International Natural Gas Supply and Quantities Available to China

8

8.1 Preface

This section analyses potential future changes in international natural gas market supply and demand and the available natural gas import volume for China, as well as what reasonable measures China should take, including suitable policy adjustments, to promote its own natural gas supply and demand security.

Currently, China's natural gas market is in a key stage of development, with demand, supply and system mechanisms each undergoing intense change. This state of flux is having a major effect on the evolution of the natural gas market. The NDRC has already issued goals and policy measures[1] that differentiate base supply gas and incremental increase volume, and that merge the price structure of the two different types of gas by the end of 2015, setting a general road map for natural gas market reforms.

However, as the price of natural gas continues to rise, there will inevitably be impacts on downstream demand, and backward energy replacement by some users (using coal instead of natural gas) and other phenomena could occur. There are also some who believe that the continued increase in natural gas prices will lead to natural gas supply in China exceeding demand in 2017 (Jiaofeng et al. 2014). In addition, the large fluctuations in international oil market prices seen recently will inevitably have a far-reaching influence on the evolution of China's natural gas market. How to determine the future supply and demand circumstances for the natural gas market is thus of critical importance to the smooth execution of China's natural gas pricing reforms.

In 2013, China imported approximately 53 billion m^3 of natural gas, which already accounted for 32% of total consumption volume. How natural gas future imports change will undoubtedly have a significant impact on the structure of China's supply and demand. Because natural gas imports are long-term (the contract length is long) and stable (take-or-pay), it is still possible to rely on current circumstances to make some reasonable predictions about imports and the

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[1]See National Reform and Development Commission Notice Regarding Conducting of Natural Gas Price Formation Mechanism Pilot Sites in Guangdong and Guangxi Autonomous Region (FGJG [2011] No. 3033); National Reform and Development Commission Notice Regarding Adjustment to Natural Gas Price (FGJG [2013] No. 1246); National Reform and Development Commission Notice Regarding Adjustment to Non-Residential Reserve Natural Gas Price (FGJG [2014] No. 1835).

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near future, even though there may still be some uncertainty regarding a contract's final process of execution. Such predictions could be highly significant in helping to understand the changing trends in China's natural gas market and could thus contribute to better natural gas price reforms.

This chapter is broken down into three parts. There is first a discussion of current international natural gas supply and potential future changes. This is followed by an analysis of China's current natural gas imports and future trends. Finally, recommendations are made regarding future natural gas trade policy for China.

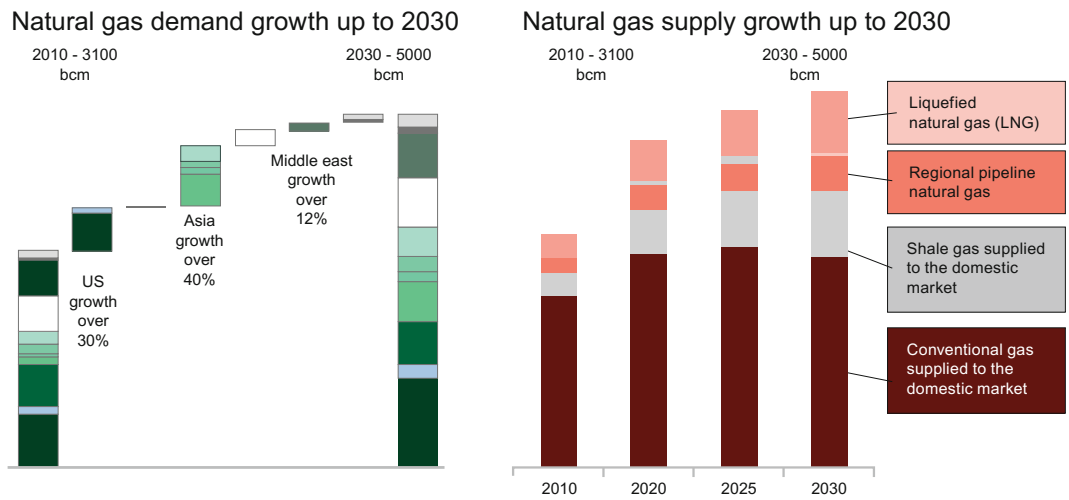
8.2 Current and Future Sources of Global Natural Gas Supply

8.2.1 Current and Projected Global Natural Gas Resources

According to IEC determinations, current global natural gas resources are approximately 784 trillion m^3 (28,000 trillion $feet^3$). Based on current consumption levels, this could last sustainably for approximately 200 years or more. Based on proved resources that are recoverable with today's economics and technology, the global natural gas resource reserve to production ratio is 54.8 (BP 2014: 20). Therefore, on the whole, the future supply of global natural gas resources is relatively ample.

In the global energy layout, natural gas is playing an increasingly important role. In the past 10 years (2005–2014), global natural gas consumption growth has been around 2.7%, making it the fastest-growing energy type (BP 2014). The IEA estimates that natural gas consumption will continue to maintain relatively strong growth up until 2030, when growth rates will be at approximately 2% (IEA Current Policies Outlook) (see Fig. 8.1). According to forecasts by Shell, natural gas supply and demand will rise from 3.1 trillion m^3 in 2010 (3100 billion m^3) to 5 trillion m^3 (5000 billion m^3) in 2030.

In addition, according to an analysis by ExxonMobil (2014), global energy consumption growth will be approximately 1% from 2010 to 2040, whereas natural gas growth will reach 1.7%, markedly higher than overall energy consumption growth. It is clear that natural gas will play a more significant role in global energy structures moving forward.



Data source: Shell Analysis

Note: all the tight gas / shale gas is calculated to standard value LPG

Fig. 8.1 Growth in global natural gas supply and demand totals

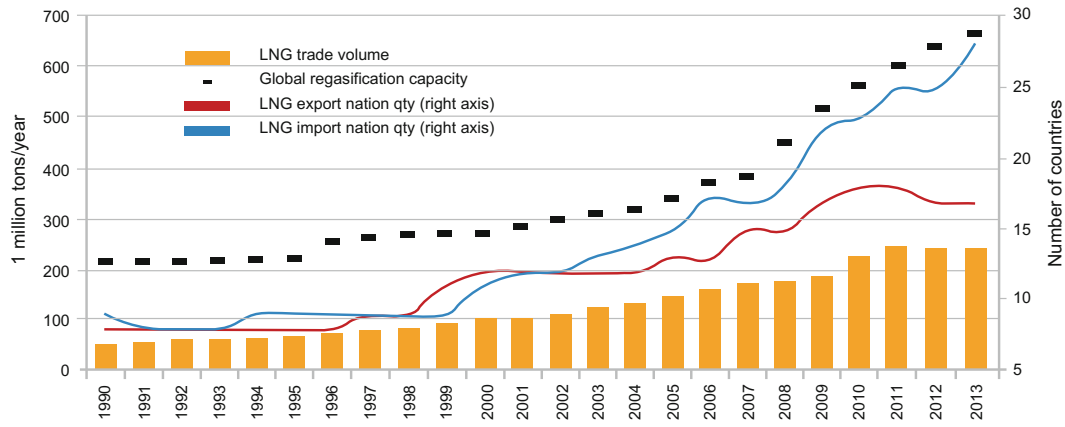


Fig. 8.2 International LNG trade volume (1990–2013). *Source* IGU (2014)

8.2.2 Global LNG Trade Development

For long periods, global natural gas trade has focused on pipeline imports as the major shipping mode, but as liquefied natural gas (LNG) technology develops, LNG is accounting for a larger proportion of trade. Beginning in 1959 with the world's first shipment of LNG across the ocean, by 2013, 320 billion m^3 of the total international natural gas trade of 1 trillion m^3 is LNG, 32% of total trade volume (IGU 2014) (Fig. 8.2).

LNG trade volume growth has broken through the shipping restrictions of pipeline natural gas, helping Japan, Korea and other countries to import natural gas. In addition, for countries facing geographical restrictions, LNG has also expanded potential import sources, helping to lower import risks. Moreover, LNG is more flexible than pipeline natural gas, and can change its export destination according to market changes. Thus LNG trade circulation has had a major influence on global natural gas trade layouts and supply and demand relationships as well as price trends.

8.2.3 Trends in Global LNG Trade

Since 2000, the global LNG trade volume annual average growth rate has reached approximately 5%. This trend will continue for the foreseeable future. At the same time, global LNG trade structure is becoming more complex. In 1990, there were eight LNG exporting nations and nine importing nations; those numbers are now up to 27 and 31, respectively. It is accepted that in the next 10 years, the number of LNG exporting nations will rise to 50 and the number of importing nations to 25. As changes to trade networks add to uncertainties over market supply and demand relationships, the future structure of global natural gas trade is going to become more complex.

Figure 8.3 shows the 2012 production capacities of the major LNG exporting regions and their respective proportions. In 2012, global LNG annual production capacity was nearly 390 billion m^3. Qatar was the largest exporting nation, with production capacity of 77 billion m^3, accounting for 27% of global capacity. Together with other Middle East nations such as Oman, Yemen and UAE, and North African countries such as Egypt and Algeria, 47% of global LNG production capacity was controlled by the Middle Eastern and North African regions, followed by south-east Asian regions including Malaysia and Indonesia, which accounted for 23% of production capacity. This is then followed by Australia and other African countries, which both account for approximately 9%, and then South America with 7% and Europe, including Russia, with 5%.

8.2.4 Developments in the Global LNG Export Market

In recent years, global LNG supply deployments have seen relatively major changes. First is that

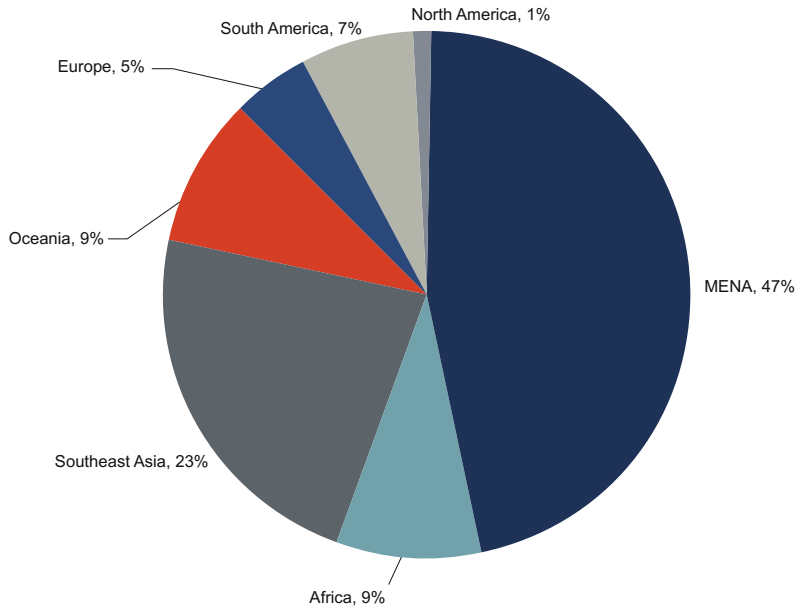


Fig. 8.3 Global natural gas regional production capacity (2012). *Source* PFC global LNG supply and demand report (2013) and IGU global LNG report (2013)

Australia's production capacity is in the process of rapid expansion, and is expected to exceed that of Qatar, making it the world's largest LNG producer. It is in the process of investing in the construction of seven LNG projects, with production capacity totalling approximately 85 billion m^3. Adding the in-progress projects of its neighbouring country Papua New Guinea brings the total to 95 billion m^3. Following this is the United States, with its successful development of shale natural gas, which has potentially transformed it from a natural gas-importing nation to a natural gas-exporting nation, with in-progress projects alone reaching 25 billion m^3. Figure 8.4 shows global regional in-progress projects, with a total of approximately 130 billion m^3.

If all the in-progress projects are completed as expected, global LNG production capacity will grow from around 390 billion m^3 in 2012 to approximately 520 billion m^3 in 2017. The proportion accounted for by Australia and Papua New Guinea will rise from 9% in 2012 to 25%, with the proportions of the Middle East and North Africa dropping from 47 to 36%. The United States' proportion will rise from essentially zero to about 5%. This means that the Middle East and North Africa in natural gas supply markets will see their leading positions weakened, and market competition will be further strengthened (Fig. 8.5).

