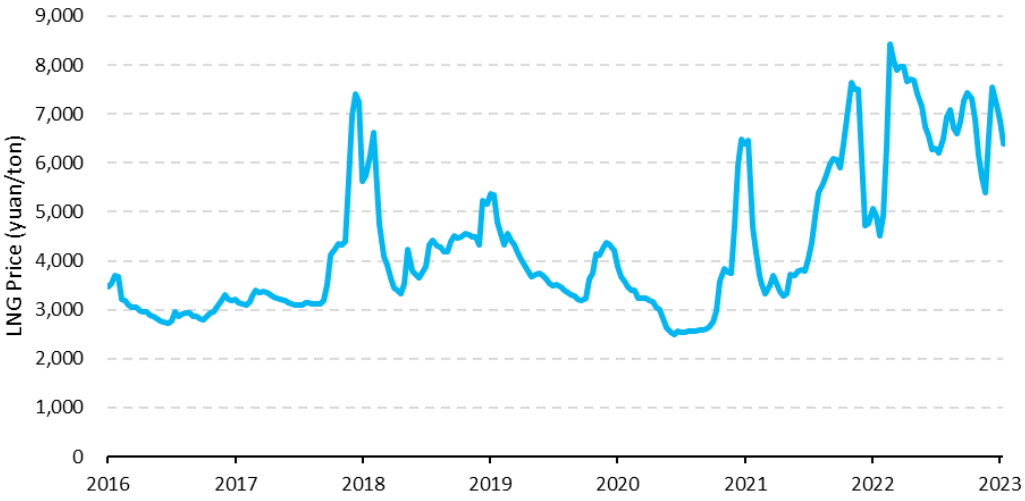
Figure 22: Natural gas gate price for non-residential use by province (CNY/m^3, VAT included)



Source: National Development and Reform Commission, China

The marketised LNG price has relatively high volatility. The market price for LNG was CNY 7 500/ton on 30 November 2021, and dropped to CNY 4 700/ton one month later. After the outbreak of the conflict between Russia and Ukraine, the LNG price in China also fluctuated hugely. On 10 February 2022, the LNG price surged to CNY 4 934/ton, and then on 28 February, it soared to CNY 8 437/ton. Since then, the LNG price has dropped down.

Figure 23: China LNG market price

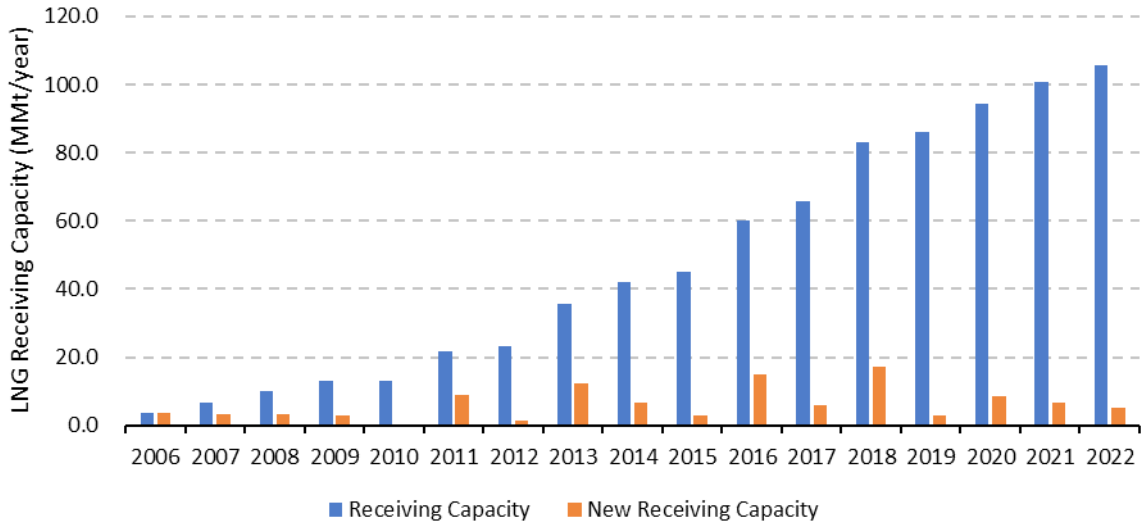


Source: National Bureau of Statistics, China.

2.7 LNG Receiving Terminals

During 2022, China launched two new LNG receiving terminals, Hangzhou Jiaxin LNG terminal with a capacity of 1 million tons per year and CNOOC's Binhai LNG terminal with a capacity of 3 million tons per year. By the end of 2022, China had brought into operation a total of 24 LNG receiving terminals, each with a designed receiving capacity of between 0.6 and 6.8 million tons/year, bringing the total receiving capacity to 106 million tons per year. According to Shanghai International Energy Exchange, China's LNG receiving capacity is set to increase to 130 million tons per year by 2023 and nearly 200 million tons per year by 2025.

Figure 24: China LNG receiving capacity



Source: CNPC Economics & Technology Research Institute; IGU.

Table 6: China's LNG Receiving Terminals

ID	Terminal Name	Province	Start Year	Nameplate Receiving Capacity (MTPA)	Ownership	Concept
1	Binhai LNG	Jiangsu	2022	3	CNOOC (76%), Huainan Mining Group (24%)	Onshore
2	Caofeidian (Tangshan) LNG	Hebei	2013	10	CNPC (51%); Beijing Enterprises Group Company (29%); Hebei Natural Gas (20%)	Onshore
3	Dalian LNG	Liaoning	2011	6	PipeChina (75%); Dalian Port (20%); Dalian Construction Investment Corporation (5%)	Onshore

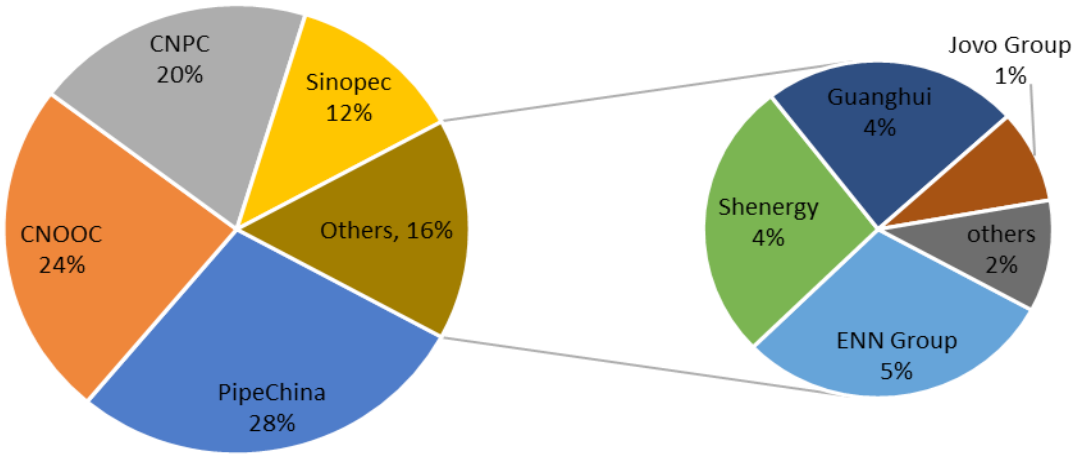
ID	Terminal Name	Province	Start Year	Nameplate Receiving Capacity (MTPA)	Ownership	Concept
4	Diefu LNG (Shenzhen)	Guangdong	2018	4	PipeChina (70%); Shenzhen Energy Group -(30%)	Onshore
5	Fangchenggang LNG	Guangxi	2019	0.6	PipeChina (51%); Guangxi Beibu Gulf Port Group (49%)	Onshore
6	Fujian LNG	Fujian	2009	6.3	CNOOC (60%); Fujian Investment and Development Co (40%)	Onshore
7	Guangdong Dapeng LNG	Guangdong	2006	6.8	Local Company (37%); CNOOC (33%); BP (30%)	Onshore
8	Guangxi (Beihai) LNG	Guangxi	2016	6	PipeChina (80%); Guangxi Beibu Gulf Port Group (20%)	Onshore
9	Hainan LNG	Hainan	2014	3	PipeChina (65%), Guodian Haikong New Energy (35%)	Onshore
10	Hainan Shennan	Hainan	2014	0.6	Beijing Gas Blue Sky Holdings Ltd. (10%), CNPC (90%)	Onshore
11	Jiangsu Rudong LNG	Jiangsu	2011	10	CNPC (55%); Pacific Oil and Gas (35%); Jiangsu Guoxin (10%)	Onshore
12	Jiaxing LNG	Zhejiang	2022	1	Jiaxing Gas Group (51%); Hangzhou Gas (49%)	Onshore
13	Jieyang LNG (Yuedong)	Guangdong	2017	4.2	PipeChina (100%)	Onshore
14	Jovo Dongguan	Guangdong	2013	1.5	Jovo Group (100%)	Onshore
15	Qidong LNG	Jiangsu	2017	4	Xinjiang Guanghui Energy (100%)	Onshore
16	Shandong (Qingdao) LNG	Shandong	2014	7	Sinopec (99%); Qingdao Port (1%)	Onshore
17	Shenzhen Gas LNG	Guangdong	2019	0.8	Shenzhen Gas (100%)	Onshore
18	Tianjin (Sinopec)	Tianjin	2018	6	Sinopec (100%);	Onshore
19	Tianjin FSRU - Hoegh Esperanza	Tianjin	2018	6	PipeChina (100%)	Floating
20	Wuhaogou LNG	Shanghai	2008	1.5	Shenergy (100%)	Onshore
21	Yangshan LNG (Shanghai)	Shanghai	2009	3	Shenergy Group (55%); CNOOC (45%)	Onshore
22	Zhejiang Ningbo LNG	Zhejiang	2012	6	CNOOC (51%); Zhejiang Energy Company (29%); Ningbo Power (20%)	Onshore

ID	Terminal Name	Province	Start Year	Nameplate Receiving Capacity (MTPA)	Ownership	Concept
23	Zhoushan ENN LNG	Zhejiang	2018	5	ENN Group (90%); SK E&S (10%);	Onshore
24	Zhuhai LNG	Guangdong	2013	3.5	CNOOC (30%); Guangdong Gas (25%); Guangdong Yuedian (25%); Local companies (20%)	Onshore

Source: Sourced from online materials.

