



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

DRIVERS OF CHINA'S ENERGY SECURITY

by

Anthony A. Ullman

March 2021

Co-Advisors:

Robert E. Looney
Covell F. Meyskens

Approved for public release. Distribution is unlimited.

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE March 2021	3. REPORT TYPE AND DATES COVERED Master's thesis		
4. TITLE AND SUBTITLE DRIVERS OF CHINA'S ENERGY SECURITY			5. FUNDING NUMBERS	
6. AUTHOR(S) Anthony A. Ullman				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited.			12b. DISTRIBUTION CODE A	
13. ABSTRACT (maximum 200 words) This thesis studied China's energy security policies' primary drivers and, more specifically, how China acquires the energy needed to satisfy its social and economic needs. This thesis examined three primary drivers of China's energy security policies: the diversification of resources due to foreign pressures, the development of green energy, and the increase in growth and urbanization. After systematic analysis, this thesis found that China has not achieved energy independence because of an increase in growth and urbanization and heavily relies on imports to meet demands. China primarily relies on coal to fulfill its demand and lacks the domestic capability to meet its oil and natural gas demands. Air pollution and climate change are the primary motivators for China's green energy policies, prompting China to develop modern technology in the renewable energy sector to reduce air pollution, making it the global leader in the sector. China diversifies its energy security portfolio to avoid geostrategic risks to the energy mix, such as the Malacca dilemma and uncertainty with the Strait of Hormuz. China is dependent on Australia for natural gas and on the Middle East for oil imports. China seeks to secure access to resources via pipelines from Central Asia and Russia to avoid security issues in the Strait of Malacca and the Strait of Hormuz.				
14. SUBJECT TERMS China, energy security, foreign reliance, green energy, diversification of resources			15. NUMBER OF PAGES 139	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release. Distribution is unlimited.

DRIVERS OF CHINA'S ENERGY SECURITY

Anthony A. Ullman
Lieutenant Junior Grade, United States Navy
BS, University of Maryland University College, 2016

Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(EAST ASIA AND THE INDO-PACIFIC)**

from the

**NAVAL POSTGRADUATE SCHOOL
March 2021**

Approved by: Robert E. Looney
Co-Advisor

Covell F. Meyskens
Co-Advisor

Afshon P. Ostovar
Associate Chair for Research
Department of National Security Affairs

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

This thesis studied China's energy security policies' primary drivers and, more specifically, how China acquires the energy needed to satisfy its social and economic needs. This thesis examined three primary drivers of China's energy security policies: the diversification of resources due to foreign pressures, the development of green energy, and the increase in growth and urbanization. After systematic analysis, this thesis found that China has not achieved energy independence because of an increase in growth and urbanization and heavily relies on imports to meet demands. China primarily relies on coal to fulfill its demand and lacks the domestic capability to meet its oil and natural gas demands. Air pollution and climate change are the primary motivators for China's green energy policies, prompting China to develop modern technology in the renewable energy sector to reduce air pollution, making it the global leader in the sector. China diversifies its energy security portfolio to avoid geostrategic risks to the energy mix, such as the Malacca dilemma and uncertainty with the Strait of Hormuz. China is dependent on Australia for natural gas and on the Middle East for oil imports. China seeks to secure access to resources via pipelines from Central Asia and Russia to avoid security issues in the Strait of Malacca and the Strait of Hormuz.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	MAJOR RESEARCH QUESTION.....	1
B.	SIGNIFICANCE OF RESEARCH QUESTION	3
1.	China’s Increased Energy Demand and Economic Rise	3
2.	Impact on U.S. Foreign Policy	7
C.	LITERATURE REVIEW	11
1.	Diversification of Resources	11
2.	Green Energy	15
D.	POTENTIAL HYPOTHESES.....	18
1.	Growth and Urbanization	18
2.	Development of Clean Energy	18
3.	Diversification of Resources due to Foreign Pressures	19
E.	RESEARCH DESIGN.....	19
 II.	 DRIVERS OF DOMESTIC ENERGY SECURITY POLICIES	 21
A.	OVERALL CONSUMPTION	22
1.	Industrial Sector.....	23
2.	Residential Sector.....	26
3.	Transport Sector	27
B.	DOMESTIC DEVELOPMENT—COAL	28
C.	DOMESTIC DEVELOPMENT—OIL	31
D.	DOMESTIC DEVELOPMENT—NATURAL GAS	34
E.	DOMESTIC DEVELOPMENT—NUCLEAR.....	36
F.	CONCLUSION	38
 III.	 DRIVERS OF CHINA’S GREEN ENERGY POLICIES.....	 41
A.	FACTORS THAT DROVE CHINA TO PURSUE RENEWABLE ENERGY	42
B.	THE CHINESE GOVERNMENT’S GOALS.....	45
C.	RENEWABLE ENERGY	50
1.	Hydropower	51
2.	Wind	53
3.	Solar	56
D.	INVESTMENT RENEWABLE ENERGY SECTOR.....	59
E.	INFRASTRUCTURE ISSUES WITHIN SOLAR AND WIND GENERATION	60
F.	CONCLUSION	66

IV.	DRIVERS OF FOREIGN ENERGY SECURITY POLICIES	69
A.	INFLUENCES OF ENERGY SECURITY ABROAD	70
B.	FOREIGN SOURCES—COAL	73
	1. Indonesia—Coal.....	74
	2. Australia—Coal.....	75
	3. Mongolia—Coal	76
C.	FOREIGN SOURCES—OIL.....	78
	1. Saudi Arabia—Oil	81
	2. Iran—Oil.....	81
	3. Russia—Oil.....	82
	4. Brazil—Oil.....	83
	5. Venezuela—Oil.....	84
	6. Angola—Oil	85
D.	FOREIGN SOURCES—LNG	85
	1. Australia—LNG	87
	2. Qatar—LNG.....	88
	3. Malaysia—LNG	89
	4. Indonesia—LNG	90
E.	FOREIGN SOURCES—PIPELINE NATURAL GAS	91
	1. Central Asia—China Gas Pipeline	94
	2. Turkmenistan	95
	3. Kazakhstan	96
	4. Russia—Pipeline Natural Gas	97
	5. Myanmar	98
F.	CONCLUSION	99
V.	CONCLUSION	101
A.	SUMMARY OF FINDINGS	101
B.	FUTURE TRENDS.....	105
	LIST OF REFERENCES.....	107
	INITIAL DISTRIBUTION LIST	123

LIST OF FIGURES

Figure 1.	China's Energy Trilemma Score.....	2
Figure 2.	BRI Current and Proposed Projects	7
Figure 3.	2009-2019 China Energy Consumption in EJ	23
Figure 4.	China's GDP by Sector by percentage.....	24
Figure 5.	Industrial Hydrocarbon Usage in KTOE	25
Figure 6.	Residential Hydrocarbon Usage in KTOE.....	27
Figure 7.	Transport Hydrocarbon Usage in KTOE	28
Figure 8.	Map of China's Coal Reserves	30
Figure 9.	2009-2019 China Oil Consumption and Production in EJ	31
Figure 10.	Location of China's Oil Basins and Oilfields	32
Figure 11.	China Oil Infrastructure	33
Figure 12.	China's Natural Gas Production and Consumption in EJ.....	35
Figure 13.	Nuclear Facilities in China.....	37
Figure 14.	Gain in Life Expectancy if China Reduced Pollution to WHO standard	50
Figure 15.	2009-2019 Change in Renewable Energy.....	51
Figure 16.	2009-2019 Hydropower Generation	52
Figure 17.	2009-2019 Wind Power Generation	54
Figure 18.	China's Onshore Wind Potential	55
Figure 19.	China's Offshore Wind Potential.....	56
Figure 20.	2009-2019 Solar Power Generation.....	58
Figure 21.	China Solar Radiation Availability	58
Figure 22.	Annual Increase in Wind and Solar Power	63

Figure 23.	2021-2023 Coal Plant Restrictions	64
Figure 24.	2013-2016 Change in Pollution	66
Figure 25.	China Energy Import Routes	72
Figure 26.	Mongolia Railway Infrastructure	77
Figure 27.	China Oil Imports 2009 vs. 2019 in Million Metric Tons	79
Figure 28.	2018-2019 China changes in Oil Imports by Percentage.....	79
Figure 29.	2019 China’s Oil Import by Country by Percentage	80
Figure 30.	2014 China’s Oil Import by Country by Percentage	80
Figure 31.	China LNG Imports 2009–2019 in BCM	86
Figure 32.	China Primary LNG Imports 2009–2019 in BCM	87
Figure 33.	China Pipeline Imports 2009–2019 in BCM	93
Figure 34.	CACGP Current and Projected Pipelines	94
Figure 35.	Russian Power of Siberia Pipelines	98
Figure 36.	China-Myanmar Oil and Gas Pipeline.....	99

LIST OF ACRONYMS AND ABBREVIATIONS

APPCAP	Air Pollution Prevention and Control Action Plan
BPD	barrels per day
BRI	Belt and Road Initiative
BCM	billion cubic meters
CACGP	Central-Asia China Gas Pipeline
CNPC	China Natural Petroleum Corporation
CPEC	China-Pakistan Economic Corridor
CCP	Chinese Communist Party
CNOOC	Chinese National Offshore Oil Corporation
ESPO	Eastern Siberia-Pacific Ocean
EJ	exajoules
FYP	Five-Year Plan
GW	gigawatts
GDP	gross domestic product
JCPOA	Joint Comprehensive Plan of Action
KTOE	kilo metric ton of oil equivalent
KWHM2	kilowatts per hour per square meter
LNG	liquified natural gas
MT	megatons
MTOE	million metric ton of oil equivalent
MW	megawatts
NOC	National Oil Companies
NETF	Naval Expeditionary Task Force
PCA	Paris Climate Agreement
PRC	People's Republic of China
TJ	terajoule
TWHR	terra-watt hours
WHO	World Health Organization

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

I would like to thank the entire NPS staff for their commitment and adaptability during the pandemic. In particular, I would like to thank the East and Southeast Asia regional staff for shaping how I now think about Asian international affairs. Furthermore, my sincerest appreciation to Professors Covell Meyskens and Robert Looney for their expertise on this project. I would like to thank my wife, Christina, and my daughter, Peyton, for your love and support during this challenging period in our lives; without it, I would have never sustained the perseverance to complete this project.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

This thesis examines how the People's Republic of China (PRC) is driving its energy security policies to meet energy security demands. Outlining how China defines its energy security policies could give an understanding of how China drives its national security, foreign policy, and domestic resource development. China recognizes that energy security is a long-term strategy toward continuous economic development and urbanization while calculating and preventing risks to the environment. As the number one energy consumer and the number one emitter of greenhouse gases, China continues to rely primarily on domestic coal and oil and natural gas imports from the Middle East. The World Energy Council ranks China 72nd with a trilemma score of 63.7 out of 100 (see Figure 1).¹ China's low score emerges from its dependence on imports, lack of energy storage, and carbon dioxide emissions per capita. Many of the concerns are recognized by the Chinese Communist Party (CCP) in the furtherance of long-term energy security strategies. Noted by the graphic, China is dominant in the energy equity quadrant of the energy trilemma, meaning reliable access and affordability of energy.²

¹ "WEC Trilemma: Country Profile," World Energy Council, accessed April 13, 2020, <https://trilemma.worldenergy.org/#!/country-profile?country=China&year=2020>.

² "World Energy Trilemma Index World Energy Council," World Energy Council, 2020, <https://www.worldenergy.org/transition-toolkit/world-energy-trilemma-index>.

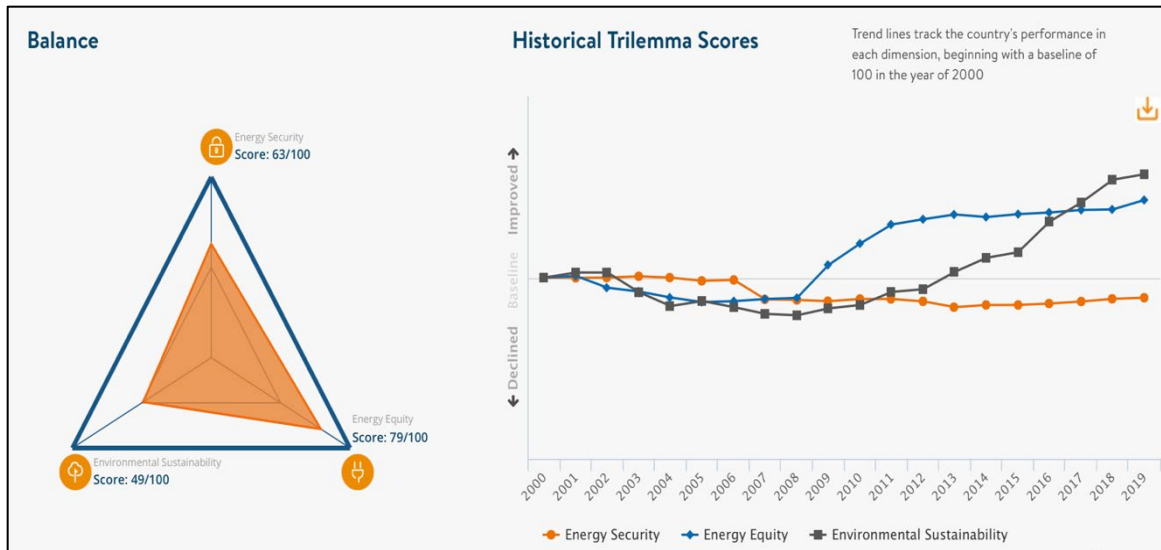


Figure 1. China's Energy Trilemma Score³

The majority of scholars and analysts argue that China's energy security policies orient toward diversifying its energy security portfolio.⁴ Diversifying its energy mix is significant for China in order to reduce dependence on foreign imports, fulfill the void in domestic supplies, and to lessen the fear of foreign dependence. Furthermore, China drives its policy toward energy efficiency and environmentally friendly policies. As the largest producer of greenhouse gases and the number one consumer of coal, scholars argue that China recognizes the long-term environmental impacts and the necessity to reduce coal use and replace it with clean energy.⁵

This thesis investigates the major drivers of China's energy security and studies, advances, and interconnects existing scholarship with new scholarship. This research assesses and describes the energy dilemma that China confronts between economic and energy development, energy efficiency, and environmental pollution. Furthermore, this

³ Source: World Energy Council, "WEC Trilemma: Country Profile."

⁴ Erica Strecker Downs, *China's Quest for Energy Security* (Santa Monica, CA: Rand, 2000), 18.

⁵ Bing Wang et al., "Role of Renewable Energy in China's Energy Security and Climate Change Mitigation: An Index Decomposition Analysis," *Renewable and Sustainable Energy Reviews* 90 (July 1, 2018): 189, <https://doi.org/10.1016/j.rser.2018.03.012>.

thesis addresses contradictions between the drivers and how the contradiction between the different drivers might lead to difficulties in achieving any of these objectives.

B. SIGNIFICANCE OF RESEARCH QUESTION

Researching the driving factors on how China structures its energy security policies is essential for two different reasons. China's increase in energy demand affects the global energy supply, demand, and prices, which is fueled by the industry sector and the increase in urbanization. Additionally, how China drives its energy security policies will determine how its national security policies are oriented, which will, in turn, affect U.S. foreign policy, such as U.S. sanctions on Iran and Venezuela, operations in the South China Sea, and the Paris Climate Agreement (PCA).

1. China's Increased Energy Demand and Economic Rise

China's economic power is on the rise and will continue to be an influence on the global stage. China's economy began its rise in 1979 when it transitioned from an agrarian command economy to a modernized industrial semi-market economy. Since opening up its economy, China has developed into one of the world's most powerful economies. From 2000–2018, China's GDP, on average increased 9% and has risen over 800 million people from poverty.⁶ The World Bank estimates that China's economic growth will average 3.5% on the low end and 6% on the high end to 2030.⁷ China is the world's largest exporter of that consists of labor-intensive products and is the largest economy in the world in terms of gross GDP purchasing power parity.⁸

⁶ Wayne M Morrison, "China's Economic Rise: History, Trends, Challenges, and Implications for the United States," June 25, 2019, 2, <https://fas.org/sgp/crs/row/RL33534.pdf>.

⁷ P.R. China World Bank and the Development Research Center of the State Council, *China 2030: Building a Modern, Harmonious, and Creative Society* (Washington, D.C: World Bank, 2013), 369, <https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-9545-5>.