In addition to in-progress projects, there are also many LNG projects in planning or being proposed. There is capacity of about 30 billion m^3 in projects that have already submitted a final investment decision, and 370 billion m^3 in projects that are in some stage of Front-End Engineering Design. There is another total of 500 billion m^3 (IGU 2014) in projects that have submitted a motion but which are still in preliminary stages. Of course, not all projects will be completed, especially those in the early stages, and there is a variety of factors and risks that could end in their cancellation. However, this does show that current international LNG supply markets are in a relatively active state. In addition to Australia, the United States and Canada are two countries that will join the list of LNG-exporting nations and which have major potential for exports: East Africa's Mozambique and Tanzania, which have both discovered major deep sea natural gas fields. The exports from these countries will have a major impact on future global natural gas trade

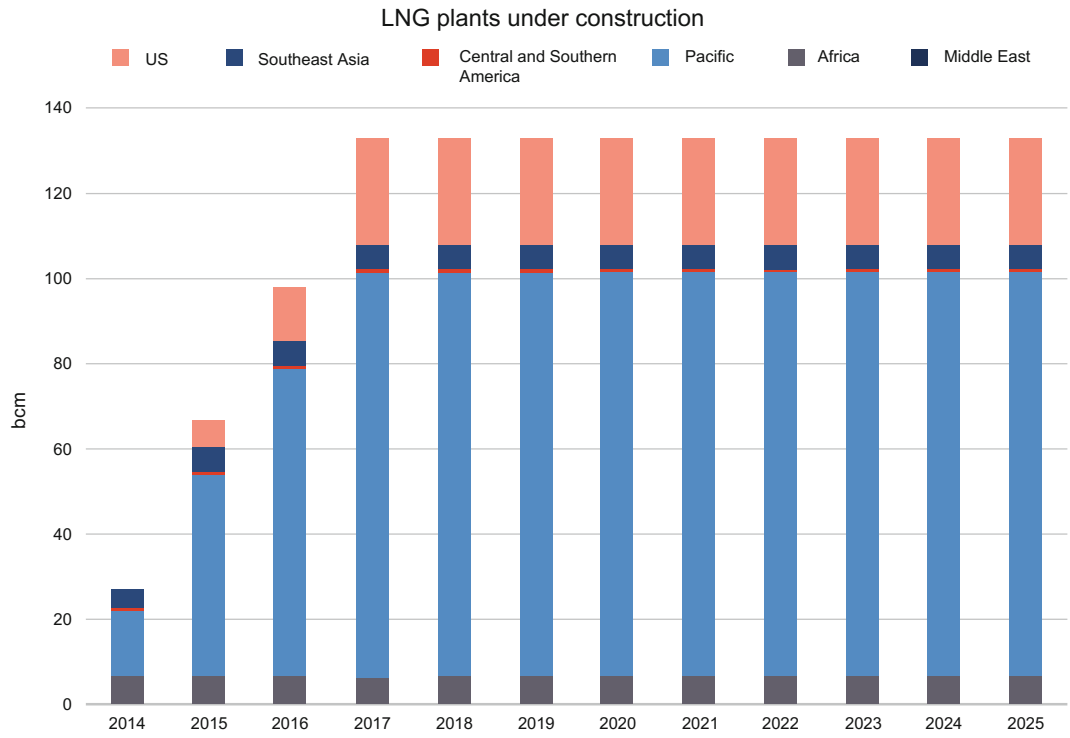


Fig. 8.4 Global in-progress LNG plant regional production capacity. *Source* Collected and assembled from PFC Global LNG Supply and Demand Report (2013), company reports and authors

layouts, and will affect the interests and risks for China's natural gas imports.[2]

8.2.5 Growing Natural Gas Demand in China, India and Other Emerging Markets

In the long term, natural gas demand growth will come primarily from China, India and other emerging economic entities. In Europe, North America, Japan and other developed nations, due to weakness in economic recovery and replacement with cheap coal, as well as subsidies given toward renewable energy development among other factors, natural gas consumption growth will be limited. Developed nations are seeing sustained increases in natural gas demand in the transportation sector, especially with increased controls and higher emissions standards, as well as growth in natural gas consumption in marine shipping fuels. However, on the whole, developed nations will see relatively stable natural gas demand growth moving forward (Fig. 8.6).

By comparison, non-OECD emerging nations will have the strongest demand for natural gas. As economic development and income levels rise, emerging economic entities will see growing demand for natural gas. At the same time, the majority of emerging economic entities still have relatively low levels of expansion of natural gas usage, leaving major room for growth in the future. Moreover, due to strengthened atmospheric pollution governance and the need to deal with climate change, emerging nations will turn more toward natural gas for new momentum.

[2]For the influence of LNG development in Australia, the US, and Canada on Chinese imports, further detailed analysis will be provided in the section dealing with China's Future LNG Imports.

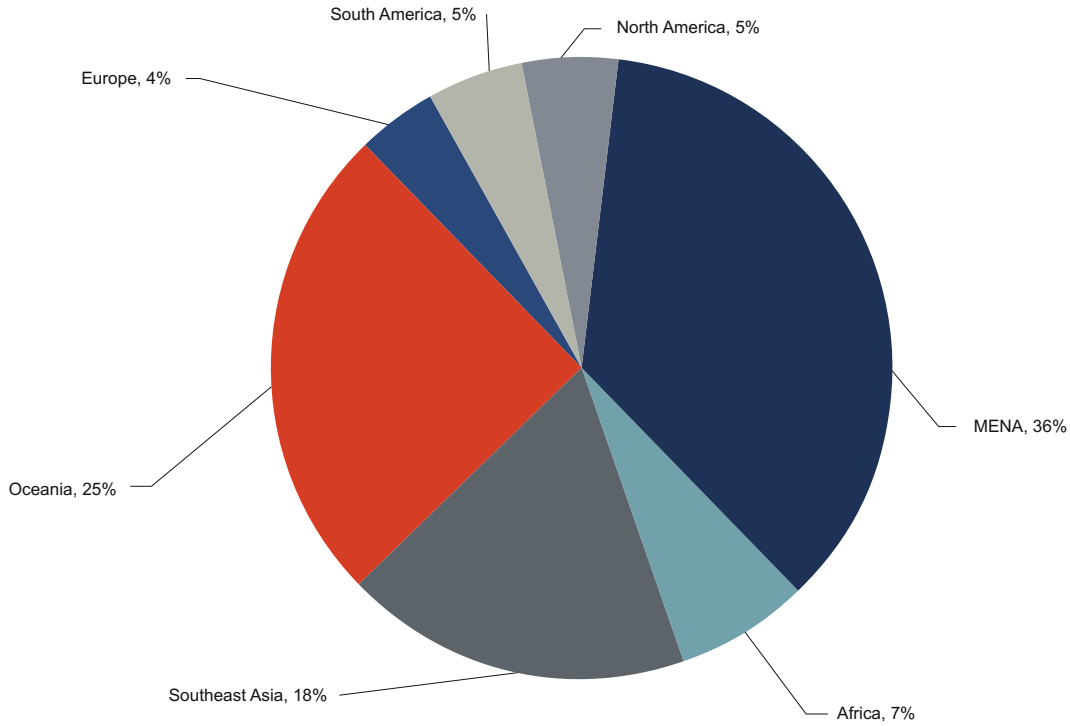


Fig. 8.5 Global LNG regional production capacity (2017 existing and in-progress capacity). *Source* Collected and assembled from PFC Global LNG Supply and Demand Report (2013), company reports and authors

8.2.6 The Influence of Oil Price Declines Future Natural Gas Trade

International crude oil prices dropped from over $100 per barrel in June 2014 to a low of CNY 43 in January 2015, driven by the US unconventional oil and gas revolution, which has seen major increases in US crude oil production volumes, falling international oil market demand and various other factors. By May 2015, the price was at approximately $60 per barrel. Because many natural gas contract prices are linked to the price of oil, international crude oil price fluctuations also immediately set off major changes in the international natural gas market, and will have far-reaching impacts on future natural gas trade layouts (Fig. 8.7).

In the short to medium term, in terms of demand, the JKP price has dropped from $20/MMBtu in 2014 to $7. This means a reduced cost for natural gas-importing nations such as China, especially for spot and short- and mid-term contracts. For suppliers, the largest impact is felt by existing projects and in-progress projects, such as the projects currently under construction in Australia, where some project investments will face sunk cost. Because many projects are established based on the economic expectation of high oil prices, a major drop in oil prices will lower the expected gains from the projects, and some could even face losses.

In the long term, major oil price drops affect natural gas projects that are in planning. These projects can have their progress halted as a result, for example the Browse project in Australia and the Pacific Northwest project in Canada, which have currently delayed the time for making their final investment decision.

A drop in international oil prices also causes Asian natural gas exports to lack their previous appeal. This is because US natural gas pricing

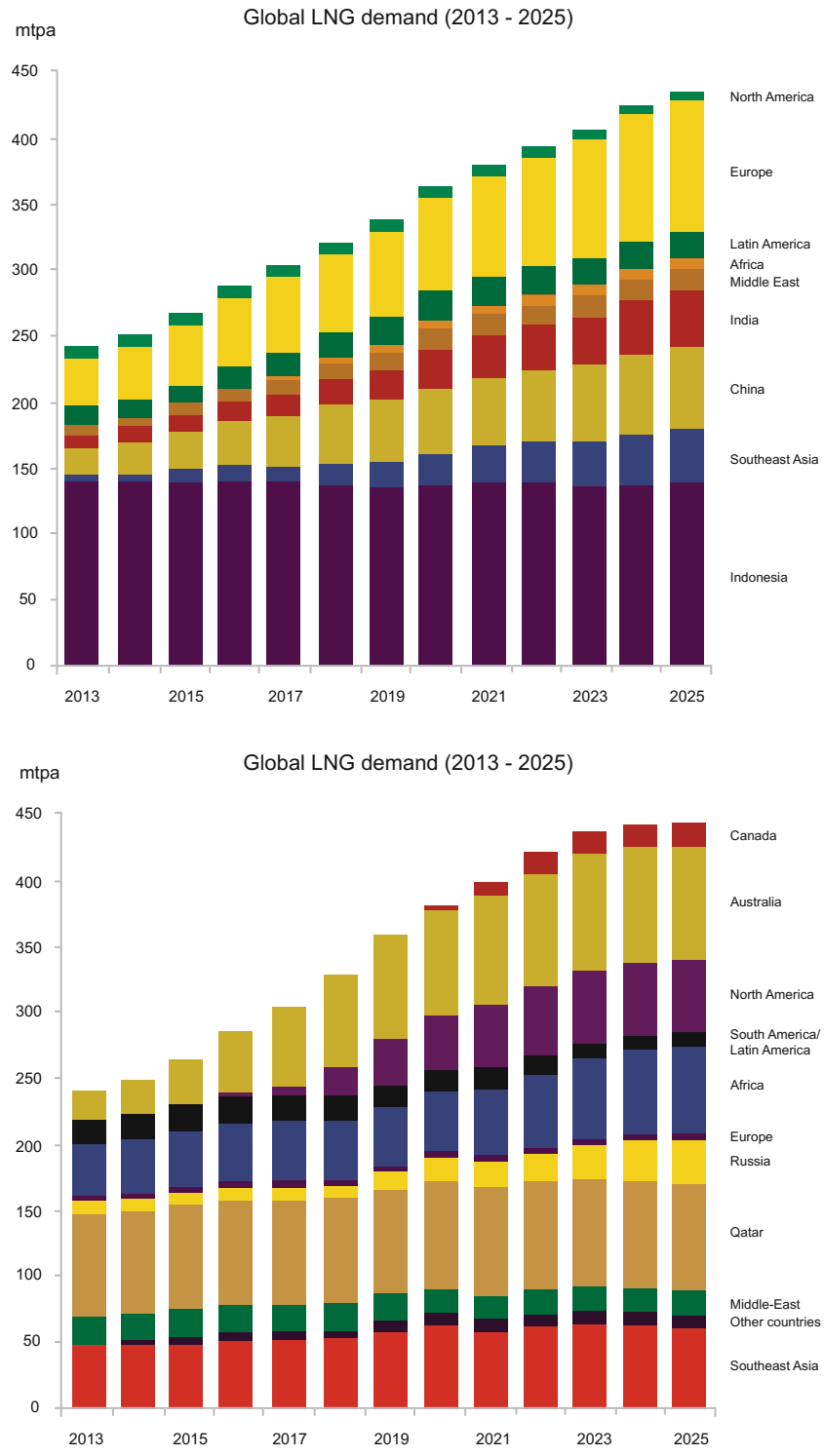


Fig. 8.6 Global LNG future supply and demand layout

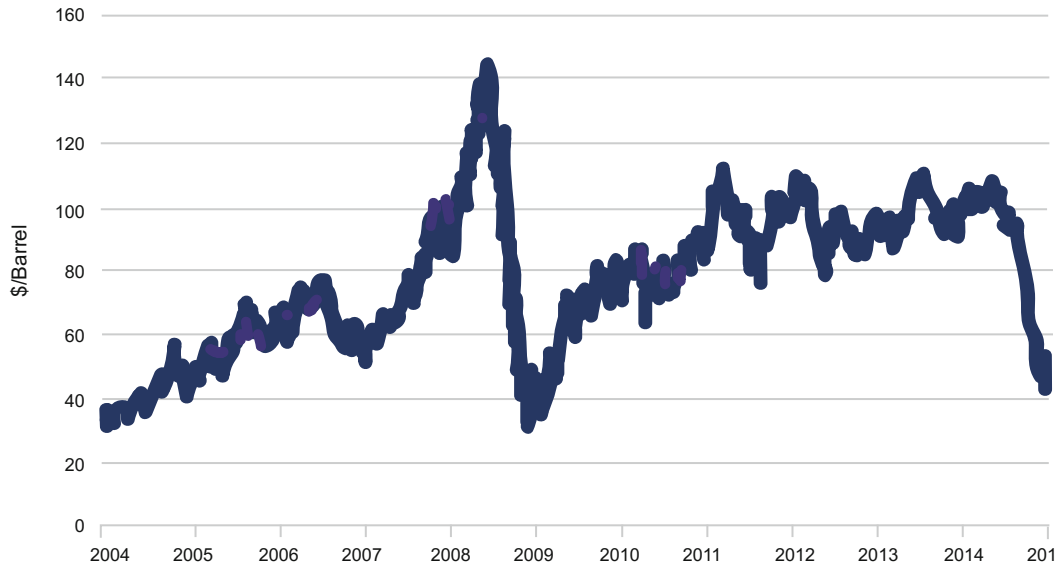


Fig. 8.7 WTI oil price trends (2004–2015). *Source* Energy Information Administration, US

mechanisms are different from Asia, and are not linked to oil prices but are directly determined by supply and demand of natural gas itself. When oil prices plunge, US natural gas price advantages are markedly reduced, and Asian market demand is thus reduced, so a portion of projects could turn toward Europe or Latin America, while another portion could be cancelled. It could be said that international oil price drops have the effect of reshuffling the deck for natural gas trade, causing markets to enter a new phase of balancing out.

If Japan's Fukushima nuclear reactor disaster of 2011 is said to have ignited a new wave of natural gas export, international oil price drops can be viewed as having poured cold water on that momentum and resulted in a more conservative approach. As can be expected, sustained low oil prices will cause natural gas international supply reductions, and this to a certain degree will help natural gas prices to avoid becoming excessively low. However, in the long term, what will allow natural gas to find a new stable price will rely upon many factors, and there are many major uncertainties. Another trend is that LNG industry participants will work hard to co-operate to reduce LNG project expenses while increasing their projects' economic competitiveness.