LNG receiving terminals operators are diversifying. In 2006, Guangdong Dapeng LNG Terminal, China's first LNG terminal led by CNOOC, was launched as a Sino-foreign joint venture, with shareholders including local enterprises and BP. Subsequently, the three major national oil companies, PetroChina, Sinopec and CNOOC, continued to build coastal LNG receiving terminals, and a number of large terminals such as Fujian LNG, Rudong LNG and Caofeidian LNG were put into operation successively. Shenergy Group, a local state-owned enterprise, was the first such business to participate in the construction of LNG terminals by investing in the Wuhaogou and Yangshan LNG terminals in 2008 and 2009 respectively. Private companies were latecomers in LNG terminal construction. Jovo Group's first private LNG terminal in Dongguan, Guangdong, came into operation in 2013, followed by terminals built by China Guanghui Energy in Qidong, Jiangsu, and by ENN Group in Zhoushan, Zhejiang. In 2019, as mid-stream company PipeChina was established, some LNG receiving stations were transferred into its ownership. As a result, 2022 receiving station capacity operated by PipeChina accounted for 28%, while CNOOC, PetroChina and Sinopec accounted for 24%, 20% and 12% respectively. The proportion of receiving stations jointly run by state-owned and private companies had risen to 16%.

Figure 25: China LNG receiving capacity according to operator



Source: Sourced from online materials.

In addition, China has several LNG receiving terminals either planned or under construction, such as Longkou LNG and Shenzhen LNG (PipeChina) and Tianjin LNG (Beijing Gas Group). Taking into account terminals currently under construction and planned, China's annual regasification capacity could reach 200 million tons per year by 2025. By 2040, it could further increase to 260 million tons per year.

3. Natural Gas Policies

The Chinese government's natural gas industry policy is closely linked with the development of the natural gas market in China. In the 1980s, the natural gas industry began to be regarded as a national strategic industry, and until the end of the 20th century, natural gas industry policy was concentrated on strengthening domestic natural gas exploration and development.

In the 21st century, natural gas policy began to emphasise the introduction of foreign natural gas resources and the expansion of overseas cooperative development. Since the 12th Five-Year Plan in 2010, China's natural gas policy has begun to support the construction of natural gas infrastructure. During the 13th Five-Year Plan period, natural gas policy focused on market-oriented natural gas reforms, the construction of natural gas storage facilities, and the development of natural gas use. A series of policies were introduced to improve the efficiency of the whole natural gas market. In fact, since 2014, the government has issued more than 50 policy documents on natural gas, such as the '13th Five-Year Plan for Natural Gas Development', 'Opinions on Accelerating the Utilisation of Natural Gas', 'Opinions on Deepening the Reform of the Oil and Natural Gas System', 'Notice on Rationalising the Price of Residential Valve Stations', etc. Of course, the biggest reform during the 13th Five-Year Plan period was the establishment of PipeChina in 2019, which laid the foundation for the open use of natural gas infrastructure, and effectively signaled the end of certain monopolistic situations in the energy market.

Table 7: Policies Affecting the Natural Gas Industry 2014-22

Year	Policy issuer	Policy name
2014	NEA	Measures for Fair and Open Supervision of Oil and Gas Pipeline Network Facilities (Trial)
2014	NDRC	Measures for the Construction and Operation of Natural Gas Infrastructure
2014	NDRC	Guiding Opinions on Establishing and Improving the Ladder Price System of Household Gas Consumption
2014	NDRC	Guiding Opinion on Accelerating Gas Storage Construction
2014	NDRC	Notice on the Establishment of a Long-term Mechanism to Ensure the Stable Supply of Natural Gas
2014	State Council	Strategic Action Plan for Energy Development (2014-2020)
2015	NDRC	Notice on Rationalizing Natural Gas Price for Non-residential Use
2015	MF; NEA	Notice on Fiscal Subsidy Policy for Shale Gas Development and Utilization
2015	State Council	Several Opinions on Promoting the Reform of Price Mechanism
2015	NDRC	Notice on Reducing Natural Gas Gate Price for Non-residential Use and Further Promoting the Price Market Reform

Year	Policy issuer	Policy name
2016	NDRC	Notice on Strengthening the Supervision of Local Natural Gas Transmission and Distribution Prices to Reduce the Cost of Gas Used by Enterprises
2016	NEA	Notice on Information Disclosure related to the Opening of Oil and Gas Pipeline Network Facilities
2016	NDRC	Notice on Gas Storage Pricing
2016	NEA	Shale Gas Development Plan (2016-2020)
2016	NDRC	Management Measures of Natural Gas Pipeline Transmission Tariffs
2016	NDRC	Supervision Measures of Natural Gas Pipeline Transmission Cost
2016	NDRC	Notice on Clarifying Pricing Policies related to Gas Storage Facilities
2016	NDRC	13th FYP on Energy Development
2016	NDRC	13th FYP on Natural Gas Development
2016	NDRC	13th FYP on CBM Development
2016	NDRC	Strategy for Revolution in Energy Production and Consumption (2016-2030)
2017	NDRC	Medium to Long-term Oil and Gas Pipeline Network Plan
2017	NDRC	Opinions on Deepening the Reform of the Oil and Gas System
2017	NDRC	Opinion on Accelerating Natural Gas Utilization
2017	NDRC	Notice on Lowering the Benchmark Gate Station Price of Natural Gas for Non-residential Use
2018	NEA	Guidelines on Energy Work in 2018
2018	NDRC	Opinions on Accelerating Gas Storage Construction and Improving the Market Mechanism for Gas Peaking Service
2018	NDRC	Notice on Rationalizing the Gate Price of Household Gas
2018	NDRC	Notice on Planning, Construction, and Operation of Gas Storage Facilities
2018	State Council	Several Opinions on Promoting the Coordinated and Stable Development of Natural Gas
2018	NEA	Measures for the Administration of Petroleum and Natural Gas Planning
2018	State Council	Three-year Action Plan to Win the Blue Sky Defense War
2019	NDRC	Measures for Regulation of Fair and Open Access to Oil and Gas Pipeline Facilities (Measures)
2019	NDRC	Notice on Guaranteeing Energy Peak Supply during the Summer of 2019
2020	NDRC	Implementation Opinion on Accelerating Gas Storage Capacity Construction
2020	NDRC	Central pricing Catalog (2020 edition)
2021	NDRC	Trial Measures of Natural Gas Pipeline Operation and Dispatch and Emergency Management (Draft)
2021	MF; GACC	Notice on Import Tax Policy for Exploration, Development and Utilisation of Energy Resources during the 14th Five-Year Plan Period
2021	NDRC	Notice on the Action Plan for Deepening Reform on Pricing Mechanisms in the 14th Five Year Plan Period

Year	Policy issuer	Policy name
2021	NDRC	Measures for the Supervision and Examination of the Pricing Cost of Natural Gas Pipeline Transportation (interim)
2021	NDRC	Measures for the Price Administration of Natural Gas Pipeline Transportation (interim)
2021	NEA	Work Plan for the Special Supervision of Natural Gas Networks and LNG Terminals
2021	NDRC	Notice On the General Administration of Market Supervision on Strengthening the Supervision of Natural Gas Transmission and Distribution Tariffs
2021	NDRC	Plan for Improving the Dual Control System of Energy Consumption Intensity and Total Volume
2021	CPC; State Council	Opinions on Completely, Accurately and Comprehensively Implementing the New Development Concept and Doing a Good Job of Carbon Peak and Carbon Neutrality
2021	State Council	Action Plan for Carbon Dioxide Peaking before 2030
2022	NDRC	14th Five-Year Plan for a Modern Energy System
2022	NDRC	Guiding Opinions on Improving the Pricing Mechanism for Regasification Services at LNG Import Terminals
2022	NDRC	Implementation Plan for Carbon Peaking in the Industrial Sector
2022	NDRC	Implementation plan for carbon peaking in urban and rural construction
2022	NDRC	Modern Comprehensive Transportation System for 14th Five-Year Plan

Source: Sourced from online materials.

Other than the reform of the midstream structure, deregulation of the natural gas market has been slow and is largely unachieved at this time.

3.1 The Establishment of PipeChina

On 9 December 2019, PipeChina was formally established. It was in 2010 that the National Development and Reform Commission put forward a proposal for pipeline network independence for the first time. In 2013, the research group of the Development Research Center of the State Council first proposed separating the pipe network business (midstream) from oil and gas enterprises.

In the following years, policies on the fair opening and connectivity of oil and gas pipeline network facilities were introduced one after another, in preparation for the establishment of the national pipeline network company. In May 2017, The State Council issued 'Opinions on Deepening the Reform of the Oil and Gas System', which proposed that 'the independence of main pipelines of large state-owned oil and gas enterprises should be promoted step by step, and the separation of pipeline transportation and sales should be realised'. The fair access mechanism for the oil and gas pipe network was improved, and the main oil and gas pipelines, provincial and inter-provincial pipe networks were all opened up to third-party market entities. The reform idea of 'Controlling the middle and Liberalising the two ends' was officially established, which also formalised implementation of the national pipe network. However, the establishment and early development of the oil and gas pipeline network slowed down briefly as a result of gas shortages during the 2017 heating season.

On 5 March 2019, Premier Li Keqiang of the State Council made it clear in the government Work Report that reforms should be more far-reaching in the fields of electricity, oil and gas and railway transport, among others. In monopoly industries, network and transportation should be separated according to the characteristics of different industries, so as to bring competition fully into the market. On the same day, the NDRC issued its 'Report on the Implementation of the 2018 National Economic and Social Development Plan and the Draft of the 2019 National Economic and Social Development Plan', which also clearly stated that 'a national oil and gas pipeline network company will be established to promote the independence of main oil and gas pipelines and realise the separation of pipeline transportation and sales'. On 19 March, the seventh official meeting of the Commission for Deepening Overall Reform of the CPC Central Committee passed the 'Opinions on the Implementation of the Reform of the Operation Mechanism of the Oil and Gas Pipeline Network', which also proposed the establishment of an oil and gas pipeline network company with state-owned capital holding and diversified investment entities.