⁸ "World Economic Outlook (October 2019) - GDP, Current Prices," International Monetary Fund, October 2019, <https://www.imf.org/external/datamapper/PPPGDP@WEO>.

China was once a net exporter of energy; however, since 1993, China has been a net importer of oil and continues to be the number one importer of oil.⁹ As China's economy continues to develop and grow, so will the demand for energy and resources to fuel the economy. Since 2000, China's energy utilization has more than doubled.¹⁰ The significant spike in China's energy demand directly correlates to its economic development in the industry sector and urbanization of rural areas. From 2000–2017, China's industry sector tripled its energy use, while the transport sector more than doubled its use.¹¹ China fueled this rise with an increase in net energy imports. Oil imports more than doubled, and China began importing natural gas in 2006.¹² Imports in 2006 were 36,984 terajoules (TJ) and increased to 3,454,731 TJ.¹³

A study of China's most recent state-led plans indicates how it assesses current and future energy security policies. In March 2016, China's National People's Congress ratified and published its *13th Five Year Plan for Economic and Social Development of the People's Republic of China* that outlines its progressive goals toward energy security and development.¹⁴ Outlined within China's plan is to “build a modern energy system that is clean, low-carbon, safe, and efficient, and will safeguard the country's energy security.”¹⁵ China places a premise on developing hydropower plants in basin areas while recognizing the importance of protecting the ecological environment.¹⁶ China also emphasizes thermal and solar development in the 13th Five-Year Plan. Additionally, the plan highlights constructing nuclear power plants along China's coast and implementing the appropriate

⁹ Jeff Barron, “China Surpassed the United States as the World's Largest Crude Oil Importer in 2017 - Today in Energy - U.S. Energy Information Administration (EIA),” February 5, 2018, <https://www.eia.gov/todayinenergy/detail.php?id=34812>.

¹⁰ “Asia Pacific – Countries & Regions - Energy Consumption by Sector,” International Energy Agency, October 29, 2019, <https://www.iea.org/regions/asia-pacific>.

¹¹ International Energy Agency.

¹² International Energy Agency.

¹³ International Energy Agency.

¹⁴ “The 13th Five-Year Plan (2016–2020),” National People's Congress, 2015, https://en.ndrc.gov.cn/newsrelease_8232/201612/P020191101481868235378.pdf.

¹⁵ National People's Congress, 84.

¹⁶ National People's Congress, 84.

safety measures to avoid crises such as the 2011 Fukushima nuclear power plant. China plans to limit the development of coal in the eastern and central parts of the country while modernizing and innovating coal development and production in the west.¹⁷ In the oil and natural gas sector, China explains that it will improve both onshore and offshore exploration, development, and procurement of oil, natural gas, and shale products while alleviating mining rights to increase public and private sector involvement.¹⁸

In addition to specific energy sector advancements, China's Five-Year Plan outlines an increase in compliance with pollution control. Specific compliance includes modernizing the industry sectors that do not maintain emissions criteria, increase the use of natural gas in major metropolitan areas by 45 billion cubic meters, which decreases coal use by 189,000 tons, and ceases developments that abuse state industrial regulations.¹⁹ All of these plans are to reduce heavy air pollution days by 25% through increased monitoring and enforcing compliance.²⁰ China also outlines to peak CO₂ emissions by 2030 and by 2020 decrease CO₂ per unit of GDP by 18%.²¹

Infrastructure projects in the energy field, as part of China's Belt and Road Initiative (BRI), are integral to China's energy portfolio. To date, 46% of projects are dedicated to energy, and 25% are transportation and shipping.²² In 2013, Xi Jinping announced that plans were in place to revive the old Silk Road. The BRIs are proposed to improve infrastructure in developing countries to increase economic and geopolitical relations. The *Vision and Actions on Energy Cooperation in Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road* highlights several key factors that illustrate how deep BRI is connected with energy security:

¹⁷ National People's Congress, 84.

¹⁸ National People's Congress, 84–85.

¹⁹ National People's Congress, 130–31.

²⁰ National People's Congress, 128.

²¹ National People's Congress, 19.

²² World Bank, "Belt and Road Economics: Opportunities and Risks of Transport Corridors" (Washington, D.C: The World Bank, March 18, 2019), 38.

- The Belt and Road Initiative seeks to foster energy cooperation in order to jointly build up an open, inclusive, and beneficial community of shared interests, responsibility and destiny;
- The cooperation will be green and efficient. We will attach great importance to the issue of environmental protection in the process of energy development, and strive to encourage the efficient development and utilization of clean energy. We will strictly control the emission of pollutants and green-house gases, raise energy efficiency and contribute to green and efficient development in all countries;
- The cooperation will be safe and secure. We will strengthen communication, increase mutual trust with relevant countries, and reduce risks in the energy supply mechanism. We will jointly secure international energy production and transmission pathways and build up a safe and efficient energy security system.²³

Projects for building pipelines in Kazakhstan were part of the first projects for importing natural gas. Thereafter, ports in Sri Lanka were built to support commercial shipping and the People's Liberation Army Navy. China also manages and finances projects that developing countries cannot afford to support joint goals. Energy is deeply connected with BRI projects. BRI projects extend through Asia and as far as Europe and Africa (see Figure 2).²⁴ China's energy security strategy is projected to change as part of BRI. Energy security approaches are supposed to shift from quantitative to qualitative.²⁵ Instead of focusing on the number of imports, China's focus is proposed to be on building new and improving existing infrastructure. However, this objective has not yet been fully realized.²⁶

²³ "Vision and Actions on Energy Cooperation in Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road," National Development and Reform Commission (NRDC), March 18, 2015, https://www.followingthemoney.org/wp-content/uploads/2017/06/2017_NDRC-NEA_Vision-and-Actions-on-Energy-Cooperation-in-BRI_E.pdf.

²⁴ "Mapping the Belt and Road Initiative: This Is Where We Stand," Mercator Institute for China Studies, June 7, 2018, <https://www.merics.org/en/bri-tracker/mapping-the-belt-and-road-initiative>.

²⁵ Erica Strecker Downs, *Asia's Energy Security and China's Belt and Road Initiative*, NBR Special Report ; #68 (Baltimore, Maryland: Project Muse, 2017), 32.

²⁶ Vaclav Smil, "A Critical Look at Claims for Green Technologies - IEEE Spectrum," IEEE Spectrum: Technology, Engineering, and Science News, June 3, 2018, <https://spectrum.ieee.org/energy/environment/a-critical-look-at-claims-for-green-technologies>.

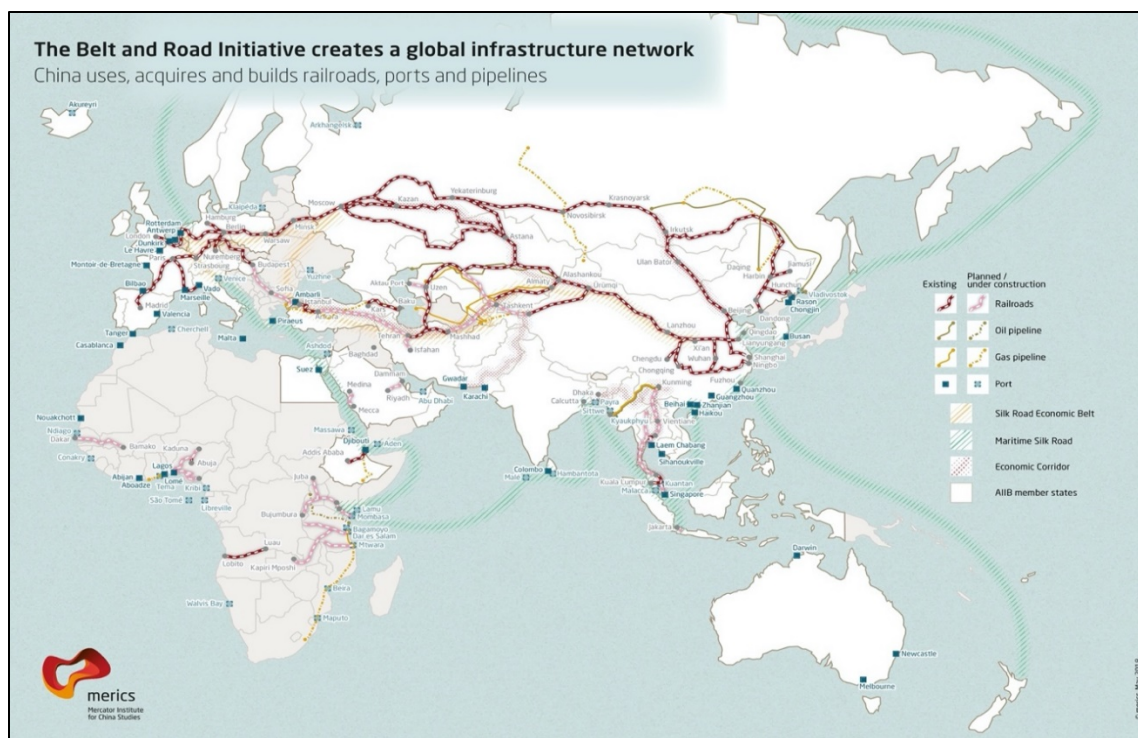


Figure 2. BRI Current and Proposed Projects²⁷

2. Impact on U.S. Foreign Policy

Chinese energy security also has a major impact on U.S. foreign policy in Asia. The Malacca Strait, according to Ole Odgaard and Jorgen Delman, is a strategic chokepoint that accounts for approximately 80% of China's imports.²⁸ The point of contention for China is the continuous presence and routine patrols of the U.S. Navy. Furthermore, the United States supports multilateral agreements by forward deploying U.S. Navy ships to the region to conduct operations to assure freedom of passage and navigation through the Malacca Strait. The dilemma is that Chinese maritime shipping travels freely through the Malacca Strait under the security of the U.S. Navy; however, if a conflict arose between the United States and China, the Malacca Strait would be controlled by the U.S. Navy and

²⁷ Source: Mercator Institute for China Studies, "Mapping the Belt and Road Initiative: This Is Where We Stand."

²⁸ Ole Odgaard and Jørgen Delman, "China's Energy Security and Its Challenges towards 2035," *Energy Policy* 71 (August 1, 2014): 113, <https://doi.org/10.1016/j.enpol.2014.03.040>.

would cut off China's maritime trade.²⁹ Although China continues to rely on the strategic chokepoint for maritime trade, the Malacca dilemma has caused China to diversify its energy security strategy overland via pipelines in Asia and the Middle East to solidify its risk mitigation plan if it were to go to war with the United States.

Another point of contention is that China imports energy resources from U.S. sanctioned countries. Through the BRI, China has loaned Venezuela \$60 billion to support infrastructure projects; however, Venezuela has been unable to make its payment, and in lieu of repaying its debt to China, Venezuela exports 10,000 barrels of oil per day.³⁰ China's financial interest opposes U.S. foreign policy in Venezuela. The United States has intervened and targeted Russian and Cuban oil companies, in addition to interdicting vessels, supporting the Maduro regime.³¹ In August 2019, China temporarily suspended oil imports in support of U.S. sanctions against Venezuela.³² Although it remains unclear when China will lift its suspension, China's financial interest in Venezuela remains an enduring controversy for U.S. foreign policy.

China and the United States are also in the same predicament over Iran; however, the difference is that China continues to import Iranian oil. China's energy security strategy complicates relations and increases tension between the United States. In 2016, China and other countries in Asia increased energy imports after the United States lifted sanctions on Iran.³³ Since then, the United States renounced its participation in the Joint Comprehensive Plan of Action (JCPOA) agreement with Iran and reinstated sanctions on Iran.³⁴ The

²⁹ Odgaard and Delman, 113.

³⁰ "China Spurns Venezuelan Exports," *Petroleum Economist*, 2019, <https://www.petroleum-economist.com/articles/politics-economics/south-central-america/2019/china-spurns-venezuelan-exports>.

³¹ "Treasury Further Targets Entities and Vessels Moving Venezuelan Oil to Cuba," U.S. Department of the Treasury, September 14, 2019, <https://home.treasury.gov/news/press-releases/sm784>.

³² Chen Aizu and Marianna Parraga, "China CNPC Suspends Venezuelan Oil Loading, Worried about U.S. Sanctions: Sources," *Reuters*, August 19, 2019, <https://www.reuters.com/article/us-china-venezuela-oil-cnpc-idUSKCN1V909C>.

³³ Cathleen D. Cimino-Isaacs and Kenneth Katzman, "Iran's Expanding Economic Relations with Asia," *Current Politics and Economics of the Middle East*, *Hauppauge* 10, no. 2 (2019): 149.

³⁴ White House, "President Donald J. Trump Is Reimposing Sanctions Lifted Under the Horrible Iran Deal," The White House, August 6, 2018, <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-reimposing-sanctions-lifted-horrible-iran-deal/>.

United States has targeted and sanctioned several Chinese oil companies in violation of U.S. sanctions, and the U.S. Treasury Secretary Steven Mnuchin stated that currently, “the China state companies are not buying oil from Iran.”³⁵ Nevertheless, despite China and the United States cooperating, illicit Chinese oil imports from Iran continue to be a security issue that complicates relations.

The South China Sea is approximately 1.4 million square nautical miles and is one of the busiest waterways, carrying one-third of the world’s trade per year, and is made up of natural and manmade islands, reefs, banks, and shoals.³⁶ Due to the rich oil and hydrocarbon gas deposits that remain below the earth’s surface, the South China Sea is highly disputed between China and five other countries. The U.S. Energy Information Administration “estimates the South China Sea contains approximately 11 billion barrels of oil...and 190 trillion cubic feet of natural gas in proved and probable reserves.”³⁷ The majority of the disputed area is near the Spratly Islands, with all countries claiming all of the area. Over the past decade, China has militarized the Spratly Islands by placing air and surface missiles, runways, and infrastructure for military supplies and personnel. The increase of military equipment gives China an advantage to forward deploy units to maintain a continuous presence, ultimately decreasing response times to threats to its self-proclaimed territorial claims.

South China Sea issues are relevant and important to the U.S. National Security policy. The U.S. National Security Strategy states, “China’s infrastructure investments and trade strategies reinforce its geopolitical aspirations. Its efforts to build and militarize outposts in the South China Sea endanger the free flow of trade, threaten the sovereignty

³⁵ “As U.S. Sanctions Increase, China Remains Iran’s Top Crude, Condensate Importer,” S&P Global, January 10, 2020, <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/011020-as-us-sanctions-increase-china-remains-irans-top-crude-condensate-importer>.

³⁶ “Territorial Disputes in the South China Sea,” Global Conflict Tracker, April 27, 2018, <https://cfr.org/interactive/global-conflict-tracker/conflict/territorial-disputes-south-china-sea>.

³⁷ “South China Sea - International - Analysis - U.S. Energy Information Administration (EIA),” Energy Information Administration, February 7, 2013, <https://www.eia.gov/beta/international/regions-topics.php?RegionTopicID=SCS>.

of other nations, and undermine regional stability.”³⁸ The reclamation and militarization of the Spratly Islands have sparked historical territorial disputes between China and other claimant states. The U.S. National Defense Strategy also states, “China is a strategic competitor using predatory economics to intimidate its neighbors while militarizing features in the South China Sea.”³⁹ Washington considers the South China Sea a potential area for future conflict if tensions rise between claimant states. The U.S. Navy conducts routine freedom of navigation operations in the South China Sea in efforts to deter Chinese aggression in the area. There will continue to be discord over the South China Sea between China and the United States.

The United States’ intent to withdrawal from the PCA also leaves an empty great power seat for China to fill, which could have political implications in the future. In a new era of great power competition, China seeks to overtake the United States in world affairs. On June 1, 2017, President Trump publicized intentions that the United States will depart the PCA and to renegotiate terms or a “new transaction on terms that are fair to the United States, its businesses, its workers, its people, its taxpayers.”⁴⁰ Trump goes on in his statement to defy China’s unfair part of the Paris Climate Accord: “China will be allowed to build hundreds of additional coal plants...China will be able to increase these emissions by a staggering number of years—13.”⁴¹ While the United States’ withdrawal from the PCA does not mean that it has completely abandoned its support for advancing clean energy, it has left room for China to lead the world in green energy for the future. As the leader in green energy, and with the departure of the United States from the PCA, a significant leadership position opens for China to exert influence within PCA and the future of green energy.

³⁸ White House, “2017 National Security Strategy,” 46, accessed October 28, 2019, <https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905-2.pdf>.

³⁹ Jim Mattis, “Summary of the 2018 National Defense Strategy,” January 19, 2018, 1.