8.3 China's Current Natural Gas Imports and Future Trends

8.3.1 China's Current Natural Gas Imports

In 2013, global natural gas consumption was approximately 3.5 trillion m^3, with natural gas trade totals of 1 trillion m^3. LNG accounted for about one third of this, while pipeline natural gas accounted for two thirds. China's 2013 natural gas imports were 53.4 billion m^3, at an average price of 10.4 \$/MMBtu (about 2.6 CNY/m^3) (Chen 2014). As part of this, LNG imports were approximately 25 billion m^3, at an average price of 10.5 \$/MMBtu. Pipeline natural gas imports were approximately 28 billion m^3, at an average price of 10.4 \$/MMBtu. China's natural gas consumption volume, imports of natural gas, LNG imports and pipeline imports correspond to 4.8, 5.3, 7.6 and 4.2% of global amounts, respectively (Table 8.1).

In terms of LNG, China's major import sources are Qatar, Australia, Malaysia and Indonesia. Import volumes are 9.2, 4.8, 3.6 and 3.3 billion m^3, respectively, at prices of 17.9, 3.5, 8.1 and 3.9 \$/MMBtu. In terms of pipeline gas, major importing nations are Turkmenistan, Uzbekistan,

Table 8.1 China's natural gas imports, by source

Natural gas imports	LNG and pipeline imports		Major importing nation	Imported amount (100 million m^3)	Import price ($/MMBtu)	Proportion of China's total imports (%)
Total: 534,100 million m^3 Price: 10.4 $/MMBtu Import dependency: 31.6%	LNG	Total: 250,100 million m^3 Price: 10.5 $/MMBtu Proportion: 14.9%	Qatar	92	17.9	17.7
			Australia	48	3.5	9.3
			Malaysia	36	8.1	7.0
			Indonesia	33	3.9	6.4
	Pipeline	Total: 284,100 million m^3 Price: 10.4 $/MMBtu Proportion: 16.7%	Turkmenistan	244	9.6	47.0
			Uzbekistan	29	9	5.6
			Kazakhstan	1	3.5	0.1
			Myanmar	10	11.5	1.9

Source "BP Statistical Review of World Energy (2014)" and author calculations

Myanmar and Kazakhstan, with import volumes of 24.4, 2.9, 1.0 and 0.10 billion m^3, respectively, at prices of 9.6, 9, 3.5 and 11.5 $/MMBtu.

Looking at the numbers, Turkmenistan is currently China's largest importer, accounting for 47.1% of all natural gas imports, followed by Qatar, Australia, Malaysia and Indonesia, accounting for 17.7, 9.3, 7.0, and 6.4% of import volumes, respectively. These five countries account for 87.4% of China's import volume. From the perspective of price, Qatar's LNG price is highest, at 17.9 $/MMBtu (approximately 4.48 CNY/m^3), and the Australian LNG price is the lowest, at 3.5 $/MMBtu (approximately 0.88 CNY/m^3) (Fig. 8.8).

Compared to other international natural gas prices, China's current imported natural gas average price of 10.4 $/MMBtu is in the mid-range, and much higher than the price on the Henry Hub of 4 $/MMBtu. However, it is markedly lower than Japan's imported LNG price (approximately 16 $/MMBtu) and roughly equal to the imported natural gas prices of the United Kingdom NBP[3] (about 10.4 $/MMBtu) and Germany (about 11.3 $/MMBtu) (Fig. 8.9).

Overall, since China began importing natural gas in 2006, import volumes have risen rapidly and import prices have also markedly risen. As Australia and other nations that signed early import contracts with China have had their import contracts come to term, China is now seeing a new wave of natural gas contract signings, which are having a decisive influence on China's future natural gas imports.

8.3.2 Potential Source Nations for China's Future LNG Imports

1. **Australia**

Australia currently has 22 proposed LNG projects, with annual production capacity of a total of 200 billion m^3. These projects are at different stages of development. Of these, seven projects are under construction and represent 85 billion m^3 of annual production capacity, with 50 billion m^3 of signed sales contracts, primarily with China, Japan and South Korea. As part of this, China and Australia have signed contract agreements for approximately 20 billion m^3: 5 billion m^3 between CNOOC and Queensland Curtis, 4.7 billion m^3 between CNPC and Gorgon and 10.5 billion m^3 between Sinopec and Australia Pacific. This results in China importing 25 billion m^3 of natural gas from Australia, accounting for over 35% of signed LNG contract agreements.

From the perspective of project progress, Australia's project development is in a leading position, with seven projects planned to

[3]NBP, National Balancing Point. This is the UK's virtual gas trading hub price.

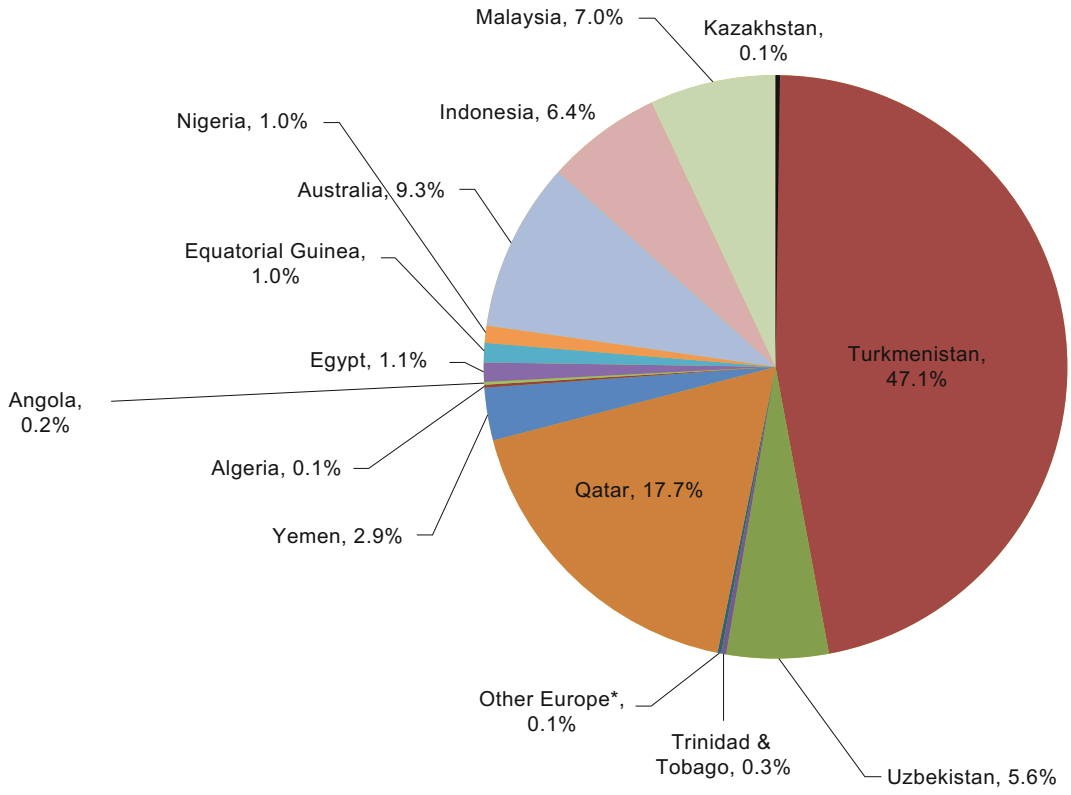


Fig. 8.8 Chinese natural gas import sources. *Source* BP Statistical Review of World Energy (2014)

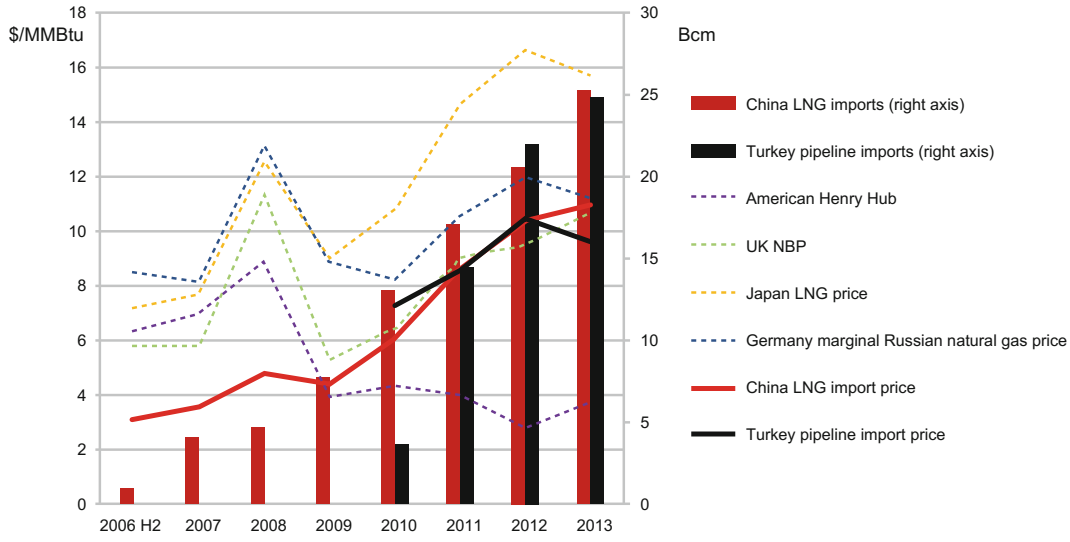


Fig. 8.9 Comparison of China's natural gas import prices and other international natural gas prices. *Source* Michael Chen (2014)

commence prior to 2017. Moreover, because of advantages in geographical location, shipping fees to China are lower compared to the United States and Canada. However, these projects in Australia are all scheduled to develop simultaneously, causing source material and labour market shortages and price increases that have caused project cost rises. In some projects, for example Gorgon, costs have even risen by as much as 40% (Forster 2013). These cost increases could affect natural gas pricing. In addition, even if cost increases are only temporary, subsequent projects could face similar problems, and Australia could face issues of insufficient natural gas supply. This problem could then further affect subsequent projects. These risks must be considered as China further signs LNG purchase contracts, especially since so many LNG contracts have already been signed with Australia.

2. **United States**

The US shale natural gas revolution is currently changing American and even global energy market layouts. According to materials from the US Energy Information Administration, in the past several years, American shale natural gas production volume increases have seen an over 20-fold increase. Today, the United States has surpassed Russia to become the world's largest natural gas producer. Research by international consulting company ICF has shown that the United States can use the natural gas reserves held as of 2011 for 130 years of consumption. Shale natural gas development has drastically reversed the United States' reliance on imports. In 2007, the United States was still planning to invest enormously in the construction of natural gas import ports, whereas as of July 2014, there were 29 LNG export projects currently seeking approval from the Department of Energy, for a total of 430 billion m^3.

American natural gas export targets include the FTA and non-FTA nations. According to the United States Natural Gas Act, revised in 1992, natural gas approvals for export to FTA nations can be obtained automatically, but to export to non-FTA nations requires authorisation from the Department of Energy, and approval is only given if the proposal is in the interests of the American public. China is a non-FTA nation.

The United States has seen fierce debate over the last two years about whether it should export natural gas. Opposition to export includes US manufacturers, the chemical industry and other natural gas downstream enterprises, who believe that exporting natural gas will cause domestic natural gas prices to rise, as well as American environmentalists, who believe that shale natural gas will harm water resources as well as add to greenhouse gas emission increases. Supporters of exporting natural gas include natural gas upstream development enterprises and free market supporters, who believe that export of natural gas will be beneficial in stimulating the US economy and creating jobs. There are also some international energy political considerations that relate to whether American exports of natural gas will help put an end to halts placed on European nations by Russia. Finally, based on its analysis and research, the US Department of Energy believes that export is on the whole beneficial to American economic interests, and thus approved a series of natural gas export projects. By July 2014, there were seven projects that had received approval, with a total of 100 billion m^3 of capacity exporting to non-FTA nations, including Sabine Pass (2.30 billion m^3), Freeport (20 billion m^3), Lake Charles (20 billion m^3), Cameron (18.0 billion m^3), Cove Point (8.0 billion m^3), Jordan Cove (8.0 billion m^3) and Oregon LNG (13.0 billion m^3).

The major reason for American natural gas attracting such excitement from natural gas buyers is that US LNG imports improve the diversification of import sources in those nations. This diversification is in two respects: one is in terms of geographical location, since prior to this natural gas exports primarily came from the Middle East and North Africa. The other is from the perspective of pricing mechanisms. For a long period, international natural gas pricing was essentially linked to oil prices, but due to its own natural gas market, and because natural gas markets are somewhat independent from oil markets, the United States prices domestic natural gas using the natural gas

price on the Henry Hub as a baseline. Thus the natural gas exported from the United States might not be entirely linked to oil prices, and provides a hedge against oil risk in natural gas import channels. From the perspective of actual price, the US Henry Hub price is currently between $3 and $5. In the long term, it could rise, especially if international oil prices plummet. There is also the consideration that the majority of US export ports are in the GOM, and require the Panama Canal in order to reach Asia, and shipping fees are going to be more expensive than Australia.

From the perspective of project progress, the United States currently only has one LNG project under construction, Sabine Pass, which is expected to be completed in 2015/2016. However, American LNG has been the focus of significant attention, especially among Asian buyers such as in Japan, South Korea, India and China, with approximately 120 billion m^3 of natural gas already signed under purchase contract: 65 billion m^3 signed with portfolio players, 23 billion m^3 with Japan, 7 billion m^3 with Spain, 9 billion m^3 with India and 7 billion m^3 with South Korea. Currently, China has not signed any natural gas purchase agreements or contracts.

3. **Canada**

Canada's LNG projects got under way later than those in Australia and the United States. Currently, there are proposals for a total of 19 LNG projects for a total of 355 billion m^3. No project has as yet entered construction. Approximately 20 billion m^3 have already been signed under some kind of purchase agreement and contract, including 5.8 billion m^3 between CNPC and Pacific Northwest, 830 million m^3 between Huadian and Pacific Northwest, and 1.38 billion m^3 under a memorandum between Guangzhou Natural Gas Group and Woodfire.

As far as distance is concerned, Canada is closer to China than the United States, and thus shipping fees will be slightly lower. Moreover, political barriers could be less of a problem. Project development has lagged behind Australia and the United States, and thus there is significant project uncertainty. At the same time, in some communities, including the native residents, opposition is still an important factor holding back project progress. In addition, severe weather and the need to construct infrastructure could increase the project development costs and thus affect future natural gas prices. Regardless, as a long-term potential natural gas-exporting nation, Canada's natural gas export dynamics and development are worthy of attention and study.