On 23 July 2020, PetroChina signed multiple asset transfer agreements with PipeChina, transferring the shareholding rights and interests held by PetroChina in PetroChina Pipeline Co. Ltd and Guangdong Natural Pipeline Network Co. Ltd to PipeChina. At the same time, Sinopec signed asset transfer agreements with PipeChina, transferring its equity in the natural gas pipeline and crude oil pipeline companies affiliated to Sinopec to PipeChina. Following oil and gas storage and transportation assets replacement, cash investment by new investors and other developments, the number of shareholders in PipeChina has risen to 11.

On 12 July 2022, PipeChina and Zhejiang Provincial Energy Group held a signing ceremony for the integration of Zhejiang natural gas pipe network into PipeChina's portfolio. The two parties agreed to set up a joint venture, PipeChina Zhejiang Natural Gas Pipe Network Co. Ltd, holding 51% and 49% of the equity of the new joint venture respectively. Zhejiang Provincial Energy Group is only the financial investor in the new pipe network company. As a large natural gas consumption province, it is of great significance for Zhejiang's natural gas pipe network to integrate into the national pipe network in a market-oriented way, offering an influential example that could accelerate the integration of other provincial pipe networks and further promote the construction of China's gas infrastructure, commonly known as the 'National Network'.

Table 8: Shareholders in PipeChina

No.	Shareholders	Ratio (%)
1	PetroChina Company Ltd	29.90
2	China Chengtong Holdings Group Ltd	12.87
3	China Reform Holdings Corporation Ltd	12.87
4	National Council for Social Security Fund of the People's Republic of China	10.00
5	China Petroleum & Chemical Corporation Ltd	9.42
6	China Insurance Investment Co. Ltd	9.00
7	Sinopec Natural Gas Co. Ltd	4.58
8	State-owned Assets Supervision and Administration Commission of the State Council	4.46
9	CNOOC Gas & Power Group Ltd	2.90
10	China Investment International Co. Ltd	2.00
11	Silk Road Fund Co. Ltd	2.00
	Total	**100**

As of 2022, PipeChina controls just 15 provincial pipeline network companies in 12 provinces. About half of the country's provincial pipeline network companies still operate independently, and some still integrate transportation and marketing.

3.2 Natural Gas Policy During the 14th Five-Year Plan

In January 2022, the National Development and Reform Commission and the National Energy Administration jointly issued the '14th Five-Year Plan for a Modern Energy System', which put forward new requirements for the development goals and key construction targets for the natural gas industry during the 14th Five-Year Plan.

In terms of development goals, the plan calls for annual natural gas production to reach 230 bcm or more by 2025. China's intensive gas storage capacity should reach between 55 and 60 bcm, accounting for about 13% of natural gas consumption. The national oil and gas pipeline network should reach about 210 000 kilometers.

3.3 The Natural Gas Industry Under the 'Dual-Carbon' Policy

On 20 September 2020, at the 75th session of the United Nations General Assembly, President Xi proposed that CO_2 emissions should peak before 2030 and that the world should strive to be 'carbon neutral' by 2060. Since then, President Xi has reaffirmed the dual-carbon goal at the United Nations Biodiversity Summit, the BRICS Summit, the G20 Summit, the Central Economic Work Conference and other important summits, consistently promoting green and low-carbon development. China has also introduced a series of policies to assist the move towards the 'dual carbon' goal.

Table 9: '14th Five-Year Plan' Natural Gas Development Goals and Key Construction Content		
Plan		**Content**
Goals	Production	230 bcm or more by 2025.
	Storage Capacity	55 to 60 bcm, accounting for about 13% of natural gas consumption by 2025.
	Infrastructure	Oil and gas pipeline network should reach about 210,000 kilometers or more by 2025.
Key	Pipeline	Speeding up the construction of long-distance natural gas pipelines and regional natural gas pipeline networks; Construction of the southern section of the China-Russia East Route Pipeline, the Sichuan-East Gas Pipeline II, the middle part of the West-East Gas Pipeline III, West-East Gas Pipeline IV, and the Shandong Longkou-Zhongyuan Wen 23 gas storage pipeline.
	Storage	Build underground gas storage clusters with over 10 bcm capacity in North China, Northeast China, Southwest China and Northwest China.
	LNG Terminals	Priority will be given to LNG receiving terminal projects built, under construction or planned at key port sites.
	Trading Platform	Accelerate the improvement of the top-level design of the natural gas market, build a natural gas market system featuring orderly competition and efficient supply assurance, improve natural gas trading platforms, and promote natural gas futures trading at an appropriate time.
	Price Reform	Steadily push forward the market-oriented reform of natural gas prices and reduce the number of gas distribution tiers.
	Consumption	Increase the scale of natural gas power generation in the Guangdong-Hong Kong-Macao Greater Bay Area and its surrounding areas.
	Development in Frontier Areas	Pilot production of natural gas hydrate resources in the South China Sea.

On 24 October 2021, 'Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy' was jointly released by the CPC Central Committee and the State Council. As the '1' in the '1+N'[5] policy system for 'Dual Carbon', the policy document was given a key role. On 26 October 2021, China released the 'Action Plan for Peaking Carbon before 2030', followed by the 'Implementation Plan for Peaking Carbon in Industrial sectors',

5 A policy announced in October 2021. The '1' refers to the 'guiding opinions' that sets out the overarching principles of all forthcoming policies that aim to facilitate China's peaking and neutrality goal. The 'N' includes a 'carbon peaking action plan' – a 10-point plan that sets out Beijing's expectations on the actions that key sectors are required to take to peak emissions. It will cover actions from all major emitting sectors (energy, industry, infrastructure, and transport) as well as other key policy areas for climate action (circular economy, technology, finance, economic policies, carbon trading, nature-based solutions). (taken from https://www.e3g.org/news/1-n-china-upcoming-climate-plans-1n-xie-beijing-han/)

'Implementation Plan for Synergising Carbon Reduction in Pollution and Carbon Reduction', 'Implementation Plan for Peaking Carbon in Urban and Rural Construction' and other implementation plans in different fields, and gradually improved the 'N' series of policies. In addition, the '14th Five-Year Plan for Modern Energy System', '14th Five-Year Plan for Green Transportation' and '14th Five-Year Plan for Renewable Energy' include specific arrangements for energy development. These policies provide a reference for understanding the trajectory of short-term natural gas consumption from the government's standpoint.

In conclusion, the power generation sector is vigorously promoting the integrated development of natural gas and a variety of energy sources and is building natural gas peaking power stations as local conditions allow. In the industrial sector, the proportion of natural gas applications needs to be increased, and industrial coal gas replacement is being promoted in an orderly way. The chemical industry departments are set to guide the growth of gas use for chemical raw materials, enhance capacity for supplies of natural gas raw materials, and work to replace coal with natural gas. In the construction sector, natural gas is used for residential needs and clean heating in northern China during the winter months. The transport sector will expand the use of natural gas in the transport sector and support the use of LNG as fuel for vehicles and ships.

Table 10: Natural Gas Consumption Under the 'Dual-Carbon' Policy

Sector	Action plan
Industry	• Guide natural gas consumption in an orderly manner and rationally guide the growth of gas use in industry and chemical raw materials. • Support enterprises in substituting fuel and accelerate the switch from industrial coal to electricity and gas.
Buildings	• Prioritise gas use for people whose livelihoods depend on it. • Promote the coupling and integration of renewable energy heating with natural gas heating in new urban areas.
Electricity	• Build natural gas peaking power stations, taking account of local conditions. • Build a number of natural gas peak-shaving power stations in areas rich in new energy resources. • Encourage the expansion of natural gas power generation in the Greater Bay Area.
Chemical	• Guide enterprises to change the way they use energy and encourage the use of natural gas in place of coal. • Increase the supply capacity of natural gas as raw materials.
Transport	• Actively expand the application of natural gas in the field of transport. • Support the use of liquefied natural gas as fuel for vehicles and ships, and develop LNG powered ships. • Improve the layout and service facilities of LNG stations.

3.4 Specific Policies for LNG

China's current policies are leaning towards extending the use of LNG in transportation, especially in heavy trucks and shipping, in addition to speeding up the construction of infrastructure such as LNG receiving stations and LNG filling stations. For example, the 'Notice on the Action Plan to Peak Carbon by 2030' calls for the promotion of LNG-powered heavy cargo vehicles and backs the use of LNG as fuel for vehicles and vessels. The '14th Five-Year Development Plan for Green Transportation' also advocates the use of LNG-powered ships on inland waterways and supports the development of LNG-powered ships in coastal areas.

4. Prospects for LNG Development in China

Despite the first recorded decline in China's natural gas consumption in 2022, the long-term trend is for growth. Future gas needs are beyond the scope of China's own gas production potential, as has been described above.

According to the World and China Energy Outlook 2060 released by China National Petroleum Corp. in 2022, China's natural gas domestic output is expected to increase to more than 300 bcm in 2040; most institutions and experts agree that China's natural gas consumption will likely peak around 2040, at approximately 600 bcm.

This anticipated natural gas supply and demand gap, which could be as high as 300 bcm, will impact the nature and content of the natural gas industry development in the long term, both in China and in the rest of the world.

Figure 26: China's natural gas pipeline network

Source: https://www.bakerinstitute.org/chinas-energy-infrastructure.

More comprehensive and smarter utilisation of domestic and foreign gas resources is key to solving the problem of natural gas supply in China.

For energy security considerations, China has been balancing its imports of pipeline gas and LNG. China's imported pipeline gas has seen steady growth over recent years.

The main import pipelines bring gas from Central Asia, Russia and Myanmar, which together accounted for more than 64 bcm of natural gas imports in 2022. Following steady investment, the total capacity of cross-border natural gas pipelines in operation reached 105 bcm by November 2022.

Russia is the main source of growth of China's pipeline gas imports. The Power of Siberia 1 gas pipeline has come onstream with a nominal capacity of 38 bcm per year. With the opening of the China-Russia Far East Line in 2026, pipeline capacity for Russian gas imports to China will reach 48 bcm per year. If progress is made on investment in and construction of the China-Russia Median Line (Power of Siberia 2), China's import capacity from Russia could reach 98 bcm per year.

The capacity of China's Central Asia Natural Gas Pipeline (Lines A, B and C) has already reached 55 bcm per year and will expand to 85 bcm per year when Line D (currently under construction) opens in 2026. Completion of these projects could bring China's import capacity for pipeline gas to 195 bcm per year.