⁴⁰ White House, “Statement by President Trump on the Paris Climate Accord,” The White House, June 1, 2017, <https://www.whitehouse.gov/briefings-statements/statement-president-trump-paris-climate-accord/>.

⁴¹ Trump.

C. LITERATURE REVIEW

1. Diversification of Resources

A survey of scholarship explains that one of China's goals is to diversify its energy resources. The necessity for diversification stems from a lack of domestic resources, a reliance on imports, and a fear of foreign dependence. China mainly relies on coal for the majority of its energy consumption. However, in attempts to replace coal with natural gas and oil, China does not have the domestic capacity to do so. China imports more hydrocarbons than any other country in the world and will likely continue to be reliant on imports.

At present, China's domestic energy production consists of nuclear, renewables, and hydrocarbons, which include oil, natural gas, and coal. China primarily uses hydrocarbons and hydropower to meet the majority of its domestic energy supply. The "China Energy Efficiency Report" states that, out of China's energy sources, coal makes up 69.7% of domestic energy production.⁴² Nuclear and renewables production is 17.3%, while oil and natural gas is 13%. While China is the world's largest producer of energy, it relies on importing 20% of its total energy consumption of coal, oil, and natural gas.⁴³

In 1993, China went from a net exporter to a net importer of oil.⁴⁴ Although, in 2001, China's imports declined to one million metric ton of oil equivalent (MTOE), its energy imports in 2017 reached a record level of 632 MTOE.⁴⁵ The significant rise in energy imports is mostly attributed to a large increase in its economy, the inability of domestic resources to meet demands, and the urbanization of rural areas. China's GDP increased elevenfold from 2000–2018.⁴⁶ Analysts forecast China's GDP will grow by an average of 5% from 2025–

⁴² "China Energy Efficiency Report," International Energy Charter, 2018, 43, https://www.energycharter.org/fileadmin/DocumentsMedia/EERR/EER-China_ENG.pdf.

⁴³ International Energy Charter, 54.

⁴⁴ Barron, "China Surpassed the United States as the World's Largest Crude Oil Importer in 2017 - Today in Energy - U.S. Energy Information Administration (EIA)."

⁴⁵ International Energy Agency, "Asia Pacific – Countries & Regions - Energy Consumption by Sector."

⁴⁶ "GDP (Current US\$) - China," World Bank, 2020, <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2001&locations=CN&start=1978>.

2030.⁴⁷ Since a high rate of growth is estimated, China's energy consumption is expected to grow. Analysts also assess that China's consumption growth is to meet U.S. and European consumption growth rates of 6.2%, which is likely due to an increase in the standard of living, urbanization, and GDP per capita.⁴⁸

Although China is rich in coal, with the third-largest coal reserves in the world, it is assessed to reach peak production by 2030.⁴⁹ Additionally, by 2030, analysts estimate that China will be import-dependent on coal. In 2008, Vietnam and Indonesia currently encompassed over 78% of China's coal imports. The majority of China's coal reserves are located in the north. Due to transportation costs, China exports coal from the north to Russia and imports coal to its southern coast.⁵⁰ In attempts to reduce coal in China's energy mix, it is likely that the alternative energy source will not be able to keep pace with China's economic growth and urbanization. Therefore, China will have to rely on coal to meet demands.

In 2017, China became the global leader in oil imports and relied heavily on oil imports to meet demands.⁵¹ China's increase in oil demand is "driven primarily by the transportation, petrochemical, and road construction sector as well as expanding foreign trade."⁵² From 2005–2010, China increased its oil use by 6.5 million barrels per day to 9.5 million barrels per day.⁵³ Furthermore, in 2011, China imported 51% of its oil imports from the Middle East, 24% from Africa, 22% from Russia, Central Asia, and Latin America, and 3% from the rest of the world. China heavily relies on the Middle East for the majority of its

⁴⁷ *China 2030: Building a Modern, Harmonious, and Creative Society* (Washington, D.C.: World Bank and the Development Research Center of the State Council, 2013), 8.

⁴⁸ McKinsey Global Institute, "China and the World: Inside the Dynamics of a Changing Relationship" (McKinsey Global Institute, July 2019), 115, <https://www.mckinsey.com/~media/mckinsey/featured%20insights/china/china%20and%20the%20world%20inside%20the%20dynamics%20of%20a%20changing%20relationship/mgi-china-and-the-world-full-report-june-2019-vf.ashx>.

⁴⁹ Bo-Qiang Lin and Jiang-Hua Liu, "Estimating Coal Production Peak and Trends of Coal Imports in China," *Energy Policy* 38, no. 1 (2010): 512, <https://doi.org/10.1016/j.enpol.2009.09.042>.

⁵⁰ Lin and Liu, 517.

⁵¹ Barron, "China Surpassed the United States as the World's Largest Crude Oil Importer in 2017 - Today in Energy - U.S. Energy Information Administration (EIA)."

⁵² Kang Wu, "China's Energy Security: Oil and Gas," *Energy Policy* 73 (October 1, 2014): 5, <https://doi.org/10.1016/j.enpol.2014.05.040>.

⁵³ Wu, 5.

oil imports. The energy dilemma for China is a continuous increase in oil imports. China is the world's largest importer of oil and relies on 69.8% of its crude oil to be imported.⁵⁴ According to China National Petroleum Corporation (CNPC), it predicts that China's reliance on imports of oil will increase to 80% by 2030.⁵⁵

Natural gas ranks third in consumption after oil in ranking energy sources consumed in China. Although natural gas only makes up approximately 20% of China's energy consumption, China's natural gas imports increased in 2018 to 45.3% and are expected to reach 50% by 2020.⁵⁶ Lin and Wang suggest that China's domestic production of natural gas is assessed to peak by 2020, which will cause an increase in imports.⁵⁷ According to these analysts, China's imports for gas come from two different transportation methods - pipelines and liquified natural gas (LNG) from maritime shipping. The pipelines run from Central Asia, Russia, and Burma, while China's imports LNG from the Middle East and Australia to its southern coast. In the concluding two months of 2019, China imported more natural gas than Japan.⁵⁸ The increase in China's natural gas use is likely in line with its goals to use cleaner energy. Natural gas remains significant in China's energy mix, and China will continue to rely on natural gas as a possible replacement for coal.

China's fear of foreign dependence is not just a contemporary concern. The concerns are drawn from historical experiences with the Soviet Union. The Chinese Communist Party has always feared to become reliant on foreign supplies to meet domestic energy demands, especially resources controlled by the United States.⁵⁹ From a historical perspective, China's reliance on foreign energy defies the "Maoist doctrine of self-reliance."⁶⁰ From the 1950–

⁵⁴ Helen Hua, "China - Oil and Gas," July 30, 2019, <https://www.export.gov/article?id=China-Oil-and-Gas>.

⁵⁵ Hua.

⁵⁶ Hua.

⁵⁷ Boqiang Lin and Ting Wang, "Forecasting Natural Gas Supply in China: Production Peak and Import Trends," *Energy Policy* 49 (2012): 232.

⁵⁸ Jessica Jaganathan, "China Imports Record LNG Volumes in Dec, Overtakes Japan for Second Month," January 6, 2020, <https://www.nasdaq.com/articles/china-imports-record-lng-volumes-in-dec-overtakes-japan-for-second-month-2020-01-06>.

⁵⁹ Downs, *China's Quest for Energy Security*.

⁶⁰ Downs, 11.

1960s, China depended on the Soviet Union for more than 50% of its energy.⁶¹ When the Sino-Soviet split occurred, China was left with ongoing joint energy projects and left to import its energy from the Soviet Union. China's unpleasant experience with the Soviet Union likely contributes to its fear of foreign dependence on energy and the continued need for diversification of resources.

China is also concerned about political threats to its access to energy resources. On land, China is concerned with regional stability, domestic and international, where railroads and pipelines are located. In areas near Xinjiang, terrorism and extremism are a risk to infrastructure and domestic stability.⁶² Scholars argue that the Strait of Malacca is a primary concern for China as 80% of its oil travels through it.⁶³ The U.S. Navy conducts routine patrols and maintains a presence in the area. In November 2003, Chinese President Hu Jintao commented on the Malacca dilemma, stating "certain powers have all along encroached on and tried to control navigation through the [Malacca] Strait."⁶⁴ Thereafter, a Chinese newspaper released this statement, "It is no exaggeration to say that whoever controls the Strait of Malacca will also have a stranglehold on the energy route of China."⁶⁵ China recognizes that the Strait of Malacca is a strategic vulnerability and fears if the diplomatic environment changes, its energy resources would be threatened, and it would have to rely on strategic reserves.

In response to the Malacca dilemma, China has diversified its energy portfolio so that if tensions escalated between China and the United States, it would have alternate supply lines to fulfill its demand. Some scholars argue that most of China's Malacca dilemma, 80% of China's oil imports, could be resolved through the BRI China-Pakistan Economic Corridor

⁶¹ Downs, 11.

⁶² Downs, *Asia's Energy Security and China's Belt and Road Initiative*, 33.

⁶³ Lu Jing and Wang Yao, "A Safety Assessment of China's Crude Oil Import Based on G1 Method," *Procedia - Social and Behavioral Sciences* 96, no. C (2013): 1744, <https://doi.org/10.1016/j.sbspro.2013.08.197>.

⁶⁴ "China's 'Malacca Dilemma' and the Future of the PLA," *Asia Dialogue* (blog), November 21, 2014, <https://theasiadialogue.com/2014/11/21/chinas-malacca-dilemma-and-the-future-of-the-pla/>.

⁶⁵ Shi Hongtao, "Energy Security Runs Up against the 'Malacca Dilemma': Will China, Japan, and Korea Cooperate?," *China Youth Daily*, June 15, 2004, http://zqb.cyol.com/content/2004-06/15/content_888233.htm.

(CPEC).⁶⁶ CPEC provides two functions for China. One, it provides an alternative to the Malacca dilemma, and two, it shortens oil transport from 45 days by sea to 10 days by land.⁶⁷ In addition to CPEC, China has energy deals with Russia and Myanmar to diversify its access to energy resources. CPEC and other pipelines provide China with an alternative to avoid the Malacca dilemma.

2. Green Energy

Another driver of China's energy policy is its strong pursuance of green energy policies. In 2010, China set a goal to reduce CO₂ per unit of GDP by 45% in 2020.⁶⁸ One challenge for China is rapid urbanization. The average urbanization of rich countries is 78%, while China in 2014 was at 52.5%. Compared to other wealthy countries, China has a significant amount of space to grow. An increase in urbanization will cause energy consumption to increase and will complicate the realization of policies to make China go green. China's economic and environmental policies tend to contradict each other, which obscures any sort of progress in accomplishing its goals.

Urbanization and economic development are drivers for China to place green energy and to reduce pollution as a top priority. China's determination to go green is outlined internally by the *Strategic Action Plan for Energy Development*.⁶⁹ This plan targets the four main sectors of pollution and goals to achieve by 2020: power, industry, building, and transport.⁷⁰ In the power sector, China aims to limit annual energy utilization at 4.8 billion tons of standard coal equivalent and oblige coal plants over 600 megawatts (MW) to achieve

⁶⁶ Jamie N. Whitman, "An Analysis Of The Primary Driver For China's Belt And Road Initiative—Security Versus Economics" (Monterey, CA; Naval Postgraduate School, 2018), 34.

⁶⁷ Rao Qasim Idrees, Rohimi Shapiee, and Haniff Ahamat, "Energy Cost Saving and Economic Prospective of China Pakistan Economic Corridor," *International Journal of Energy Economics and Policy* 8, no. 6 (2018): 218, <https://doi.org/10.32479/ijeep.6713>.

⁶⁸ Zhen-Yu Zhao, Rui-Dong Chang, and George Zillante, "Challenges for China's Energy Conservation and Emission Reduction," *Energy Policy* 74 (November 1, 2014): 709, <https://doi.org/10.1016/j.enpol.2014.07.004>.

⁶⁹ "Strategic Action Plan for Energy Development (2014 - 2020) – Policies," International Energy Agency, November 5, 2017, <https://www.iea.org/policies/1543-strategic-action-plan-for-energy-development-2014-2020>.

⁷⁰ International Energy Agency.

300 grams of coal equivalent per kilowatt per hour.⁷¹ In the industry sector, China plans to eliminate excess energy capacity and to remove outdated equipment that cannot be modernized. In the building sectors, the number of new green buildings produced will account for 50% of new buildings in urban regions. China's emphasis in the transport sector focuses on increasing the development of energy-efficient transport, including metro subways, high-speed rail, and electric vehicles.⁷²

Clean and renewable energy, such as nuclear, hydropower, geothermal, solar, biofuels, and waste, are significant for improving environmental conditions and reducing coal usage. In 2013, clean and renewable energy accounted for 12% of China's overall energy usage.⁷³ Biofuels, geothermal, and solar-powered fueled 68% of the residential sector. Hydropower and nuclear plants accounted for 19% of electricity in China. From 2013–2016, China increased renewable and clean energy almost twofold from 42.3 to 81.7 MTOE.⁷⁴ A contributing factor to China's drive for clean energy is not only to replace coal but to reduce the amount of greenhouse gases and the number of polluted days to reduce risks to its population as urbanization and the economy grows.

Another challenge is changing the incentives for Chinese officials. Regardless of the fact that the Chinese Communist Party sets goals for pollution control and environmental policy enforcement, China's state environmental policies contradict with implementation at the local government level.⁷⁵ Elite level "vested interests, interagency rivalries and an overriding focus on high growth rates" contradict environmental state policies.⁷⁶ At the local government level, leaders have faced a dilemma of energy conservation or economic growth. Local government officials have chosen economic growth because it is used to evaluate and

⁷¹ International Energy Agency.

⁷² International Energy Agency.

⁷³ International Energy Agency, "Energy Balances of Non-OECD Countries 2015" (Paris, France: OECD, 2015), 76.

⁷⁴ British Petroleum Company, "BP Statistical Review of World Energy: 2019" (London: British Petroleum Company, 2019), 51.

⁷⁵ Sam Geall and Adrian Ely, "Narratives and Pathways towards an Ecological Civilization in Contemporary China," *The China Quarterly* 236 (2018): 10, <https://doi.org/10.1017/S0305741018001315>.

⁷⁶ Geall and Ely, 10.

assess how those local officials are performing for promotion.⁷⁷ There have been efforts, however, to address how performance is measured for local officials. In 2015, the central party tied environmental pollution to evaluation reports for local officials.⁷⁸ Time will be a factor to assess how these changes have not only affected promotions but for the environment and pollution through China.

As a signatory to the United Nations Framework Convention on Climate Change, China has taken an all-inclusive approach to pollution control to establishing institutions, enforcing energy efficiency policies, and developing clean energy. China is the world leader in renewable energy, holding a 25% stake, and produced 106.7 MTOE in 2017, which was a record-setting year.⁷⁹ In 2014, China was responsible for 30% of global carbon dioxide emissions.⁸⁰ China is faced with a dilemma between economic and social development and decreasing greenhouse gases; however, China continues to pursue policies that support both goals.

China is also a significant contributor to the PCA and a world leader in renewables and green energy. China produces and consumes 30% more in renewable energy than the second-place United States.⁸¹ One of China's goals, as part of the PCA, by 2030, is to create 800–1000 gigawatts of renewable electricity.⁸² That amount of electricity is enough to power all of the United States. Not only is China devoted to developing new energy but it agreed to start closing down some of its obsolete coal furnaces and replace with new and clean coal

⁷⁷ Zhao, Chang, and Zillante, "Challenges for China's Energy Conservation and Emission Reduction," 710.

⁷⁸ Hannah Beech, "China Ties Officials' Promotions to Saving the Environment," *Time*, May 6, 2020, <https://time.com/3848171/china-environment-promotions/>.

⁷⁹ "BP Statistical Review of World Energy 2018" (London, England: British Petroleum Company, June 2018), 44.

⁸⁰ "Global Greenhouse Gas Emissions Data," Overviews and Factsheets, U.S. Environmental Protection Agency, January 12, 2016, <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>.

⁸¹ British Petroleum Company, "BP Statistical Review of World Energy: 2019," 51.

⁸² David Roberts, "By 2020, Every Chinese Coal Plant Will Be More Efficient than Every U.S. Coal Plant," *Vox*, May 15, 2017, <https://www.vox.com/energy-and-environment/2017/5/15/15634538/china-coal-cleaner>.

furnaces that are “lower emissions and higher efficiency.”⁸³ China also set a goal that by 2030, it expects greenhouse gases to peak and to increase clean and renewables to 20% of its energy mix.⁸⁴ In 2016, out of the world’s top producers in solar, five Chinese companies ranked in the top six.⁸⁵ Furthermore, Chinese companies acquired four of the five largest deals in green energy. China’s dedication to PCA and to green energy exemplifies that China is the global environmental leader.