8.3.3 Trends in China's Future Natural Gas Imports

1. **Trends in LNG imports to China's**

Since China's natural gas consumption has increased rapidly in recent years, the three major oil corporations are actively seeking out opportunities to purchase natural gas from international natural gas markets to satisfy future demand. Table 8.2 shows long-term signed LNG contracts that China currently holds, including sales and purchase agreements, heads of agreement and memorandums of understanding. It is estimated that in the next few years China will see rapid growth in LNG imports. New LNG imports from Australia will be largest part of this increase, rising from approximately 5 billion m^3 currently to 25 billion m^3 by 2015. Other LNG import increases currently planned will be from Russia (approximately 4 billion m^3), Papua New Guinea (approximately 3 billion m^3) and from third parties (approximately 9 billion m^3). In addition, China is currently in talks with Canada to sign a purchase of LNG contract letter of intent or memorandum of understanding for approximately 8 billion m^3.

However, these projects are still uncertain. First, contract letters of intent or understanding could potentially end without the final transition to a purchase contract taking place. In addition, while these projects plan to begin imports to China in 2017–2019, they have still not entered construction, and the repercussions of the international oil price drops could introduce uncertainty into the expected timeframe. For example, the Pacific

Table 8.2 China's LNG long-term contracts

Type	Exporting nation	Name of plant	Buyer	Volume (bcm)	Start year	End year
Spot	Australia	Withnell Bay	CNOOC	4.55	2006	2030
Spot	Indonesia	Tangguh	CNOOC	3.59	2009	2033
Spot	Malaysia	Malaysia LNG Tiga	CNOOC	4.14	2009	2029
Spot	Qatar	Qatargas	CNOOC	2.76	2009	2034
Spot	Portfolio seller	Portfolio	CNOOC	1.38	2010	2024
Mid-/long-term	Portfolio seller	Portfolio	CNOOC	6.90	2015	2035
Contract letter of intent	Portfolio seller	Portfolio	CNOOC	2.07	2019	2039
Purchase contract	Australia	Queensland Curtis	CNOOC	4.97	2014	2034
Spot	Qatar	Qatargas	CNPC	4.14	2011	2036
Purchase contract	Russia	Yamal	CNPC	4.14	2018	2038
Purchase contract	Australia	Gorgon	CNPC	3.10	2014	2033
Purchase contract	Australia	Gorgon	CNPC	2.70	2014	2033
Purchase contract	Australia	Australia Pacific	Sinopec	10.49	2015	2035
Purchase contract	Papua New Guinea	PNG LNG	Sinopec	2.76	2014	2034
Contract letter of intent	Canada	Pacific Northwest	Sinopec	4.14	2019	2039
Contract agreement	Canada	Pacific Northwest	Sinopec	1.66	2019	2039
Contract agreement	Canada	Pacific Northwest	Huadian	0.83	2019	2039
Memorandum of understanding	Canada	Woodfibre	Guangzhou Natural Gas Group	1.38	2017	2042

Source International Group of Liquid Natural Gas Importer (GIIGNL), LNG Industry 2006–2014, and author compiled and organised

Northwest project recently announced a delay in the project's final investment decision due to international oil price drops. Therefore, even if in the long term international oil prices support the continued progress of these projects, they are still very likely not to be executed until after 2020. Taking this into consideration, China is likely to see a rise in LNG imports from the current 25 billion m^3 to approximately 57 billion m^3 in 2020. By 2030, if the Canadian contract is realised, LNG imports will rise to approximately 65 billion m^3. Two east African countries are also likely to become LNG-exporting nations in the latter half of the 2020s.

Looking at importers (see Table 8.2), CNOOC accounts for a major share of the current LNG long-term contracts, and has signed contracts for approximately 30 billion m^3. Sinopec and CNPC currently have approximately 14 billion m^3 and 20 billion m^3 of LNG contracted, while Huadian Group and Guangzhou Natural Gas Group have signed for 0.83 billion m^3 and 1.28 billion m^3 in LNG contracts respectively (Fig. 8.10).

In addition to long-term contracts, spot and short-term contracts are also used to import natural gas. In 2013, Chinese spot imports of LNG were approximately 5.4 billion m^3, accounting

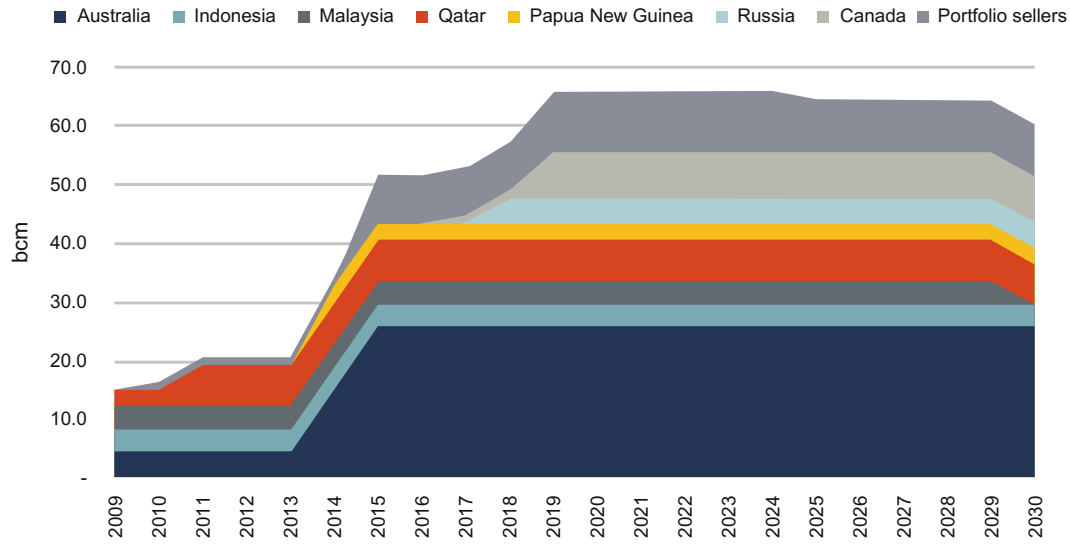


Fig. 8.10 China LNG imports. *Source* International Group of Liquid Natural Gas Importer (GIIGNL), LNG Industry 2006–2014, and author compiled and organised

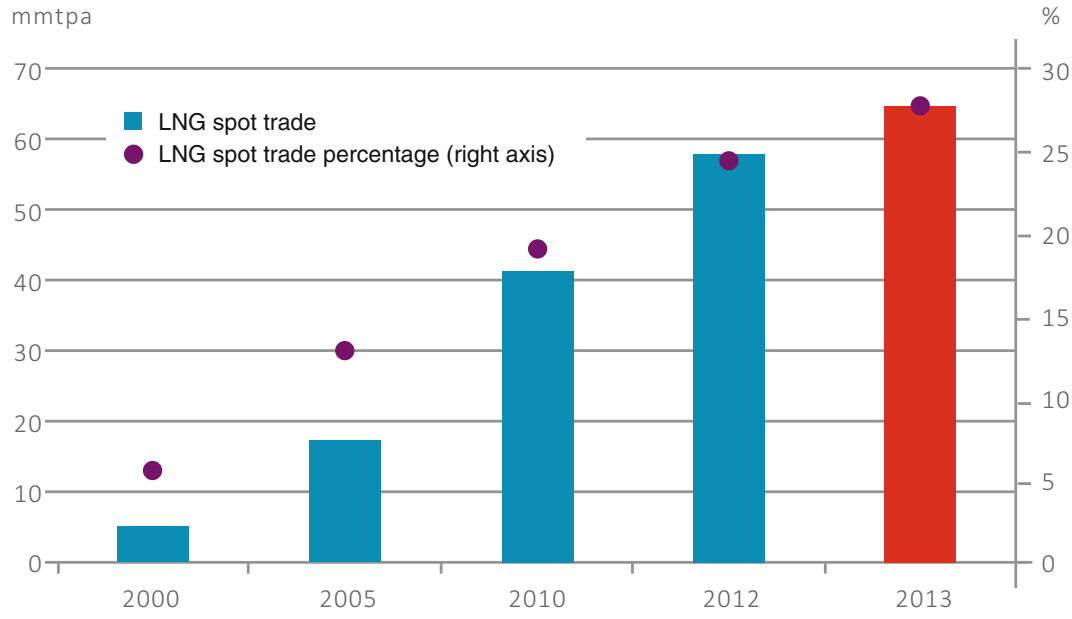


Fig. 8.11 Global spot trade market change trends this year. *Source* GIIGNL 2013. *Data source* International Group of Liquid Natural Gas Importer (GIIGNL), LNG Industry in 2013

for around 22% of the total LNG import volume, slightly less than the current global LNG spot transaction volume percentage of all trades of 27%. As shown in Fig. 8.11, global spot transactions have seen a rising trend in recent years, primarily due to their flexibility, which allows them to top up supply shortages from long-term contracts and enables arbitrage of price

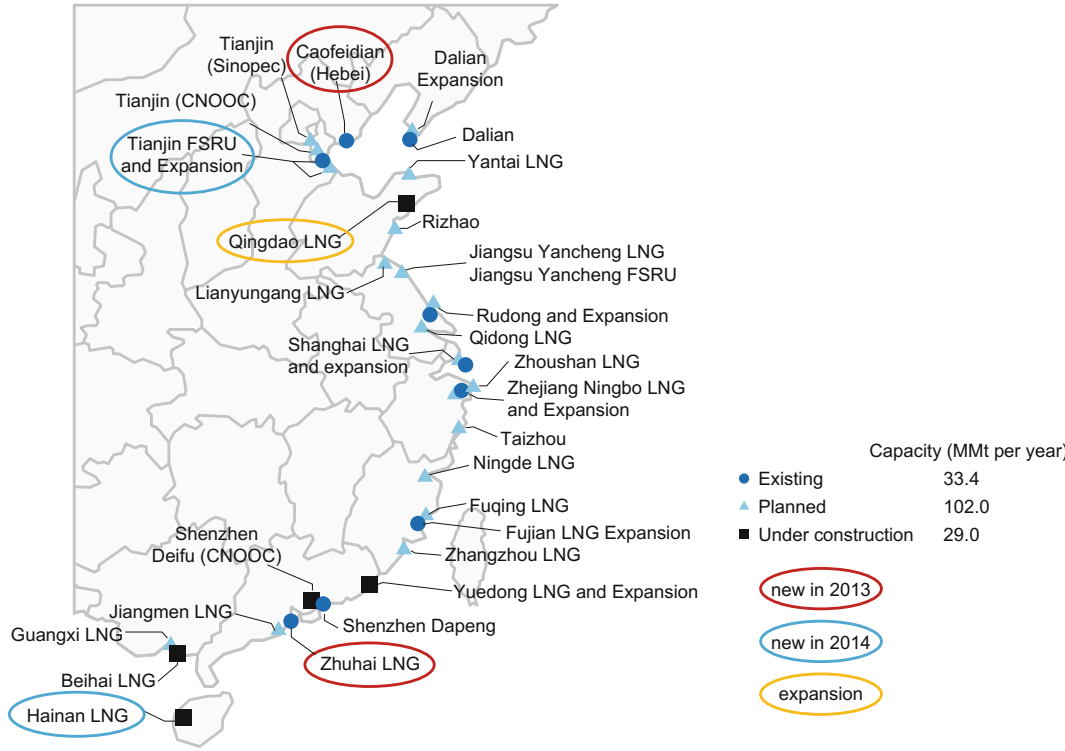


Fig. 8.12 China natural gas receiving station construction

between different LNG markets. As China's natural gas trade market develops, awareness of risk aversion will strengthen and the construction of a natural gas financial market is sure to result in spot and short-term markets also seeing further growth through natural gas import increases. Taking 20–25% as an estimate of spot LNG trade's percentage of total LNG trade volume, by 2020 spot LNG trade volume could reach approximately 10 billion m^3, and approximately 15 billion m^3 by 2030.

2. **China's LNG receiving station construction trends**

Natural gas receiving stations are a critical part of the infrastructure for the LNG trade chain, and can also restrict the ability to import natural gas. China's first LNG receiving station, the Shenzhen Dapeng Receiving Station, started operations in 2006. China currently has LNG receiving station capacity of 45.4 billion m^3/year (33.4 MMt/y), with projects under construction of 40 billion m^3/year (29 MMt/y). There is also planned construction of 140 billion m^3/year (102 MMt/y).

Based on these figures, by 2020 China's LNG receiving station capabilities could reach 85–225 billion m^3/year, which would enormously surpass the possible scope of future LNG imports. These planned projects could be increased or reduced along with China's natural gas demand and international natural gas trade market changes. However, considering current signed natural gas long-term contracts and expressions of intents on the part of China, at first sight it seems clear that the overall capabilities of China's LNG receiving stations will not be a bottleneck for the import of natural gas (Fig. 8.12).

Table 8.3 China's future pipeline natural gas import capacities

	Current (100 million m^3)	Future imports (100 million m^3)	Remarks
Central Asia pipeline	550	850	
A line and B line	300	300	Gas sourced from Turkmenistan, having entered operation in December 2009 and October 2010 respectively
C line	250	250	Gas source: Turkmenistan (10 billion m^3), Uzbekistan (10 billion m^3) and Kazakhstan (5 billion m^3), began operation in June 2014
D line		300	Expected to begin operation in 2016
Myanmar	120	120	Began operation in August 2013, and as of August 2014 had received 4 billion m^3
Russia		380–680	
East line		380	Began construction in September 2014, expected to open in 2018
West line		3000–6000	Came to understanding memorandum in November 2014, expected to open in 2019. Signed intention is for 60 billion m^3, but 30 billion m^3 is a more realistic expected goal
Pipeline natural gas	670	1650–1950	

Data source Company websites, news, and author collected and arranged information

3. China's future pipeline natural gas imports

China's existing pipeline natural gas imports primarily come through central Asia and Myanmar, with the future Russian pipeline set to become a major import source as well (Table 8.3).