Table 11: China's Cross-border Gas Pipelines

Source	Pipeline	Status	Start year	Capacity (bcm/yr)
Russia	Power of Siberia 1	Operational	2019	38
	Far East Pipeline	Under construction	2026	10
	Power of Siberia 2 (via Mongolia)	Planned	2030	50
Central Asia	Central Asia-China Pipeline A	Operational	2009	15
	Central Asia-China Pipeline B	Operational	2010	15
	Central Asia-China Pipeline C	Operational	2017	25
	Central Asia-China Pipeline D	Under construction	2026	30
Myanmar	China-Myanmar pipeline	Operational	2013	12

Diversification is a key component of China's energy import strategy, as set out in 'Several Opinions on Promoting the Coordinated and Stable Development of Natural Gas', which advocates the diversification of importing countries (regions), modes of transport, import channels, contract models and participants in the international context. While the increase in pipeline gas import capacity can bring significant competition to LNG imports, an excessively large reliance on such imports is not China's preferred option given the national energy security issues that come in its wake. Even with the planned development of China's LNG receiving terminals capacity, there is still a large space for future LNG imports which will be negotiated hand in hand and in parallel with the expansion of pipeline imports. As a demonstration of this duality, on 21 November 2022, Sinopec signed a 27-year LNG purchase and sale agreement with Qatar Energy, which will supply 4 million tons per year of LNG to Sinopec.

5. The EU Status Quo

It is appropriate now to review the gas supply and demand conditions in Europe.

5.1 EU Gas Consumption

The 27 countries of the European Union, where gas is mainly used for electricity generation and home heating (which together account for over 30% of gas use), industry (around 23%) and services (10%) consumed 412 bcm in 2021 and 420 bcm in 2022.

Natural gas consumption is highly seasonal, with the peak occurring during the winter season, as it does in northern China.

5.2 EU Natural Gas Supply and Demand

In the EU, both oil and natural gas production are declining steadily due to the depletion of the region's North Sea oil and gas fields, with the main remaining economically developable natural gas reserves situated in the Netherlands, Romania, and Poland, as well as in some neighbouring countries (in particular, Norway and the United Kingdom).

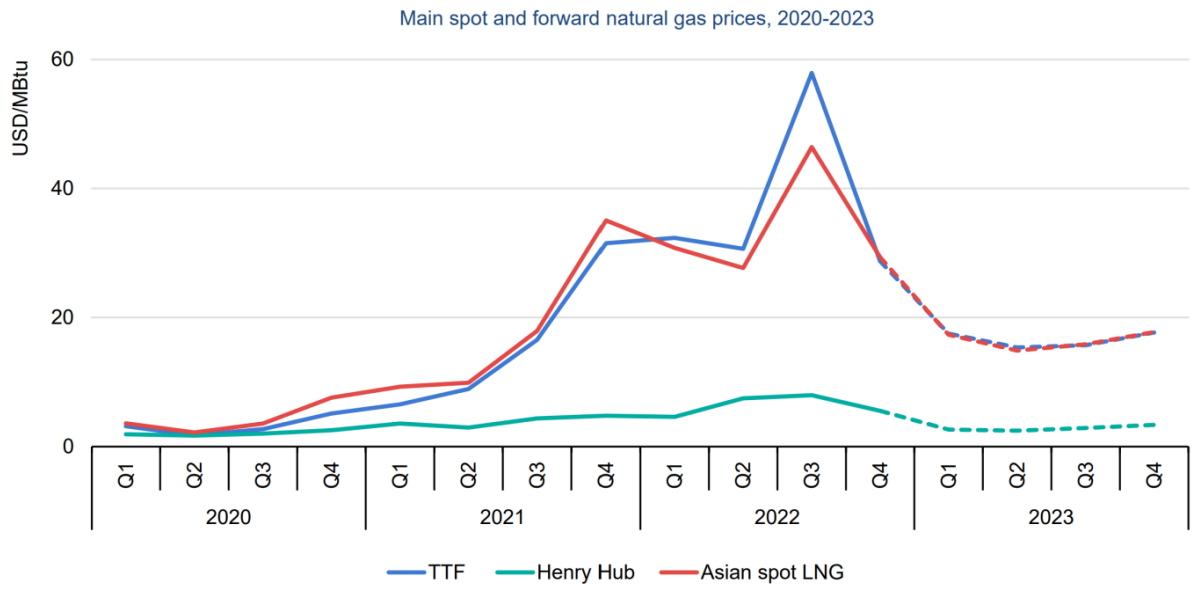
In 2020, the total gas production of the EU reached a mere 55 bcm, the Netherlands being its largest producer with 24 bcm. However, this 'domestic' output - including gas from neighbouring countries - represents only a fraction of overall EU consumption.

To meet its energy demands, the EU has to import large quantities of fossil fuels, including natural gas, a situation that has made it heavily dependent on eastern resource-rich neighbour, Russia, from which it used to import large quantities of coal, oil, and natural gas.

As a continent, Europe is largely dependent on natural gas pipeline imports - albeit the level of dependency varies from one Member State to another. Most imports originated from Russia, until early 2022 when the conflict between Russia and Ukraine caused a huge disruption to oil and gas trade in the region. This crisis, which came hot on the heels of the Covid-19 pandemic, has brought LNG into renewed focus.

The figures witness to the huge shift in import volumes: in 2020 EU imported 153 bcm of gas from Russia, of which 17 bcm was delivered in LNG form, with the rest via pipeline. By the end of 2022 and early 2023 pipeline imports from Russia stood at a quarter of their levels of 2020 and 2021. The gap in the supply side led to very high prices which saw several spikes in 2021 and 2022 (see IEA graph below).

Figure 27: Natural gas price 2020-23



Source: IEA Analysis based on 2022 data.

While supply bottlenecks have since eased since mainly due to favourable winter conditions, these prices are likely to stay relatively high for the foreseeable future as European production and non-Russian pipeline imports are expected to remain at their 2022 levels at best and may even decline.

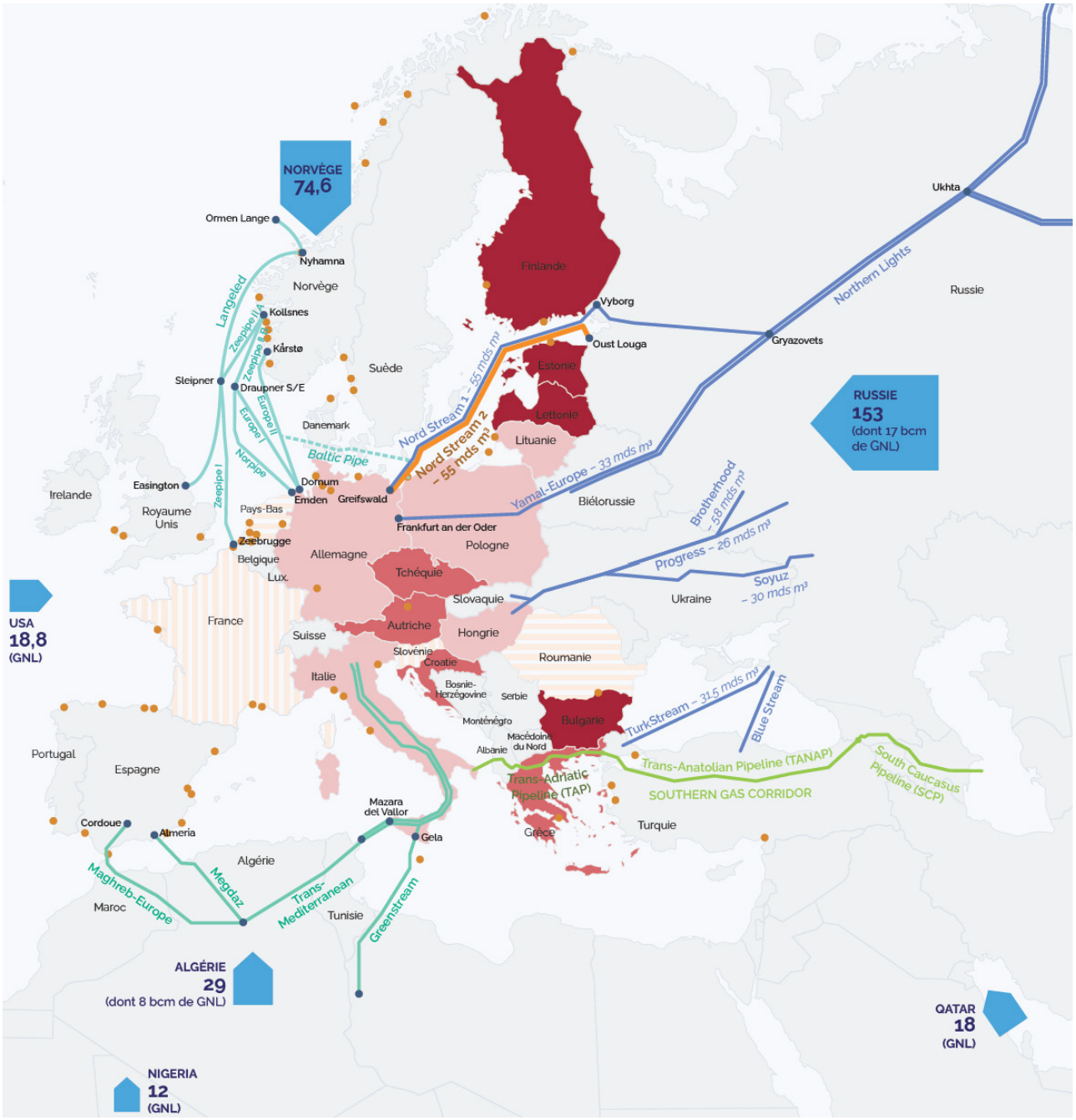
Alternative gas supplies via pipeline come from Algeria (21 bcm) and Norway (75 bcm).

Indicatively, LNG supplies by sources were delivered as follows in the years 2020, 2021 and 2022 (see map below with numbers shown for 2020):

- Qatar LNG: 18 bcm (2020), 16.4 bcm (2021), 19.1 bcm (2022)
- Algeria LNG: 8 bcm (2020), 8.5 bcm (2021), 7.4 bcm (2022)
- USA LNG: 18.8 bcm (2020), 22.3 bcm (2021), 56.4 bcm (2022)
- Nigeria LNG: 12 bcm (2020), 11.2 bcm (2021), 10.8 bcm (2022)

Europe continues to boast substantial coal reserves, especially in Poland and Germany (lignite), but production is declining mainly due to the EU's climate policy. Therefore, unlike in China and despite a temporary rehabilitation of coal in 2022 in certain European countries, notably Germany, coal is little by little being excluded from the EU energy mix.