D. POTENTIAL HYPOTHESES

1. Growth and Urbanization

The first hypothesis is an increase in growth and urbanization in China. China is the largest country by population in the world.⁸⁶ In 2017 it became the largest importer of oil.⁸⁷ Urbanization and an increase in Chinese consumption are expected to increase to the western rate of 6.2%, which has been a product of China’s sustained economic growth since the 1980s.⁸⁸ As rural citizens of China move to cities, they acquire automobiles and increase their standard of living, which leads to an increase in consumerism and energy consumption.

2. Development of Clean Energy

Another hypothesis of the driver behind China’s energy security is developing renewable and clean energy to reduce greenhouse gases and pollution. To reduce pollution, China developed goals through the Five-Year Plans to reduce pollution by 45% CO₂ per unit

⁸³ Roberts.

⁸⁴ David Stanway, “China’s Climate ‘ambition’ Pledge Could Lead to Tougher CO₂ Targets: Experts,” *Reuters*, July 2, 2019, <https://www.reuters.com/article/us-climatechange-china-idUSKCN1TX0SY>.

⁸⁵ “China’s Global Renewable Energy Expansion,” Institute for Energy Economics and Financial Analysis, January 2017, https://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion_January-2017.pdf.

⁸⁶ International Energy Charter, “China Energy Efficiency Report,” 36.

⁸⁷ Barron, “China Surpassed the United States as the World’s Largest Crude Oil Importer in 2017 - Today in Energy - U.S. Energy Information Administration (EIA).”

⁸⁸ McKinsey Global Institute, “China and the World: Inside the Dynamics of a Changing Relationship,” 115.

of GDP by 2020.⁸⁹ China's plan to reduce energy usage by shutting down and replacing high-carbon pollutant coal plants with low-carbon and highly efficient coal plants or renewables will significantly improve energy efficiency and reduce pollution. Additionally, plans to develop electric vehicles and green public transportation will also help reduce pollution and increase efficiency. While the green energy sector has experienced several technology and infrastructure issues, it remains the global leader.

3. Diversification of Resources due to Foreign Pressures

The most discernable explanation of what drives Chinese energy security is its objective of diversifying resources to reduce risks and threats to foreign sources and to develop domestic resources and offshore production. China relies heavily on foreign imports to fulfill the lack of domestic resources. On average, China imports 20% of its overall resources, and the majority are oil and natural gas.⁹⁰ U.S. sanctions on Iran and Venezuela impacts China's oil imports and constrains its policies elsewhere for resources. The Central Asia pipeline is located in an unstable region that faces threats of terrorism and political instability. The Malacca Strait is not only vital to China's consumer industry but to the maritime flow of energy to China. The Malacca dilemma is concerning to China because of U.S. influence and control over shipping through the chokepoint and is developing energy infrastructure in Pakistan and Kazakhstan and increasing imports from Russia to diversify its resource portfolio.

E. RESEARCH DESIGN

This thesis examines the drivers of Chinese energy security policies and is divided into four chapters. Chapter I set up the research question, outlined the significance, gave an overview of the existing scholarly literature, and established the hypotheses that will be tested. Chapter II focuses on the diversification of resources as a driver to China's energy security policies. It begins with an investigation of China's energy consumption in the industrial, residential, and transportation sectors and what resources are utilized to meet demands. Then,

⁸⁹ National People's Congress, "The 13th Five-Year Plan (2016–2020)," 8.

⁹⁰ International Energy Charter, "China Energy Efficiency Report," 54.

the chapter examines China's domestic development of resources broken down by each energy sector, excluding green energy, since green energy will be discussed in Chapter IV.

Chapter III analyzed China's domestic environmental policies. The chapter first discusses the underlying effects of hydrocarbons, air pollution, and then discusses how the CCP outlines its goals to reduce its impact on climate change. This chapter also discusses the goals and efforts that China has made to improve the environment by sector—hydrocarbons, wind, solar—and then analyzed the results. Then, each sector is investigated to display current consumption and demand and then examine future initiatives and issues.

Chapter IV examines China's foreign consumption of hydrocarbons and the geopolitical factors that drives China's mixed energy portfolio. Each energy source is broken down by country and reviews statistical data and the drivers that secure resources for China abroad, which include energy developments from the BRI.

Chapter V summarizes the findings of the drivers for China's energy security policies and assesses the prospective explanations. Additionally, this chapter will explain the future implications for China's energy security policies on China's domestic and foreign policy. Lastly, this chapter will conclude with an investigation into the future trends of how China's policies will be developed and executed in the near future.

To build out Chapters II, III, and IV, I reviewed translated Chinese government documents to assess the intent and direction of the government to reduce its reliance on foreign imports and the development of domestic resources. Another indicator of reducing foreign reliance is to reduce overall energy consumption, and so I examined government documents to reveal how China plans to reduce consumption. I also investigated external documents from international energy institutions to analyze China's foreign energy security policies that could explain further diversification of resources. Additionally, I evaluated new literature from primary and secondary sources for changes in the geopolitical environment that could adjust China's long-term plan for energy security.

II. DRIVERS OF DOMESTIC ENERGY SECURITY POLICIES

The rapid growth of China has significantly impacted China's domestic energy security policies. This chapter will focus on illustrating the drivers of China's domestic energy security policies. The first four sections will discuss China's overall energy consumption and the top three consumers of energy—industrial, residential, and transport—broken down by sector. Then, domestic hydrocarbons—coal, oil, and natural gas—production, consumption, and significant issues will be analyzed, followed by nuclear energy. While greenhouse gas and climate change issues are essential for China's energy mix because of social issues and environmental pollution, these issues will be discussed as a separate driver for China's energy security policy in the next chapter.

This study finds the industrial sector represents the largest consumer of energy in China. While the service sector has overtaken the industrial sector in the gross domestic product (GDP) value-added, the industrial sector will continue to be the top consumer of energy. The industry sector drives coal consumption. Due to the increase in population and rapid urbanization, natural gas and oil have increased in the residential sector. Additionally, urbanization has led to a rise in automobile use in China, which has drastically increased oil consumption in the transport sector.

The main driver for coal consumption in China is the industrial sector. Issues within the coal sector are the physical location of coal and the lack of infrastructure for transportation. While social problems exist with pollution and climate change, coal still dominates China's energy portfolio. In the past, China experienced transportation bottlenecks for coal transportation. The bottlenecks occurred due to the natural distribution of coal, and because China did not have the infrastructure to support coal demand, which has led to energy blackouts. However, the new Hanoi railway will attempt to alleviate bottlenecks so that coal shortages do not occur in the future.

The main driver for China's domestic energy for oil in China is urbanization, an increase in automobile usage, and population increases. The main problem in the domestic oil sector is that consumption has consistently continued to outpace domestic production.

Between 2009–2019, consumption has exceeded domestic production. In an attempt to increase production, China’s offshore program is actively exploring domestic oil.

China’s natural gas sector’s main driver is an increase in consumption and social issues with climate change and pollution. Natural gas consumption is increasing at a quicker rate than production. While China contains the largest shale gas reserve globally, it does not have the technological infrastructure to fully exploit that energy source. Nuclear energy could be a viable replacement for coal-powered electricity. However, nuclear energy powerplant projects in China have decreased over the Chinese population’s concern over nuclear safety after the 2011 Fukushima nuclear incident.

A. OVERALL CONSUMPTION

In 2009, China took the role of the number one consumer of energy in the world.⁹¹ Between 2018–2019, China consumed 141.70 exajoules (EJ) of energy, more than any other country in the world (see Figure 3).⁹² Coal was consumed more than any other source at 81.67 EJ, followed by oil at 27.91 EJ. Hydroelectricity followed oil at 11.32 EJ. China consumed 11.06 EJ of natural gas, 6.63 EJ of renewable energy, and 3.11 EJ of nuclear power. Overall consumption increased by 4% from 135.77 EJ.⁹³ Compared to 2010 at 104.28 EJ, China consumed 35% more energy in 2019, averaging 3.48% year on year growth in consumption between 2009–2019.⁹⁴ The industrial sector consumes the most energy in China.

⁹¹ Barbara Finamore, “China as the World’s Number One Energy Consumer... and World Leader in Clean Energy,” NRDC, August 4, 2010, <https://www.nrdc.org/experts/barbara-finamore/china-worlds-number-one-energy-consumer-and-world-leader-clean-energy>.

⁹² British Petroleum Company, “BP Statistical Review of World Energy 2020” (London, England: British Petroleum Company, June 2020), 9.

⁹³ British Petroleum Company, 9.

⁹⁴ British Petroleum Company, 11.

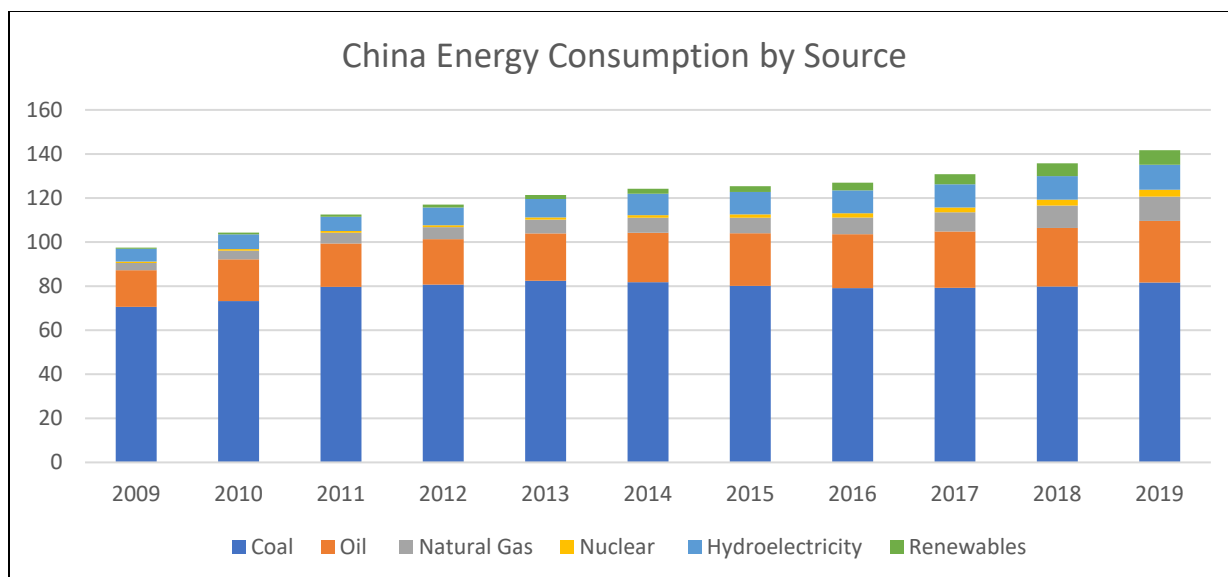


Figure 3. 2009-2019 China Energy Consumption in EJ⁹⁵

1. Industrial Sector

China is the world's largest manufacturer, with a 20% share in global manufacturing.⁹⁶ The industrial sector is composed of mining, factories, and electricity production.⁹⁷ China's industrial sector accounted for 46.49% of GDP in 2010 and decreased to 38.97% in 2019 (see Figure 4).⁹⁸ The service industry in 2010 was 44.17% and increased to 53.9% by 2019.⁹⁹ The decrease of industrial and growth in the service sector is part of China's transition to a service-based economy; however, industrial sector

⁹⁵ Adapted from: British Petroleum Company, "BP Statistical Review of World Energy 2020."

⁹⁶ Darrell M. West and Christian Lansang, "Global Manufacturing Scorecard: How the U.S. Compares to 18 Other Nations," *Brookings* (blog), July 10, 2018, <https://www.brookings.edu/research/global-manufacturing-scorecard-how-the-us-compares-to-18-other-nations/>.

⁹⁷ Prableen Bajpai, "China's GDP Examined: A Service-Sector Surge," Investopedia, April 22, 2020, <https://www.investopedia.com/articles/investing/103114/chinas-gdp-examined-servicesector-surge.asp>.

⁹⁸ World Bank, "Industry (Including Construction), Value Added (% of GDP) - China," World Bank, 2020, <https://data.worldbank.org/indicator/NV.IND.TOTL.ZS?locations=CN>.

⁹⁹ World Bank, "Services, Value Added (% of GDP) - China," World Bank, 2020, <https://data.worldbank.org/indicator/NV.SRV.TOTL.ZS?locations=CN>.

energy consumption has increased since 2010. Overall, the industrial sector is the leading consumer of energy and accounted for 49.5% of China’s energy consumption in 2017.¹⁰⁰

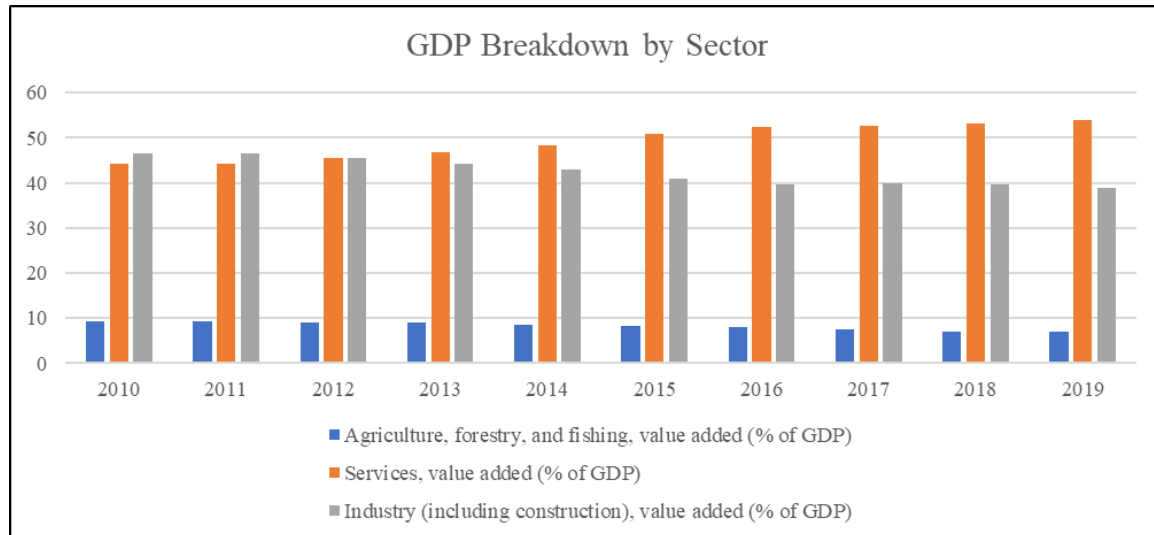


Figure 4. China’s GDP by Sector by percentage¹⁰¹

With the “Made in China 2025” initiatives, China is changing how it views manufacturing to increase its value-added to global consumerism. The manufacturing sector will change from producing cheap goods such as toys and houseware to advanced technology products such as ships, airplanes, and green energy transportation.¹⁰² With this initiative, China’s goal is to create high-quality brands with which it can compete on the international level. The industrial changes will impact the economy and directly affect China’s energy mix because advanced products will use more energy.

The industrial sector is vital to China’s economic prosperity. Economic drivers indicate that China will continue to use coal and natural gas produced electricity to fuel the

¹⁰⁰ “China - Countries & Regions,” International Energy Agency, December 4, 2019, <https://www.iea.org/countries/china>.

¹⁰¹ Adapted from: “Agriculture, Forestry, and Fishing, Value Added (% of GDP) - China,” World Bank, 2020, <https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=CN>; “Services, Value Added (% of GDP) - China”; “Industry (Including Construction), Value Added (% of GDP) - China.”

¹⁰² Renato Balderrama and Amado Trejo, “Made in China 2025,” *Revista (Cambridge)* 18, no. 1 (2018): 64.

vast majority of the industrial sector. Electricity accounted for 296,566 of the 985,923 kilo metric ton of oil equivalent (KTOE) in 2017 and has increased by 45% since 2010. While electricity has increased between 2010–2017, coal usage for the industrial sector declined 11% to 517,617 KTOE (see Figure 5).¹⁰³ In addition to the decline in coal usage, oil also declined by 15% to 50,549 KTOE. In contrast, natural gas increased 62%, filling in the gap for coal and natural gas, directly in line with China’s 12th Five-Year Plan (FYP).¹⁰⁴ In the 12th FYP, China planned to double its natural gas usage from 2010–2015. Additionally, the Chinese government has targeted the industrial sector as the country’s highest pollutant, which is why the shift from coal to natural gas is apparent. While the Chinese government has reduced natural gas prices, coal is three times cheaper than natural gas.¹⁰⁵ Local officials and manufacturers will continue to take the more affordable option, which is why the industrial sector will remain fueled by coal for the near future.