The Central Asia line is divided into the four lines: A, B, C and D. The A and B lines are sourced from Turkmenistan and currently have capacity of 30 billion m^3/year. The C line is 25 billion m^3/year (10 billion m^3 from Turkmenistan, 10 billion m^3 from Uzbekistan and 5 billion m^3 from Kazakhstan, began operation in June 2014). The D line shipping capability is 30 billion m^3/year and is expected to open in 2016. The Myanmar line began operation in August 2013 and by August 2014 had imported 4 billion m^3, with capacity for 12 billion m^3/year.

With regard to Russia, currently Russia and China have signed an East Line contract as of May 2014, with shipment capabilities to reach 38 billion m^3/year. The Western Line has had a memorandum of understanding signed as of November 2014, and could include scope of 30 billion m^3/year. Of course, until a formal contract is signed, nothing is certain. Although both projects are slated to commence prior to 2020 (the Eastern Line in 2018, and the Western Line in 2019), the actual start time could yet be after 2020. First, since 2014, Russia's project progress and development has slowed, with approvals not yet obtained from the Russian government. In addition, Russia's geographical location and severe weather, among other factors, will make it more difficult for the project to make progress. Moreover, the Eastern Line and Western Line both require large quantities of funds, labour and resources to be invested, which is a challenge for Gasprom, especially as international oil prices have dropped.

In summary, it is expected that in 2020 China's pipeline imports will be in the region of 97 billion m^3. In 2030, China's pipeline import capacity will reach approximately 135–165 billion m^3, with the main uncertainty in this figure

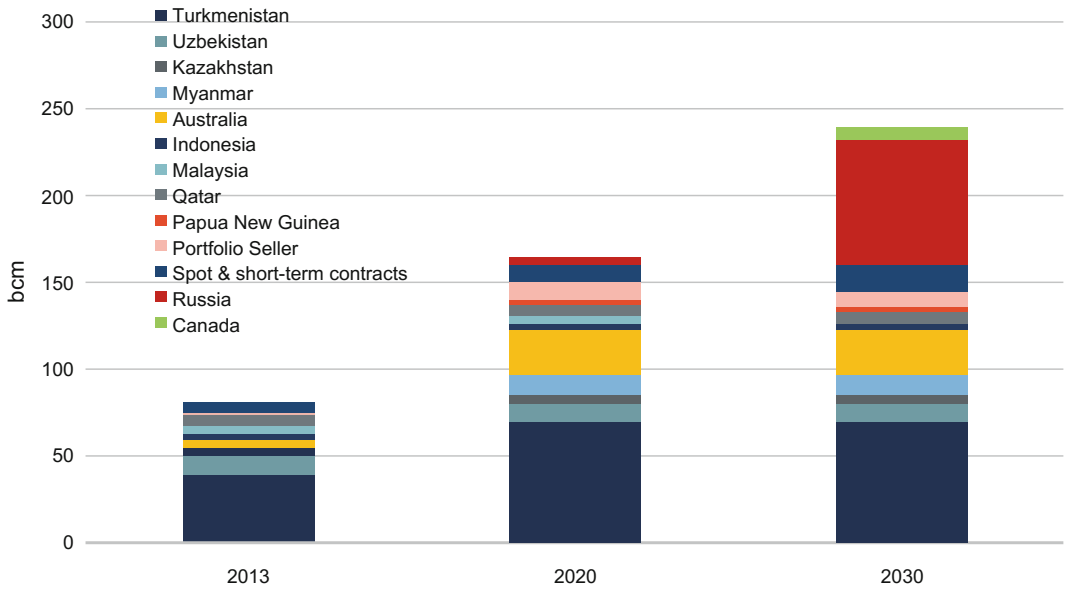


Fig. 8.13 China's future natural gas imports. *Note* Long-term contracts include purchase contracts, co-operation intention agreements and memorandums of understanding

coming from the progress of Russia's Western Line.

4. **China's future natural gas import trend outlook**

In summary, given the long-term LNG and pipeline contracts that China has already signed, China's natural gas imports will grow rapidly in the next few years, from 53 billion m^3 in 2013 to 167 billion m^3 in 2020, including 70 billion m^3 from LNG and 97 billion m^3 from pipeline natural gas. By 2030, imported natural gas will further expand to approximately 210 billion m^3, including 75 billion m^3 in LNG and 135 billion m^3 in pipeline supply. If Russia's Western Line is able to implement its 30 billion m^3, then imported natural gas will grow further to around 240 billion m^3, including 75 billion m^3 in LNG and 165 billion m^3 in pipeline supply.

Figure 8.13 shows China's 2030 natural gas import source country proportions based on long-term contract calculations. Currently signed contracts and intentions clearly indicate that Turkmenistan and Russia will become the major natural gas importers to China, each accounting for approximately 30%. Following this will be Australia, whose natural gas imports will account for 12%. Another approximately 30% will be sourced from eight nations, including Myanmar, Qatar, Uzbekistan and Papua New Guinea, as well as from third-party natural gas suppliers. This is a major change from the figures in 2013: the proportion of China's imports that are sourced from the Middle East will have been reduced the most, from 17.7% in 2013 to just 3%. Turkmenistan's proportion will move from nearly 47 to 30%, while Russia will move from 0 to 32%. In addition, Australia will see a slight increase. It is clear that from 2020–2030, China's will increase the diversity of its natural gas import sources, primarily by achieving historical breakthroughs with Russia in natural gas contract negotiations, thus enabling China to reduce its reliance on Central Asia's natural gas (Fig. 8.14).

What should be noted is that the predictions of China's future natural gas import trends outlined

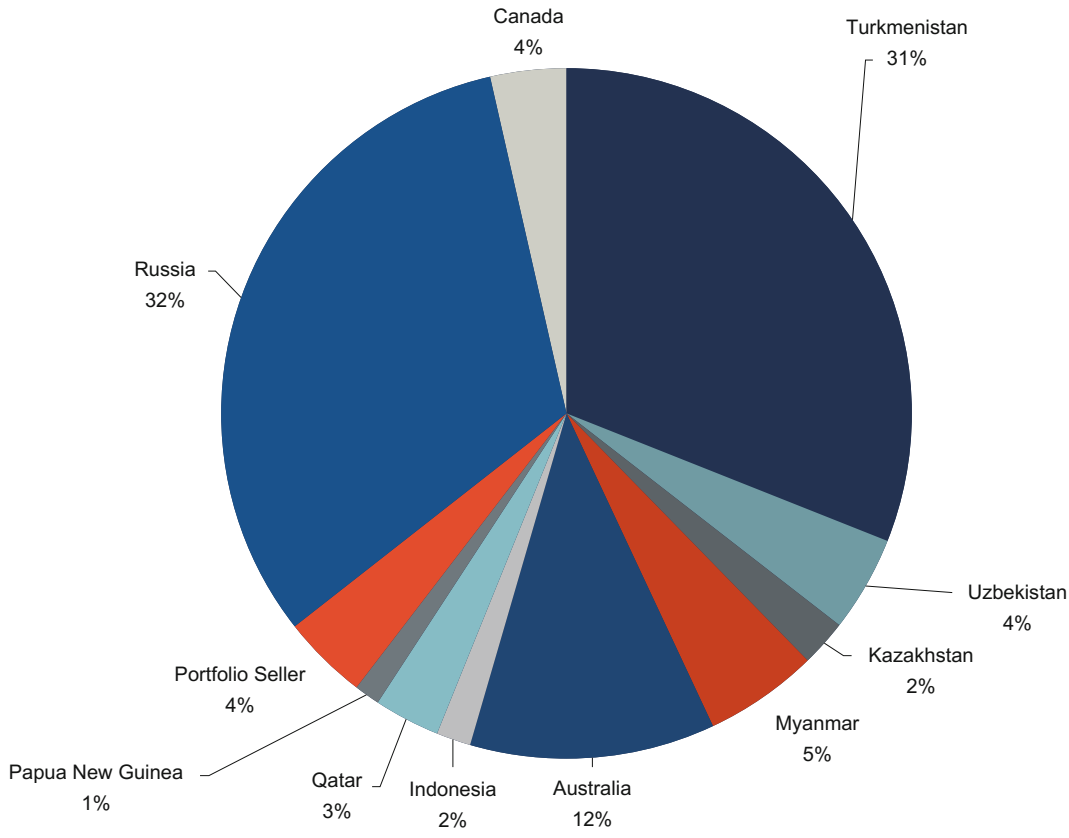


Fig. 8.14 Future Chinese natural gas import source nation proportions. *Source* GIGNL and author collection and arrangement

above are based on natural gas import capabilities and quantity of contracts. However, import capabilities are not entirely equivalent to the quantity of actual imports. For example, after a pipeline is constructed, the volume of actual shipments can be less than its maximum shipping capability. Moreover, even though natural gas long-term contracts are relatively stable, they are still not completely fixed, and both parties are still able to negotiate and make adjustments according to actual changes in circumstances. Thus China's actual natural gas import volume in the future will be determined not only by import capabilities and contracts, but also by domestic demand.

At the same time, the risks and uncertainties facing China's future natural gas imports must be acknowledged:

- First, the global natural gas market structure still presents several variable factors. Many Front-End Engineering Design projects are in planning stages and may not be ultimately completed, especially those in early stages, which could be influenced by various factors and risks and cancelled. Currently there is significant export potential in Australia, the United States and Canada, and various project planning capabilities are very promising, but how these projects will ultimately affect the global natural gas trade is hard to say.
- Second, international oil price changes present a major variable to the international trade in natural gas. A drop in international oil prices represents a reshuffling of the cards, and currently markets have begun to enter a

new process of balancing out, and long-term natural gas prices will have their new points of balance determined by multiple factors. There are significant uncertainties, and this will affect China's interests and risks as it imports natural gas.

- Furthermore, along with cost increases, political risk and various other factors are also having significant influences on future Chinese natural gas imports. Currently, Australia's in-progress projects are seeing significant cost increases, while if China wishes to achieve imports from the United States and Canada, there are significant political barriers that must be overcome, presenting major political risks. Therefore, even if China insists in future upon a strategy of natural gas import diversification, the success of this strategy will still depend on the circumstances of the international natural gas market and the political environments within individual nations.
- Finally, there is a certain amount of uncertainty over China's future imports of pipeline natural gas. Even based on current circumstances, pipeline natural gas imports will play a determining role in future natural gas imports for China, but the final realised pipeline natural gas import volume is as still a significant variable. For example, in the Russian pipeline natural gas project, actual project progress since 2014 has not been ideal, and the project has encountered difficulties as a result of Russia's geographical location and severe weather. Russia still faces a major challenge to satisfy the enormous requirements for funding, labour and resources that are necessary to complete the project.

In brief, looking at the current LNG contracts and pipeline natural gas agreements, Chinese natural gas imports are set to expand. However, close attention must be paid to risk and uncertainty, as well as to the rapid changes in international circumstances and specific conditions in nations which can lead to fluctuations in international natural gas markets. China must prepare for a rainy day and make suitable preparations to ensure its own security of supply as it pursues a strategy to diversify natural gas imports.

8.4 China's Natural Gas Trade Policies and Recommendations for Reform

8.4.1 China's Current Natural Gas Trade Policies

China's natural gas trade policies can be grouped into the following major sectors, based on the stages of the natural gas import process:

- **Commodity trading policy**: Treating natural gas as a trade commodity while managing imports. This includes answering questions such as: Do domestic entities have the right to import natural gas? Do approvals from relevant authorities need to be obtained? Are approvals from authorities required for a domestic entity to sign a contract with a foreign company?
- **Facility construction and operation policy**: After natural gas is imported into China, managing facilities (receiving stations, gas reserve pipeline networks etc.), construction and operation. This includes answering questions such as: Which entities can construct receiving stations and other infrastructure? Are approvals required, and how are they handled? What policies are there for infrastructure operation? How are policies implemented?
- **Price and taxation policy**: Policies relating to imported natural gas pricing and taxes. This includes answering questions such as: Is there regulatory interference in imported natural gas pricing? For imported natural gas, what tax policies apply, for example subsidies and tax rebates?

1. **Commodity trading policy**

In terms of the foreign trade sector, natural gas does not constitute a state-run commodity, and is viewed as a "general commodity".[4] At customs, conducting natural gas trade does not require prior approval, with customs currently overseeing statistics for natural gas commodity trading. Requirements for corporate reporting and filing have also been cancelled, making it no different than other general commodities.

Therefore, in theory, natural gas imports are open to all qualifying enterprises, and there is no substantial barrier arising from commodity trading policies. So long as the business scope includes "natural gas trade" (when handling administration for industry and commerce registration) and all Ministry of Commerce approvals have been obtained (routine procedures), the enterprise can carry out natural gas import business, and the signed trade contracts do not require approval and review from relevant authorities.

2. **Facility construction and operation policy**

The main facility construction and operation policy approvals are at the facility construction stage. According to national policy, a construction project beyond a certain size requires approval from the NDRC, and natural gas sector building construction is included within the scope of approvals. Currently, there are different policy directions for the different natural gas facilities. For LNG receiving station project construction, since receiving capabilities are far ahead of actual shipping volume, China is strictly controlling such projects. For pipeline networks and gas reserves and other facilities, China is implementing an attitude of encouragement, encouraging various ownership systems to participate in gas reserve facility investment, construction and operation.[5] Therefore in practice the true barrier to an enterprise conducting LNG trade is whether or not it has corresponding facilities to accept the imported natural gas.

Even if the nation is attempting to encourage more enterprises to participate in natural gas import trade, thereby expanding imports, enlivening markets and increasing the degree of competitiveness, thanks to restrictive factors such as the limit on receiving stations, there is still only a limited number of enterprises engaged in natural gas trade markets (the three major oil companies, Huadian, Jiufeng, ENN and a small number of other companies).

Regarding receiving station construction, third-party access is not yet in place (policies have just been released) and thus various entities still wish to construct their own receiving stations. As a result, current receiving station capabilities have become much greater than actual shipping volume, but even so, domestic parties are still actively seeking to build new receiving stations. At the same time, the NDRC is strictly controlling construction of new receiving stations. In practice, whether or not approval can be obtained depends on an interplay between the central government, local government and enterprises, and there is a lack of openness and transparency in the approval standards and procedures, resulting in significant uncertainties.