Figure 28: European gas pipeline network and gas flows (2020)



Source: data from ENSTO-G and Gazprom, infographic from Jacques Delors Institute.

5.3 Global LNG Market Highlights 2021-22

5.3.1 2021 at a glance

- At the end of 2021 the global LNG tanker fleet consisted of 700 vessels including 48 floating LNG terminals (FSRUs), the fleet representing a total cargo capacity of 104 million cubic meters. In the years prior to 2021, an average of 50 to 70 new vessels were put in operation each year.

- Global LNG Imports amounted to 372 million tons, a small year-on-year increase of 4.5% but still below pre-pandemic levels.

- Thanks to a year-on-year increase of 17%, China overtook Japan in 2021 to become the world's largest LNG importer at 78.9 million tons, buoyed by high economic activity, and an upsurge in the use of gas for power generation and coal to gas switching.

- 18% of global LNG volumes were imported from the US.

- In parallel, Europe's net LNG imports decreased by 8% to 75 million tons, as an unusually unfavourable JKM/TTF price[6] differential incentivised flexible LNG volumes to go to Asia (37% of LNG traded volumes are imported on a spot or short-term basis).

5.3.2 2022 at a glance

- In 2022 delivery of new LNG tankers accelerated, with 165 new carriers joining the global fleet (two-thirds built in South Korea, one-third in China), representing a 130% year of year increase: orders are piling up in Chinese yards for even more deliveries in 2023.

- Global LNG imports amounted to 395 million tons, a rise of 6% year-on-year, but still below pre-pandemic levels.

- Thanks to rising volumes of LNG imports, combined with historically high average prices, the value of the global LNG trade reached an all-time high of USD 450 billion. For the EU LNG cost more than tripled in 2022 vs 2021 to USD 190 billion (according to the IEA).

- The EU imported 66 bcm (48 million tons) more LNG than in 2021 of which the US supplied two-thirds (43 bcm, or 31 million tons).

- While imports surged in the EU, China imported less LNG in 2022 (63 million tons, down 15 million tons) losing its pole position as leading global LNG importer, which it briefly held in 2021.

- Final investment decisions (FIDs) for LNG liquefaction projects (three only) were below the five-year average in both numbers and capacity.

In February 2022, the escalation in hostilities between Russia and Ukraine shook up global energy markets and highlighted how Asia's demand could rebalance global oil and gas trade.

Overall, this shift has highlighted surging demand for gas in India, the persistent prosperity of Japan, and the crucial role that China plays as a swing trader.

6 In a balanced market, the marginal source of supply that balances the Pacific basin determines the price spread between Asia (JKM) and Europe (TTF, or more specifically DES NW Europe). This price spread is based on the diversion cost to travel to either Europe or Asia. https://timera-energy.com/drivers-of-the-jkm-vs-ttf-price-relationship/

The conflict in Ukraine and subsequent decisions to block certain categories of crude and oil imports from Russia on 5 December 2022 and 5 February 2023 respectively have highlighted China's ability to influence set prices. Indeed, according to commercial and customs databases, it is evident that China was paying less for gas imports from Russia than competing countries such as India, while at the same time ramping up exports of energy and energy-related products.

To be sure, the conflict between Russia and Ukraine is not the only factor. Another element is the geopolitical rivalry between the US and China, a defining story at this moment of the 21st century, which may persist in the long-term. On top of this, China's strict zero-Covid measures that were in place for the most part of 2022 roiled supply chains and lowered China's demand for energy.

As we progress through 2023, stubborn inflation, financial turmoil and high interest rates are increasing investment risks and sapping business confidence worldwide.

These conditions are also influencing the financing of new projects in the US where a significant proportion of new global liquefaction capacity is likely to be generated (from shale gas).

In energy terms, the world can be seen as dividing itself into three main regions:

- Asia, where intra-ASEAN trade is booming, and GDP is still growing at relatively high pace.
- Europe and the US, where GDP growth is lagging.
- Latin America and Africa, rich in mineral resources but with struggling economies and low energy demand.

The main drivers with the potential to impact global energy markets in the near term are:

- the scale of shale gas production in the US, and the ability to marketise the resource rapidly on the global markets.
- the pace of expansion of all types of LNG infrastructure throughout the world.
- China's continuing appetite for oil and gas.
- Embargos on Russian oil and gas supplies to Europe.

5.4 Natural Gas and LNG in Europe in the Context of EU Climate Policies and the Conflict in Ukraine

Increased LNG imports have allowed the European gas market to remain balanced despite the drop in Russian pipeline supplies observed in 2022. But what are the prospects for LNG in 2023 and beyond?

Global gas markets suffered a major crisis in 2022 thanks to Russian gas pipeline supply cuts amounting to roughly 80 bcm on an annualised basis. The stress on the market and reciprocal threats of further sanctions led to very high energy prices (TTF and electricity).

The EU adopted a series of remedial measures involving demand reduction in the industrial and in the heating sectors. High prices and mild temperatures helped drive

down consumption (household electricity and voluntary cuts to gas consumption).

As a result, natural gas consumption in OECD Europe fell by an estimated 13% (>70 bcm) in 2022 – its steepest decline in absolute terms in history. Baseline demand in EU countries amounts to 395 bcm in 2023.

There remains a risk of excessively volatile prices in 2023: for example, an unusually hot summer, followed by a cold winter and/or a strong rebound in Chinese LNG demand, could see Europe and China competing to buy on the spot market.

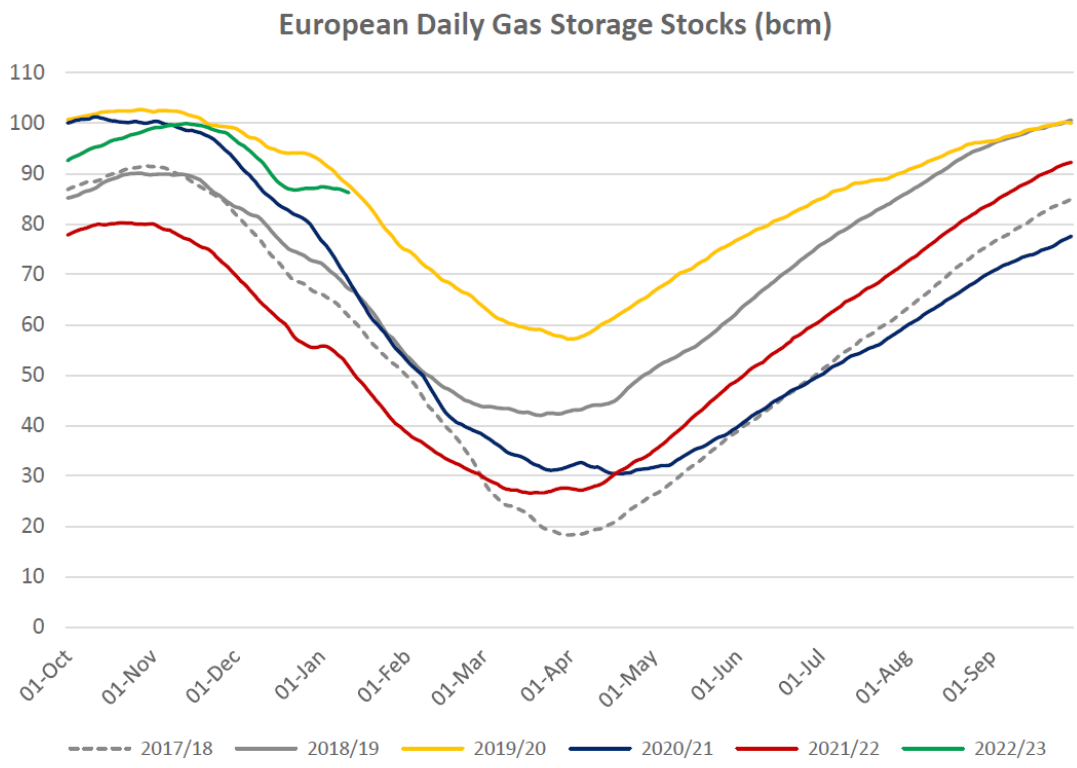
5.4.1 European (EU + UK) Gas Storage

European storage capacity amounts to around 100 bcm, representing roughly 90 days of consumption. This is a strategic feature of European energy security.

Record low withdrawals during the mild winter of 2022-23, combined with injections continuing until mid-November 2022, allowed storage stocks to stay close to record levels throughout the European heating season (see Figure 30).

As a result, supply tensions remained at a bearable level allowing international spot prices to recede from their earlier peak in 2022.

Figure 29: Europe gas storage stocks 2017-23



Source: ENSTO-G, Eurostat, AGSI.

5.5 EU Energy-Related Policies

5.5.1 The European Green Deal (EGD)

First and foremost, the EU has positioned itself as the global leader in relation to the energy transition and climate change.

Published in December 2019, the European Green Deal (EGD) is the defining policy of the EU Commission in terms of climate and energy.

This policy was initially intended to facilitate an orderly transition in the EU's Member States away from fossil fuels (which include natural gas) in line with UN-defined climate goals, i.e. the limitation of world temperatures to 1.5 degrees above the pre-industrial period by the end of the century in line with its 2015 COP19 (Paris Agreement) commitments.

The subsequent European Climate Law established the principle and objectives of climate neutrality by 2050 and a cut in Greenhouse Gas (GHG) emissions by at least 55% before 2030. Since then, the September 2021 'Fit for 55' policy, together with the 'Gas Decarbonisation' legislative packages, represent the most noticeable developments.

