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China's Natural Gas: Uncertainty for Markets

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Summary

China could potentially be a much larger producer and consumer of natural gas than it is now. Despite China's pollution problems and international environmental commitments, the role of natural gas in China's energy mix remains relatively low, particularly compared to the United States. China has announced big plans for its natural gas development and use, but the changes will require significant investment in exploration, production, infrastructure, and consumption. With a slowing economy, China may not be in a position in the short-term to undertake these investments.

China's natural gas plans have implications for a number of issues in which Congress has expressed a strong interest. Those issues include the prospects for U.S. hydrocarbon exports to China, prospects for U.S. energy companies' investments in China, Chinese investment in the U.S. energy sector, China's ability to meet its global commitments to reduce greenhouse gas emissions in order to combat climate change, and China's plans for disputed waters in the South China Sea, which may contain hydrocarbon resources, among other topics.

In the 114th Congress, Members have expressed interest in Chinese policy related to natural gas in hearings, such as the Senate Committee on Energy and Natural Resources' January 2015 hearing on S. 33, The LNG Permitting Certainty and Transparency Act, and the same committee's February 2015 hearing on The Fiscal Year 2016 Budget Request for the U.S. Department of Energy.

China's energy sector, including its natural gas industry, is controlled by the government via the National Development and Reform Commission's National Energy Administration and other regulatory and planning bodies. There are three main national energy companies—China National Petroleum Corporation (CNPC), China Petrochemical Corporation (Sinopec), and China National Offshore Oil Company (CNOOC). The first two are among the world's largest energy companies. These companies are the primary actors domestically and internationally.

China has made significant strides in diversifying its natural gas supplies. Domestic production rose 164% from 2004 to 2014, to 135 billion cubic meters (BCM). Natural gas imports, which did not begin until 2006, grew from one BCM that year to over 58 BCM in 2014. With its imports split almost evenly between pipeline and liquefied natural gas (LNG), China is the fourth largest natural gas importer in the world, with Turkmenistan supplying just under half of its imports.

Growth in China's demand for natural gas has slowed in recent years. State media reported that annual consumption in 2015 was 191 BCM, up 3.7% from 2014. This represented the lowest rate of annual growth in a decade. China's government expects its overall energy consumption to grow in 2016, and for natural gas to rise to 6.2% of primary energy needs, from 6% in 2014. Part of the slowdown in consumption growth is attributed to the slowing economy. In November 2015, China cut natural gas prices to spur demand.

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Introduction: Potential Is the Key Word¹

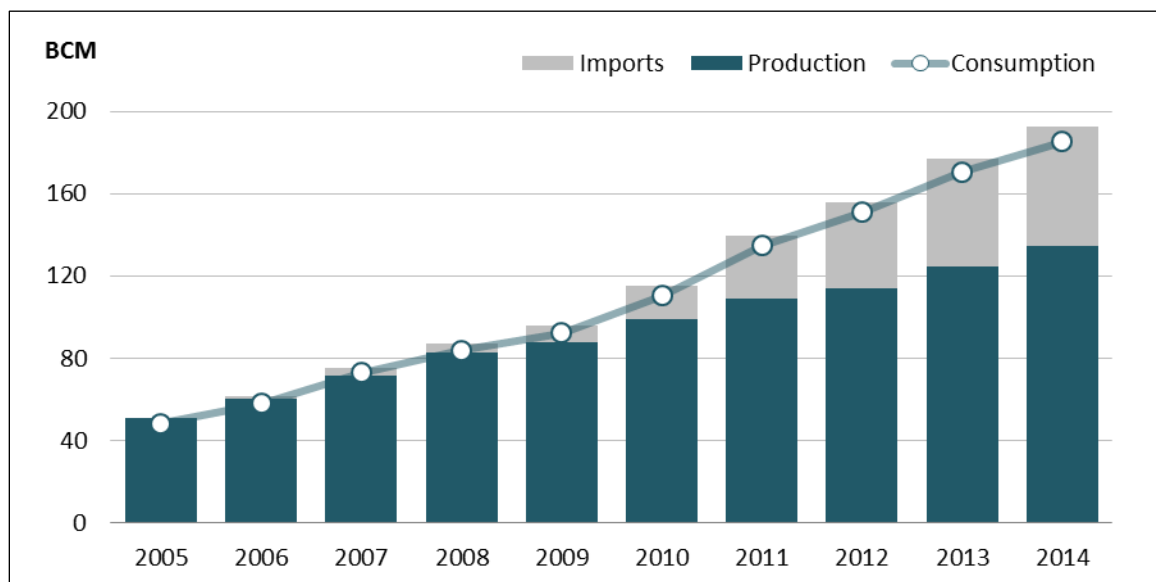
When it comes to global supply and demand for natural gas, China is the main wildcard. China is the sixth largest natural gas producer in the world, with its production almost tripling over the course of 2005-2014 (see **Figure 1**). Its natural gas resource base is large, and its shale gas endowment is estimated to be nearly double that of the United States.² China's production is currently less than 20% of U.S. natural gas production. This is partly due to its geology, regulatory regime, and a lack of technical skills, all of which make it difficult to bring natural gas to market, among other issues (see "Domestic Industry Concerns"). Natural gas is dwarfed by coal as a primary source of energy in China (see **Figure 2**). China is the largest producer and consumer of coal in the world, producing three times and consuming four times as much as the United States, the next country in both respects. The interests of the coal industry play a significant role in Chinese energy policy at the national, provincial, and local levels of government.

In 2014, China ranked third in global liquefied natural gas (LNG) imports behind Japan and South Korea, which are both relatively established markets compared to China. China ranked sixth for pipeline imports. Central Asia, especially Turkmenistan, is China's main source of pipeline imports of natural gas. China has built a large amount of LNG import capacity to add to its import pipelines. With major LNG export projects in Australia and the United States coming online by the end of the decade, China should be in a good position to take advantage of a potential supply glut. If China can ramp up its natural gas production, especially its unconventional resources, foreign export projects targeting China's natural gas market may face a dilemma similar to that faced by those constructed to supply the U.S. market prior to the advent of shale gas—displacement by domestic supplies.

¹ For this report, the Hong Kong and Macau Special Administrative Regions of China are not included in the analysis or data as part of China. Units in this report are in billion cubic meters (BCM). One cubic meter of natural gas is equivalent to 35.3 cubic feet.

² Energy Information Administration, "World Shale Resource Assessments," September 24, 2015, <https://www.eia.gov/analysis/studies/worldshalegas>.

Figure 1. China's Production, Imports, and Consumption of Natural Gas
2005-2014

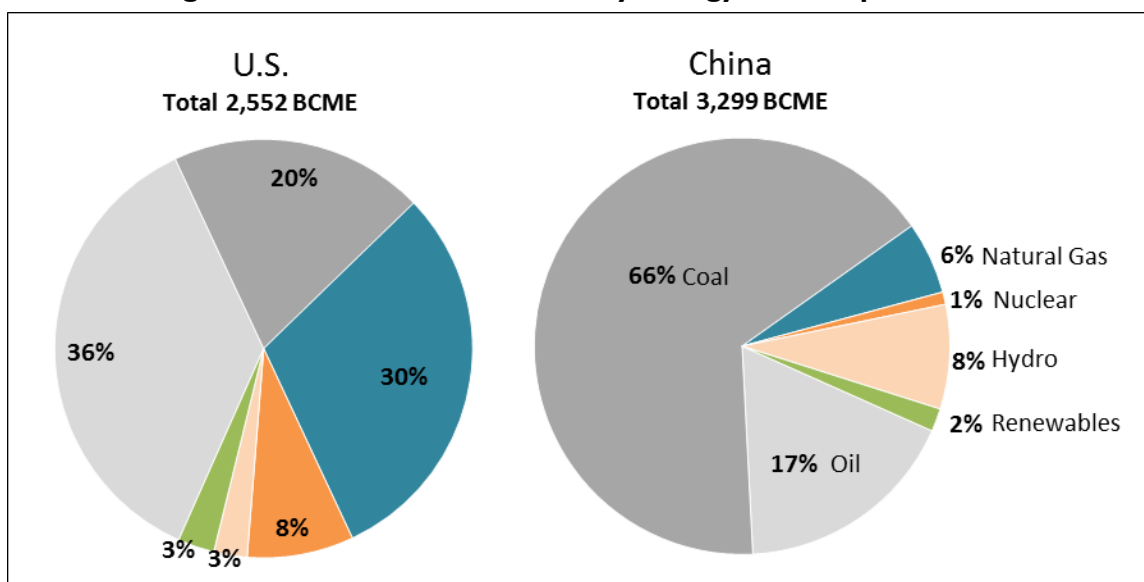


Source: Data from BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>. Graphic by CRS.

Notes: Units = billion cubic meters (BCM).

On the consumption side, China is the third largest consumer of natural gas behind the United States and Russia, which are also the two largest natural gas producers, respectively. China has added more new demand over the last ten years than any other country. Yet, natural gas made up only 6% of China's primary energy consumption in 2014 (see **Figure 2**), while natural gas accounted for 30% of the U.S. fuel mix.³

³ The BP Statistical Review of World Energy defines primary energy as commercially-traded fuels, including modern renewables used to generate electricity.

Figure 2. U.S. and Chinese Primary Energy Consumption, 2014

Source: BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>.

Notes: Units = billion cubic meters of natural gas equivalent (BCME).

Issues for Congress

China's natural gas plans have implications for a number of issues in which Congress has expressed a strong interest. Those issues include the following:

- The prospects for U.S. energy exports, including exports of natural gas⁴ and coal⁵;
- Prospects for U.S. energy companies' investments in China;
- Chinese investment in the U.S. energy sector;
- Manufacturing competitiveness between the United States and China;⁶
- China's ability to meet its global commitments to reduce greenhouse gas emissions in order to combat climate change;⁷

⁴ For additional information on LNG exports see CRS Report R42074, *U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes*, by Michael Ratner et al.

⁵ For additional information on coal exports see CRS Report R43198, *U.S. Coal Exports*, coordinated by Marc Humphries.

⁶ For additional information on China's manufacturing and other economic issues see CRS Report RL33534, *China's Economic Rise: History, Trends, Challenges, and Implications for the United States*, by Wayne M. Morrison.

⁷ Recent hearings on China and climate change include an October 2015 hearing before the House Committee on Foreign Affairs, Subcommittee on Asia and the Pacific. Subcommittee Chairman Matt Salmon stated with regard to President Xi's 2015 state visit to Washington, DC: "I am concerned about the climate deal, however, which signs U.S. businesses up to strictly adhere to environmental standards while China is not obligated to implement any reforms at all until 2030." See U.S. Congress, House Committee on Foreign Affairs, Subcommittee on Asia and the Pacific, *Reviewing President Xi's State Visit*, October 7, 2015, <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg96907/pdf/CHRG-114hhrg96907.pdf>.

- China's ability to reduce the severe air pollution that hangs over parts of the country, and thus reduce the airborne pollutants that have been shown to travel from China to the west coast of the United States;⁸
- China's political and economic relationships with such regions as Central Asia, a major supplier of natural gas to China via pipelines, and the Middle East, currently a major supplier of oil and LNG to China;
- China's plans for disputed waters in the South China Sea, which may contain significant hydrocarbon resources;⁹ and
- China's management of its energy-rich but troubled Xinjiang region, which has a large ethnic Turkic population and has been the subject of human rights concerns from governments and groups outside China, and of Chinese government concerns about separatism, terrorism, and religious extremism.¹⁰

In addition, Congress has oversight and appropriations roles related to U.S. dialogues and other cooperation with China on natural gas issues. Agencies involved in those efforts include the U.S. Department of Energy, the U.S. Department of State, and the U.S. Trade and Development Agency.