With natural gas trade being restricted by facilities such as receiving stations, and receiving station construction also being closely controlled by the central government, the core question affecting natural gas trade is therefore: Can current domestic receiving station facilities provide true third-party access?

There is already a clear provision that has been provided in the recently released Natural Gas Infrastructure Construction and Operation Management Measures (implemented April 1 2014):

[4]See Commerce Department Office Opinions Regarding Several Issues Involving LNG Commodities, June 5, 2007.

[5]See NDRC Guiding Opinions Regarding Acceleration of Reserve Gas Facilities, April 5, 2014; NDRC Opinions Regarding Establishment of Effective Mechanisms to Ensure Stable Supply of Natural Gas, May 5, 2014.

> Natural gas infrastructure operators shall announce and provide information regarding service conditions, obtained service procedures, and remaining service capacity, fairly and justly providing all users with pipeline shipping, storage, gasification, liquefaction, and compression services.
> Natural gas infrastructure operators may not use their control of infrastructure to exclude other natural gas operators. Where service capacity exists, users meeting requirements may not be refused provision of service, or be presented with unreasonable requirements. Existing users preferentially obtain natural gas infrastructure service.

However, the third-party access policy requirements for natural gas infrastructure described above are somewhat vague, lacking specific details and a relevant series of procedures, and thus lacking practicality. In reality, because of the imperfection of the above policy provisions, and also due to current market structure, monopolistic powers are still strong, and without proper regulation the current policies relating to third-party access are essentially a blank document. As far as international natural gas pipeline trade is concerned, the enormous investment involved and complex geopolitical factors, and the extreme requirements these place on the relevant entities, currently appear to have resulted in an exclusive monopolistic structure, and in the short term this is unlikely to see fundamental change.

3. **Price and tax policy**

There are no review and approval requirements for trade commodity natural gas prices. So, from a policy perspective, natural gas price decisions are open, and are decided by the buyer and seller involved in the trade. This is particularly true of LNG, though in pipeline natural gas pricing there is indirect reliance on national negotiating power. However, this reliance is indirect, and pipeline natural gas contracts are still ultimately determined by the two parties involved in the trade. In terms of tax policy, policies on VAT rebates or discounts on natural gas imports are determined and adjusted by the Ministry of Finance. As China's natural gas pricing becomes better adjusted in the future, this practice could be halted (Table 8.4).[6]

8.4.2 Recommendations for Adjustments to China's Natural Gas Trade Policy

1. **Encouragement imports and focus on expanding domestic production**

In terms of natural gas import policy focus, China needs to balance three main conflicting factors: dealing with environmental pollution; the continued growth of domestic natural gas consumption as economic growth and residential living standards rise; and ensuring natural gas supply security. The first two require more natural gas usage, and to a certain degree will result in the import of more natural gas. The third, however, requires restraining natural gas import dependency at a certain level, and thus there could be a need to take some sort of control of the rapid growth of natural gas imports.

In the next period of time (from the present to 2020, 2030), the direction that should be taken in terms of natural gas import policy is: prudent encouragement. This is because currently China's natural gas sector's most fundamental problem is how to rapidly increase domestic consumption of natural gas, and whether it be in terms of proportion of energy consumption (6.5%) or residential diffusion rate (16%), domestic natural gas consumption is still in need of major increase. Considering that as economic development increases and residential living standards rise there will be a greater requirement for energy consumption models, there is a need

[6]Relevant policy references: Finance Department General Administration of Customs National Tax Bureau Notice Regarding Issues Surrounding Ratio-Based Return Import Stage VAT for 2011–2020 Imported Natural Gas and Pre-2010 "Central Asia Pipeline" Project Imported Natural Gas (CGS [2011] No. 39); Finance Department General Administration of Customs National Tax Bureau Notice Regarding Adjustments to Imported Natural Gas Preferential Support Policies (CGS [2013] No. 74); and Finance Department General Administration of Customs National Tax Bureau Notice Regarding Adjustments to Preferential Tax Policy Natural Gas Import Projects (CGS [2014] No. 8), April 21, 2014.

Table 8.4 China's existing natural gas trade policies

	Commodity trade	Facility construction	Facility operation	Price	Taxes	Foreign investment
Policy	"Natural gas" is considered to be a general commodity. So long as the business scope includes "natural gas trade" (when dealing with Administration for Industry and Commerce registration) and all Ministry of Commerce approvals have been obtained (routine procedures), the enterprise can carry out natural gas import business, and the signed trade contracts do not require approval and review from relevant authorities	Pipeline networks, gas reserves and other facilities are encouraged in construction, with participation possible by a variety of ownership structures. LNG receiving station construction is strictly controlled and foreign investment is barred from participation	Requires existing natural gas infrastructure operators to provide their excess capacity information and offer third-party access. Natural gas operators cannot control their infrastructure to exclude other natural gas operators. With regard to service capacity, they may not refuse users who meet the conditions, nor may they make unreasonable demands on them	–	For natural gas import VAT proportional rebate discount policies, the target of rebates is determined and adjusted by the Ministry of Finance	Approval required for foreign investment over a certain amount
Reality	Market entities involved in domestic natural gas trade are still very limited (only the three major oil companies, Huadian, Jiufeng, ENN, and a small number of other companies)	Currently, receiving station capacity is far higher than actual shipping volume, but gas receiving and pipeline facilities are severely lacking	Because of the imperfection of the policy provisions and due to the current market structure, monopolistic powers are still strong, and without proper regulation the policies released relating to third-party access essentially amount to a blank document	Price is determined by the trade participants and there are no approval or review requirements	–	–
Problems	In practice, the true barrier to an enterprise conducting LNG trade is whether or not it has corresponding facilities to accept the imported natural gas	Whether or not approval can be obtained depends on an interplay between the central government, local government and enterprises, and there is a lack of openness and transparency in the approval standards and	Natural gas infrastructure third-party access policy requirements are somewhat vague, lacking specific details and relevant series of procedures and missing corresponding operability	–	Not all natural gas importers are treated equally	–

(continued)

Table 8.4 (continued)

	Commodity trade	Facility construction	Facility operation	Price	Taxes	Foreign investment
		procedures, resulting in significant uncertainties				
Recommendations	–	Strengthen facility construction approval standards, openness and transparency	Consider international experience in releasing operable rules for third-party access and strengthen corresponding regulation	–	–	–

for energy consumption that is more efficient, safer and cleaner. From this perspective, domestic natural gas consumption has entered a stage of rapid growth, and there is already strong inherent growth momentum.

Given the serious need to control environmental pollution, especially in terms of limiting atmospheric smog, a major increase in domestic natural gas consumption has become a pressing measure that must be addressed. So, driven by the need to rapidly increase natural gas domestic consumption, the formulation and announcement of policies for this sector must address this major issue. Thus policy incentives to increase natural gas supply and promote natural gas domestic consumption should be enacted.

At the same time, given that China has abundant natural gas resources (including conventional and unconventional gas), and that current exploration and development levels are still relatively low, ensuring natural gas supply security requires controlling external reliance on natural gas to a certain level, and therefore increasing natural gas imports to satisfy growing domestic demand for natural gas is not a viable option. A more reasonable policy is, at the same time as expanding natural gas imports, to give greater attention to domestic natural gas production, implementing a principle of "the nation first". In this way, natural gas import growth can be encouraged to satisfy domestic demand while also preventing dependency on imports and as domestic natural gas production volumes quickly rise. Therefore, if import dependency is to be controlled to a reasonable level without inhibiting imports, then creative efforts should be made to increase the domestic production volume—and this will also solve the dilemma caused by domestic natural gas consumption being insufficient. In addition, even at the same level of imports, import methods (import source diversification, contract and pricing diversification) and domestic infrastructure conditions (whether gas reserve and peak shaving capabilities are sufficient, and whether pipeline network facilities are well established) also have an important influence on natural gas supply security.

In summary, China on the one hand needs to enact policies that are supportive and encouraging toward natural gas imports, effectively expanding them and striving to diversify the country's import sources and import modes. On the other hand, it must also focus on expanding domestic production and optimising relevant gas reserves, pipeline networks and other facilities. Therefore, China should take the following attitude toward natural gas import policies in the coming years: prudent encouragement.

2. **Make LNG an integral part of China's natural gas supply**

Given the unique properties of LNG, its flexibility and the natural gas consumption centres nearby China's eastern regions, LNG can be used in peak shaving and complementary approaches. In addition, international experience has shown that connecting Chinese LNG procurement with international markets can introduce and promote competition, which will in turn promote market liberalisation in the China's natural gas market.

In the European Union market, LNG both balances out EU natural gas supply and demand and also balances out global LNG markets. This is beneficial to EU natural gas consumers, and LNG in Chinese markets can play a similar role. LNG can promote market openness while also playing a role in optimising energy structures, giving consumers greater benefits and also prompting further progress in the market liberalisation of the China's natural gas market.

3. **Diversify imported natural gas, encouraging multilateral participation**

China should take measures on the international market for import of natural gas. First, it should include long-term, mid-term, short-term and spot portfolios to facilitate increased flexibility to deal with and control market changes. Second, integration should be achieved with oil indexes and reserve typical diversified pricing indexes. Furthermore, when assessing price competitiveness, full consideration must be given to project risk, commercial structure and other factors, and through rolling contracts suited to one's own supply/demand balance, procurement of LNG can be achieved to relieve risk and achieve a natural gas supply portfolio that is sourced from diverse geographical locations.

At the same time as this, it is important to encourage more large-scale end users to purchase natural gas from international LNG markets. Whether it is power companies or large urban fuel enterprises, all of these will bring benefits to the market. This is because this will help to reduce intermediary stages and improve natural gas value chain efficiency. In order to achieve this goal, it is necessary to have third-party access, which is a key to supporting liberalisation.

4. **Strengthen regulation promoting third-party access**

Policies in the Chinese natural gas trade sector tend, on the whole, to be open and encouraging, though some specific rules still need to become more practical. This openness is clear from policies such as: seeking to diversify the countries imported from; importing more natural gas to resolve the issue of "domestic natural gas consumption being insufficient"; and promoting increased market supply while raising market competitiveness. Therefore, whether it is treating natural gas imports as a commodity, open trade and encouraging third-party access to facilities or VAT rebate discount policies, on the whole, further natural gas imports are being encouraged.

However, in reality, the construction and operation of receiving stations and other facilities have become key influences on natural gas imports. Third-party access has become a core issue affecting Chinese natural gas trade. Based on the current policies, even though there are relevant provisions, there is still a lack of common-sense workability and there is a major doubt as to how effective they will be.

Thus, on the one hand it is important to achieve better standard processes and greater openness and transparency in the approval of building new receiving stations and other facilities. On the other hand, it is necessary to learn

Table 8.5 China's natural gas supply volume (100 billion m^3)

	2015	2020	2030
Conventional gas	1400	1800	2600–2800
Shale natural gas	65	400–600	800–1500
Coalbed methane	45	100–300	400
Coal methane	0	300–600	500–900
Import pipeline	390–420	970	1350–1650
Imported LNG	390–410	700	750
Total	2290–2340	4270–4970	6400–8000

Data source Analysis based on Ministry of Land and Resources and State Council Research Center study results

from international experience in order to bring in rules for third-party access and effectively strengthen the relevant regulation.

8.5 Conclusions for Chinese Natural Gas Supply and Availability

In summarising domestic natural gas production volume and international natural gas available volume, we can come to the following preliminary conclusions:

- **China's natural gas available volume total will rise from 234–239 billion m^3 in 2015 to 425–495 billion m^3 in 2020. The 640–800 billion m^3 in 2030 will be a relatively stable and ample supply**: Specifically, by 2015, the amount is expected to reach 234–239 billion m^3. As part of this, conventional gas production volume will reach 140 billion m^3, shale natural gas will reach 6.5 billion m^3, coalbed methane will reach 4.5 billion m^3, imported pipeline gas will reach 39–42 billion m^3 and imported LNG will reach 39–41 billion m^3.

  By 2020, the amount is expected to reach 425–495 billion m^3. As part of this, conventional gas production volume will reach 180 billion m^3, shale natural gas will reach 40–60 billion m^3, coalbed methane will reach 10–30 billion m^3, coal methane production will reach 30–60 billion m^3, imported pipeline gas will reach 95 billion m^3 and imported LNG will reach 70 billion m^3.

  By 2030, the amount is expected to reach 640–800 billion m^3. As part of this, conventional gas production volume will reach 260–280 billion m^3, shale natural gas will reach 80–150 billion m^3, coalbed methane will reach 40 billion m^3, coal methane production will reach 50–90 billion m^3, imported pipeline gas will reach 135–165 billion m^3 and imported LNG will reach 75 billion m^3.
- **From the perspective of natural gas availability structure, domestic conventional gas proportion will drop, and domestic unconventional gas proportion will rise, with a rise in import pipeline gas and a drop in LNG imports**: In 2015, conventional gas proportion of total production volume availability will reach 60%, while shale natural gas will account for approximately 2.7%, coalbed methane approximately 2%, import pipeline gas approximately 17–18% and imported LNG approximately 17%.

  In 2020, conventional gas proportion of total production volume availability will drop to 36–42%, while shale natural gas will account for approximately 8–13%, coalbed methane approximately 2–7%, coal methane will account for 7–13%, import pipeline gas approximately 19–22% and imported LNG approximately 14–16%.

  In 2030, conventional gas proportion of total production volume availability will be 33–42%, while shale natural gas will account for approximately 11–21%, coalbed methane approximately 4–6%, coal methane will account for 6–13%, import pipeline gas

Table 8.6 2015 China natural gas supply volume and structure

Gas source	Domestic gas (100 million m^3)				Imported gas (100 million m^3)		Remarks
	Conventional natural gas	Shale natural gas	Coal methane	Coalbed methane	LNG	Pipeline gas	
Production volume or import volume	1400	65	45	50	390–410	390–420	
Total	1560				780–830		
	2340–2390						

Data source Integration, analysis, and compilation of study results from the Ministry of Land and Resources and other institutions

Table 8.7 2020 China natural gas supply volume and structure

Gas source	Domestic gas (100 million m^3)				Imported gas (100 million m^3)		Remarks
	Conventional natural gas	Shale natural gas	Coalbed methane	LNG	Pipeline gas	Conventional natural gas	
Production volume or import volume	1800	400–600	100–300	300–600	700	950	
Total	2600–3300				1650		
	4250–4950						

Data source Based on the above analysis and compilation

Table 8.8 2030 China natural gas supply volume and structure

Gas source	Domestic gas (100 million m^3)				Imported gas (100 million m^3)		Remarks
	Conventional natural gas	Shale natural gas	Coalbed methane	LNG	Pipeline gas	Conventional natural gas	
Production volume or import volume	2600–2800	800–1500	400	500–900	750	1350–1650	
Total	4300–5600				2100–2400		
	6400–8000						

approximately 18–25% and imported LNG approximately 9–12%.