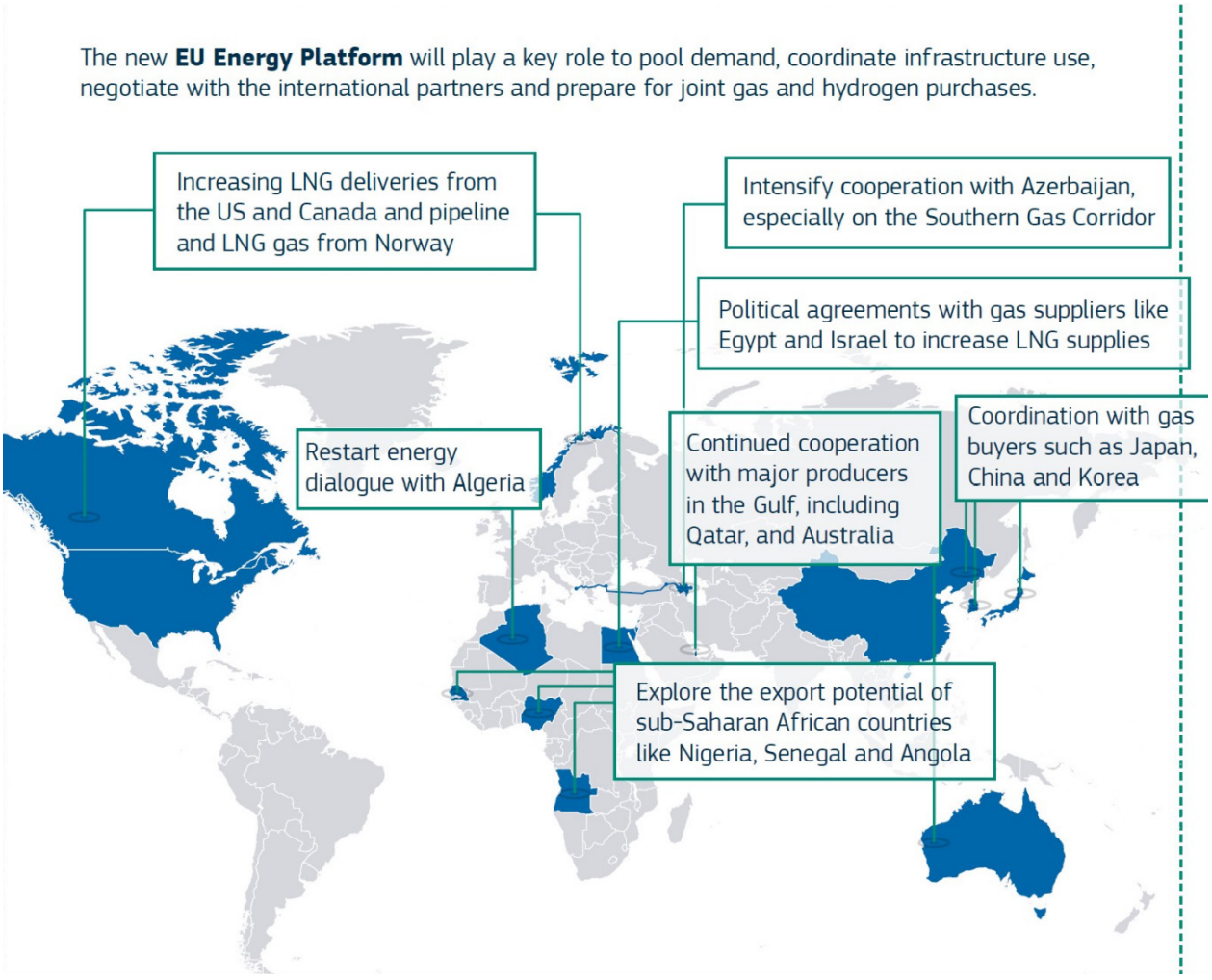
The Fit for 55 package has itself been enriched with several new or revised application instruments such as the Renewable Energy Directive, the Energy Efficiency Directive, the Emission Trading System, the Carbon Border Adjustment Mechanism, the Tax Directive, and the Methane Emissions Reduction Regulation, all of form part of the drive to achieve the EU's decarbonisation goals.

Additionally, it is noteworthy that in 2022 those overseeing the European Green Deal were able to adjust to and take into account unanticipated external and destabilising factors, (most notably restrictions on gas supplies resulting from armed conflict in Ukraine and excessively high energy prices) and to introduce a complementary program, 'RePowerEU', designed to accelerate further the deployment of renewable energies and energy efficiency initiatives in the EU, but also conveniently providing for new LNG infrastructure investments, securing natural gas and LNG deals and temporarily reintroducing fossil fuel subsidies.

The REPowerEU instrument manages the double objective of addressing emergency issues intended to reduce Europe's dependence on Russian gas and keeping the Paris Agreement objectives alive. In doing so, it also offers to alleviate climate concerns in a cooperative effort with China, a point which has been reiterated on many occasions by Europe's leadership in recent months.

Most of the gas demand gap will be substituted with renewables, low carbon energy sources and enabled by energy saving measures. However, in the short term, a substantial part of the demand will also have to be replaced by diversifying suppliers and supply routes (Azerbaijan, Israel, Egypt and so on) as shown below.

Figure 30: Expected global footprint of the EU Energy Platform



In addition to above countries the EU will continue working with G7, G20, OPEC and the IEA.

Source: EU Commission, LNGnet Project.

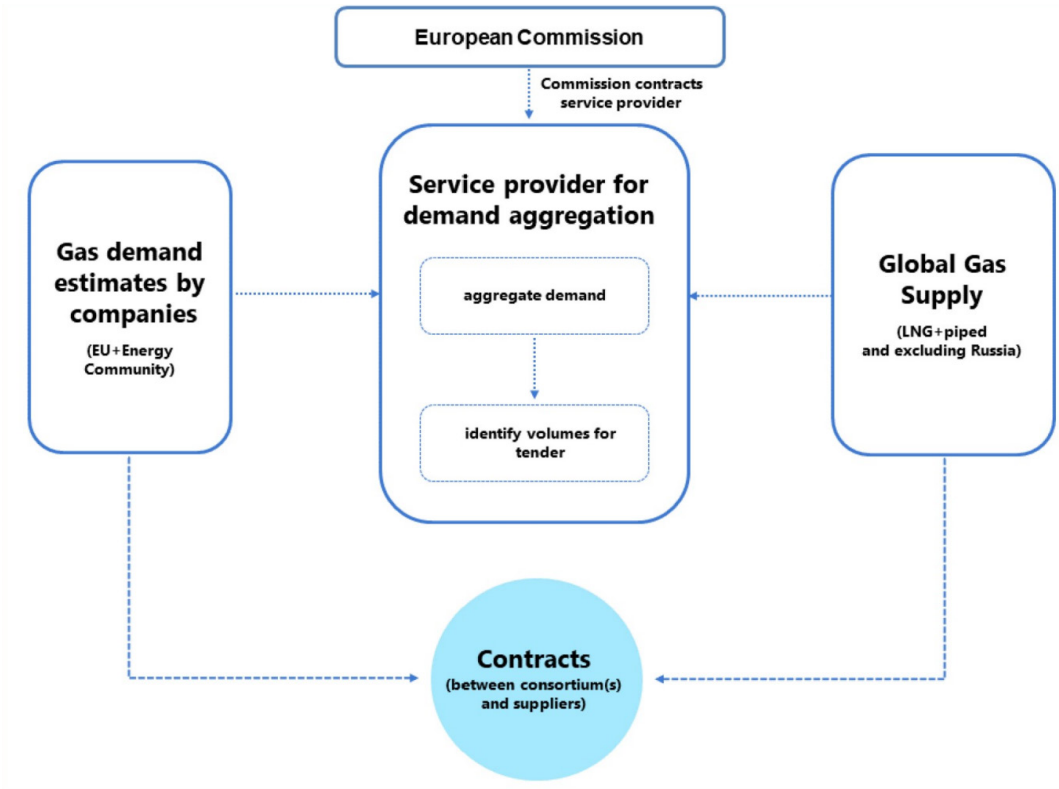
5.5.2 Emergency Measures Applicable to the Gas Sector

In response to the supply crisis emanating from the conflict in Ukraine and resulting sanctions on Russian energy supplies, the following emergency interventions were decided and implemented to address specific market-related issues:

- Gas storage regulation, requiring EU-wide gas storage to be filled to 85% for 2022 and 90% in subsequent years along an annually-defined pre-stated trajectory, until end 2025.
- Market correction mechanism or wholesale gas price cap. This is a relatively high price cap, or rather safety valve, that is designed to be in place for one year. It has not been triggered yet due to the current market price not meeting the threshold.

- Establishment of a Gas Demand Aggregation and Joint Purchasing Platform to enhance solidarity and avoid counterproductive competition between Member States. The mechanism consists of a two-step process: demand aggregation followed by the option for joint purchasing (see diagram below).

Figure 31: Diagram of the EU joint purchasing mechanism for gas



Source: EU Commission 2022, EU Energy Platform.

- LNG Price Benchmark: to support market participants, a new price benchmark will be generated by the European Association of Energy Regulators (ACER) i.e. a price index reflecting actual market conditions.

5.6 European Import Infrastructure - LNG Terminals

As of 2021, Europe and the UK had 41 regasification terminals (four in the UK) representing a total nominal capacity of 184 million tons per year. Six of these 41 terminals are floating LNG terminals, while 29 are large-scale LNG import terminals, of which the majority are large-scale onshore facilities. The largest LNG import terminal is located in Milford Haven, United Kingdom, with a nominal annual capacity of 21 bcm.