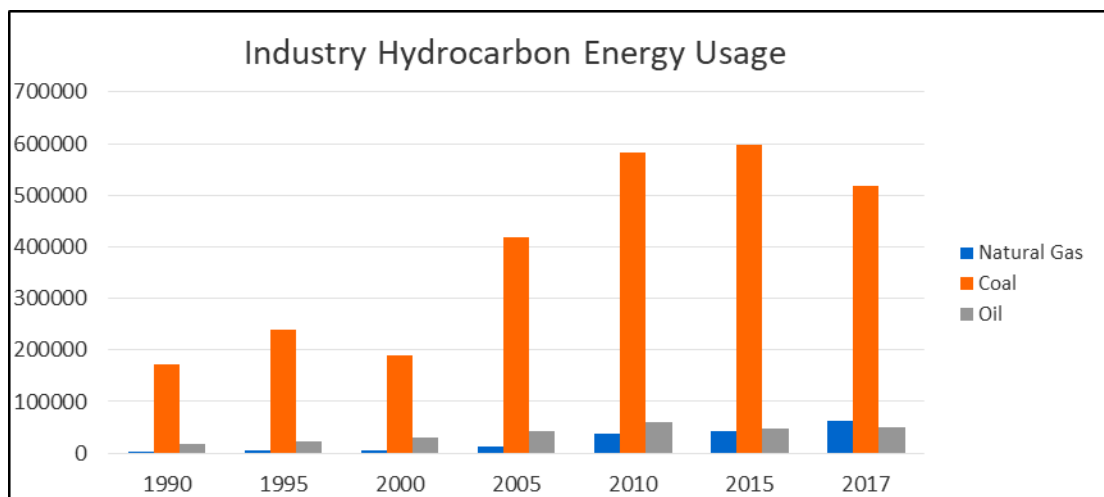


Figure 5. Industrial Hydrocarbon Usage in KTOE¹⁰⁶

¹⁰³ International Energy Agency, “China - Countries & Regions.”

¹⁰⁴ “China’s 12th Five Year Plan” (Washington, D.C: APCO Worldwide, December 10, 2010), 6, http://www.export.gov.il/UploadFiles/03_2012/Chinas12thFive-YearPlan.pdf.

¹⁰⁵ Meghan O’Sullivan, *Windfall: How the New Energy Abundance Upends Global Politics and Strengthens America’s Power* (New York, New York: Simon & Schuster, 2017), 223.

¹⁰⁶ Adapted from: International Energy Agency, “China - Countries & Regions.” Natural gas figures were converted from terajoules to KTOE.

2. Residential Sector

The residential sector is the second-highest consumer of energy in China.¹⁰⁷ The sector is composed of 1.4 billion people.¹⁰⁸ Since 2010, the population growth rate declined from 0.56% to 0.39% in 2020. Analysts estimate that China's population growth rate will be negative by 2035 at -0.04%, due to China's one-child policy initiatives.¹⁰⁹ While population growth is expected to decline, urbanization is expected to increase. In 2011, the proportion of the urban population was more than the rural population for the first time. Since 2011, the urban population has increased, on average, 1.07%.¹¹⁰ In 2018, the urbanization rate was 59.58%.¹¹¹ Urbanization is estimated to increase to 70% by 2035 and increase consumption and ultimately increase electricity usage and energy consumption.¹¹²

In 2017, the residential sector consumed 333,585 KTOE (see Figure 6).¹¹³ Hydrocarbons accounted for 39% of energy usage, while the remaining 61% consisted of biofuels, geothermal, solar, and electricity.¹¹⁴ In 2017, 78,001 KTOE of electricity was consumed, increasing 77% since 2010. Since 2010, the use of natural gas in the residential sector increased by 85%, and the use of oil increased by 88%.¹¹⁵ However, coal decreased by 4%. Natural gas is used more because climate change and clean air became a social issue for China. Four-fifths of respondents from a 2013 survey in China indicated that the

¹⁰⁷ International Energy Agency.

¹⁰⁸ "China Population 2020 (Demographics, Maps, Graphs)," World Population Review, 2020, <https://worldpopulationreview.com/countries/china-population>.

¹⁰⁹ World Population Review.

¹¹⁰ "China Statistical Yearbook 2019," China Statistical Yearbook, 2019, <http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>.

¹¹¹ China Statistical Yearbook.

¹¹² Zhang Jie, "Urbanization Rate to Reach 70% by 2035: Study," China Daily, June 24, 2019, <https://www.chinadaily.com.cn/a/201906/24/WS5d1089b0a3103dbf14329ea7.html>.

¹¹³ International Energy Agency, "China - Countries & Regions."

¹¹⁴ 61% is the remaining percentage; however, the source did not describe the composition of that number. Geothermal, solar, and biofuels were used in the past.

¹¹⁵ International Energy Agency, "China - Countries & Regions."

environment should be prioritized over the economy.¹¹⁶ As China is transitioning from an industrial-based to a consumption-based economy, the CCP focuses more on such social issues to maintain its legitimacy.

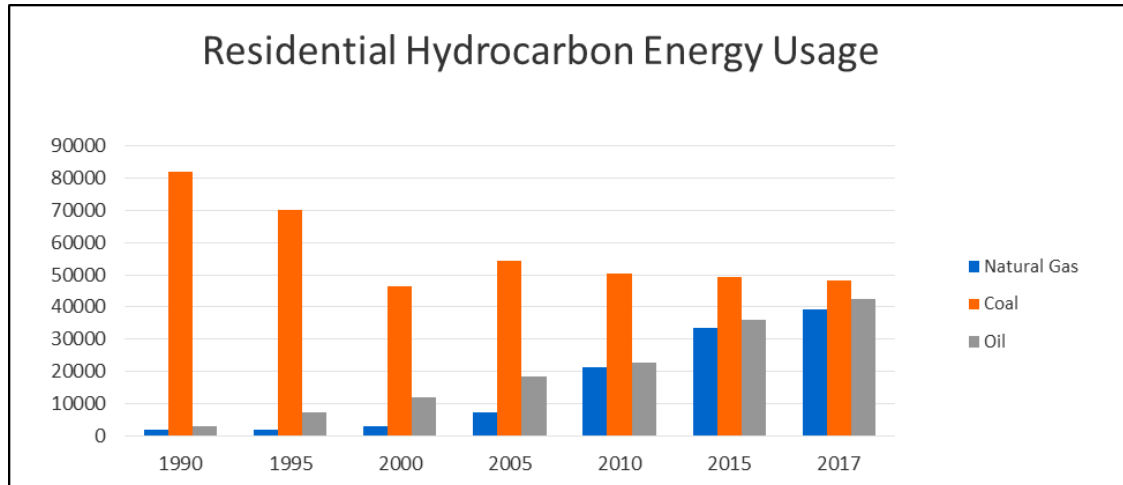


Figure 6. Residential Hydrocarbon Usage in KTOE¹¹⁷

3. Transport Sector

The transport sector is the third-largest consumer of energy in China.¹¹⁸ Urbanization and increased consumption led to increased use of fuel for this sector. Since 2010, the number of automobiles rose from 91 million to 258 million in 2019.¹¹⁹ Owning a car in China is not difficult but having the right to drive it is. Residents must obtain the right to drive by winning a lottery.¹²⁰ China is the world leader in electric vehicles, with

¹¹⁶ O’Sullivan, *Windfall: How the New Energy Abundance Upends Global Politics and Strengthens America’s Power*, 222.

¹¹⁷ Adapted from: International Energy Agency, “China - Countries & Regions.” Natural gas figures were converted from terajoules to KTOE.

¹¹⁸ International Energy Agency.

¹¹⁹ “China: Number of Cars 2019,” Statista, 2019, <https://www.statista.com/statistics/285306/number-of-car-owners-in-china/>.

¹²⁰ Katrina Yu and Dan Sagalyn, “How China Is Driving the Future of Electric Cars,” PBS NewsHour, October 2, 2019, <https://www.pbs.org/newshour/show/how-china-is-driving-the-future-of-electric-cars>.

3.5 million electric cars on the road.¹²¹ Oil is the most used source of energy for the transport sector. From 2010–2017, oil increased 52% from 182,955 to 278,298 KTOE (see Figure 7).¹²² Natural gas accounted for approximately 10% of the transport sector but increased by 85% between 2010–2017. Electricity increased twofold between 2010–2017 and will increase as more of the transport sector transitions from oil to electricity.

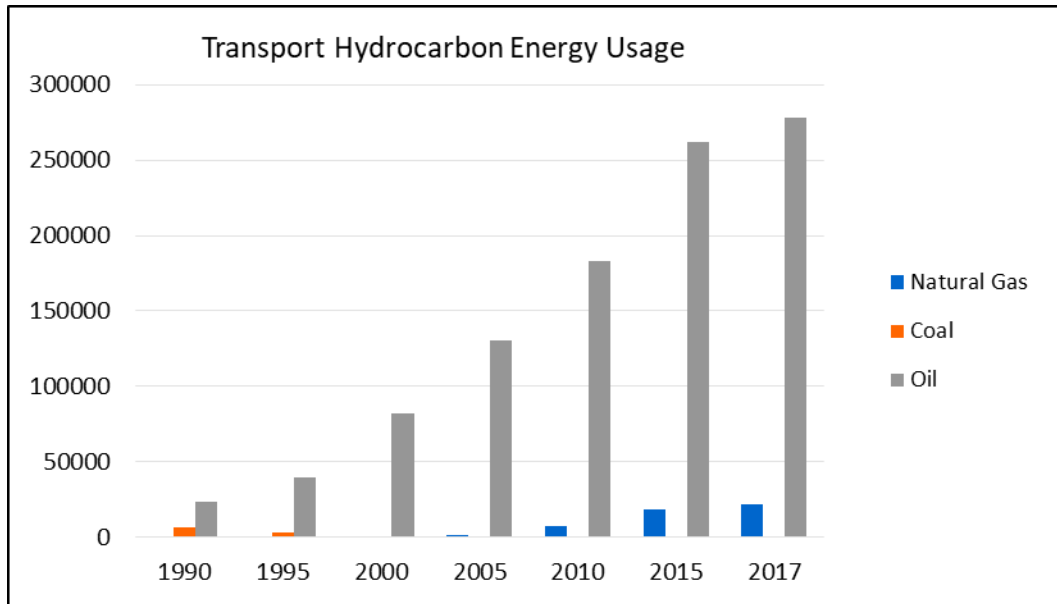


Figure 7. Transport Hydrocarbon Usage in KTOE¹²³

B. DOMESTIC DEVELOPMENT—COAL

Out of all the energy sources used in each sector, coal is the dominant fuel in China’s economy. China is a coal-dependent country that consumes, produces, and imports more coal than any country in the world. China has the fourth-largest coal reserves in the world, with 13.2% of the world’s share.¹²⁴ Coal is the primary energy source in China and

¹²¹ “Estimated Electric Vehicles in Use in Selected Countries,” Statista, accessed August 26, 2020, <https://www.statista.com/statistics/244292/number-of-electric-vehicles-by-country/>.

¹²² International Energy Agency, “China - Countries & Regions.”

¹²³ Adapted from: International Energy Agency. Natural gas figures were converted from terajoules to KTOE.

¹²⁴ British Petroleum Company, “BP Statistical Review of World Energy 2020,” 44.

reached peak consumption in 2013.¹²⁵ In 2019, China consumed 81.67 EJ of coal and only produced 79.82 EJ. If the same consumption rate is applied to China's reserves, China would have 37 years of coal use remaining in its proven reserves.¹²⁶ As of 2019, China has 2,997 coal power plants with the capacity to produce 1,145 gigawatts (GW) of energy; however, only 997 GW are currently operational.¹²⁷ Coal produced 64% of electricity in 2019, decreasing from 66% in 2018.¹²⁸

China's domestic coal source location and transportation bottlenecks are drivers for China's coal imports. China's coal consumers are not located near domestic deposits. China's proven reserves are located in 27 provinces.¹²⁹ However, 75% of its reserves are located in the north and northwestern provinces of Xinjiang, Inner Mongolia, Shanxi, and Shaanxi (see Figure 8).¹³⁰ The location of resources and consumers is a problem for China. The majority of China's GDP growth comes from China's southeastern region and along the coast, where most industries and the population reside.¹³¹ Therefore, coal must be transported from coal-rich provinces to provide for consumer demand. The output of coal has strained transportation infrastructure, and due to bottlenecks in transportation, blackouts and energy shortages have occurred.¹³² While China has an abundance of coal, in 2019, China imported 8% of its consumption to avoid bottlenecks and energy shortages.¹³³

¹²⁵ British Petroleum Company, 47.

¹²⁶ British Petroleum Company, 44.

¹²⁷ "Open-Source Mapping Of China's Energy Infrastructure," Baker Institute, July 25, 2020, <https://www.bakerinstitute.org/opensource-mapping-of-chinas-energy-infrastructure/>.

¹²⁸ British Petroleum Company, "BP Statistical Review of World Energy 2020," 61.

¹²⁹ Sylvie Cornot-Gandolphe, "China's Coal Market: Can Beijing Tame 'King Coal'?" (Oxford, United Kingdom: Oxford Institute for Energy Studies, December 2014), 50, <https://doi.org/10.26889/9781784670177>.

¹³⁰ Cornot-Gandolphe, 52.

¹³¹ "China's GDP Growth - More Shocks Ahead," China Briefing News, October 26, 2015, <https://www.china-briefing.com/news/chinas-gdp-growth-more-shocks-ahead/>.

¹³² Cornot-Gandolphe, "China's Coal Market," 66.

¹³³ British Petroleum Company, "BP Statistical Review of World Energy 2020," 49.

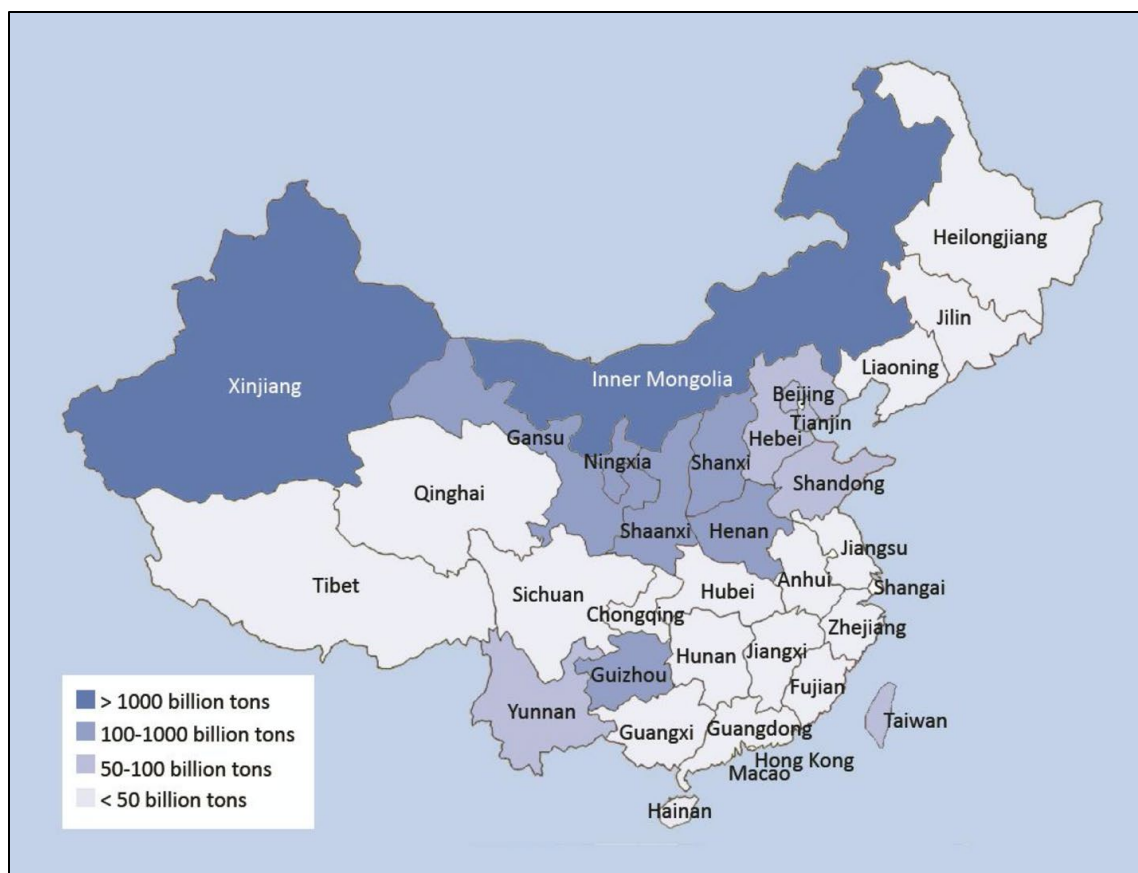


Figure 8. Map of China's Coal Reserves¹³⁴

Improvements to transportation infrastructure have alleviated coal shortages in central and southeastern China. China uses trains, ships, and trucks to distribute domestic coal to its consumers. In 2019, the decade long project Hanoi railway was completed.¹³⁵ The new railway will transport 200 million tons from Inner Mongolia to Jiangxi and shorten transport times from 20 days down to three days. The railway will reduce transportation bottlenecks and allow consumers more flexibility in coal usage. Tian Mao, a Beijing analyst at Everbright Sun Hung Kai Co, stated, “Coal will remain a dominant source of power in the next ten years, even though it’s being gradually replaced by new

¹³⁴ Source: Cornot-Gandolphe, “China’s Coal Market,” 53.