- **From the perspective of foreign reliance, China's reliance on foreign natural gas will continue to rise significantly and be controlled to within 36% by 2030**: In 2015, China's reliance on foreign natural gas was approximately 33–35%, while in 2020 that number will reach approximately 33–39%. If domestic natural gas, especially shale natural gas, production volume achieves major increases through breakthroughs in technology or policy, then in 2030 China's foreign reliance in natural gas will be at approximately 27–36%. Namely, by 2030, China's reliance on foreign natural gas can be controlled within 36%. However, the prerequisite is that domestic natural gas production, especially unconventional natural gas, sees a breakthrough increase (Tables 8.5, 8.6, 8.7 and 8.8).

Case 9: Global natural gas/LNG market outlook

1. **Global energy and natural gas market development**

Global energy demand is continuing to rapidly grow, especially in nations and regions outside of OECD countries. As populations quickly grow and economies flourish, people have more numerous channels through which to obtain reliable power supply, and this will cause demand to grow for energy across the world by 50% from 2010 to 2050 (Shell 2014).

In the past several decades, natural gas has consistently been one of the fastest growing energies. From 2005 to 2014, average annual growth maintained at approximately 2.7% (BP 2014). Currently it is commonly recognised that up to 2030, natural gas demand will maintain annual average growth rates of 2% (IEA, Current Policies Outlook). Global natural gas resource reserves are massive and broadly distributed, and at current production speeds can be used for more than 200 years.

With the exception of the United States, growth in unconventional resources in other countries is very uncertain, because these countries have very little or no momentum toward production. Argentina (23 trillion m^3; source: US Energy Information Administration) could have the best development conditions, but faces severe financial and non-technical risk limitations.

Even though, according to the US EIA, China has approximately 32 trillion m^3 of unconventional resources, the Chinese government recently adjusted its recent development expectations for shale natural gas downward by half, and thus China's energy growth could be reduced. (China's natural gas is distributed across 500 basins, but because there are currently only a few companies, and there is a lack of international company involvement in this sector to carry out development, complex terrain, costs, infrastructure construction, waste water treatment and technical innovation insufficiencies and other problems are faced).

The national authorities and relevant policies will affect long-term LNG demand growth, and it is not a case of simple determination of project cycle costs, especially in Europe and Asia. Policymakers incorporate four aspects into energy policy portfolios, namely energy security, cost and competitiveness, environment and health, and energy availability. The choices they make will determine the energy structure of nations and regions.

This means that even though broad areas have become homogenous in terms of energy growth, nonetheless local and short-term dynamic factors have a high degree of uncertainty and changes are occurring rapidly.

2. **Global LNG market outlook**

Since 2000, global LNG demand has grown at a rate of approximately 5%, and this trend will continue for the foreseeable future (BP 2014).

In the past 10 years, there have been 31 nations engaged in LNG imports, and 27 nations engaged in export. Therefore, LNG demand and supply has enormously diversified, and estimates are that in the next 10 years, LNG demand nations and supply nations will grow respectively to 50 and 25.

Looking to the long term, LNG growth in demand will primarily come from Asian emerging markets (in particular China, India, and south-east Asia) and Europe. Even though LNG is only in early stages of development in the transportation sector, nonetheless LNG has major potential to become an important niche market.

Japan, South Korea and Taiwan currently account for approximately 60% of

the global LNG market, and will continue to be a major demand centre in a moving world. Even though as nuclear power returns and renewable energy develops (especially solar power) Japan's demand for LNG will be limited, LNG demand will still continue to remain at a high level. Another uncertainty is future degree of market liberalisation.

In south-east Asia and India, because domestic gas reserves are declining, and because electricity and other industries are increasing demand for LNG, south-east Asia and India LNG demand will increase further. The major uncertainty in this region is price tolerance and the infrastructure construction needed for import and shipping of LNG.

China's policy to increase natural gas market share is critical. Given China's released policies for pollution control and GDP growth, China has already and will continue to become a market with rapid growth in natural gas. China has the potential to influence global market balance and price levels. Uncertainties are potential slowdowns in GDP growth, as well as degree of implementation of ambitious policies.

With regard to Europe, in addition to local production and pipeline import energy, LNG offers flexible supply. Europe has ample regasification capabilities (in 2013 for each 140 mtpa, 40 mtpa could be produced), and the region could become a flexible market for LNG. Europe's LNG used in transportation sectors has potential for growth, especially in marine shipping, because strict air quality laws will drive a fuel switch.

From 2010 to 2013, Europe's economic growth slowed, and with cheap American coal and significant subsidies in Europe for renewable energy development, natural gas demand in Europe was pushed lower. Even though to a certain degree the factors causing this reduction will exist in the long term, European market natural gas demand could still rebound, with the precondition being reduced import of coal and reductions in subsidies supporting renewable energy growth.

3. **Global LNG supply**

By 2030, the United States, Australia, and Eastern Africa LNG supply will account for over 80% of total supply (source: 2015 Shell analysis).

- North America has already proposed utilising its over 6 million tons/year production capacity for LNG export (shared equally between the United States and Canada).
- A total of over 44 million tons/year of natural gas has already received a final investment decision and is under construction (locations all in the United States). North American natural gas supply quantities rely upon permits, financing, construction costs and speed.

Russia and Australia have a potential new project list. Cost increases and non-technical risks have slowed the progress of many projects. In addition, sanctions could delay or destroy the Russia's LNG plans.

Eastern Africa (primarily Mozambique and Nigeria) could in the next 10 years become new gas supply sources. Challenges faced include the fact that Eastern Africa has large swathes of undeveloped regions, and the majority of companies are not LNG companies with stable market presence.

- Nigeria's non-technical risks (such as political, regulatory and financial uncertainties, damage risks and domestic power demand) continue to represent the major obstacles to LNG supply growth.
- Due to domestic market demand, Egypt has seen a reduction to zero LNG

exports, and will even need to import LNG. Egypt is currently actively seeking LNG exporters (and has already signed contracts with Algeria's Sonatrach and Russia's Gazprom; additional natural gas supply could come from Israel or international enterprises).

- Qatar has not yet clarified its direction post-2016 for its northern oil fields, and thus there exists some supply uncertainty. Despite this, Qatar has 77 mtpa of LNG supply capability, and because it is equidistant from Europe and Asia, it will continue to hold an important price-determining position.
- For Middle Eastern regions, the removal of sanctions on Iran could bring about major effects, and natural gas supply is able to catch up to domestic demand growth. Therefore, LNG imports will be incorporated into planning.

4. **A focus on North American markets**

The United States was once one of Shell's largest markets, and now is preparing to export LNG. Potential export projects have not been announced for 300 mtpa in the United States and over 130 mtpa in Canada.

Initial project liquefaction costs will be relatively "low" (approximately $3.5/MMBtu) (addition of LNG import end), but subsequent costs will successively rise (we have already seen the initial price of <$3/MMBtu rise to the current quote of >$4/MMBtu) (Fig 8.15).

Such projects are equivalent to traditional Asia Pacific project levels, and are even at HH$4/MMBtu.

Other barriers are: approval, construction speed, construction costs (labour) and users seeking resource portfolios (if major Asia Pacific users restrict North American project development risks to 20–30%, then this will turn into 100 mtpa supply).

However, the former view of American LNG being "cheap" has changed, as oil prices have significantly dropped. Add to this the market uncertainty (for example Japan's deregulation of electricity), and this has caused users to limit LNG investment portfolio Henry Hub quoted supply volumes.

Therefore, when users are unwilling to sign large volumes of Henry Hub quoted long-term agreements, project final investment decisions will face major challenges, because final project investment decisions require the support of long-term agreements.

5. **Global LNG market is more active**

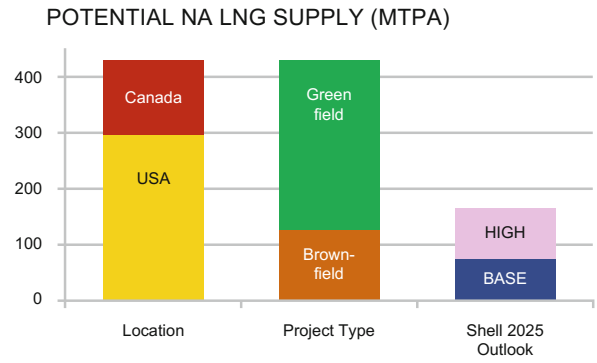
We have seen continuous increases in the market share held by natural gas in fundamental energy. Other energy industries are continually growing, but natural gas growth rates have been faster. We expect that in the next 20 years, global natural gas demand will grow at an annual rate of 2–3% (Fig. 8.16).

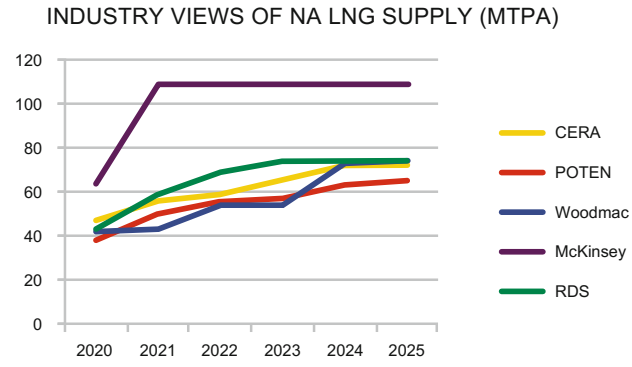
As natural gas usage increases, cross-border natural gas trade using pipelines and LNG will continue to increase.

The growth in natural gas trade requires that natural gas import and export infrastructure continue to receive investment.

Large new pipeline projects are continually achieving progress. For example, last year an early announcement was made of the Sino-Russian natural gas pipeline export project having early stage shipping volume that should reach 38 billion m^3/year, with the possibility of further increases. LNG has also become a major part of natural gas trade. Currently, LNG accounted for 10% of natural gas trade, and this will rise to 15% by 2025.

In recent years, LNG supply and demand has markedly diversified. There are now 30 LNG importing nations and 20 exporting nations, with this expected to change in the next decade to 50 LNG





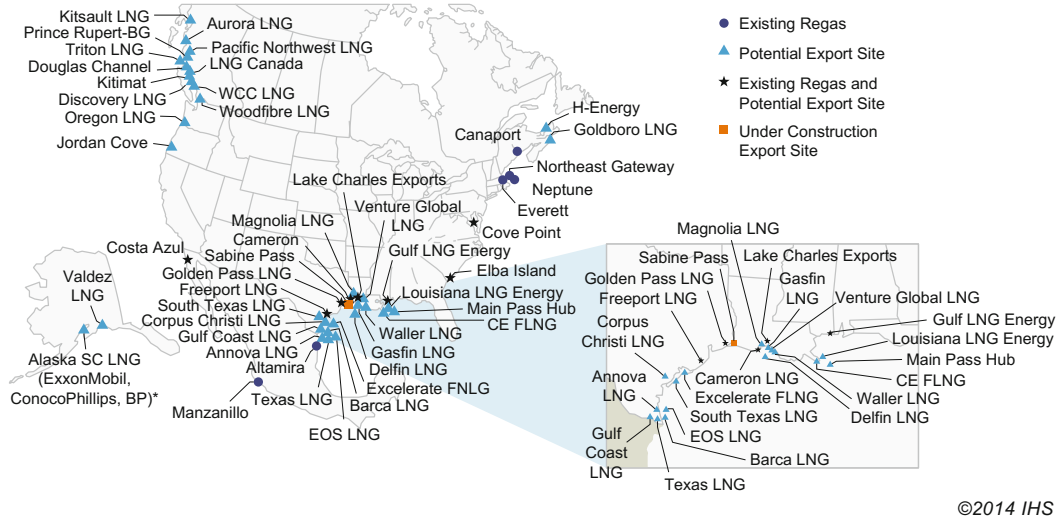


Fig. 8.15 North American LNG supply. *Source* IHS Cera. * Potentially located near Valdez

exporting nations and 25 importing nations. This is different from the situation in the 1990s when the global LNG market was only 50 million tons per year, and there were only eight exporting nations and nine importing nations.

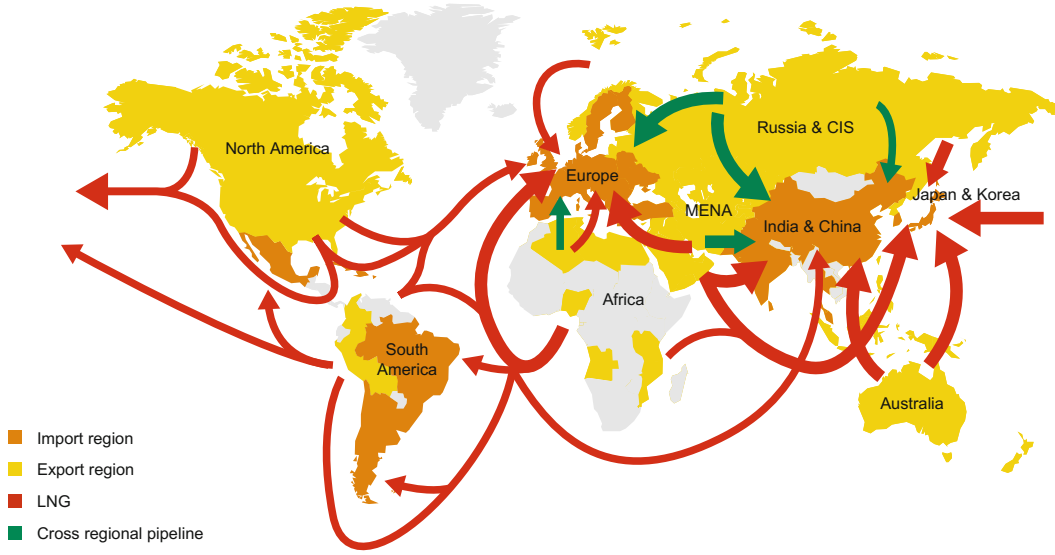


Fig. 8.16 Global natural gas import and export

From now until 2025, a major change will occur as North America rises as a substantive natural gas exporting region.