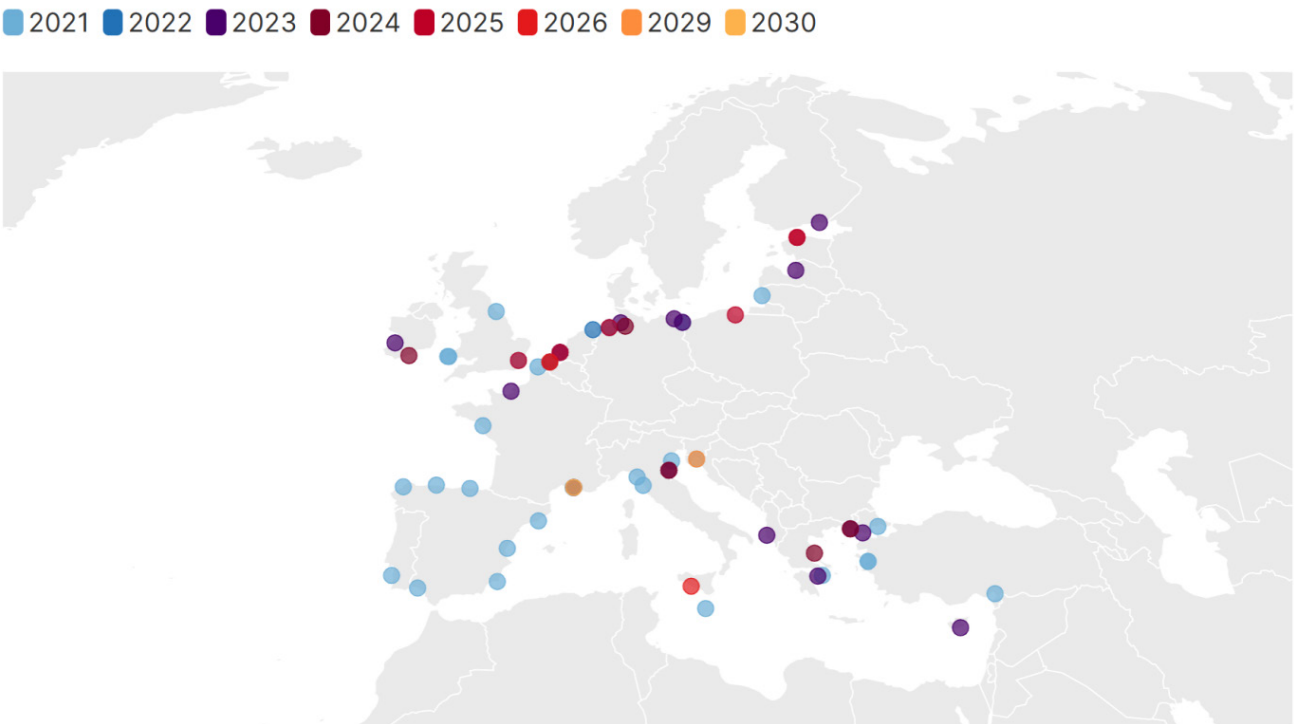
This compares with 24 regasification terminals in China with a nominal capacity of 106 million tons per year, and 37 regasification terminals in Japan with a nominal capacity of 227 million tons per year.

Faced with the threat of gas supply cuts and congestion in its existing LNG terminals, the EU has shown a renewed interest in its LNG import and regasification infrastructure in 2022, with new projects planned or under construction in several countries, in particular in Germany which has more than 40 bcm under these two categories for the next few years, with Greece, Belgium and Italy following behind.

The Wilhelmshaven terminal in Germany is the largest LNG import terminal project in the EU, with an expected annual capacity of 20 bcm.

Overall, with the announcements on acceleration of on-going projects, extension of existing LNG facilities and construction of new terminals, the EU could see 130 bcm of import capacity come into play within a few years. Of this, 40 bcm will be completed in the period 2022-23.

Figure 32: LNG regasification terminals in Europe by expected launch of operation

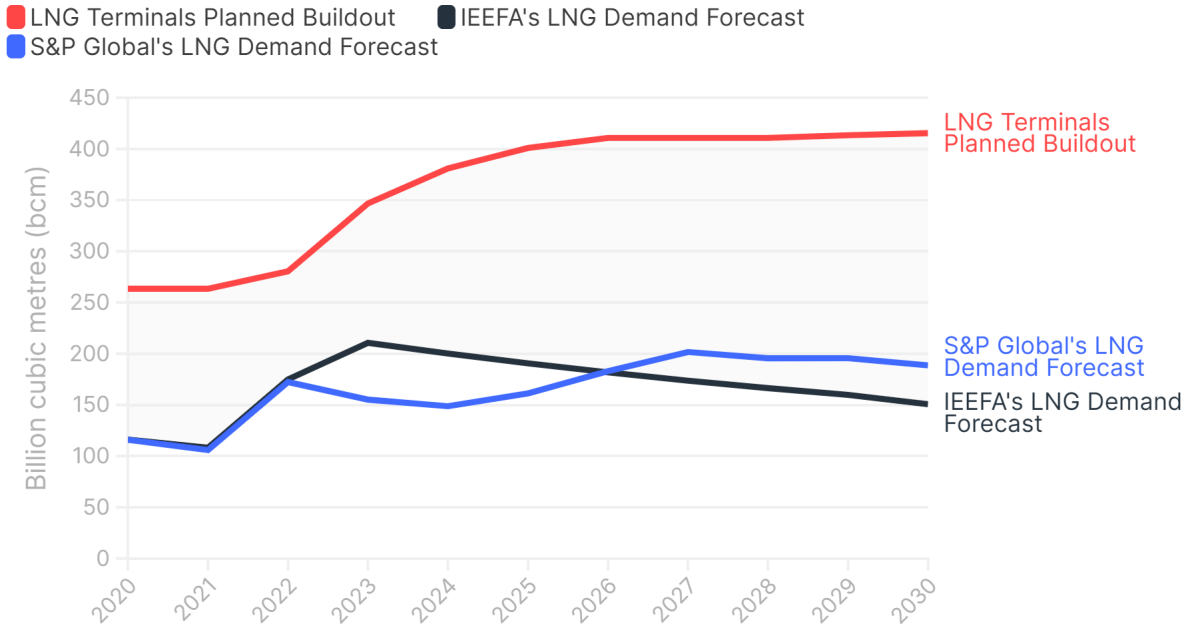


Source: Institute for Energy Economics and Financial Analysis.

5.7 Trading Partners and Retail Market Size

Although many European countries are reliant on LNG supplies, Russia and Norway are the only two LNG exporters on the European continent. Qatar is the leading exporter of LNG to Europe, although the United States is likely to surpass Qatar in 2023. Spain receives by far the largest LNG retail volume of any country in Europe. More than two million cubic meters of truck-load cargos left Spanish LNG terminals in 2021.

Figure 33: Planned terminals buildout and LNG demand forecast 2020-30



Source: Institute for Energy Economics and Financial Analysis.

5.8 Anticipated Liquefaction Capacity Additions and Contracting Trends

In a recent report, the IEA indicates that LNG liquefaction capacity additions are set to slow. While an average of 40 bcm per year was added during the period 2016-20, the pace has halved, slowing down to 15-18 bcm per year during 2021-24.

It is expected to surge again in 2025-26 with new and large projects being commissioned in the US and Qatar which will add roughly 120 bcm of fresh LNG resource to the market.

The balance between supply and demand for the medium and long term, however, remains a subject of intense debate, with demand projections varying significantly among different market participants.

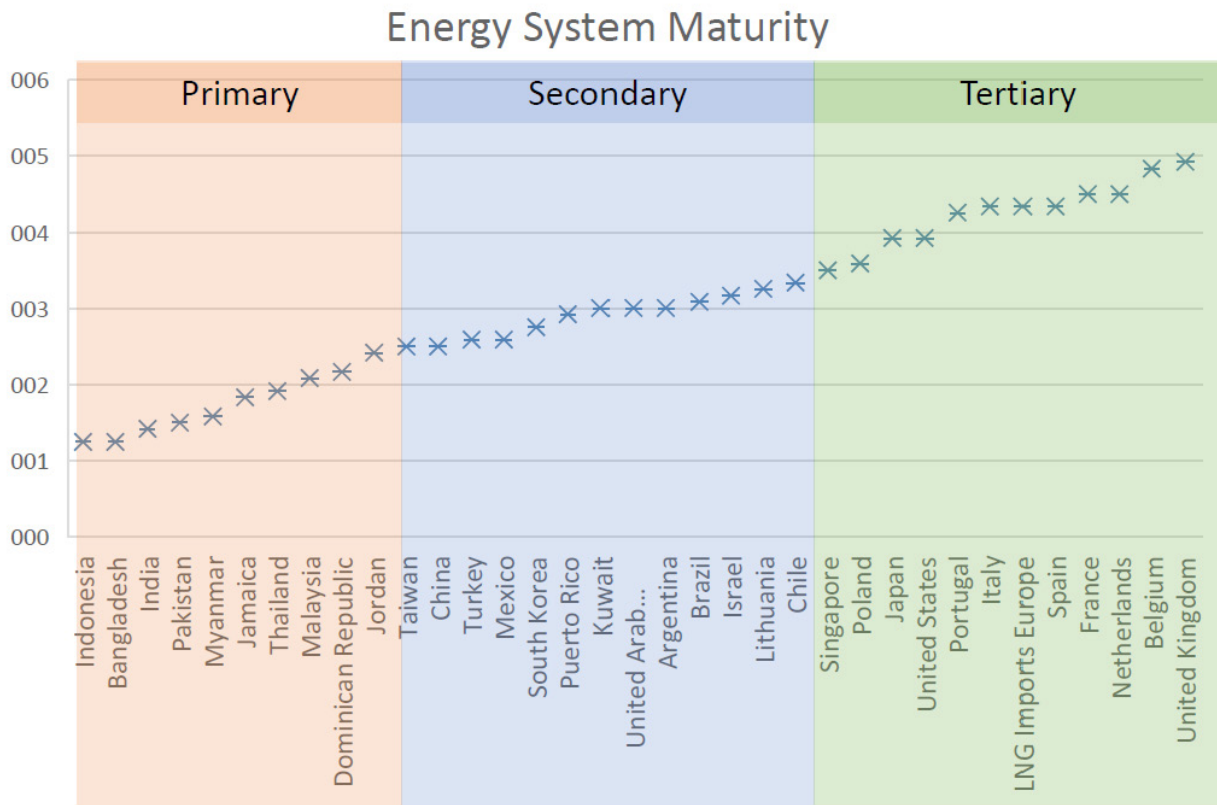
6. Conclusion

Despite presenting some similarities such as the need to diversify supplies, and insufficient domestic production, it is fair to say that the EU and China are at very different stages of their fossil fuel industry development.

Expert commentators and industry participants have often stated that Chinese market is where Europe's market was 20 years ago and advocated that it should continue to open up more steadily.

This difference is evident in an index developed by the EU Commission - the LNGnet Project, which compares different countries' energy systems. In terms of maturity, China ranks at the lower end of the secondary category (see below graph and table). This categorisation makes it possible to calculate the role LNG could play in the energy transition process.

Figure 34: Energy systems maturity – country categorisation graph



Source: LNGnet Project, funded by the European Union.