In the 114th Congress, Members have expressed interest in Chinese policy related to natural gas in hearings, such as the Senate Committee on Energy and Natural Resources' January 2015 hearing on S. 33, The LNG Permitting Certainty and Transparency Act,¹¹ and the same committee's February 2015 hearing on The Fiscal Year 2016 Budget Request for the U.S. Department of Energy.¹²

Background: Big Plans for Natural Gas

China has struggled to manage serious environmental problems caused, in part, by its longtime reliance on coal for electric power. To address air pollution and to meet recent global commitments it has made to reduce its greenhouse gas (GHG) emissions, China has prioritized expanding consumption of cleaner energy sources, including natural gas. Under China's Energy Development Strategy Action Plan for 2014-2020, natural gas is targeted to make up at least 10% of energy consumption by 2020, with coal's percentage dropping from 66% (2014) to 62%.¹³ The

⁸ Nicole Ngo, Xiaojia Bao, and Nan Zhong, "Panel Paper: The Environmental and Health Impacts of Transboundary Air Pollution from China to the U.S.," Miami, FL, November 13, 2015, <https://appam.confex.com/appam/2015/webprogram/Paper12766.html>.

⁹ U.S. Congress, House Committee on Foreign Affairs, Subcommittee on Asia and the Pacific, *America's Security Role in the South China Sea*, July 23, 2015, <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg95637/pdf/CHRG-114hhrg95637.pdf>.

¹⁰ U.S. Congress, Congressional-Executive Commission on China, *Annual Report 2015*, October 8, 2015, <https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg96106/pdf/CHRG-114hhrg96106.pdf>.

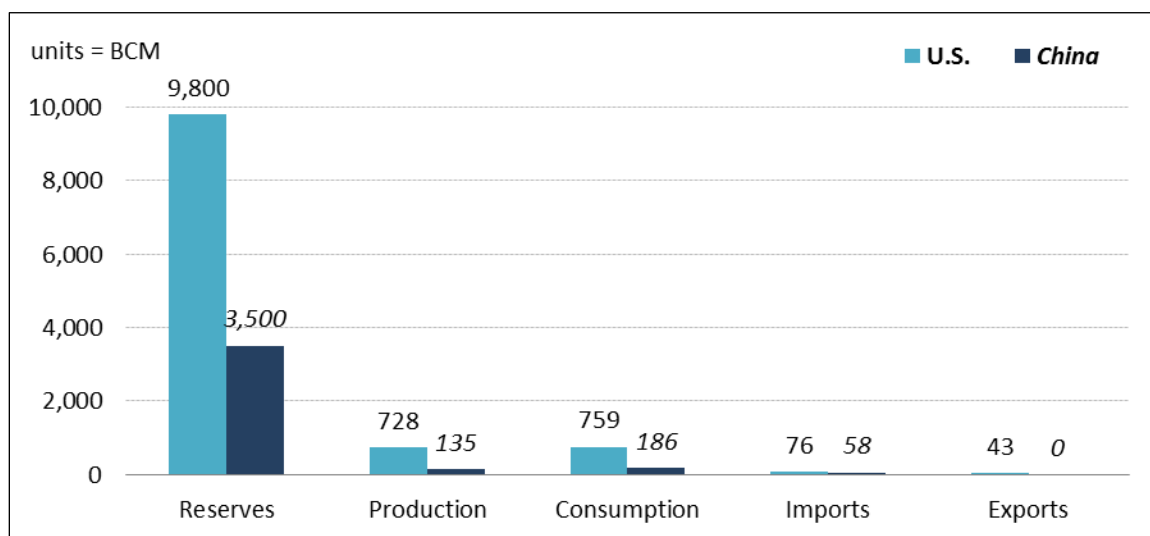
¹¹ U.S. Congress, Senate Committee on Energy and Natural Resources, S. 33, *The LNG Permitting Certainty and Transparency Act*, 114th Cong., 1st sess., January 29, 2015, S. Hrg. 114-9 (Washington: GPO, 2015), pp. <https://www.gpo.gov/fdsys/pkg/CHRG-114shrg93179/pdf/CHRG-114shrg93179.pdf>.

¹² U.S. Congress, Senate Committee on Energy and Natural Resources, *The Fiscal Year 2016 Budget Request for the U.S. Department of Energy*, 114th Cong., 1st sess., February 12, 2015, S. Hrg. 114-44 (Washington: GPO, 2015), pp. <https://www.gpo.gov/fdsys/pkg/CHRG-114shrg94045/pdf/CHRG-114shrg94045.pdf>.

¹³ "国务院办公厅关于印发能源发展战略行动计划（2014-2020年）的通知" ("State Council General Office Notification of Publication Related to 2014-2020 Energy Development Strategic Action Plan") (in Chinese) State Council of the People's Republic of China, June 7, 2014, http://www.gov.cn/zhengce/content/2014-11/19/content_9222.htm.

previous energy plan set 2015 targets under which natural gas was to make up 7.5% of energy consumption and coal was to drop to 65%.¹⁴ These targets were not achieved.

Figure 3. United States/China Natural Gas Data Comparison, 2014



Source: Data from BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>. Graphic by CRS.

Notes: Units = billion cubic meters (BCM). Reserve is an industry term that refers to an amount of natural gas that can be produced with a high degree of certainty, and with existing technology and market conditions.

By 2025, energy firm BP projects that natural gas consumption in China will reach almost 400 billion cubic meters (BCM), more than double China's estimated 2015 natural gas consumption of 191 BCM.¹⁵ If consumption does grow at those rates, in addition to increasing natural gas production, China will need to invest in the requisite infrastructure to transport and consume greater natural gas volumes, including shipping terminals, pipelines, and natural gas power plants. **Figure 3** shows where China stood compared to the United States regarding proved reserves, supply sources, and usage in 2014.

Key Chinese Government Agencies and Companies

The National Development and Reform Commission (NDRC) is China's most powerful economic agency, focused on macroeconomic planning. It is part of the State Council, China's cabinet.¹⁶ The NDRC houses the National Energy Administration (NEA), which is tasked with formulating and implementing industrial policy in the energy sector.¹⁷ In addition to the NEA, several other government agencies play a role in the Chinese gas industry:

¹⁴ “国务院关于印发能源发展“十二五”规划的通知” (“State Council Notification of Publication Related to Energy Development 12th Five-Year Plan”) (in Chinese) State Council of the People's Republic of China, January 23, 2013: http://www.gov.cn/jwqk/2013-01/23/content_2318554.htm.

¹⁵ “China's Natural Gas Consumption in 2015 Hits Lowest Growth Rate in 10 Years,” *Xinhua*, February 10, 2016: http://news.xinhuanet.com/2016-02/10/c_1118018340.htm.

¹⁶ For additional information on China's political hierarchy see CRS Report R43303, *China's Political Institutions and Leaders in Charts*, by Susan V. Lawrence.

¹⁷ National Development and Reform Commission of China, “Main Functions of Departments of the NDRC,” December 18, 2008: http://en.ndrc.gov.cn/mfod/200812/t20081218_252224.html.

- The Ministry of Commerce (MOC) is responsible for negotiations on international trade and economic issues, such as the construction of gas pipelines in Central Asia, Burma, and Russia.¹⁸
- The Ministry of Land and Resources (MLR) controls land-access rights and in the past has held auctions for shale gas exploration rights.¹⁹
- The Ministry of Finance (MOF) administers a program that subsidizes the development of shale gas fields. In April 2015, the MOF announced a five-year renewal of this program, but with reductions in the per-cubic meter subsidy planned depending upon how the industry develops.²⁰
- The Ministry of Environmental Protection (MEP) has historically had limited authority within China's energy sector, but the central government may be seeking to expand the agency's mandate.²¹
- Provincial and local governments regulate end-user gas prices beyond the "city-gate," the point where natural gas is distributed to consumers.²²

Big Three Oil Companies

The Chinese gas industry is dominated by the so-called "three barrels of oil"—three large, vertically integrated oil and gas state-owned enterprises (SOEs), also known as national oil companies (NOCs), which are among the biggest oil and natural gas companies and highest-revenue firms in the world.²³ China National Petroleum Corporation (CNPC) and China Petrochemical Corporation (Sinopec) are the biggest of the three. CNPC is ranked fourth overall in *Petroleum Intelligence Weekly's* global oil and natural gas industry ranking and fifth in natural gas production, while Sinopec is 19th overall in the industry ranking and 35th in natural gas production.²⁴ Sinopec is also Asia's largest oil refiner.

China National Offshore Oil Corporation (CNOOC) is a smaller SOE, ranking 32nd overall in the industry ranking and 48th in natural gas production. It was originally intended to focus mainly on offshore extraction but is now much more vertically integrated. CNOOC is China's leading LNG importer.

CNPC owns PetroChina, a company listed on stock exchanges in New York, Hong Kong, and Shanghai (but not ranked as a top-50 oil and natural gas company in its own right).²⁵ The industry rankings, which are primarily based on a company's operating results, indicate that natural gas is less of a contributor to each of China's big three companies than oil.

¹⁸ Chinese Ministry of Commerce, "Mission," 2015, <http://english.mofcom.gov.cn/column/mission2010.shtml>.

¹⁹ "China Shale Gas Auction Attracts 83 Bidders," *Xinhua*, October 25, 2012, http://news.xinhuanet.com/english/china/2012-10/25/c_131930479.htm.

²⁰ "China Renews Subsidies for Shale Gas Exploration," *Xinhua*, April 29, 2015, http://news.xinhuanet.com/english/2015-04/29/c_134196584.htm.

²¹ Ma Tianjie, "China's Move to Centralize Environmental Oversight," *The Diplomat*, November 25, 2015, <http://thediplomat.com/2015/11/chinas-move-to-centralize-environmental-oversight>.

²² Michael Chen, "The Development of Chinese Gas Pricing: Drivers, Challenges and Implications for Demand," Oxford Institute for Energy Studies, July 2014, <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2014/07/NG-89.pdf>.

²³ "Fortune Global 500," *Fortune*, 2015, <http://fortune.com/global500>.

²⁴ "PIW Ranks the World's Top 50 Oil Companies," *Petroleum Intelligence Weekly*, December 16, 2015, Special Supplement Issue.

²⁵ PetroChina, "Company Profile," 2015, http://www.petrochina.com.cn/ptr/gsjj/gsjj_common.shtml.

Other Chinese gas industry players include Sinochem Corporation, CITIC Group Corporation, and Shaanxi Yanchang Petroleum (Group) Corporation, all SOEs that have expanded into China's oil and natural gas sector over the past decade, but remain relatively small.²⁶ There has been some private sector involvement, but that has been limited by China's policies that favor its national oil companies.

State-supported industry groups such as the China Electricity Council have discussed transitioning towards an "X+1+X" supply-chain model. In this model, the first "X" signifies a diverse upstream marketplace for gas extraction and the "1" represents state-owned oligopolies or monopolies operating pipelines and other midstream infrastructure. The second "X" represents a diverse downstream marketplace for distributing gas to end-users.²⁷

Domestic Industry Concerns

Observers of China's energy sector have identified several challenges for the gas industry in coming years. These include the following:

- The ongoing anticorruption campaign being waged by the Communist Party under Party General Secretary and President Xi Jinping;
- Monopoly power among state-owned enterprises;
- The country's complicated gas pricing system; and
- Limited access for domestic and foreign private investors.