6. **Recommendations for China**

(I) **Multiple supply channels to ensure energy supply security**

In the past decade, China's natural gas consumption volume growth has been fierce, and in 2014 reached 183 billion m^3. In addition, natural gas supply has comprised domestic supply, pipeline natural gas imports and liquefied oil and gas imports. This shows that diversified supplies are an important guarantee for energy security. In the next decade, the government has designated the natural gas portion of energy structure to grow from 4% to over 10%. This will require multiple supply channels to satisfy market demand. Furthermore, considering the market scale at that time, the wide diversity of supply channels will play an important role in guaranteeing energy security.

In the north-east Asian regions of Japan and South Korea, reliance is on single natural gas supply sources, and this is markedly different from China. Precisely because of this diversity in supply portfolios, China enjoys benefits when procuring natural gas from international markets, ultimately helping Chinese consumers.

(II) **LNG's unique role makes it an integral part of China's natural gas supply portfolio**

Considering that China has constructed import channels to import natural gas via pipeline corridors (whether it be from Western Central Asia, Eastern and Western Russia or south-western Myanmar), and these are maturing by the day, this case study focuses on the possible choice of LNG as a supply source on the international market.

Given that LNG has the unique properties of being flexible and near to the eastern consumption centres, LNG can play a unique role in peak shavings and as a complement to pipeline gas.

In addition, prior experience has shown that because Chinese LNG procurement is directly linked to international markets,

this can introduce and promote competition, through which Chinese natural gas liberalisation can be catalysed.

Previously we have discussed the role of LNG in EU markets. On the one hand it balances out EU natural gas supply, while on the other it balances out the global LNG market, benefiting natural gas consumers in the European Union. We have reason to believe that LNG can also play a similar role in the Chinese market, but it is important to realise that the reason that LNG could play such a role in the EU was because of the historical progress of market liberalisation. Therefore, we would say that LNG on the one hand can promote market opening, bringing benefits to consumers, while on the other hand it can also assist as China completes the liberalisation of its natural gas market.

(III) **LNG procurement considerations**

By observing similar markets, it is possible to obtain some lessons:

1. Experienced LNG buyers on international markets often have a diversified portfolio, including long-term, medium-term, short-term and spot portfolios to facilitate improvements to flexibility and to meet market changes. They also have a connection to oil indexes or a hub as a platform of diversified pricing mechanisms, because when the market changes, for example when oil prices change, the price competitiveness of each sales and purchase agreement will likewise change. In addition, when assessing price competitiveness, it is necessary to wholly consider project risk, commercial structure and other factors, thus avoiding only considering price labels, otherwise it is not a valid comparison. LNG supply portfolios must have a diversity of geographical sources. Another commonly made error is to believe one is smarter than the market and able to manipulate the market. Therefore, a commonly seen method of risk avoidance is to procure LNG through rolling windows to satisfy one's own supply and demand balances.
2. If more numerous large end users can purchase natural gas from international LNG markets, whether it be power companies or large urban fuel enterprises, this would bring benefits to the market. This is because such actions help to reduce intermediary stages and make the natural gas value chain more efficient. To achieve this, though, third-party access is needed, and this is a key factor to supporting progress in liberalisation. We are very happy to see companies such as Huadian becoming active in the realm of liberalisation.
3. However, this is not to say that every enterprise should be encouraged to establish its own receiving terminal and carry out importing, since this would cause a large quantity of infrastructure to be less than amply utilised, resulting in price wars and ultimately harming the sustainable and healthy development of natural gas markets. In this regard, we recommend that managers make adjustments through formulation of game rules rather than artificial controls.
4. As regards the game rules for the natural gas sector, including natural gas pipeline networks and receiving station infrastructure, management standards are extremely important. This is because as pipeline network standardisation becomes more mature and plays a greater role, it will increase natural gas value chain transparency, thus improving market efficiency. Taking the European Union as a typical mature market, they primarily use the following typical pipeline management rules

to manage major issues: (a) requiring non-discriminatory third-party access rule restrictions; (b) capacity auctions, balance, pricing, distribution and receipt issuance; (c) holding full negotiations; (d) natural gas delivery pipeline network capacity release and price schedules; (e) auction trades held in secondary markets; (f) separation of input/output, separation of capacity/commodity; (g) third-party access to receiving stations, gas storage, and pipeline networks, whether it be established through bilateral negotiations or based on TPAs.

5. Maintaining natural gas/fuel oil portfolios is also of assistance, because this will enable natural gas users to optimise gas portfolios through switching, thus avoiding gas users seeking to resolve all problems through LNG SPA, which pushes LNG purchase contract negotiations into a stalemate.

Case 10: China international pipeline natural gas imports

China has an advantageous geographical location for pipeline natural gas imports, with Russia to its north, central Asia (especially Turkmenistan) to its west and south-east Asia (especially Myanmar). Existing and planned import pipeline capacity is approaching 190–200 billion m^3/year, which is likely to be one quarter to one third of the natural gas consumption volume of China expected in 2030.

Pipeline gas imports are one of the three main supply sources for China, with the other two being domestic natural gas production and LNG imports (respectively having multiple supply channels). These three fundamentals ensure China's natural gas supply while also forming competition with regard to baseline prices, thus satisfying the natural gas demand that continues to grow in China.

Regarding the greatest factors of uncertainty for these international natural gas pipeline imports, they are as follows:

1. Russia's natural gas supply base for the east-west line.
2. Whether Russian companies have the ability to develop the eastern Siberian natural gas field and create natural gas pipelines and deliver natural gas within the promised timeframe. Given that the United States and European Union are implementing sanctions on Russia, this is especially critical.
3. In order to enrich client groups, what decisions will Turkmenistan make? For example, participating in the Turkmenistan-Afghanistan-Pakistan-India (TAPI) natural gas pipeline and/or overcoming legal and political difficulties to co-operate with Azerbaijan and directly supply Turkmenistan natural gas to Europe through Azerbaijan and Turkey.

1. **Pipeline natural gas import sources**

As can be seen from Table 8.9, the world has 14 nations whose conventional natural gas reserves exceed 100 trillion m^3, and based on its advantageous geographical location, China can import natural gas from essentially any country.

Currently, Iran, which is subject to United Nations sanctions, has the largest proved natural gas reserves in the world, with proved conventional natural gas reserves of nearly 120 trillion m^3. If developed, Iran will very likely become like Qatar, another LNG and unconventional natural gas supplier to China.

Russia and Turkmenistan have natural gas resource reserves that respectively rank second and fourth globally. Russia

Table 8.9 Most proved conventional natural gas reserves by country

	Proved reserve quantity		2013 production volume	R/P
	Trillion m^3	Trillion $feet^3$	1 billion m^3/year	Year
Iran	33.8	1193	167	202
Russia	31.3	1104	605	52
Qatar	24.7	872	159	155
Turkmenistan	17.5	617	62	282
United States	9.3	330	688	14
Saudi Arabia	8.2	291	103	80
UAR	6.1	215	56	109
Venezuela	5.6	197	28	199
Nigeria	5.1	179	36	141
Algeria	4.5	159	79	57
Australia	3.7	130	43	86
Iraq	3.6	127	0.6	5980
China	3.3	116	117	28
Indonesia	2.9	103	70	42

Source BP Data Review (2014) (only conventional natural gas)

produces 605 billion m^3 of natural gas each year, to satisfy enormous domestic demand and to meet 30% of Europe's demand for natural gas. Their reserve mining term is 52 years, which is relatively short compared to other major natural gas resource reserve nations. Russia has also promised to supply China with nearly 90 billion m^3 of natural gas per year through the Eastern and Western lines. In doing so, unless new resources are discovered, Russia's reserve mining term will be markedly shortened. This could perhaps explain why Russia is so urgently wishing to develop unconventional natural gas, including its domestic coalbed methane and shale natural gas.

In comparison, the landlocked Turkmenistan has 617 trillion m^3 of proved natural gas and over 280 years of natural gas reserves to mine. It is also very likely to enrich its own natural gas demand market, supplying natural gas to China, Russia and Iran. Two considerations for the future are worth noting:

- TAPI can provide natural gas to two countries with major populations—India and Pakistan. According to previous reports, Chevron and other US companies are looking to join this plan, and recent reports show that French company Total might also participate in relevant discussions.
- The European Union urgently wishes to increase its supply diversity, and the pipeline through TAPI is one important potential source. The European Union, including Vice President of the European Commission Maroš Šefčovič, is actively encouraging Turkmenistan to plan out this pipeline (Financial Times 2015), despite the fact that in the short term there are many legal and political roadblocks to its achievement. If the TAPI pipeline is realised, Europe and China could face direct price competition/connectivity.

Kazakhstan and Uzbekistan and other central Asian nations are not major natural gas reserve nations, and in the foreseeable

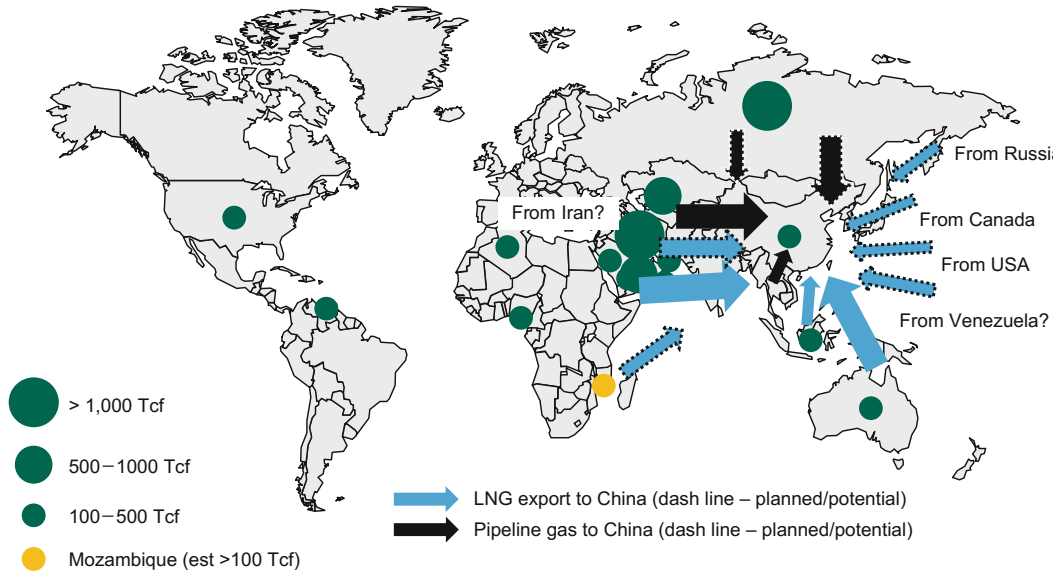


Fig. 8.17 Major natural gas resource reserve nations and China's potential natural gas export nations

Table 8.10 China's existing and planned natural gas import pipelines

	Capacity (1 billion m^3)	Announced term	PFC expected time	Remarks
Imported natural gas pipelines (operation)				
Central Asia natural gas pipeline Line A	15	2009		
Central Asia natural gas pipeline Line B	15	2010		
Myanmar-China 1	12	2013	Not yet at full load operations (>50% idle capacity)	
Sub-total	42			
Imported natural gas pipelines (planned)				
Central Asia natural gas pipeline Line C	25	2014		10 billion m^3 comes from Turkmenistan, 10 billion comes from Uzbekistan, and 5 billion comes from Kazakhstan
Central Asia natural gas pipeline Line D	30	2016	2017	
Siberian pipeline	38	2018	2021	Signed natural gas export agreement. Under construction
Siberian pipeline extension	30			
Azerbaijan (West Line)	30			Signed memorandum
Kazakhstan–China	5			
Myanmar–China 2	7			
Sub-total	165			
Pipeline import capacity total	207			

Source WoodMac, HIS. Basic arrangement by study group

future there is still limited possibility for them to become natural gas pipeline supply nations to China.

In south-east Asia, Myanmar is currently supplying approximately 5 billion m^3 of natural gas per year to China through Yunnan. Likewise lacking in natural gas are south-east Asian nations, and Myanmar is currently supplying Thailand with pipeline gas. Recently, Myanmar successfully obtained a deep sea oil tender, attracting the attention of large transnational companies. According to geological analysis, these deep sea regions have the potential to have more natural gas than oil. In the next 5–10 years, could Myanmar find a large quantity (larger than 1 trillion m^3) of deep sea natural gas to become the Mozambique of Asia? If it does happen, China should consider making Myanmar's (deep sea) natural gas another source of pipeline delivery. It could necessitate a round of competition, with Myanmar perhaps hoping to develop other LNG markets in Asia to improve its own export capabilities in LNG, for example Japan and South Korea, so as to expand its buyer nation group.

2. **Existing and planned natural gas import pipelines**

Table 2.16 lists the import natural gas pipelines from Russia, Central Asia and Myanmar to China. Currently, China's pipeline import capacity is approximately 40 billion m^3/year, but this is not to say that each line is always at capacity. In 2013, China's pipeline import volume was approximately 25 billion m^3, accounting for approximately 15% of China's natural gas consumption of 166 billion m^3.

Once they are fully completed, these pipelines will have total capacity of nearly 200 billion m^3/year, and will account for one quarter to one third of all of China's estimated natural gas consumption by 2030. Therefore, the focus of the 13th Five-Year Plan may not be confirming added pipeline natural gas import volume, but joint efforts with Turkmenistan, Russia and Myanmar to ensure that these projects can be completed on time so that China can import pipeline natural gas at a competitive price (Fig. 8.17, Table 8.10).