This observation is particularly applicable to gas markets.

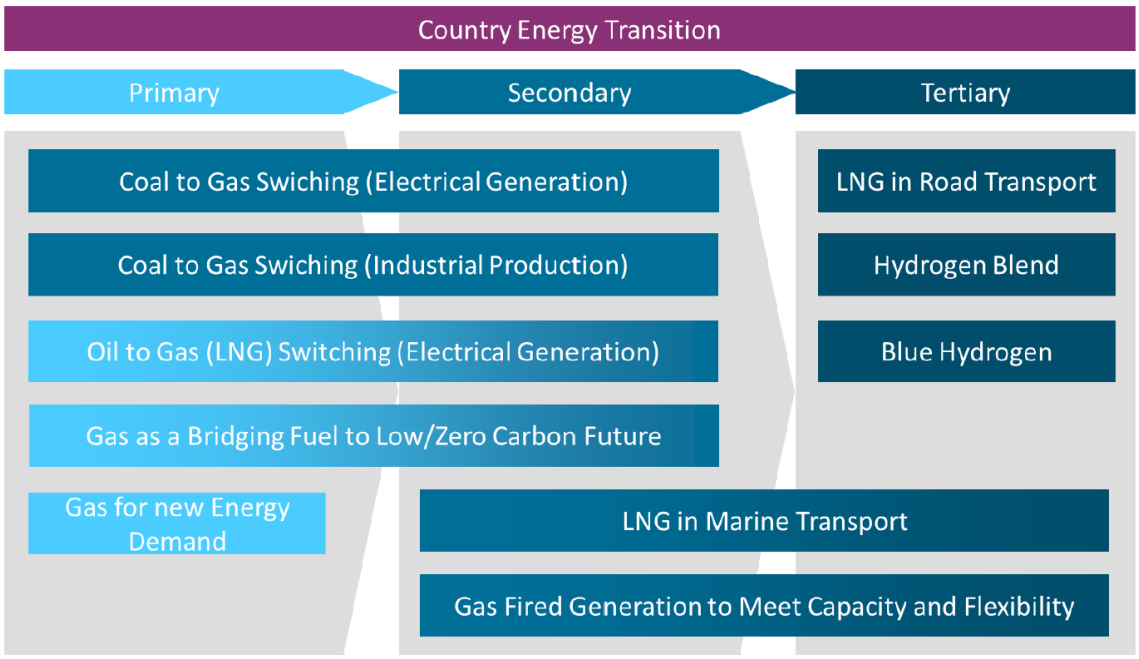
Beyond the simple maturity matrix shown above, China lacks several constituents required for the establishment of fair and functional market conditions for this commodity:

- gas storage capacity is insufficient.
- market price regulations are excessively heavy.
- market competition is lacking.

The philosophy of development is also different.

There are significant contrasts between the economic and social systems in the EU and China, which impact their respective policy making processes, and lead to a divergence in priorities.

Figure 35: Energy systems maturity and use of gas table



Source: LNGnet Project, funded by the European Union.

The Chinese energy system is highly regulated, and remains largely in the hands of state-owned enterprises, whereas in the EU the energy system is market oriented and privately driven.

A chart from the Oxford Institute, published in 2020, provides a useful illustration of the differences between China and the EU when it comes to natural gas and LNG (see Table 12).

Despite these differences, there is scope for Europe and China to cooperate in the natural gas and LNG markets.

Europe's natural gas production is declining; at the same time China is seeing gas demand soar while domestic production has slowed. That means China's supply gap is widening, and the country will need more gas imports to support its growing economy for at least several decades.

Third-party access is crucial to stimulating gas trade in China, lowering prices and adding flexibility, and Europe could help by sharing its experience in getting faster to where it is now, including the crisis management measures it has elaborated during the last two years.

Table 12: Market Differences Between Europe and China

Gas Storage Infrastructure • Europe has over 100 bcm of gas storage (excluding access to Ukraine), equivalent to 20% of annual gas demand. • China has 10 bcm of gas storage, equivalent to 3% of annual gas demand.
Regasification Plant Capacity • Europe has around 230 bcm of regasification capacity, with imports of 113 bcm in 2020. • China has around 110 bcm of regasification capacity, with imports of 90 bcm in 2020.
Market Structure • Most of Europe has a liberalised competitive gas market with multiple participants and buyers and sellers able to freely trade gas and full access to infrastructure. • China has far fewer market players and no real trading of gas and is still in the early days of market liberalisation.
Liquid Physical Trading Market • Europe has some of the world's most liquid trading hubs in TTF[7] and NBP[8] and these allow market players to balance their portfolios and hedge their positions. • The Asian LNG market does have some bilateral trades of LNG cargos but it is very far from being a liquid physical trading market - the very high prices in mid-January 2023 reflected a very thin market - JKM futures[9] is a paper market and does not involve physical trades to any great extent.

Source: The Oxford Institute for Energy Studies.

7 The TTF (Title Transfer Facility) is the main reference virtual market for gas trading in Europe which is based in Amsterdam, the Netherlands.
8 National Balancing Point (NBP) is a virtual trading location for the sale of UK natural gas supplies.
9 JKM is the Northeast Asian spot price index for LNG delivered ex-ship to Japan and Korea, assessed by S&P Global Platts. The price reflects not only the cargo delivered to Japan and Korea, but also to China (Taiwan included).

7. Recommendations

7.1 Emphasising the Role of Gas and LNG in Achieving Carbon Neutrality

China's gradual transition from coal to gas has been recognised in numerous past Five-Year Plans. However, the progress made so far has not yet met domestic and global expectations. The National Energy Administration's 2022 policy continues to focus on coal as the backbone of China's energy security, reducing potential for further advancements in emission reductions and energy efficiency. Consequently, the international community is closely observing China's CO_2 emissions and 'Dual Carbon' commitments.

China might consider reinforcing restrictions on coal consumption and placing greater emphasis on natural gas, including LNG, in its energy agenda.

Natural gas and LNG are more dependable, eco-friendly and secure than coal as primary energy sources. LNG, as a highly efficient form of natural gas, offers the quickest and most flexible energy solution to help address supply constraints in the energy mix. Expanding and optimising the utilisation of LNG throughout the gas value chain could yield significant benefits.

7.2 Exploring Opportunities for Deep Gas Collaboration with Foreign Competitors

Chinese national oil companies have made commendable efforts to discover and provide new natural gas resources for the country. However, they face certain limitations in terms of exploration investment capacities and technological advancements.

In China, most accessible gas resources have been discovered, and uncovering new ones will demand increasingly complex and sophisticated technologies. European multinational and private companies possess the required technology, expertise, and financial capacities to carry out these activities efficiently, aligning with the climate ambitions set for 2050 by the EU and 2060 by China.

By offering non-discriminatory exploration and production rights to foreign companies, China could potentially stimulate competition in its gas-prone geological basins, both onshore and offshore. This approach may expedite the discovery of new economically viable resources, contributing positively to the energy landscape.

7.3 Exploring Opportunities for Enhanced Access to Gas and LNG Infrastructures, Including Storage

China's current transportation and storage capacities are not yet on a par with growing demand. The following suggestions, some of which have been previously mentioned in the most recent EU-China Commerce Chamber Energy Group position paper, may provide valuable insights in this area:

- Consider opening provincial gas pipeline companies to both PipeChina and foreign enterprises.
- Look into promoting the construction of additional gas storage capacity, such as underground storage facilities, and examine the possibilities of involving private and foreign enterprises while ensuring adequate remuneration mechanisms for investors and operators.
- Review market regulations to potentially foster foreign enterprises' direct investments in areas like regasification plants, transportation, and storage facilities management.
- Contemplate supporting LNG bunkering by establishing national standards that align with international standards.

7.4 Exploring Opportunities to Accelerate Reforms in the Gas Value Chain Regulatory Regime

The deregulation of China's gas market is highly anticipated and could potentially be prioritised and accelerated. In this context, a set of suggestions, some of which have been previously mentioned in the most recent EU-China Commerce Chamber Energy Group position paper, have been put forward by foreign energy players in the Chinese market:

- Consider further refining the market-oriented pricing structure of natural gas nationwide.
- Explore opportunities to enhance the interconnection of gas trunklines and interprovincial gas networks for improved market flexibility.
- Examine the possibility of fully opening gas infrastructure investment to foreign-funded and private enterprises.
- Review access provisions for all upstream gas producers and downstream players.
- Evaluate options to boost downstream competition by offering smaller companies fair and open access to gas supply, and allowing city gas companies and industrial entities to source their gas directly from producers.

- Contemplate implementing a transparent high-pressure gas pipeline tariff regime nationwide, applicable down to the provincial level.
- Clarify the conditions of Third-Party Access (TPA) for natural gas infrastructure.
- Assess and optimise the terms of terminal use agreements (tariffs, capacity attributions, penalties).
- Consider adopting non-discriminatory rules for the sale of infrastructure capacity.

7.5 Fostering Collaboration in LNG International Markets

As LNG has become a significant factor in global energy markets, it may be beneficial for the EU and China, two of the largest global energy markets, to explore the development and implementation of a joint information-sharing mechanism. This collaboration could address the potential global impact of their respective LNG demand forecasts on a regular basis, such as annually or semi-annually.

The specifics of this mechanism could be initially discussed within the framework of existing cooperation instruments between the EU Commission Directorate-General for Energy (DG ENER) and China's National Development and Reform Commission (NDRC) / National Energy Administration (NEA).

8. Summary

To conclude and provide a practical way forward, the authors of this Report suggest that if China and the EU are able to work more closely on LNG imports and capacity, the global LNG price could become more stable, and some of the excessive volatility of the past two years could be assuaged.

By sharing information on a regular basis and more openly, and by intensifying their cooperation via ad-hoc mechanisms and organisations, China and the EU could act as partners rather than pure market competitors and so ensure supplies at an optimum price for their respective consumers.

Cooperation between the EU and China and learning from each other's experience have the potential to contribute to help enhance the LNG global market and lead to more stability of prices and supply.

86-10 6587 6175
info@ececp.eu
Unit 3123 & 3125, Level 31, Yintai Office Tower C,
2 Jianguomenwai Avenue, Chaoyang District,
Beijing 100022, People's Republic of China
www.ececp.eu

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