Anti-corruption

A wide-ranging anti-corruption drive has been underway in China since before General Secretary Xi came to power in 2012, and has roiled the ranks of top current and former CNPC and Sinopec managers. The most senior target of the drive to date, former Politburo Standing Committee member Zhou Yongkang, who was sentenced to life in prison for corruption in June 2015, spent much of his career in the oil and gas industry, including in top management positions at CNPC from 1988 to 1998.²⁸ A number of his former oil and gas industry associates have also fallen afoul of the anti-corruption drive. These include former CNPC chief Jiang Jiemin and former head of Sinopec Su Shulin, who had both been promoted to other positions before being put under investigation.²⁹ Prominent serving oil and gas industry executives targeted include Sinopec's President Wang Tianpu, the number two executive at the firm, who was put under investigation in April 2015.³⁰

²⁶ U.S. Energy Information Administration, *China*, Washington, DC, May 14, 2015, http://www.eia.gov/beta/international/analysis_includes/countries_long/China/china.pdf.

²⁷ China Electricity Council, "“十三五”天然气产业将成为投资热点" ("13th Five-Year Plan Natural Gas Industry will become an Investment Hotspot") (in Chinese), March 7, 2016, <http://www.cec.org.cn/xiangguanhangye/2016-03-07/149930.html>.

²⁸ Yuwen Wu, "Profile: China's fallen security chief Zhou Yongkang," BBC, October 12, 2015, <http://www.bbc.com/news/world-asia-china-26349305>; Shen Xueming and Zheng Jianying, eds., *中共第一届至十五届中央委员 (Members of the First to Fifteenth Central Committees)* (in Chinese), Zhongyang Wenxian Chubanshe, 2001.

²⁹ Lucy Hornby, "Former Head of China's CNPC Jailed for 16 Years for Graft," *Financial Times*, October 12, 2015, <http://www.ft.com/intl/cms/s/0/d105d696-70c8-11e5-9b9e-690fdae72044.html>.

³⁰ Aibing Guo, "Sinopec No. 2 Caught in Graft Probe as China Crackdown Widens," *Bloomberg*, April 27, 2015, <http://www.bloomberg.com/news/articles/2015-04-27/sinopec-no-2-faces-corruption-probe-as-china-crackdown-widens-i902nvx>.

Anticorruption investigators have extended their attention to CNPC and Sinopec's overseas operations. Those detained reportedly include the former head of CNPC's subsidiaries in Turkmenistan and Iran.³¹ An investigation into Sinopec executives has reportedly focused on several large, unprofitable investments in Angola.³² Early in the investigations, one expert on China's oil and gas industry advanced three possible explanations for them: to crack down on corruption, weaken "vested interests likely to oppose reforms necessary to put the Chinese economy on a more sustainable path," and target the former Politburo Standing Committee member Zhou Yongkang by taking down his associates.³³

Monopolies

The gas extraction and distribution industries are widely considered to be highly concentrated and oligopolistic. CNPC dominates the natural gas industry and claims to produce roughly 80% of the country's total in four provinces alone. At the end of 2014, the firm reported that it owned 50,836 kilometers of gas pipelines in China, or 78% of the country's total.³⁴ A 2013 joint study by Harvard University and China's Central Party School calculated a market concentration ratio for the big three of 99.7%—indicating "almost total dominance" of the natural gas industry by these SOEs.³⁵

In May 2014, CNPC's market-listed affiliate PetroChina said that it would spin off a reported \$6.3 billion worth of major pipelines into a subsidiary, with the eventual intention of selling the assets to non-state investors.³⁶ By July 2014, the company appeared to be backtracking on the commitment to open up to private investment, instead suggesting that it would retain a controlling stake in partnership with two Chinese financial firms.³⁷ In November 2015, PetroChina said it would sell a 50% stake in much of its western Chinese pipeline infrastructure to a state-owned asset management firm that specializes in reforming other SOEs. *Bloomberg* characterized this move as "a step forward."³⁸

Analysts suggest that long-standing monopoly control over the gas pipeline industry has led to significant inefficiencies. An analysis by *Radio Free Asia* in December 2015 estimated that for the stake sold in November 2015, pipeline construction costs far exceeded the market value suggested by the sale price. The analysis suggested that this lack of profitability may also have been exacerbated by government regulation of gas prices.³⁹

³¹ Huang Kaixi and He Chunmei, "Corruption Clampdown on CNPC Nets Two More Executives," *Caixin*, May 17, 2014: <http://english.caixin.com/2014-05-17/100678740.html>.

³² Huang Kaixi, "Inquiry into Fujian Governor Said to Be Linked to Audit of Sinopec," *Caixin*, October 9, 2015: <http://english.caixin.com/2015-10-09/100861184.html>.

³³ Erica S. Downs, "Tiger Hunt in China's Oil Patch: Why Are So Many Former Oil Executives Under Investigation?" The Brookings Institution, September 13, 2013, <http://www.brookings.edu/blogs/up-front/posts/2013/09/11-tiger-hunt-china-oil-patch-downs>.

³⁴ CNPC, "Natural Gas & Pipelines," 2015, http://www.cnpc.com.cn/en/naturalgaspipelines/naturalgas_index.shtml.

³⁵ Peijun Duan and Tony Saich, "Reforming China's Monopolies," Harvard University and the Central Party School, 2013, http://ash.harvard.edu/files/reforming_chinas_monopolies.pdf.

³⁶ Benjamin Haas, "PetroChina to Sell Pipeline Assets Valued at \$6.3 Billion," *Bloomberg*, May 12, 2014: <http://www.bloomberg.com/news/articles/2014-05-12/petrochina-to-sell-pipelines-worth-6-3-billion-as-controls-ease>.

³⁷ Chen Aizhu and Charlie Zhu, "PetroChina Reconsiders Sale of Natural Gas Pipeline Assets: Sources," *Reuters*, July 25, 2014: <http://www.reuters.com/article/us-petrochina-pipeline-sale-idUSKBN0FU0BF20140725>.

³⁸ Aibing Guo, "China Steps Up Energy Overhaul With PetroChina Pipeline Sale," *Bloomberg*, November 25, 2015: <http://www.bloomberg.com/news/articles/2015-11-26/china-steps-up-energy-overhaul-with-petrochina-pipeline-sale>.

³⁹ Michael Lelyveld, "China Pipelines Sold Far Below Cost," *Radio Free Asia*, December 28, 2015, <http://www.rfa.org> (continued...)

Natural Gas Pricing

For many years, China used a “cost-plus” method to determine gas prices, based on production cost rather than end-user value. Under this system, the NDRC and NEA would add together production costs, transportation costs, and a predetermined profit margin to determine “city-gate” prices, meaning those to be paid by locally-regulated distributors.⁴⁰

In June 2013, the NDRC issued a directive outlining changes to this pricing system, which shifted the focus away from production and transportation costs.⁴¹ Under the newer system, city-gate prices are determined as a function of the average import prices of fuel oil and liquefied petroleum gas⁴²—a recognition of the increasingly important role that global markets exert on China’s gas industry.⁴³ In its Energy Development Strategic Action Plan for 2014-2020, the NEA stated its continued commitment to allowing natural gas import and domestic supply prices to be determined according to market mechanisms.⁴⁴ The NDRC released follow-up directives in 2014 and 2015 that clarified its position by specifically allowing for closer convergence of the prices paid by residential consumers and those paid by industrial and transportation end-users.⁴⁵

Even with the NDRC’s recent pricing policy changes, local prices continue to be benchmarked by the national government according to the economic sector of the end-user. The Organization for Economic Cooperation and Development (OECD) has stated that prices for industrial gas users are kept high in order to subsidize low prices for residential consumers, which are “often kept low to avoid triggering high inflation rates” and can “distort the market’s reaction to fuel prices.”⁴⁶ A 2015 joint paper by the Massachusetts Institute of Technology and Tsinghua University found that as of mid-2014, average gas prices for transportation industry end-users were nearly twice as high as those for residential end-users.⁴⁷ Another study from 2015 generally corroborated these

(...continued)

[english/commentaries/energy_watch/pipelines-12282015104204.html](http://www.englishcommentaries.com/energy_watch/pipelines-12282015104204.html).

⁴⁰ Jason Zhao, “Nationwide Natural Gas Pricing Reforms Implemented in China,” *Energy Law Advisor*, 2013, <http://www.cailaw.org/media/files/IEL/Publications/2013/ela-nationwide-natural-gas-vol7-no4.pdf>.

⁴¹ National Development and Reform Commission of China, “Notice on the Adjustment of Gas Prices,” June 28, 2013, http://www.gov.cn/gzdt/2013-06/28/content_2436328.htm.

⁴² Liquefied petroleum gas, known as LPG, is a mix of butane and propane. Liquefied natural gas, known as LNG, is natural gas that has been cooled to -260 degrees Fahrenheit.

⁴³ Sergey Paltsev and Danwei Zhang, “Natural Gas Pricing Reform in China: Getting Closer to a Market System?” Massachusetts Institute of Technology Joint Program on the Science and Policy of Global Change, July 2015, http://globalchange.mit.edu/files/document/MITJPSPGC_Rpt282.pdf.

⁴⁴ National Energy Administration of China, “Energy Development Strategic Action Plan (2014-2020)” (Chinese), June 7, 2014: http://www.nea.gov.cn/2014-12/03/c_133830458.htm.

⁴⁵ National Development and Reform Commission of China, “Notice on the Adjustment of Non-Residential Gas Stock Prices,” August 2014, http://www.sdpc.gov.cn/gzdt/201408/t20140812_622009.html.

National Development and Reform Commission of China, “Notice on Reasonable Gas Prices for Non-Residential Usage,” February 2015, http://www.sdpc.gov.cn/zcfb/zcfbtz/201502/t20150228_665694.html.

⁴⁶ Anne-Sophie Corbeau, Dennis Volk, Jonathan Sinton, Julie Jiang Jiang Ping, Tammy Teng, Li Boshu, and Yue Fen, “Gas Pricing and Regulation: China’s Challenges and IEA Experience,” Organization for Economic Cooperation and Development and International Energy Agency, 2012, http://www.oecd-ilibrary.org/energy/gas-pricing-china-s-challenges-and-iea-experience_9789264247437-en.

⁴⁷ Nationwide averages expressed in U.S. dollars per million British Thermal Units: Residential = \$11.13, industry = \$15.30, and transport = \$19.71. See Paltsev and Zhang, 2015 (p. 13).

findings, showing an average 2012 subsidy rate of 38.65% for residential consumers and 26.46% for industrial consumers.⁴⁸

There are signs, however, that the government intends to try to reduce this large price differential. In February 2015, state-run media stated that the government would “unify” prices of non-residential natural gas and “liberalize” prices of gas supplied directly to industry.⁴⁹ In November 2015, the NDRC announced that prices would be significantly reduced for industrial and transport end-users.⁵⁰ *Bloomberg* quoted an estimate stating that the total effect of this change in policy would be to cut about 28% from businesses’ gas expenditures—but also suggested that this action may have been less about industry reform and more about increasing gas’s role in China’s energy mix.⁵¹ The news agency pointed out that China’s 2014-2020 Energy Development Strategy Action Plan requires that the share of natural gas consumption in the country’s primary energy mix rise to 10%.⁵²

Limited Private Investment

Although China completed its first auction of shale gas in 2012 and has continued to hold auctions since, the auctions have not attracted significant interest from the private sector. At several points in recent years, including as recently as 2015, the Ministry of Land Resources has delayed holding a long-awaited third auction, reportedly due to low demand.⁵³

Some observers claim that if Chinese policymakers want to see high growth in the shale gas industry, they will need to provide investors with tax incentives and easier access to pipeline infrastructure.⁵⁴ Other observers have attributed the lack of private investment to widespread overestimation of China’s unconventional gas reserves, which is just beginning to be corrected.⁵⁵ By not providing accurate information, China may be increasing the risk for foreign investors. China’s complex geology and geography may play a role in deterring private investors: much of China’s shale gas is in remote and underdeveloped regions and is commonly as much as five kilometers underground, deeper than in much of the United States.⁵⁶ Additionally, the natural gas is in regions that suffer from scarcity of water resources, which are needed for extraction with existing technology.