¹³⁵ “China’s Energy Game Plan Features a Giant Coal-Hauling Rail Line - Bloomberg,” Bloomberg, September 19, 2019, <https://www.bloomberg.com/news/articles/2019-09-19/china-s-energy-gameplan-features-a-giant-coal-hauling-rail-line>.

energy.”¹³⁶ While replacing coal with clean energy is a top priority for China, it appears that coal will remain a primary source of energy for long-term energy security.

C. DOMESTIC DEVELOPMENT—OIL

Oil is the second most used source of energy in China. Economic reforms by Deng Xiaoping in the early 1990s opened China to foreign investment, which increased industry and energy consumption. Since then, China has been dependent on foreign oil. In 2009, China domestically produced 47% of the oil it consumed (see Figure 9).¹³⁷ Since then, that number has decreased to 28% but not solely due to a lack of increased production. Oil production in China remained stagnant over the last ten years, but consumption has risen dramatically. Oil consumption increased by 67% from 2009–2019, with an average of 5.3% yearly increase. The increase in oil consumption is primarily from the transportation and residential sector, which can be attributed to a rise in population, urbanization, and automobile usage.

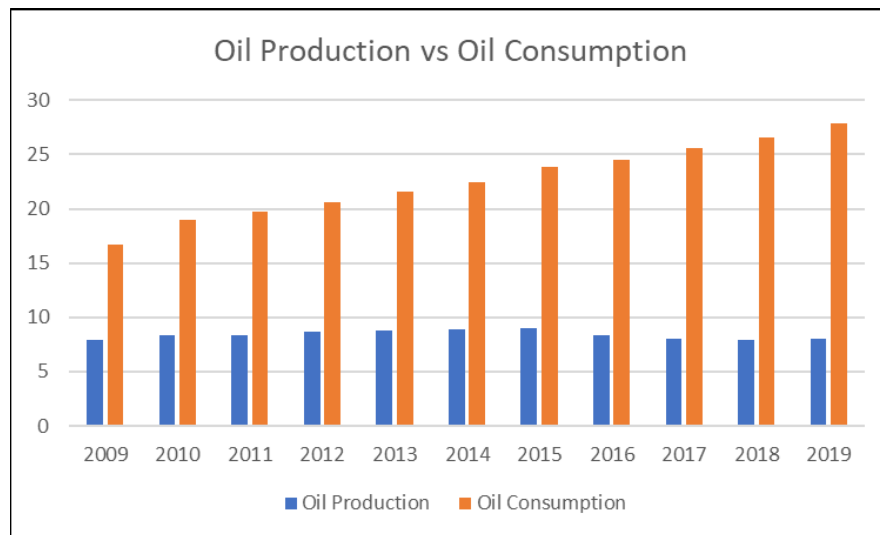


Figure 9. 2009-2019 China Oil Consumption and Production in EJ¹³⁸

¹³⁶ Bloomberg.

¹³⁷ British Petroleum Company, “BP Statistical Review of World Energy 2020,” 16–22.

¹³⁸ Adapted from: British Petroleum Company, 16–22.

Oil for domestic consumption comes partially from domestic sources. China's oilfields are located in the north, northwestern, northeastern, and central China (see Figure 10). At the end of 2009, China had 21.6 million thousand barrels of oil in proven reserves, and by 2019, it contained 26.2 million thousand barrels.¹³⁹ If consumption, production, and proven reserves remained the same, China would have enough oil to last 18.7 years.¹⁴⁰ China uses pipelines throughout the country to transport oil from oilfields to storage tanks and refineries to refined oil storage tanks. China has 185 pipelines across the country, 98 that transport crude oil and 87 that transport refined products (see Figure 11).¹⁴¹ Crude oil pipelines can move 23 million barrels per day (BPD), while refined pipelines carry 7.7 million BPD.

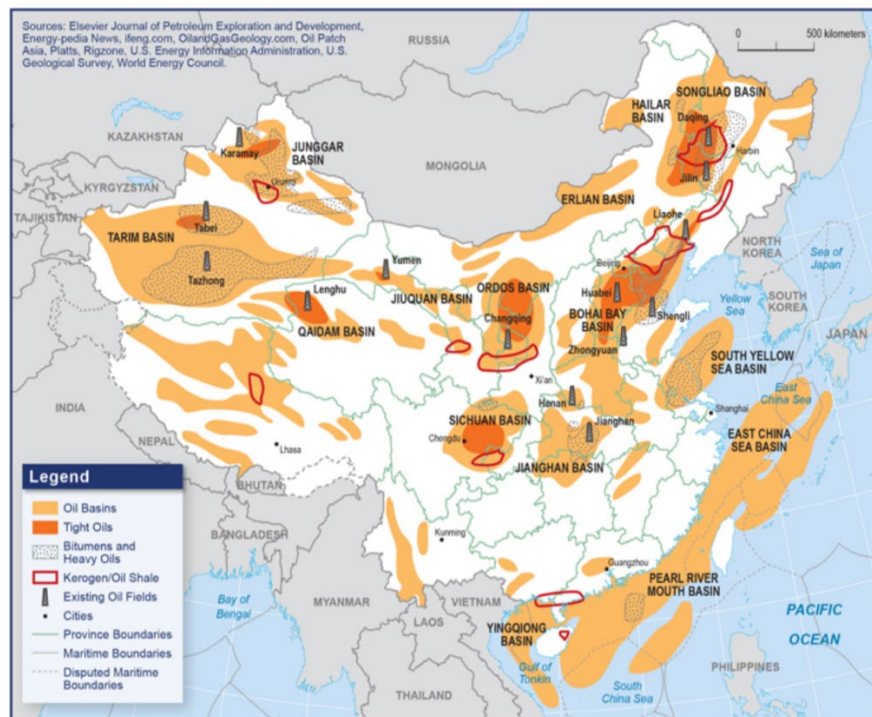


Figure 10. Location of China's Oil Basins and Oilfields¹⁴²

¹³⁹ British Petroleum Company, 14.

¹⁴⁰ British Petroleum Company, 14.

¹⁴¹ Baker Institute, "Open-Source Mapping Of China's Energy Infrastructure."

¹⁴² Source: "China's Oil Future," Carnegie Endowment for International Peace, May 6, 2014, <https://carnegieendowment.org/2014/05/06/china-s-oil-future-pub-55437>.



Figure 11. China Oil Infrastructure¹⁴³

Chinese national oil companies (NOC) dominate the oil and gas industries. Chinese National Petroleum Corporation (CNPC) and Chinese National Offshore Oil Corporation (CNOOC) control upstream oil activities, while Sinopec maintains refinement and allocation of products. Sinopec controls upstream onshore, and CNOOC leads offshore operations.¹⁴⁴ CNOOC partners in joint venture operations offshore with foreign companies to employ technical expertise to explore and extract challenging offshore projects; however, CNOOC is the majority shareholder of the contract and became the project owner after foreign companies have recouped costs.¹⁴⁵ In January 2020, China opened onshore projects to international oil companies.¹⁴⁶ China adopted the same

¹⁴³ Source: Baker Institute, “Open-Source Mapping Of China’s Energy Infrastructure.”

¹⁴⁴ “China - International Energy Data and Analysis,” May 14, 2015, 5, <https://www.eia.gov/international/analysis/country/CHN>.

¹⁴⁵ Energy Information Administration, 5.

¹⁴⁶ Chen Aizu and Muyu Xu, “China Opens up Oil and Gas Exploration, Production for Foreign, Domestic Firms,” *Reuters*, January 9, 2020, <https://www.reuters.com/article/us-china-oil-mining-idUSKBN1Z806Q>.

principles from foreign offshore activities to expand domestic exploration and production. While foreign offshore companies were given money for their services, NOCs will be required to relinquish land portions to foreign companies for payment for their services.¹⁴⁷

Offshore oil production provided 15% of oil production, while offshore natural gas provided 6% of production.¹⁴⁸ CNOOC is the primary NOC that is responsible for conducting offshore activities. CNOOC actively explores new resources in the Bohai Gulf, East China Sea, and the South China Sea. Since 2014, CNOOC has increased its oil production by 15% and natural gas by 53% by 2019.¹⁴⁹ Successful exploration operations in the Lufeng area in the South China Sea are attributed to increased natural gas production. While an abundance of oil and natural gas remain in the East and South China Seas, territorial disputes remain active. The U.S. Energy Information Administration “estimates the South China Sea contains approximately 11 billion barrels of oil and 190 trillion cubic feet of natural gas in proved and probable reserves.”¹⁵⁰ The East China sea contains approximately 200 million barrels of oil and 1–2 trillion TCF of natural gas.¹⁵¹ In the East China Sea, active disputes between China and Japan occur, while in the South China Sea, Taiwan, China, Vietnam, Malaysia, and the Philippines dispute islands, resources, and territorial features.

D. DOMESTIC DEVELOPMENT—NATURAL GAS

While oil fuels part of China’s economy, natural gas is a cleaner replacement for coal. While natural gas only accounted for 7.8% of China’s energy consumption in 2019, it remains a priority for the CCP’s diversified energy portfolio. In 2019, China consumed 11.06 EJ of natural gas, which increased by 240% from 3.25 EJ since 2009 (see Figure

¹⁴⁷ Aizu and Xu.

¹⁴⁸ “2019 Annual Results Release,” Chinese National Offshore Oil Corporation, March 25, 2020, 18, <https://www.cnooltd.com/attach/0/aa2dd9ad20da47bc9ad119383e49d805.pdf>.

¹⁴⁹ “2015 Annual Results Release,” Chinese National Offshore Oil Corporation, March 24, 2016, <https://www.cnooltd.com/attach/0/1603301051157661645.pdf>.

¹⁵⁰ Energy Information Administration, “South China Sea - International - Analysis - U.S. Energy Information Administration (EIA).”

¹⁵¹ Chinese National Offshore Oil Corporation, “2019 Annual Results Release,” 201; Chinese National Offshore Oil Corporation, “2015 Annual Results Release.”

12).¹⁵² However, China only produced 6.39 EJ of natural gas, but it has increased by 106% from 3.09 EJ since 2009. Since 2009, China has doubled its proven reserves, and if both consumption and production remained the same, China would have 47.3 years of natural gas.¹⁵³ Much like oil, natural gas consumption is increasing at a faster pace than domestic production. As part of a diversified energy plan, the CCP stated in the 12th Five-Year Plan to “promote the rapid growth of natural gas output” and “strengthen the exploration and development of petroleum and natural gas resources.”¹⁵⁴ Natural gas is clean energy currently used as a substitute for coal, while sustainable renewable energy is developed.

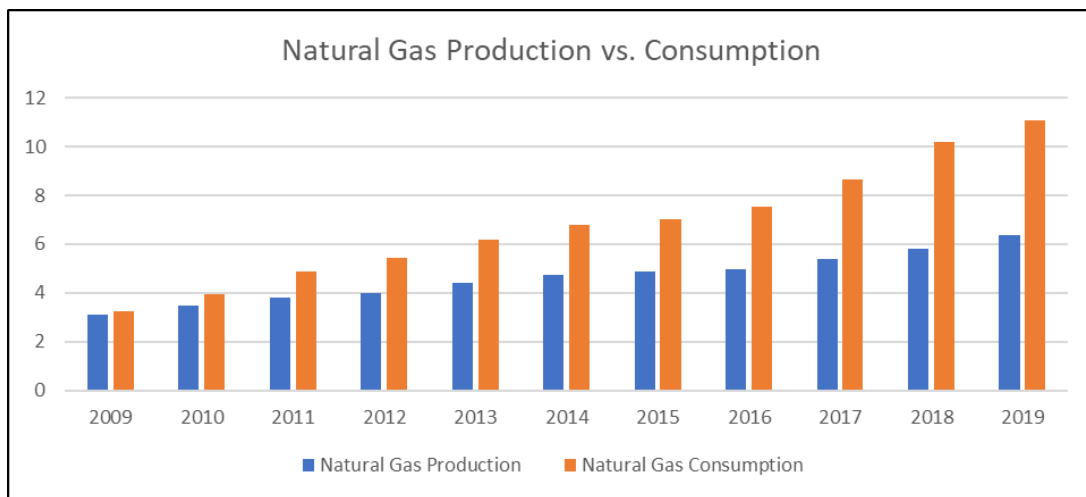


Figure 12. China’s Natural Gas Production and Consumption in EJ¹⁵⁵

China sits on the most considerable amount of untapped shale gas in the world. The 2015 EIA China shale publication estimates that China has 1,115 trillion cubic feet of shale gas.¹⁵⁶ While an abundance of shale is located in China, and the CCP wants to exploit it

¹⁵² British Petroleum Company, “BP Statistical Review of World Energy 2020,” 35–37.

¹⁵³ British Petroleum Company, 32.

¹⁵⁴ APCO Worldwide, “China’s 12th Five Year Plan,” 11.

¹⁵⁵ Adapted from: British Petroleum Company, “BP Statistical Review of World Energy 2020,” 35, 37.

¹⁵⁶ Energy Information Administration, “Technically Recoverable Shale Oil and Shale Gas Resources: China” (Washington, D.C: Energy Information Administration, 2015), 10.

to realize its clean energy goals, China, however, does not have the technology to extract at full capacity. China invested heavily in the shale gas industry in hopes of an abundant amount of resources; however, issues such as drilling costs and lack of water have caused China to change its target estimates for production.¹⁵⁷ Shale gas deposits in China are located deeper than deposits found in the United States, making it difficult for current hydraulic fracturing equipment to operate effectively.¹⁵⁸ While China remains in the elementary stages of shale gas production, it will continue to rely on other energy sources while advances are made in research and development. Additionally, inviting foreign oil and gas companies to China could help extract shale gas to add to China's energy mix.

E. DOMESTIC DEVELOPMENT—NUCLEAR

China ranks third in the world for nuclear energy use. China produced and consumed 3.11 EJ of nuclear energy in 2019.¹⁵⁹ Since 2009, China has increased its nuclear use by 370% from 0.66 EJ. China has operational 48 nuclear reactors and 11 under construction (see Figure 13).¹⁶⁰ Nuclear power plants are located along the coastline near major populations and high GDP growth areas fuel energy demands that coal cannot. In the 13th Five-Year Plan, China's goal is to generate 58 GWs and 30 GWs under construction.¹⁶¹ Additionally, the 13th Five-Year Plan stresses improvement for radiation safety, monitoring systems, and preventing radioactive pollution to the population.¹⁶²

¹⁵⁷ Energy Information Administration, "China - International Energy Data and Analysis," 19–20.

¹⁵⁸ Irina Slav, "Here's Why China Won't Have a Shale Boom - Business Insider," Business Insider, April 23, 2018, <https://www.businessinsider.com/heres-why-china-wont-have-a-shale-boom-2018-4>.

¹⁵⁹ British Petroleum Company, "BP Statistical Review of World Energy 2020," 50.

¹⁶⁰ "Nuclear Power in China," World Nuclear Association, August 2020, <https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx>.