⁴⁸ Boqiang Lin, Chang Liu and Lei Lin, “The Effect of China’s Natural Gas Pricing Reform,” *Emerging Markets Finance and Trade*, Volume 51, Issue 4, 2015, <http://www.tandfonline.com/doi/full/10.1080/1540496X.2015.1043791>.

⁴⁹ “China Press Ahead Market-Oriented Reform on Industrial Natural Gas Pricing,” *Xinhua*, February 28, 2015, <http://en.xinfiance.com/html/Industries/Utilities/2015/59172.shtml>.

⁵⁰ National Development and Reform Commission of China, “Reducing Non-Residential City-Gate Natural Gas Prices and Further Advancing Price Marketization Reforms,” November 18, 2015, http://www.sdpc.gov.cn/xwzx/xwfb/201511/t20151118_758896.html.

⁵¹ “China Cuts Gas Price for Industrial Users Amid Fuel Reforms,” *Bloomberg*, November 18, 2015, <http://www.bloomberg.com/news/articles/2015-11-18/china-cuts-gas-price-for-industrial-users-amid-energy-reforms>.

⁵² “China Unveils Energy Strategy, Targets for 2020,” *Xinhua*, November 19, 2014, http://news.xinhuanet.com/english/china/2014-11/19/c_133801014.htm.

⁵³ Chen Aizhu, “China Struggles to Find Prospective Blocks for Third Shale Auction,” *Reuters*, January 5, 2015, <http://www.reuters.com/article/china-shalegas-idUSL3N0TH35F20150105>.

⁵⁴ Fei Kwok, “What Does China’s Second Shale Gas Auction Tell Us?” Norton Rose Fulbright, December 2012, <http://www.nortonrosefulbright.com/knowledge/publications/73025/what-does-chinas-second-shale-gas-auction-tell-us>.

⁵⁵ Manchu Song, “China’s Shale Prospects May Be Very Overstated,” *OilPro*, January 5, 2015, <http://oilpro.com/post/9412/china-shale-prospects-may-very-overstated>.

⁵⁶ Pingli Liu, Yinsheng Feng, Liqiang Zhao, Nianyin Li, and Zhifeng Luo, “Technical Status and Challenges of Shale Gas Development in Sichuan Basin, China,” *Petroleum*, Volume 1, Issue 1, pp.1–7, March 10, 2015, <http://www.sciencedirect.com/science/article/pii/S2405656115000024>.

13th Five-Year Plan

In March 2016, China held the annual full session of its parliament, the National People's Congress (NPC). The NPC approved the final text of China's 13th Five-Year Plan (FYP), outlining China's economic agenda for the years 2016-2020. Chinese Premier Li Keqiang and the NDRC also delivered two key reports to the NPC.

The 13th FYP does not place a strong emphasis on the natural gas sector, but it refers to China's general plans for the industry in several chapters. The plan's energy section (Chapter 30) calls for an increase in both land and marine oil and gas extraction, an "orderly" liberalization of extraction rights, and active development of coalbed methane and shale gas.⁵⁷ The FYP also restates China's intention to "speed up liberalization" of the electricity and natural gas industries, specifically addressing the need to "reduce government intervention in the price formation mechanisms" for electricity, oil, natural gas, and transportation.⁵⁸

In Premier Li's Report on the Work of the Government, he provided specifics on what the government's planned gas industry liberalization measures would entail. He stated that China would "significantly relax restrictions on entry," "remove hidden barriers," and "encourage private companies to increase investment" in natural gas and other industries. He promised that private companies would "enjoy the same treatment afforded to SOEs" in terms of project approvals, financing, tax policies, and land availability. He also stated China's intention to continue increasing its natural gas supply and to "do more to see coal substituted with electricity and natural gas."⁵⁹ Li did not mention specific natural gas projects in the government work report, but at a subsequent press conference he suggested a continued interest in cooperation with Russia.⁶⁰

⁵⁷ "中华人民共和国国民经济和社会发展第十三个五年规划纲要，第三十章：建设现代能源体系" ("People's Republic of China 13th Five-Year Plan for National Economic and Social Development, Chapter 30: Building a Modern Energy System") (in Chinese), *Xinhua*, March 17, 2016, http://news.xinhuanet.com/politics/2016lh/2016-03/17/c_1118366322_8.htm.

⁵⁸ "中华人民共和国国民经济和社会发展第十三个五年规划纲要，第二十四章：加快推动服务业优质高效发展" ("People's Republic of China 13th Five-Year Plan for National Economic and Social Development, Chapter 24: Pushing for Rapid Development of Improved Efficiency in the Service Sector") (in Chinese), *Xinhua*, March 17, 2016, http://news.xinhuanet.com/politics/2016lh/2016-03/17/c_1118366322_7.htm.

"中华人民共和国国民经济和社会发展第十三个五年规划纲要，第十三章：健全现代市场体系" ("People's Republic of China 13th Five-Year Plan for National Economic and Social Development, Chapter 13: Strengthening the Modern Market System") (in Chinese), *Xinhua*, March 17, 2016, http://news.xinhuanet.com/politics/2016lh/2016-03/17/c_1118366322_4.htm.

Translated quote from Chapter 13 on "sound and modern market-based systems": "减少政府对价格形成的干预，全面放开竞争性领域商品和服务价格，放开电力、石油、天然气、交通运输、电信等领域竞争性环节价格。"

⁵⁹ State Council of the People's Republic of China, "Full Text: Report on the Work of the Government (2016)," March 17, 2016, http://english.gov.cn/premier/news/2016/03/17/content_281475309417987.htm.

⁶⁰ State Council of the People's Republic of China, "Premier Li Keqiang Meets the Press: Full Transcript of Questions and Answers," March 16, 2016, http://english.gov.cn/premier/news/2016/03/16/content_281475308806830.htm.

Premier Li stated during the press conference: "Last year I had a deep discussion about China-Russia business cooperation with Prime Minister Dmitry Medvedev, we agreed that we can explore cooperation in the integrated development of oil and natural gas, sectors that will help attract more Chinese investment, and we can also introduce a greater level of diversity into our trade mix." In May 2014 Alexey Miller, CEO of Russia's Gazprom, announced "the biggest contract in the entire history of Gazprom" to supply pipeline gas to China's far northeastern Heilongjiang Province via the planned "Power of Siberia" pipeline. Throughout the second half of 2015, however, media reports suggested that the project was being delayed due to concerns over high cost, persistently low energy prices, and declining Chinese economic growth rates. In early 2016, *Reuters* reported that Russia was "likely to scale back (continued...)"

The NDRC report to the NPC discussed many of the same issues covered in Li's report. The NDRC stated its commitment to "accelerate structural reform," "advance reform of the commodity distribution system," and extend rural networks in the gas industry. The report also stated that in 2015, city-gate gas prices were "significantly decreased" for non-residential consumers.⁶¹

U.S.-China Cooperation on Natural Gas

The U.S. Department of Energy, U.S. Department of State, and the U.S. Trade and Development Agency are all involved in projects with Chinese counterparts on natural gas issues. Congress has oversight and appropriations roles related to these activities, and has at times questioned U.S. support for energy programs in China.⁶²

Examples of U.S.-China cooperation on natural gas issues include the following:

- The U.S. Department of Energy participates in an annual U.S.-China Oil and Natural Gas Forum, the most recent of which was held in September 2015 in Chongqing, China.⁶³
- The Department of Energy is also involved in "outreach and communications activities" to bring U.S. coal gasification technologies to Chinese firms and research institutions.⁶⁴
- The U.S. Department of State partnered with China's Ministry of Land and Resources to hold an Unconventional Gas Sustainable Development Workshop in Beijing in May 2014.
- The U.S. Department of State invited regulatory experts from China to visit the United States for a tour focused on shale gas development in September 2014.
- The U.S. Trade and Development Agency funds a U.S.-China Gas Training Program, a forum for U.S. and Chinese gas industry experts to share "best practices and tested solutions."⁶⁵ Under a \$417,055 contract with the Chicago-based Gas Technology Institute (GTI), USTDA funded a December 2015 workshop in Beijing covering environmental policy and technology and a workshop in Sichuan province in March and April 2016, covering gas utilization and production.⁶⁶

(...continued)

volumes of gas it plans to ship to China" starting in 2019, <http://www.reuters.com/article/us-russia-china-gas-exclusive-idUSKCN0UT1LG>.

⁶¹ State Council of People's Republic of China, "Full Text: Report on China's Economic, Social Development Plan," March 19, 2016, http://english.gov.cn/news/top_news/2016/03/19/content_281475310332486.htm.

⁶² See, for example, U.S. Congress, House Committee on Foreign Affairs, Subcommittee on Asia and the Pacific, *Feeding the Dragon: Reevaluating U.S. Development Assistance to China*, 112th Cong., 1st sess., November 15, 2011, Serial No. 112-78 (Washington: GPO, 2011).

⁶³ Department of Energy, "15th US-China Oil and Gas Industry Forum Opens in Chongqing, China," September 17, 2015, <http://energy.gov/fe/articles/15th-us-china-oil-and-gas-industry-forum-opens-chongqing-china>.

⁶⁴ Department of Energy, "Bilateral Agreements with China," 2015, <http://energy.gov/fe/services/international-cooperation/bilateral-agreements-china>.

⁶⁵ Department of State, "U.S.-China Strategic & Economic Dialogue Outcomes of the Strategic Track," June 24, 2015, <http://www.state.gov/r/pa/prs/ps/2015/06/244205.htm>.

⁶⁶ U.S. Trade and Development Agency, "2015 Annual Report" (page 25), September 30, 2015, https://www.ustda.gov/sites/default/files/pdf/about/reports/annualreports/ustda_annual%20report_2015.pdf.

- USTDA also funds a U.S.-China Shale Gas Training Program, which sponsors conferences with China's National Energy Administration.

International Joint Ventures

International oil and gas firms have been involved, mainly with CNPC and Sinopec, in several gas extraction projects in China, particularly focused on the shale gas sector. The slow pace of involvement by international companies highlights their caution, despite the potential size of China's shale prospects. Texas-based FTSI announced in 2014 that it would enter into a 15-year joint venture with Sinopec to provide services in the Sichuan basin.⁶⁷ California-headquartered Chevron is partnered with CNPC in gas extraction in the same shale basin, and in January 2016 the firm announced the beginning of gas production at its Chuandongbei facility.⁶⁸ The natural gas in this basin contains high levels of hydrogen sulfide, however, making it difficult to produce.

Royal Dutch Shell, a Netherlands-based firm, is partnered with CNPC in one of the biggest international joint ventures to tap China's shale gas reserves, but the project has reportedly faced major hurdles.⁶⁹ Texas-based ConocoPhillips was in talks with PetroChina to develop a block of shale gas in Sichuan, but these talks ended without agreement in mid-2015.⁷⁰ New York-based Hess Corporation signed a production sharing contract in 2013 with PetroChina to explore the Santanghu Basin in northwest China, but it is unclear whether this project will move forward.⁷¹ Texas's Anadarko Petroleum had a subsidiary operation in China until late 2014, when the subsidiary was sold for \$1.075 billion.⁷² Until 2014, Texas-based Noble Energy held a 57% stake in a gas and oil extraction joint venture with Sinopec.⁷³ In February 2014, however, it sold all Chinese assets for \$186 million.⁷⁴

Texas-based ExxonMobil has a long history of operating in China, and it has long-term LNG sales and purchasing agreements in place with PetroChina and Sinopec.⁷⁵ ExxonMobil also

⁶⁷ FTSI, "FTSI International Enters Chinese Market with 15-year Joint Venture Company with Sinopec," June 10, 2014, <http://www.ftsi.com/news/Pages/FTSI-International-Enters-Chinese-Market-with-15-year-Joint-Venture-Company-with-Sinopec.aspx>.

⁶⁸ Chevron, "Chevron Announces First Gas from the Chuandongbei Project in Southwest China," January 26, 2016, http://www.chevron.com/chevron/pressreleases/article/01242016_firstgasfromthechuandongbeiprojectinsouthwestchina.news.

⁶⁹ Brian Spegele and Justin Scheck, "Energy-Hungry China Struggles to Join Shale-Gas Revolution," *Wall Street Journal*, September 5, 2013, <http://www.wsj.com/articles/SB10001424127887323980604579030883246871124>.

⁷⁰ "ConocoPhillips Halts Sichuan Shale Gas Talks with PetroChina," *Bloomberg*, July 22, 2015, <http://www.bloomberg.com/news/articles/2015-07-22/conocophillips-halts-shale-gas-talks-with-cnpc-for-sichuan-field>.

⁷¹ Hess Corporation, "Operations Map," 2015, <http://www.hess.com/operations/operations-map>.

Brian Spegele, "Oil Producers Sound Retreat From China," *Wall Street Journal*, March 26, 2015, <http://www.wsj.com/articles/oil-producers-sound-retreat-from-china-1427407192>.

⁷² Anadarko Petroleum, "2014 Annual Report," February 20, 2015, https://www.anadarko.com/content/documents/apc/Operations/Anadarko_2014_Annual_Report.pdf.

⁷³ Noble Energy, "Noble Energy Begins Crude Oil Production in China's Bohai Bay," January 13, 2003, <http://investors.nobleenergyinc.com/releasedetail.cfm?ReleaseID=360031>.

⁷⁴ Noble Energy, "Form 10-K Annual Report," February 19, 2015, <http://investors.nobleenergyinc.com/secfiling.cfm?filingID=72207-15-7>.

⁷⁵ ExxonMobil, "ExxonMobil in China," 2010, <http://www.exxonmobilchemical.com/IOGCEC/exxonmobil-in-china-en.pdf>.

reportedly conducted a joint study with Sinopec starting in 2011 to look at shale gas extraction in Sichuan.⁷⁶

China's Belt and Road Initiative

China's "Belt and Road" initiative is a large-scale development plan consisting of planned investment in roads, rail, pipelines, and other infrastructure in as many as 70 countries. The "Belt" refers to a "Silk Road Economic Belt," running overland to Europe through Central Asia. The "Road" refers to a "21st Century Maritime Silk Road," running from the Pacific through the Indian Ocean to the Mediterranean Sea. The Belt and Road Initiative has been a core part of China's commercial foreign policy since 2013, when President Xi Jinping announced the concept during speeches in Kazakhstan and Indonesia.

The Chinese government states that the basic principles of the Belt and Road Initiative include adherence to "market rules and international norms," "in-depth regional cooperation of higher standards," and "the primary role of enterprises" in resource allocation.⁷⁷ Chinese state media have described the gas industry—and particularly China's construction of gas infrastructure to facilitate trade with Central Asia—as an important part of the Belt and Road Initiative's ongoing implementation.⁷⁸

In 2014, CNPC advocated for a regional natural gas and LNG trading center in Shanghai, developed under the rubric of the Belt and Road Initiative and modeled after Singapore's experience developing itself into a regional oil trading hub.⁷⁹ A pilot version of the trading center, designed to take advantage of Shanghai's large financial sector and the presence of many international firms, was launched in July 2015.⁸⁰ Shanghai is also home to existing LNG import terminals (see **Table 1**) and additional projects are planned in its proximity (see **Figure 4**).

Supply: Importance of Diversity

China has made significant strides in diversifying its natural gas supplies. Domestic production has risen 164% in the last ten years, to 135 BCM in 2014.⁸¹ Natural gas imports, which did not begin until 2006, have grown from one BCM to over 58 BCM in 2014. In 2014, imports were split 46% from LNG and 54% from pipelines, with Turkmenistan being the single largest supplier (44% of imports). **Figure 4** highlights the dispersion of China's natural gas resources and the country's infrastructure constraints. In some cases, natural gas deposits do not have pipelines in place to bring that gas to market. This is the situation in China's northeastern provinces of Jilin and Heilongjiang.

⁷⁶ Fan Gao, "Will There Be a Shale Gas Revolution in China by 2020?" Oxford Institute for Energy Studies, April 2012, <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/04/NG-61.pdf>.

⁷⁷ State Council of the People's Republic of China, "Full Text: Action Plan on the Belt and Road Initiative," March 30, 2015, http://english.gov.cn/archive/publications/2015/03/30/content_281475080249035.htm.

⁷⁸ "China-Central Asia Natural Gas Pipeline Assists in Construction of 'One Belt, One Road'" (Chinese), *Xinhua*, March 11, 2015, http://news.xinhuanet.com/energy/2015-03/11/c_127570432.htm.

⁷⁹ Yu Hongyuan, "China Must Develop a 'One Belt, One Road' Natural Gas Trading Center as Soon as Possible" (Chinese), *CNPC News Center*, December 9, 2014, <http://news.cnpc.com.cn/system/2014/12/09/001519492.shtml>.

⁸⁰ "NDRC Studying on Market-Oriented Natural Gas Pricing Reform," *Xinhua Finance*, November 5, 2015, <http://en.xinfiance.com/html/Industries/Energy/2015/161707.shtml>.

⁸¹ BP, *BP Statistical Review of World Energy*, June 2015, p. 22, <http://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2015/bp-statistical-review-of-world-energy-2015-full-report.pdf>.

Figure 4. China's Natural Gas Resources and Infrastructure Assets

Source: Map generated by CRS using data from IHS, Petroleum Economist, U.S. Department of State, and Esri.

Domestic Supply: Lots of Potential

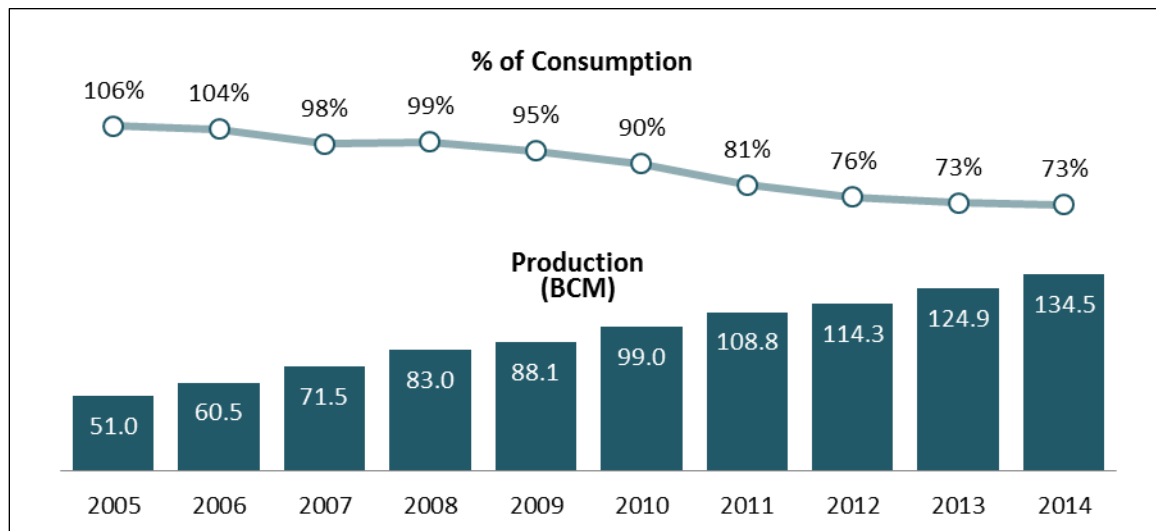
China has one of the largest natural gas resource bases in the world. Despite rising production (see **Figure 5**), China's potential as a natural gas producer has been constrained by government policies. China was mostly self-sufficient in natural gas until 2008, but now imports approximately 31% of its consumption. China ranks in the top 15 countries in terms of proved reserves of natural gas, and has the most technically recoverable shale gas resources, which does not assume that the natural gas is economical to produce.^{82 83} China ranked sixth globally in

⁸² BP, *BP Statistical Review of World Energy, 2015*, June 2015, p. 20, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>.

⁸³ U.S. Energy Information Administration, "Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States," June 2013, p. 6, <http://www.eia.gov/analysis/studies/worldshalegas/>.

natural gas production in 2014. China forecasts its production in 2016 to rise to 140 BCM, not much higher than its 2014 natural gas output.⁸⁴

Figure 5. Domestic Natural Gas Production and Its Percent of Consumption
2005-2014



Source: BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>. Graphic by CRS.

Notes: When production is over 100% of consumption, the natural gas is either exported or put into storage. Units = billion cubic meters (BCM).

According to the U.S. Energy Information Administration, China's primary onshore natural gas-producing regions are Sichuan Province in the Southwest (Sichuan Basin); the Xinjiang Uyghur Autonomous Region and Qinghai Province in the Northwest (Tarim, Junggar, and Qaidam Basins); and Ningxia Hui Autonomous Region and Shaanxi Province in the North (Ordos Basin). (See the **Appendix** for a map of China's provinces.) China has delved into several offshore natural gas fields located in the Bohai Basin and the Panyu complex of the Pearl River Mouth Basin (South China Sea), and also is exploring more technically challenging areas such as deepwater, coalbed methane, and shale gas reserves with foreign companies.

China held its first shale gas licensing round in June 2011, and limited participants to only Chinese companies.⁸⁵ The Sichuan Basin, in and around Sichuan province in China's west, has been the focus of China's shale efforts. China produces small amounts of natural gas from shale formations and the pace of development has been slow, primarily because of a lack of technical skills and complex geology. Additionally, a lack of natural gas infrastructure—pipelines and processing facilities—and price controls have hindered development. In 2013, the cost of drilling an equivalent shale gas well in China was 4-5 times more than drilling the well in the United States, according to the China Geological Survey.⁸⁶ In late 2014, China's high-end target for shale gas and coalbed methane production by 2020 was set at 30 BCM.⁸⁷ This was a significant

⁸⁴ "China Sees Energy Consumption Rising in 2016," *Reuters*, December 30, 2015.

⁸⁵ Song Yen Ling, "China Shale Blocks See Some Progress But Challenges Abound: Ministry," *Platts*, July 29, 2013.