¹⁶¹ National People's Congress, "The 13th Five-Year Plan (2016–2020)," 87.

¹⁶² National People's Congress, 129.



Figure 13. Nuclear Facilities in China¹⁶³

China is developing next-generation nuclear technology but must consider social issues with safety and contamination. Mark Hibbs argues that China is on pace to overtake the United States and France in nuclear power generation and technology by 2030 and will have over 100 nuclear reactors.¹⁶⁴ To be the global leader in nuclear energy, China needs to focus on efficient and safe domestic nuclear powerplant operations. The 2011 Fukushima nuclear disaster impacted the Chinese population's outlook on nuclear energy. The *Proceedings of the National Academy of Sciences of the United States of America* surveyed the Chinese community before and after the Fukushima nuclear incident.¹⁶⁵ The

¹⁶³ Source: Mark Hibbs, "The Future of Nuclear Power in China" (Washington, D.C: Carnegie Endowment for International Peace, 2018), 146.

¹⁶⁴ Hibbs, 1.

¹⁶⁵ Lei Huang et al., "Effect of the Fukushima Nuclear Accident on the Risk Perception of Residents near a Nuclear Power Plant in China," *Proceedings of the National Academy of Sciences* 110, no. 49 (December 3, 2013): 1, <https://doi.org/10.1073/pnas.1313825110>.

survey found after the disaster, Chinese support for nuclear energy decreased, and when asked if they supported the construction of a nuclear powerplant in their town, the results illustrated a 41% increase in opposition.¹⁶⁶ Since the Fukushima incident and the Chinese public reaction, the Chinese Communist Party's (CCP) projection for nuclear power by 2050 was cut in half.¹⁶⁷ While China does not have a strong track record for industrial safety, the fewer reactors China has, the less likely the CCP can be blamed for a nuclear incident.¹⁶⁸

F. CONCLUSION

Ultimately, while China is the largest consumer of energy globally, the domestic drivers for energy are primarily consumption, caused by an increase in urbanization, automobile usage, and an increase in population. Domestic production has not been capable of keeping pace with consumption due to a lack of infrastructure and technology. Additionally, the top three energy consumers—industrial, transport, and residential sectors—drive how China engineers its energy portfolio. While coal remains the primary energy source for the industrial sector, oil and natural gas are increasing in the residential sector because of an increase in both population and urbanization. Oil consumption in the transport sector increased by 52% from 2010–2017 because of the significant rise in automobile use in China.¹⁶⁹

China is the largest coal producer, consumer, and importer globally, which will arguably continue to be the dominant source of energy because coal is the primary source of energy in the industrial sector. While social issues and transportation issues have caused China to change its stance on coal, it has reduced transportation bottlenecks with the Hajoi railway project to reduce coal shortages. China lost its self-sustainment of oil in 1993. Since 2009, oil production remained stagnant while consumption increased by 67%

¹⁶⁶ Huang et al., 2.

¹⁶⁷ Hibbs, “The Future of Nuclear Power in China,” 2.

¹⁶⁸ Hibbs, 2.

¹⁶⁹ International Energy Agency, “China - Countries & Regions.”

because of urbanization, a population increase, and an increase in automobile usage.¹⁷⁰ The drastic increase in natural gas use as a source of energy, combined with stagnant coal production, could be an indicator that China is using natural gas as a replacement for coal. While China is the number one country for shale gas reserves, it does not have the technological infrastructure to exploit the resources. Nuclear energy is a clean source of energy, but since the 2011 Fukushima nuclear incident, safety and social issues have shifted the Chinese population's opinion against nuclear power. While China will continue to be the number one consumer of energy globally, the heavy use of hydrocarbons has caused massive air pollution, which has contributed to the development of green and renewable energy and will be the focus of the next chapter.

¹⁷⁰ British Petroleum Company, "BP Statistical Review of World Energy 2020," 16–22.

THIS PAGE INTENTIONALLY LEFT BLANK

III. DRIVERS OF CHINA'S GREEN ENERGY POLICIES

China's efforts in renewable energy will have enduring impacts on the globe. This chapter will begin by briefly investigating the drivers for China's renewable energy policies and then analyze the CCP's policies for renewable energy and the implementation of government policies. This study will then explore China's renewable energy sector—hydropower, wind, and solar—by reviewing consumption, production, and underlying issues for each energy source. As the leader in renewable energy technology production, technological innovation, and investment, its efforts will have an impact on reducing domestic pollution and impact the globe through its leadership in the Paris Climate Agreement. While the Belt and Road Initiative play a crucial role in the energy sector, this study focuses on the internal side of how China acquires its own renewable energy and issues that are associated with renewable energy.

This chapter finds that drivers that influenced China's pursuit of renewable energy are primarily air pollution, created from a long period of sustained economic growth. Air pollution has become a domestic concern for Chinese citizens and the CCP because of negative health issues and pressure from the international community. The Chinese government states that it is committed to decreasing air pollution, and President Xi Jinping has claimed that China will achieve “peak CO₂ emissions by 2030 and achieve carbon neutrality by 2060.”¹⁷¹ China is committed to fighting climate change, which is illustrated in its Five-Year Plans. China's goals with climate change are to “control greenhouse gas emissions, increase adaptability to climate change, and to launch wide ranging international cooperation.”¹⁷²

To outline targets for renewable energy, the CCP has used Five-Year Plans and additional government policies. To alleviate confusion, however, the CCP has decided that

¹⁷¹ “Xi Addresses 3rd Paris Peace Forum,” Ministry of Foreign Affairs of the People's Republic of China, November 12, 2020, https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1831895.shtml.

¹⁷² “China's Twelfth Five Year Plan (2011-2015) - the Full English Version,” China Direct, May 11, 2011, 29, https://cbi.typepad.com/china_direct/2011/05/chinas-twelfth-five-new-plan-the-full-english-version.html.

the government will only use Five-Year Plans to outline future targets. The significant themes in government documents are adapting to air pollution and climate change throughout China.¹⁷³ Moreover, international collaboration and assistance represent another central theme for CCP's devotion to renewable energy as it expands its role in the international community. Another theme that was brought out was that short term Five-Year Plans constrain laissez-faire market principles, which impacts the supply and demand of China's renewable energy sector.

Hydropower, wind, and solar represent the majority of renewable energy in China. Hydropower dominates the renewable energy sector almost twofold.¹⁷⁴ Wind and solar became a prominent component of the renewable energy sector between 2009–2013. Energy sources in the renewable energy sector, however, experienced curtailment issues because of the lack of interconnectedness of the energy grid, which caused local governments to rely on coal. Wind and solar experienced a boom-and-bust market cycle because of the inability to manage prices and adjust subsidies within the sector.¹⁷⁵ Domestic renewable energy has increased drastically, and coal plant restrictions have eased, likely until the infrastructure is complete for renewable energy. While coal plant restrictions have eased, all new coal plants are built using China's cutting-edge coal technology. New coal plants will have a reduced impact on the environment compared to older model coal plants.

A. FACTORS THAT DROVE CHINA TO PURSUE RENEWABLE ENERGY

This section will briefly review some of the major drivers that influenced the CCP to pursue renewable energy, for which air pollution appears to be the primary driver. When Deng Xiaoping opened China up to the world in the late 1970s, it experienced sustained

¹⁷³ China Direct, 29.

¹⁷⁴ "Statistical Review of World Energy – All Data, 1965–2019" (London, England: British Petroleum Company, June 2020), <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2020-all-data.xlsx>.

¹⁷⁵ Anders Hove, "Current Direction for Renewable Energy in China," *The Oxford Institute for Energy Studies*, June 2020, 8.

economic growth that built the world's most polluted economy.¹⁷⁶ China's hyper-focused efforts on economic growth, using Soviet and western ideals for industrialization such as steel, iron, and coal significantly contributed to large scale pollution.¹⁷⁷ During the period of sustained economic development, local officials prioritized economic growth over concerns for the environment because the bureaucrat promotion system incentivized economic growth. Coal was the primary energy source during that period because of its availability and has remained the dominant energy source to the present day. In addition to the industrial sector, an increase of automobiles and Chinese built diesel trucks, which put off more nitrogen dioxide than Western models, impact air pollution.¹⁷⁸

As China emitted 27% of the world's greenhouse gases in 2014, pollution has caused health issues to rise throughout China.¹⁷⁹ Air pollution causes approximately 1.2 million premature deaths every year and "respiratory, cardiovascular, and cerebrovascular diseases."¹⁸⁰ Additionally, 11% of stomach cancers have been linked to water contamination from polluted drinking water. The pollution in China has also affected neighboring countries such as Japan and South Korea, who have concerns because of acid rain and smog caused by China.¹⁸¹ Health issues and public safety concerns have become a high priority for China's citizens, displayed by a notable increase in environmental protests.

These domestic protests have increased because of the increasing air pollution, smog, and health concerns in China. A former member of the Committee of Political and Legislative Affairs, Chen Jiping, stated "that environmental issues are a major reason for 'mass incidents' in China—unofficial gatherings of one hundred or more that range from

¹⁷⁶ Robert B. Marks, *China: Its Environment and History* (Lanham, Md: Rowman & Littlefield Publishers, 2011), 265.

¹⁷⁷ Marks, 312.

¹⁷⁸ Marks, 315.

¹⁷⁹ Eleanor Albert and Beina Xu, "China's Environmental Crisis," Council on Foreign Relations, January 18, 2016, <https://www.cfr.org/backgrounder/chinas-environmental-crisis>.

¹⁸⁰ Albert and Xu.

¹⁸¹ Albert and Xu.

peaceful protest to rioting.”¹⁸² The number of environmental mass incidents increased to 732 in 2013, a 31% increase from 2012.¹⁸³ Protests have called for the CCP to raise the government’s response to pollution. “In March [2014] President Xi Jinping ‘declared war’ on pollution. Addressing the opening session of the National People’s Congress, China’s largely rubber-stamp parliament, Xi said pollution is ‘nature’s red-light warning against the model of inefficient and blind development’.”¹⁸⁴ The CCP has responded multiple ways with scrutiny on high polluters and emphasizes reducing pollution in the CCP’s Five-Year Plans, which will be discussed in depth later in this chapter.

As the number one emitter of greenhouse gases globally, and as China entered onto the world stage as a great power, its intense amount of carbon emissions caused the international community to exert pressure on China to fight climate change. To strive to be seen as a responsible member of the international community, China joined the Paris Climate Agreement on September 3, 2016, and committed to:

- Peak CO₂ emissions by 2030, or earlier if possible;
- Increase the share of non-fossil energy sources in the total primary energy supply to around 20% by 2030;
- Lower the carbon intensity of GDP by 60% to 65% below 2005 levels by 2030.¹⁸⁵

On November 12, 2020, President Xi Jinping announced during a video teleconference during the third Paris Peace Forum that China will achieve “peak CO₂ emissions by 2030 and achieve carbon neutrality by 2060.”¹⁸⁶ Fighting climate change is a fundamental principle of a great power, and China will use its commitments to exert soft power influence on the global stage.

¹⁸² Albert and Xu.

¹⁸³ Albert and Xu.

¹⁸⁴ Jennifer Duggan, “China’s Polluters to Face Large Fines under Law Change,” the Guardian, April 25, 2014, <http://www.theguardian.com/environment/chinas-choice/2014/apr/25/china-environment-law-fines-for-pollution>.

¹⁸⁵ “Pledges and Targets,” Climate Action Tracker, September 21, 2020, <https://climateactiontracker.org/countries/china/pledges-and-targets/>.

¹⁸⁶ Ministry of Foreign Affairs of the People’s Republic of China, “Xi Addresses 3rd Paris Peace Forum.”

B. THE CHINESE GOVERNMENT’S GOALS

The CCP recognizes the adverse effects of climate change. This section analyzes China’s four government documents to illustrate the broad goals, ambitions, and objectives for reducing pollution and increasing renewable energy: Twelfth and Thirteenth Five-Year Plans, the Air Pollution Prevention and Control Action Plan (APPCAP) 2013–2017, and the Action Plan for Winning the Blue Sky War 2018–2020.¹⁸⁷ China’s Five-Year Plans are released every five years, whereas the APPCAP 2013–2017 was released to solely combat air pollution. The Action Plan for Winning the Blue Sky War 2018–2020 is a continuation of APPCAP 2013–2017; however, it does not introduce any targets that differ from the Thirteenth Five-Year Plan. The Twelfth and Thirteenth Five-Year Plans are synonymous with their broad goals to combat pollution and climate change. While there may be more specificity to decrease the number of heavy pollutant days in the Thirteenth Five-Year Plan, both plans share three primary policy goals for managing its response to climate change:

- Control Greenhouse gas emissions;
- Increase adaptability to climate change;
- Launch wide ranging international cooperation.¹⁸⁸

With the first component, “Control Greenhouse gas emissions,” China seeks to decrease overall energy consumption, reducing pollution.¹⁸⁹ Additionally, in the Twelfth Five-Year Plan, China planned to implement a system to control greenhouse gas emissions from the high pollutant sectors: industry and transportation. As expected, the industry and transportation sector are the first and second highest consumers of energy. The industry sector primarily uses coal, while the transport sector uses mainly oil.

The second component to battle climate change is to “Increase adaptability to climate change.”¹⁹⁰ To realize this goal, China plans to increase scientific research and

¹⁸⁷ “AQLI Policy Impacts—China: National Air Quality Action Plan (2014),” Air Quality Life Index, 2019, <https://aqli.epic.uchicago.edu/policy-impacts/china-national-air-quality-action-plan-2014/>.

¹⁸⁸ China Direct, “China’s Twelfth Five Year Plan (2011-2015) - the Full English Version,” 29.

¹⁸⁹ China Direct, 30.

¹⁹⁰ China Direct, 30.

development to improve its understanding of climate change's adverse effects and improve its surveillance systems for climate change and natural disasters. In 2019, according to China's Ministry of Emergency Management, natural disasters contributed to \$47.5 billion in economic losses caused by earthquakes and typhoons.¹⁹¹ This second component is significant to protecting China's inland areas from earthquakes and coastal regions from typhoons while acclimating to new changes in the environment caused by climate change.

China's last element in the fight against climate change points to "Launch[ing] wide ranging international cooperation."¹⁹² China intends to foster information exchange in the international community, enhance technology, and increase its capacity to support countries needing its technology.¹⁹³ By doing so, China's objective is to increase its international community involvement in climate change. Additionally, China grew its global involvement, but it is now attempting to create a market for its green energy products. Where jobs have declined in the coal industry, China has increased domestic jobs in the green energy sector.

China mandates guidelines in government documents that outline its determination to decrease pollution and increasing renewable energy. The Twelfth Five-Year Plan initiatives reduce non-fossil fuel sources by 11.4% and reduce carbon dioxide emissions by 17%.¹⁹⁴ China's Thirteenth Five-Year Plan increased these goals slightly by increasing non-fossil fuel sources to 12% of energy consumption and to decrease carbon dioxide emissions by 20% per unit of GDP over the five-year phase.¹⁹⁵

Renewable energy construction in the Twelfth Five-Year Plan was more specific in the Twelfth Five-Year Plan than in the Thirteenth Five-Year Plan. The following goals were set for the Twelfth Five-Year Plan for renewable energy:

¹⁹¹ Lu Hui, "China Reports Losses Caused by Natural Disasters - Xinhua," January 18, 2020, http://www.xinhuanet.com/english/2020-01/18/c_138715415.htm.

¹⁹² China Direct, "China's Twelfth Five Year Plan (2011-2015) - the Full English Version," 29.

¹⁹³ China Direct, 31.

¹⁹⁴ China Direct, 9.

¹⁹⁵ National People's Congress, "The 13th Five-Year Plan (2016-2020)," 9.

- Construct large-sized hydropower stations in key watersheds, such as those of the Jinsha, Yalong and Dadu Rivers, and commence the construction of hydropower projects with a total installed capacity of 120 million kW.
- Construct 6 onshore and 2 coastal and offshore large wind power bases, with an additional installed capacity of over 70 million kW.
- Construct solar energy power stations with a total installed capacity of over 5 million kW with focus on Tibet, Inner Mongolia, Gansu, Ningxia, Qinghai, Xinjiang and Yunnan.¹⁹⁶

The following are goals that were set in the Thirteenth Five-Year Plan:

- Begin construction on 60 gigawatts of regular hydropower capacity, giving priority to hydropower development in the southwest;
- Coordinate the development of end-use markets and power transmission routes; take ordered steps to optimize the development of wind energy and photovoltaic energy in the northern, northeastern, and northwestern regions and in coastal areas;
- Accelerate the development of dispersed wind power and distributed photovoltaic power in the central, eastern, and southern regions;
- Carry out solar thermal energy demonstration projects;
- Build the national new energy integrated demonstration zone in Ningxia, and actively move forward with the development of demonstration zones for renewable energy such as those in Qinghai and Zhangjiakou.¹⁹⁷

The similarities between the two plans are the continued focus on increasing hydropower in regions where possible. The Twelfth Five-Year Plan focused on constructing wind and solar in China's outer periphery. In contrast, the Thirteenth provides initiatives for the central, eastern, and southern regions, which are major population centers.