⁸⁶ Song Yen Ling, "Chinese Oil Companies Attempt to Slash Shale Gas Drilling Costs," *Platts*, October 25, 2013, online.

⁸⁷ "China Unveils Energy Strategy, Targets for 2020," *Xinhua*, November 19, 2014, [http://news.xinhuanet.com/english/\(continued...\)](http://news.xinhuanet.com/english/(continued...))

downgrade from the 100 BCM target that news media attributed to a senior NEA official in 2012.⁸⁸ China has also cut the subsidy for shale gas production, a blow to unconventional natural gas development.⁸⁹

Xinjiang: Key for Production and Transit, but a Troubled Region

The westernmost region of Xinjiang, which has faced religious and ethnic violence in recent years, is China's gateway to Central Asian and Russian pipeline gas supplies, as well as a major producer of oil and gas in its own right.⁹⁰ Xinjiang contains the second-highest natural gas reserves and highest oil reserves of any province-level jurisdiction, reportedly producing more than 30 BCM of natural gas in 2015.⁹¹ Xinjiang's energy infrastructure appears, for the most part, to have escaped the impact of regional violence, but a 2013 report by security publication firm Stratfor claimed that as the region's infrastructure improves and more oil and natural gas are sent eastward, "the stakes for maintaining security in the west will rise."⁹² A 2015 analysis in *The Diplomat*, however, suggests that Xinjiang's energy infrastructure may be more secure than some other analyses have implied.⁹³

Imports: Diversity is Key

China is the fourth largest importer of natural gas in the world behind Japan (LNG only), the United States (mainly pipeline), and Germany (pipeline only). China's natural gas imports rose significantly in early 2015, increasing by over 15% for the month of March alone.⁹⁴ However, by the end of 2015, China's LNG imports fell, the first time since 2006.⁹⁵ Chinese import terminals operated at less than 50% of their capacity in 2015.⁹⁶ The fall in Chinese LNG demand casts doubt about forecasts for future Chinese natural gas demand. It also does not bode well for the international market being able to absorb the rising capacity of global LNG exports over the next few years. However, China's slowing economy may be a short-term event.

China has poured technical and financial resources into developing its own natural gas resources, but has also staked its near- to medium-term energy future on increased imports. In 2014, according to industry sources, imports accounted for 31% of total Chinese natural gas

(...continued)

china/2014-11/19/c_133801014.htm.

⁸⁸ Michael Lelyveld, "China Sets Shale Gas Goal," *Radio Free Asia*, April 2, 2012, http://www.rfa.org/english/commentaries/energy_watch/gas-04022012110142.html.

⁸⁹ Lucy Hornby, "Beijing Plans Curbs on Shale Gas Subsidies," *Financial Times*, April 29, 2015.

⁹⁰ For additional information on Xinjiang's unrest see CRS In Focus IF10281, *Uyghurs in China*, by Thomas Lum and Gabriel M. Nelson, October 21, 2015.

⁹¹ "Xinjiang's Natural Gas Output Exceeds 30 bln Cubic Meters," *Xinhua*, December 24, 2015, http://news.xinhuanet.com/english/2015-12/24/c_134948893.htm.

⁹² "China's Ambitions in Xinjiang and Central Asia," *Stratfor*, October 2, 2013, <https://www.stratfor.com/analysis/chinas-ambitions-xinjiang-and-central-asia-part-3>.

⁹³ Gabe Collins, "Beijing's Xinjiang Policy: Striking Too Hard?" *The Diplomat*, January 23, 2015, <http://thediplomat.com/2015/01/beijings-xinjiang-policy-striking-too-hard>.

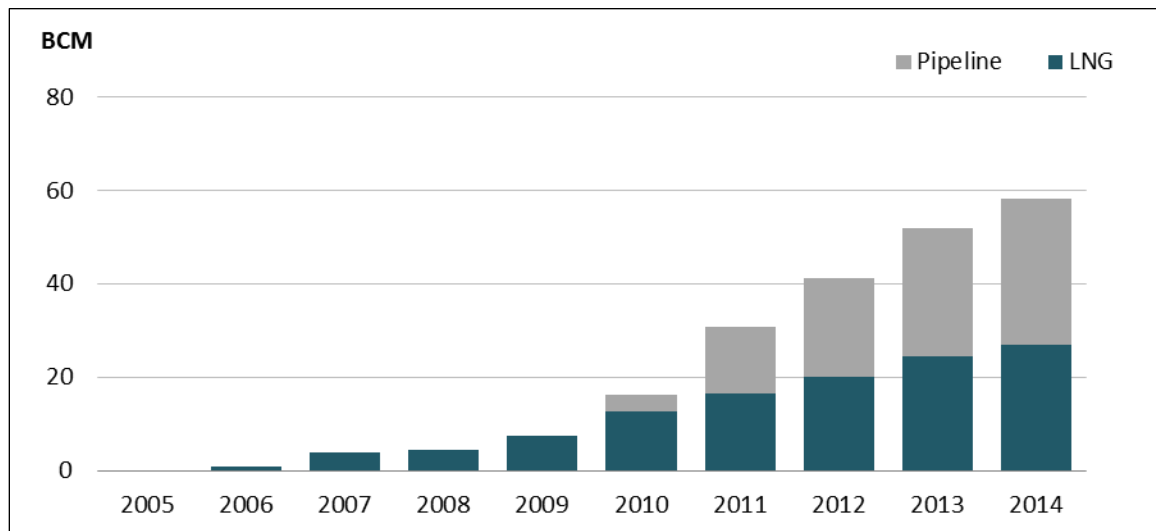
⁹⁴ Max Gostelow, "China's March Natural Gas Pipeline Imports Rise 41.3% on Year to 2.73 Bcm," *Platts*, April 23, 2015.

⁹⁵ "China Delivers LNG Import Shock, Forecasts for NatGas Imports Fall," *Energy Intelligence*, February 1, 2016, online.

⁹⁶ "China Resales Help Swell Global Glut," *Energy Intelligence Group*, February 3, 2016.

consumption. Almost half of those imports were of LNG (see **Figure 6**), making China the world's third largest importer of LNG in 2014, after Japan and South Korea.⁹⁷

Figure 6. Natural Gas Imports by Transportation Method
2005-2014



Source: BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>.

Notes: Units = billion cubic meters (BCM).

China's 2014 LNG imports rose 10% over 2013. In a January 2014 document setting targets for the energy industry for the year, China's National Energy Administration committed to "vigorously promote" construction of additional LNG terminals and storage facilities, suggesting continued sharp increases in LNG imports.⁹⁸ However, transporting natural gas from LNG import terminals is constrained, especially for new entrants to the natural gas sector. China's natural gas pipeline network is controlled by its three big companies, which do not allow third-party access. This has contributed to some LNG import terminals operating significantly below their capacity. According to Cedigaz data, China now has approximately 55 BCM of LNG import capacity (see **Table 1**) with almost 30 BCM at various stages of development. CNOOC controls most of China's LNG import terminals with 34 BCM, or 63% of capacity, from seven facilities.

⁹⁷ BP, *BP Statistical Review of World Energy*, 2015, June 2015, p. 28, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>.

⁹⁸ National Energy Administration of the People's Republic of China, "Notice on Issuing of 2014 Energy Work Guidance," January 20, 2014: http://zfxgk.nea.gov.cn/auto82/201401/t20140124_1756.htm (in Chinese).

Table 1. China's LNG Import Terminals

| Terminal | Province | Start-up Year | Operator | Capacity (BCM) |
|----------------------|-----------|---------------|------------|----------------|
| Dalian LNG | Liaoning | 2011 | CNPC | 4.2 |
| Fujian LNG | Fujian | 2008 | CNOOC | 6.9 |
| Guangdong Dapeng LNG | Guangdong | 2006 | CNOOC | 9.0 |
| Hainan LNG | Hainan | 2014 | CNOOC | 2.7 |
| Jiangsu Rudong LNG | Jiangsu | 2011 | CNPC | 4.7 |
| JOVO Dongguan | Guangdong | 2013 | JOVO Group | 1.3 |
| Qingdao | Shandong | 2014 | Sinopec | 4.0 |
| Shanghai LNG | Shanghai | 2009 | CNOOC | 4.0 |
| Tangshan LNG | Hebei | 2013 | CNPC | 4.7 |
| Tianjin FSRU | Tianjin | 2013 | CNOOC | 3.0 |
| Wuhaogou LNG | Shanghai | 2008 | Shenergy | 1.3 |
| Zhejiang Ningbo | Zhejiang | 2012 | CNOOC | 4.0 |
| Zhuhai LNG | Guangdong | 2013 | CNOOC | 4.7 |
| TOTAL | | | | 54.5 |

Source: Cedigaz, Petroleum Economist, and company websites.

Notes: The JOVO Group, which is the majority owner of the JOVO Dongguan terminal, was the first private Chinese company to own a majority stake in a regasification terminal. Units = billion cubic meters (BCM).

Pipelines: Big Projects with Big Price Tags

Just over half of China's natural gas imports in 2014 came via overland pipelines from Central Asia—primarily Turkmenistan—and Burma. The volume of natural gas imports via pipelines is expected to increase rapidly in coming years. The big news in 2014 was the announcement of a deal for Russia to begin supplying China with natural gas, although the prospects for the future of that project are currently in doubt.

Central Asia: Main Supplier

Central Asia is the most important region for pipeline imports of natural gas to China. China's move into Central Asian energy resources appears to be driven by several factors. Foremost, natural gas is needed to meet the energy requirements of China's economy, despite slowing GDP growth. China has also cited its desire to reduce domestic air pollution and carbon emissions by increasing the proportion of natural gas and lowering the proportion of coal in its overall energy consumption. China's entry into the Central Asian energy market has posed perhaps the biggest challenge to Russian dominance in the region.

China's primary Central Asian supplier of natural gas is Turkmenistan, where state-owned CNPC has major investments in gas fields, including the Bagtyyarlyk and Galkynysh fields. Uzbekistan began supplying natural gas to China in mid-2012 and Kazakhstan began shipments to China in 2014.

Central Asian natural gas is transported to China via the Central Asia-China Gas Pipelines (CACGP). Two main lines, Lines A and B, run from eastern Turkmenistan through Uzbekistan

and Kazakhstan to the border with China's Xinjiang region. Spanning a distance of 1,130 miles, they entered operation in December 2009 and October 2010 respectively. A 1,143 mile-long Line C, running parallel to Lines A and B, began operations in 2014. Line D, running from Turkmenistan to China through Uzbekistan, Tajikistan, and Kyrgyzstan, is intended to help boost Turkmen gas shipments to China to 65 BCM per year, a level the two countries agreed to in Beijing in May 2014.⁹⁹ Construction on Line D began in 2014. Line D was originally scheduled to enter operation by 2016, but the general manager of CACGP has been quoted stating that the pipeline will in fact be completed "by the end of 2020."¹⁰⁰ According to CNPC, the overall delivery capacity for lines A, B, and C is now 55 BCM per year.¹⁰¹

At the Kazakhstan-China border, the CACGP connects with West-East pipelines that carry the gas to central China and China's east coast. Three such pipelines are currently in operation. China is reportedly planning at least two more.¹⁰² Together, the Central Asia-China Gas Pipelines and China's West-East pipelines make up the longest natural gas pipelines in the world.

Additional Sources of Pipeline Supplies

China started receiving natural gas from Burma in 2013. On May 21, 2014, the Chinese and Russian presidents announced that they had reached agreement on a 30-year deal for Russia to supply China with natural gas (valued roughly at \$400 billion at the time) through a new pipeline slated for completion in 2018. As the two countries have announced previous deals that never materialized, some industry analysts have questioned the announcement, particularly as the oil price basket linked to the contract has dropped by more than 50%. If completed, the Russia-China pipeline is expected to provide China with 38 BCM of Russian natural gas annually, starting in 2018. China and Russia signed a second deal in November 2014 for an additional 30 BCM.¹⁰³ International media reports, however, have suggested that low energy prices and uncertainty about China's economic future will lead to a scaling-down of these plans, with one private sector source claiming that China and Russia will likely "postpone the project commissioning into the late 2020s."¹⁰⁴

As noted above, on May 12, 2014, the Turkmen and Chinese presidents announced an agreement whereby Turkmenistan will increase its supply of natural gas to China to 65 BCM of gas annually by 2016. The Burma pipeline, completed in October 2013, is expected to deliver 10 BCM

⁹⁹ "China Targets Increased Gas Imports from Turkmenistan," Xinhua News Agency, May 12, 2014, http://news.xinhuanet.com/english/china/2014-05/12/c_133328801.htm; U.S. Energy Information Administration, *China*, February 4, 2014, <http://www.eia.gov/countries/cab.cfm?fips=ch>; "Asia-China Gas Pipeline Metering Station Passes Appraisal," Xinhua News Agency, April 27, 2014, http://news.xinhuanet.com/english/china/2014-04/27/c_133293294.htm; "Turkmenistan, China—Largest Partners in Gas Sphere," Cihan News Agency, May 14, 2014, http://en.cihan.com.tr/news/Turkmenistan-China-largest-partners-in-gas-sphere_1100-CHMTQzMTEwMC8z.

¹⁰⁰ Payrav Chorshanbiyev, *ASIA-Plus*, "Tajikistan Seeks Consultant for Construction of Its Section of Turkmen-Chinese Gas Pipeline," February 24, 2015, <http://news.tj/en/news/tajikistan-seeks-consultant-construction-its-section-turkmen-chinese-gas-pipeline>.

"100 bcm of Gas Delivered by China-Central Asia Pipelines," *Xinhua*, November 14, 2014, http://news.xinhuanet.com/english/china/2014-11/14/c_133790789.htm.

¹⁰¹ "Flow of Natural Gas from Central Asia," CNPC, <http://www.cnpc.com.cn/en/FlowofnaturalgasfromCentralAsia/FlowofnaturalgasfromCentralAsia2.shtml>.

¹⁰² "China Starts Constructing 3rd West-to-East Gas Pipeline," Xinhua News Service, October 16, 2012, http://news.xinhuanet.com/english/china/2012-10/16/c_131910496.htm.

¹⁰³ Lucy Hornby, "Russia to Increase Gas Supply to China," *Financial Times*, November 10, 2014.

¹⁰⁴ Olesya Astakhova and Chen Aizhu, "Exclusive: Russia Likely to Scale Down China Gas Supply Plans," *Reuters*, January 15, 2016, <http://www.reuters.com/article/us-russia-china-gas-exclusive-idUSKCN0UT1LG>.

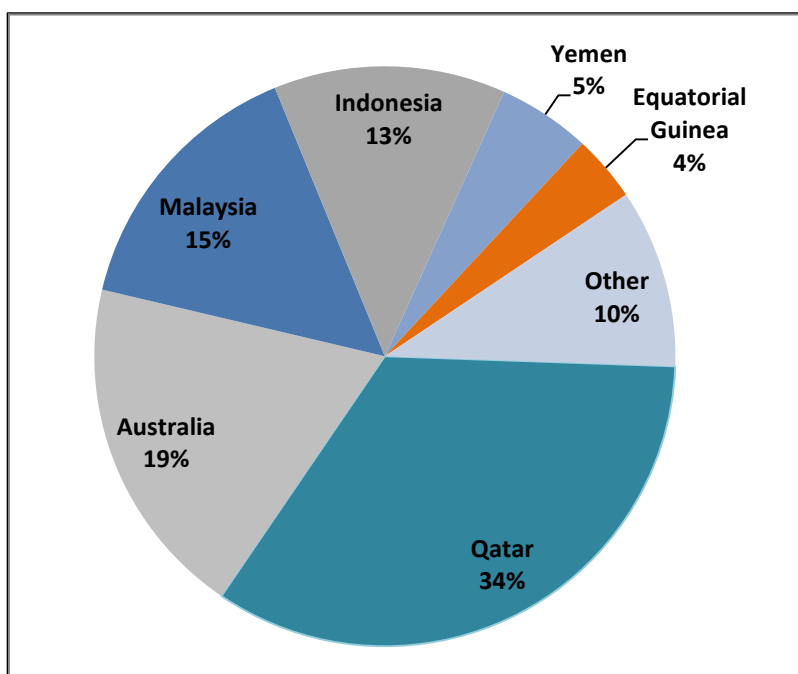
annually.¹⁰⁵ Some analysts have suggested that the Russia-China pipeline deal may give China more leverage in negotiations over pricing of its LNG imports, potentially driving down LNG prices in Asia and affecting the bottom line for LNG exporters.¹⁰⁶ Australia, as the second largest supplier of natural gas to China, may be vulnerable due to the high cost of its projects.

LNG: Many Sources

Asia is by far the largest LNG importing region in the world, importing almost five times as much LNG as any other region, and China is a fast-growing component of this demand. China, which began importing LNG in 2006, is the world's third largest importer of LNG behind Japan¹⁰⁷ and South Korea. China imports LNG from a wide variety of suppliers (see **Figure 7**), which has given it negotiating leverage in its contracts.

Figure 7. China's LNG Suppliers, 2014

Total = 27.1 BCM



Source: BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>.

Notes: Other includes Algeria, Angola, Brunei, Egypt, Nigeria, Norway, Oman, Papua New Guinea, Russia, and Trinidad and Tobago. Units = billion cubic meters (BCM)

¹⁰⁵ "China Targets Increase Gas Imports from Turkmenistan," Xinhua News Agency, May 12, 2014, http://news.xinhuanet.com/english/china/2014-05/12/c_133328801.htm; Du Juan, "Myanmar-China Gas Pipeline Completed," *China Daily*, October 20, 2013, http://usa.chinadaily.com.cn/business/2013-10/20/content_17046790.htm; "China, Russia Ink Long-Awaited Gas Deal," Xinhua News Agency, May 22, 2014, http://news.xinhuanet.com/english/bilingual/2014-05/22/c_133353357.htm.

¹⁰⁶ Robert Tuttle, Anna Shiryayevskaya and Isis Almeida, "Russia-China Deal to Damp LNG Prices as Output Rises," Bloomberg News, May 22, 2014, <http://www.bloomberg.com/news/2014-05-21/russia-china-deal-seen-damping-lng-prices-as-outpt-rises.html>.

¹⁰⁷ For reference, Japan has been importing LNG since the 1960s.

U.S. LNG Exports

China does not import LNG from the United States and no Chinese company has signed a contract with any of the U.S. LNG export projects. Nevertheless, China has expressed an interest in importing U.S. LNG in the future. After the July 2013 meeting of the premier U.S.-China dialogue, the annual Strategic and Economic dialogue, China highlighted a U.S. commitment to “inform China about the statutory process required by the Natural Gas Act that governs evaluations of LNG export applications” to countries with Free Trade Agreements with the United States, and to countries without them, such as China.¹⁰⁸ In a November 2013 report, one analyst opined, however, that, “While the economics of U.S. LNG exports to China may make sense in the current low-price environment, the prospects for this trade remain doubtful. Even if exports to China were to be approved by the U.S. Department of Energy (DOE), Beijing may view buying these supplies as fostering an unacceptable level of energy dependence on the U.S.”¹⁰⁹

DOE permits are not exclusive by country, but are either for countries with which the United States has a free trade agreement or not. Permits to export natural gas to free trade partners are expedited in the DOE process. Factors that may give China pause about significant imports of U.S. LNG include Chinese wariness of the U.S. strategic rebalance to Asia, strains with the United States over Chinese actions in the East China Sea and South China Sea, and tensions sparked by allegations and counter-allegations related to cyber security. The cancellation of CNOOC’s bid to buy California-based energy company Unocal in 2005 remains an issue. However, greater energy interdependence may broaden cooperation.

LNG exports to China were raised during a Senate Energy and Natural Resources Committee hearing in January 2015.¹¹⁰ In a response to a question from Senator Maria Cantwell about U.S. natural gas prices and manufacturing, Paul Cicio, President of Industrial Energy Consumers of America, stated that China was paying a high price for imported natural gas, and then heavily subsidizing the cost of that gas for its manufacturers. Senators Debbie Stabenow and Angus King raised concern that such policies might be giving Chinese manufacturers a significant competitive advantage in energy costs over U.S. companies, at a cost to U.S. manufacturing jobs, and thus questioned whether LNG exports to China were in U.S. interests.¹¹¹

¹⁰⁸ U.S. Department of the Treasury, “Joint U.S.-China Economic Track Fact Sheet of the Fifth Meeting of the U.S.-China Strategic and Economic Dialogue,” July 12, 2013, <http://www.treasury.gov/press-center/press-releases/Pages/jl2010.aspx>.

¹⁰⁹ Damien Ma, *China’s Coming Decade of Natural Gas*, National Bureau of Asian Research, November 2013, <http://www.nbr.org/publications/element.aspx?id=711>.

¹¹⁰ U.S. Congress, Senate Committee on Energy and Natural Resources, *Full Committee Hearing on LNG Export Legislation*, Hearing on S. 33, 114th Cong., 1st sess., January 29, 2015, S. Hrg. 114-9 (Washington: GPO, 2015), pp. 70-72.

¹¹¹ International observers consider energy subsidies to be widespread in the Chinese economy. A 2015 IMF study calculated—not without controversy—the “post-tax” subsidies (i.e., accounting for the projected negative economic impact of climate change) on various energy subsectors in each major global economy. For China, the study concluded that in 2013 China’s subsidies on natural gas were equivalent to 0.23% of GDP—substantially lower than 1.77% of GDP for the oil industry and 17.22% of GDP for coal. See “Access the country database” at International Monetary Fund, “Counting the Cost of Energy Subsidies,” July 17, 2015, <http://www.imf.org/external/pubs/ft/survey/so/2015/NEW070215A.htm>.

Chinese FDI in United States

China's oil and gas firms have made a number of large U.S. acquisitions in recent years. In 2010 and 2011, CNOOC purchased several shale oil and gas assets from Oklahoma-based Chesapeake Energy.¹¹² Over the course of 2013, Sinopec also acquired several Chesapeake shale oil and gas assets.¹¹³ In early 2013, CNOOC also purchased Canadian energy firm Nexen for \$15.1 billion.¹¹⁴

At the time of these acquisitions, some analysts opined that CNOOC and Sinopec's apparently growing interest in U.S. assets was partly due to "a greater willingness in the U.S. to encourage Chinese investment."¹¹⁵ Others suggested that the primary motivation for such investments was to gain access to advanced technologies in order to effectively exploit China's own shale deposits.¹¹⁶

Consumption: A Case of Mixed Messages

Growth in China's demand for natural gas has slowed in recent years. State media reported that annual consumption in 2015 was 191 BCM, up 3.7% from 2014.¹¹⁷ This represented the lowest rate of annual growth in a decade (see **Figure 8**). China's government expects its overall energy consumption to grow in 2016, with natural gas rising to 6.2% of primary energy needs.¹¹⁸ (See **Figure 9**.) Part of the slowdown in consumption growth is attributed to the sluggish economy. In November 2015, China cut natural gas prices to spur demand.¹¹⁹

Predictions of future growth in gas consumption vary. The deputy head of CNPC's Economic and Technology Research Institute projected 7.3 % growth for 2016, while the deputy head of CNOOC's Economic and Technology Institute projected between 4.5% and 5% growth.¹²⁰ The large differences in projections by the two companies reflect the difficulty in obtaining good data on Chinese natural gas consumption.¹²¹

A 2014 study used a regression model to estimate residential gas price and income elasticities in Chinese urban centers. The study found that the price elasticity of natural gas was much more negative in northern China than in southern China—in other words, a rise in gas prices would be expected to cause much larger consumption declines in northern cities than in southern ones. The

¹¹² Chris Nicholson, "Cnooc in \$2.2 Billion Deal With Chesapeake Energy," *New York Times*, October 11, 2010, <http://dealbook.nytimes.com/2010/10/11/cnooc-in-2-2-billion-deal-with-chesapeake-energy>.

¹¹³ Sinopec, "SIPC Announces Mississippi Lime Joint Venture," March 7, 2013, http://sipc.sinopec.com/sipc/en/news/com_news/20130307/news_20130307_573043770000.shtml; Sinopec, "切萨皮克计划出售 10 亿美元页岩资产" ("Chesapeake Plans to Sell \$1 Billion in Shale Assets") (in Chinese), July 5, 2013, <http://cpy.sinopec.com/web/portal/BrowserPostInfo.aspx?postId=da0f7772-777e-49ae-9d96-221ac9f7925f>.

¹¹⁴ Carolyn King, "Cnooc Purchase of Nexen Is Approved by U.S.," *Wall Street Journal*, February 12, 2013, <http://www.wsj.com/articles/SB10001424127887324196204578299862176958542>.

¹¹⁵ Jim Polson and John Duce, "Cnooc Pays \$570 Million for Chesapeake Shale Stake," *Bloomberg*, January 31, 2011, <http://www.bloomberg.com/news/articles/2011-01-31/cnooc-pays-570-million-for-stake-in-chesapeake-u-s-shale-play>.

¹¹⁶ Cyrus Sanati, "What China Seeks in Chesapeake Shale Deal," *New York Times*, October 11, 2010, <http://dealbook.nytimes.com/2010/10/11/what-china-seeks-in-chesapeake-shale-deal>.

¹¹⁷ "China's Natural Gas Consumption in 2015 Hits Lowest Growth Rate in 10 Years," *Xinhua*, February 10, 2016, http://news.xinhuanet.com/2016-02/10/c_1118018340.htm.

¹¹⁸ "China Sees Energy Consumption Rising in 2016," *Reuters*, December 30, 2015.

¹¹⁹ "China Cuts Gas Prices and Boosts Hope Among Big Exporters," *Energywire*, November 20, 2015.

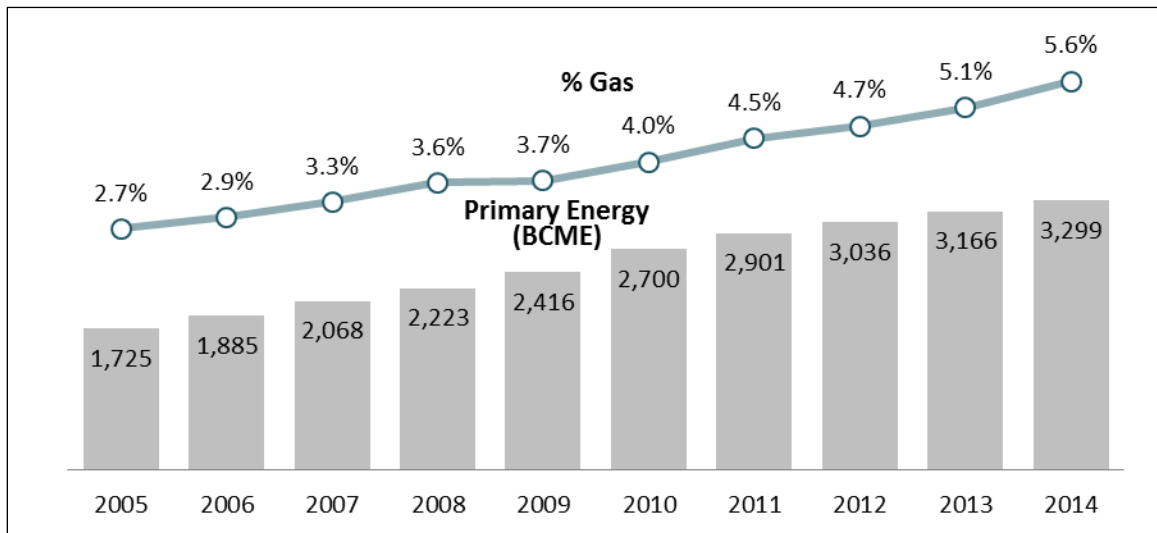
¹²⁰ "China Focus: China Natural Gas Consumption Growth to Rally in 2016," *Xinhua Finance*, January 27, 2016, <http://en.xinfiance.com/html/Industries/Energy/2016/191680.shtml>.

¹²¹ China does not release government data on natural gas demand.

authors suggested that this was due to the widespread availability of coal in the north, which can be easily substituted for gas in most cases.¹²²

Natural gas vehicles (NGVs) have been one of the major factors behind the fast growth in gas usage in China, chiefly because of their cost competitiveness, although NGV users have encountered severe problems at filling stations during winter's chronic gas shortages.¹²³ By the end of 2013, China already had some 3,000 LNG and compressed natural gas (CNG) refilling stations, supporting some 80,000 LNG vehicles, with about 40% located in the north and 20% in the northwest of the country. Based on the government plan for China's automobile industry, the number of natural gas-fueled vehicles is expected to reach 1.2 million by 2020. To accommodate such development, China would need to increase the number of natural gas filling stations to 12,000 by 2015, including 10,000 CNG outlets and 2,000 LNG stations, the plan says.¹²⁴ According to the China Automotive Technology and Research Center (CATARC), China had approximately 3,800 CNG filling stations and 3,100 LNG filling stations in 2015. In 2013, the electric power sector used 26 BCM, or 16% of total gas demand.¹²⁵

**Figure 8. Primary Energy Consumption and the Percent of Natural Gas Used
2005-2014**



Source: BP Statistical Review of World Energy, 2015, <http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy.html>. Graphic by CRS.

Notes: Units = billion cubic meters of natural gas equivalent (BCME).

¹²² Yihua Yu, Xinye Zheng, and Yi Han, "On the Demand for Natural Gas in Urban China," *Energy Policy* 70 (2014), pp. 57–63, https://www.researchgate.net/publication/262074696_On_the_demand_for_natural_gas_in_urban_China.

¹²³ Dawn Lee, "China's Cleaner Air Policies Seen Causing Gas Shortages," *International Oil Daily*, September 25, 2013.

¹²⁴ "China's Burgeoning Gas Market Lures Host of Newcomers," *International Oil Daily*, January 20, 2014.

¹²⁵ Song Yen Ling and Stephanie Wilson, "China Raises On-Grid Tariffs of Gas-Fired Power Plants," *Platts*, October 16, 2013.

Climate Change and Pollution Mitigation as Drivers of Natural Gas Use

China surpassed the United States as the world's highest greenhouse gas emitter roughly in 2006.¹²⁶ Carbon dioxide emissions from natural gas are a minor contributor to China's total, accounting for about 3% of emissions from fuel consumption in 2013, according to a report by the International Energy Agency.¹²⁷ Coal emissions were approximately 84%. Chinese policymakers face pressure to clean up the coal industry, not only for reasons related to greenhouse gas emissions but also due to public health concerns from conventional pollutants. A 2014 study at Beijing's Tsinghua University suggested that coal and other sources of small-particulate emissions were responsible for 670,000 premature deaths per year throughout the country.¹²⁸

The future of natural gas depends greatly on the degree to which Chinese policymakers address these problems. "Whether or not China will further increase the share of natural gas in its energy mix depends on how fast the government wants to solve air pollution," according to Lin Boqiang, Director of the China Center for Energy Economics Research at China's Xiamen University.¹²⁹

Some analysts believe that increasing domestic production and imports of natural gas to China could have benefits for global efforts to reduce greenhouse gas (GHG) emissions.¹³⁰ In this view, Chinese natural gas imports could help reduce carbon dioxide and other greenhouse gas emissions by, for instance, limiting the use of coal in China's electric power sector. Many of China's coal-fired power facilities are older than 20 years and lack the pollution controls of more modern plants. CNPC argues that the 55 BCM of natural gas that China now imports through the Central Asia-China Gas Pipelines allows China to substitute natural gas use for 73 million tons of standard coal use annually, "cutting carbon dioxide and sulfur dioxide emissions by 78 million tons and 1.21 million tons each year, respectively."¹³¹

¹²⁶ The United States is still responsible for the highest cumulative contribution of human-related emissions.

¹²⁷ International Energy Agency, *CO2 Emissions from Fuel Combustion*, 2015 Edition, 2015, Part II, p. 189.

¹²⁸ "670,000 Smog-Related Deaths a Year: The Cost of China's Reliance on Coal," *South China Morning Post*, November 5, 2014, <http://www.scmp.com/news/china/article/1632163/670000-deaths-year-cost-chinas-reliance-coal?page=all>.

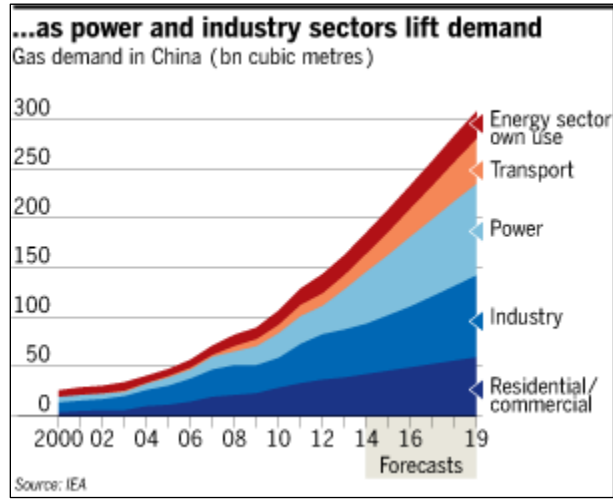
¹²⁹ Coco Liu, "China Fuels New Boom in Natural Gas," *Climate Wire*, June 30, 2014.

¹³⁰ Candace Dunn, "Natural Gas Serves a Small, but Growing, Portion of China's Total Energy Demand," Energy Information Administration, August 18, 2014, <http://www.eia.gov/todayinenergy/detail.cfm?id=17591>.

On September 25, 2015, President Obama and Chinese President Xi issued a U.S.-China Joint Announcement on Climate Change that, among other things, outlined each countries respective actions to limit domestic greenhouse gas emissions.

¹³¹ "Flow of Natural Gas from Central Asia," CNPC, <http://www.cnpc.com.cn/en/FlowofnaturalgasfromCentralAsia/FlowofnaturalgasfromCentralAsia2.shtml>.

Figure 9. Natural Gas Consumption by Sector
2000-2019



Source: International Energy Agency.

Appendix. Provincial Map

Figure A-1. Provincial Map of China



Source: Map created by CRS using data from Esri (2014).

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