China's desire goal to decrease pollution became more specific in the Thirteenth Five-Year Plan. Specifically, China intended to reduce the number of heavy pollutant days by 25%.¹⁹⁸ Additionally, as part of the Environmental Governance and Protection Initiatives in the Thirteenth Five-Year Plan, China plans to:

¹⁹⁶ China Direct, "China's Twelfth Five Year Plan (2011-2015) - the Full English Version," 12-13.

¹⁹⁷ National People's Congress, "The 13th Five-Year Plan (2016-2020)," 86.

¹⁹⁸ National People's Congress, 127.

- Transform enterprises in the steel, cement, plate glass, papermaking, printing and dyeing, nitrogenous fertilizer, and sugar refining industries that cannot consistently meet emissions standards;
- Work to basically eliminate coal-fired steam boilers with a capacity of ten tons or lower in all cities at or above the prefectural level across the country;
- Control the aggregate coal consumption of all regions;
- Promote the use of natural gas in place of coal in major cities;
- Step up the removal of old or high-emissions vehicles from the roads.¹⁹⁹

China's motivation to adapt and battle climate change is evident in its Five-Year Plans and aligns with a decrease in coal consumption by replacing it with natural gas, eliminating industries that cannot abide by environmental regulation, and removing automobiles from the road that do not meet emission standards. Since the new focus on climate change and pollution in CCP Five-Year Plans, they have issued two environmental action plans that further outline details and goals.

While the Air Pollution Prevention and Control Action Plan of 2013 replicated most of the Twelfth Five-Year Plan targets, supplemental reforms to combat pollution were mandated. The main two goals were to:

- Reduce PM2.5 in the three target regions of Beijing-Tianjin-Hebei, Pearl River Delta, Yangtze River Delta by 25, 20, 15 percent, respectively;
- Reduce annual PM2.5 in Beijing by 34% from the 2013 level.²⁰⁰

The Beijing-Tianjin-Hebei, Pearl River Delta, and Yangtze River Delta are urban population centers in China and significant contributors to pollution, which explains why China targeted these regions. CCP additionally grasped that local officials were not going to enforce environmental targets unless the officials were evaluated based on the environment instead of economic growth.²⁰¹ The initiatives included environmental protection in the rubric for the promotion of officials, based on their contributions to both environmental assessments and economic development. Furthermore, in those three key

¹⁹⁹ National People's Congress, 130–31.

²⁰⁰ Air Quality Life Index, "AQLI Policy Impacts—China: National Air Quality Action Plan (2014)."

²⁰¹ Air Quality Life Index.

areas, the CCP restricted any new construction of coal plants and mandated the reduction of emissions in coal plants; or, if not, they would be superseded with natural gas.²⁰² Other vital mandates included increasing the obligations to comply with environmental restrictions and reporting air quality values to the public accurately.²⁰³ Green energy reform from the 2013 policy sparked the evolution of China's green energy policies. Feng Hao stated, "After an exhausting five-year sprint, China is settling in for a long and steady jog."²⁰⁴ Guidelines from the Air Pollution Prevention and Control Action Plan of 2013 produced positive results and provided China with a baseline for moving forward to the publication of its Air Pollution Prevention and Control Action Plan 2018–2020.

While China is committed to clean air throughout the country, the latest Action Plan for Winning the Blue Sky War 2018–2020 does not introduce any additional goals beyond the Thirteenth Five-Year Plan. The director for the Ministry of Ecology and Environment Wang Jinnan stated "that setting another target outside of the 13th Five-Year Plan framework (which runs 2016 to 2020) would create confusion for local governments. Therefore, no new quantitative targets have been set. Instead, the plan reiterates the need to meet the goals of the 13th Five-Year Plan."²⁰⁵ Furthermore, the latest action plan does not target specific regions of the country and applies to the entire country. Out of 331 cities, 231 do not meet government policy and the World Health Organization (WHO) standard of PM2.5.²⁰⁶

The Energy Policy Institute at the University of Chicago Air Quality Life Index produced Figure 14, and it explains that, if China were to reduce pollution to the WHO standard, life expectancy would increase in years relative to the specific region.²⁰⁷ In Hebei, life expectancy would increase by six or more years. In Beijing, Hubei, and Anhui,

²⁰² Air Quality Life Index.

²⁰³ Air Quality Life Index.

²⁰⁴ Feng Hao, "China Releases 2020 Action Plan for Air Pollution," *China Dialogue* (blog), July 6, 2018, <https://chinadialogue.net/en/pollution/10711-china-releases-2-2-action-plan-for-air-pollution/>.

²⁰⁵ Hao.

²⁰⁶ Hao; "Ambient (Outdoor) Air Pollution," World Health Organization, May 2, 2018, [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health).

²⁰⁷ Air Quality Life Index, "AQLI Policy Impacts—China: National Air Quality Action Plan (2014)."

life expectancy would increase by three to five years (see Figure 14).²⁰⁸ While urban areas have more room for growth, over 75% of China has the opportunity to increase life expectancy, which is part of the Chinese government’s goal to provide clean air throughout the country.

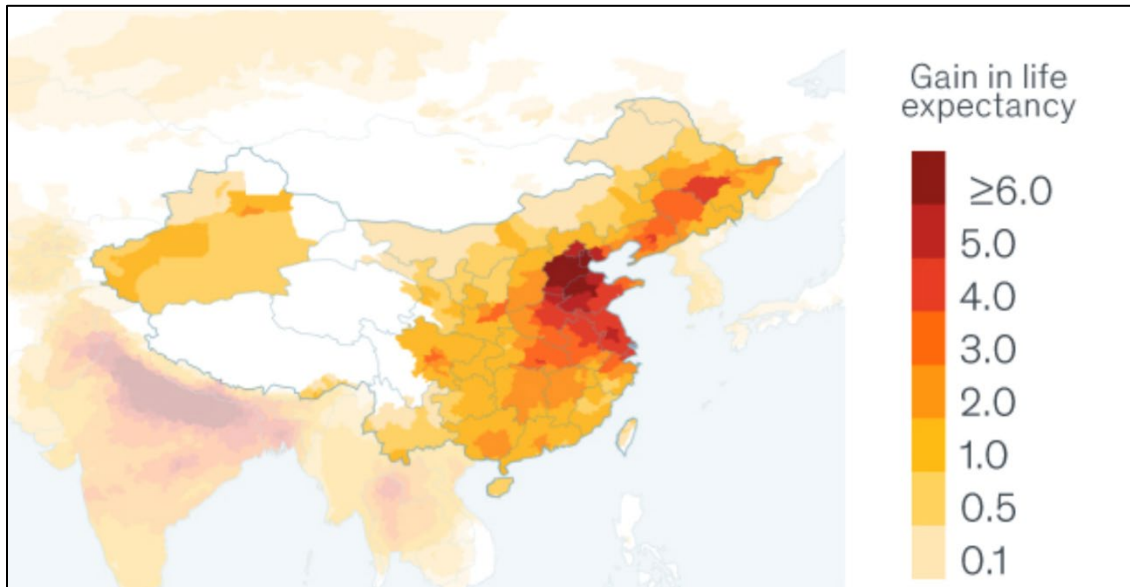


Figure 14. Gain in Life Expectancy if China Reduced Pollution to WHO standard²⁰⁹

C. RENEWABLE ENERGY

This next section will review and analyze the efforts that have been realized by China’s policies, goals, and ambitions. Renewable energy and hydroelectricity are an integral part of China’s energy mix, not only for countering pollution but providing a reliable source of electricity. China’s renewable energy is composed of mostly hydropower, wind, and solar.²¹⁰ In 2019, China produced and consumed 732.3 terra-watt hours (TWhr) of renewable energy and 1,270 TWhr of hydroelectricity, all of which

²⁰⁸ Air Quality Life Index.

²⁰⁹ Source: Air Quality Life Index.

²¹⁰ British Petroleum Company, “Statistical Review of World Energy – All Data, 1965–2019.”

were used for electricity generation (see Figure 15).²¹¹ Additionally, renewables accounted for 9.7% out of all electricity generation sources, while hydroelectricity generated 17%. Between 2009–2019, renewable energy increased, on average, 31% per year. During the latter half of APPCAP 2013, renewables increased by 32% in 2015 and 36% in 2016.²¹² While hydropower is the dominant non-fossil fuel in the amount of electricity produced, solar and wind have increased more year on year average.

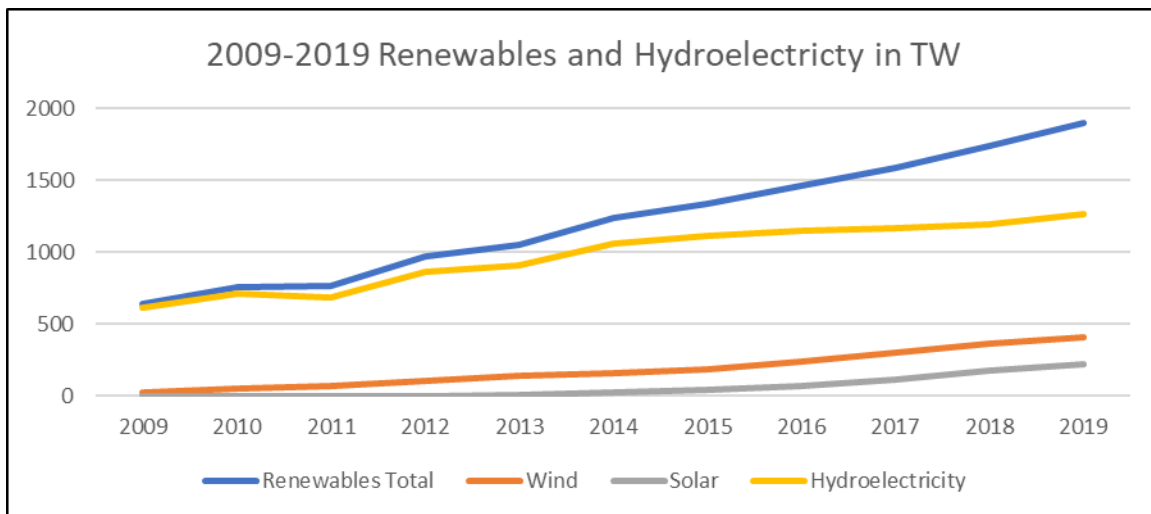


Figure 15. 2009-2019 Change in Renewable Energy²¹³

1. Hydropower

Hydropower is the oldest and dominant non-fossil fuel source in China’s energy mix. China is the global leader in hydropower generation and is home to the largest hydropower plant in the world, the Three Gorges Dam.²¹⁴ Between 2009–2019, hydropower increased by 106% (see Figure 16).²¹⁵ The International Hydropower

²¹¹ British Petroleum Company.

²¹² British Petroleum Company.

²¹³ Adapted from: British Petroleum Company.

²¹⁴ “China International Hydropower Association,” International Hydropower Association, July 5, 2019, <https://www.hydropower.org/country-profiles/china>.

²¹⁵ British Petroleum Company, “Statistical Review of World Energy – All Data, 1965–2019.”

Association estimates that by 2022 two mega projects on both the Jinsha and Yalong rivers will be complete, which will add 30,700 megawatts of hydropower.²¹⁶ China Three Gorges Corporation is the top company in the world for providing clean energy and has constructed 124GW in China and 17.7GW abroad.²¹⁷

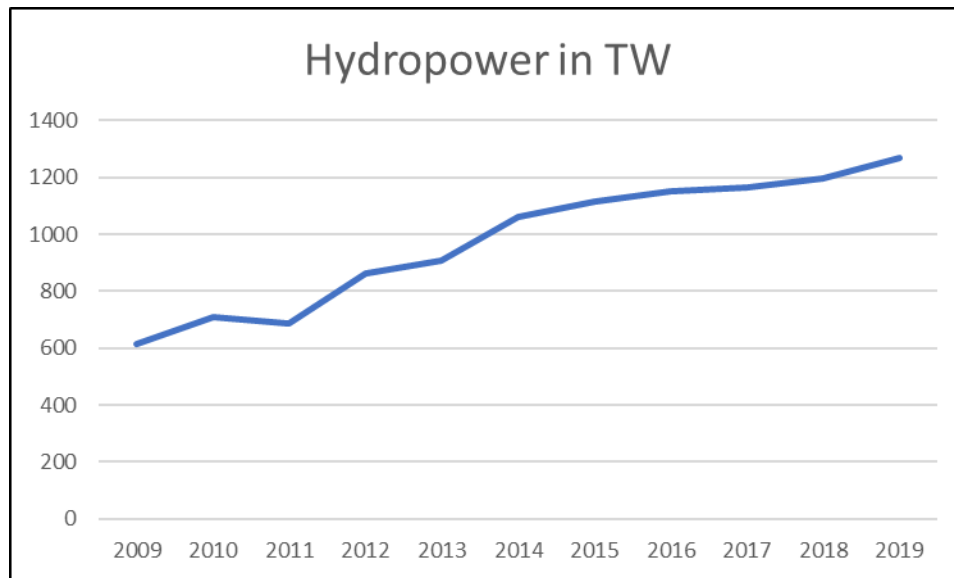


Figure 16. 2009-2019 Hydropower Generation²¹⁸

While hydropower is less impactful to air pollution, it has significant consequences on social issues, such as resettling citizens and the environment. A strong debate amongst scholars suggests that while dams prevent flooding, create jobs, and provide a reliable source of electricity, the negative environmental and social impacts outweigh the positive.²¹⁹ The Three Gorges Dam project is an example that displays the broader issues and trends of dam construction. A study by Mount Holyoke College on China's Three Gorges Dam project revealed that citizens who resided along the Yangtze River were

²¹⁶ International Hydropower Association, "China International Hydropower Association."

²¹⁷ Adapted from: "China Three Gorges Corporation," International Hydropower Association, July 24, 2014, <https://www.hydropower.org/companies/china-three-gorges-corporation>.

²¹⁸ British Petroleum Company, "Statistical Review of World Energy – All Data, 1965–2019."

²¹⁹ "The Three Gorges Dam Project Environmental Impacts," Mount Holyoke College, March 7, 2006, <https://www.mtholyoke.edu/~lpohara/Pol%20116/enviro.html>.

forced to move and resettle.²²⁰ Furthermore, while the Chinese provided government assistance, some citizens were forced to move to higher-cost areas where they could not afford to live. The dam causes adverse environmental impacts both upstream and downstream such as earthquakes, mudslides, and erosion and has damaged the natural ecosystem, which the population relies on for fishing and sustenance.²²¹

2. Wind

Wind power plays a significant role in China's renewable energy sector. In 2017, China surpassed the United States and became the world leader for wind power.²²² Additionally, between 2009–2019, China increased its wind power generation thirteenfold. The first wind farm was completed in 2009 near Shanghai, which contained 34 turbines providing three megawatts of electricity.²²³ Since then, wind power has increased to 405 TWhr in 2019 (see Figure 17).²²⁴ A study conducted by Fitch Solutions indicates that due to technological innovation in the wind sector, construction costs have decreased, and it forecasts that by 2028 China will reach upwards of 700 TWhr.²²⁵

²²⁰ "The Three Gorges Dam Project Social Impacts," Mount Holyoke College, March 7, 2006, <https://www.mtholyoke.edu/~lpohara/Pol%20116/social.html>.

²²¹ Mount Holyoke College, "The Three Gorges Dam Project Environmental Impacts."

²²² British Petroleum Company, "Statistical Review of World Energy – All Data, 1965–2019."

²²³ "Oceans of Opportunity," European Wind Energy Association, September 2009, 19, http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/Offshore_Report_2009.pdf.

²²⁴ British Petroleum Company, "Statistical Review of World Energy – All Data, 1965–2019."

²²⁵ "Tech Upgrades to Push China's Wind Generation to 700TWh by 2028," Asian Power, February 5, 2020, <https://asian-power.com/power-utility/news/tech-upgrades-push-chinas-wind-generation-700twh-2028>.

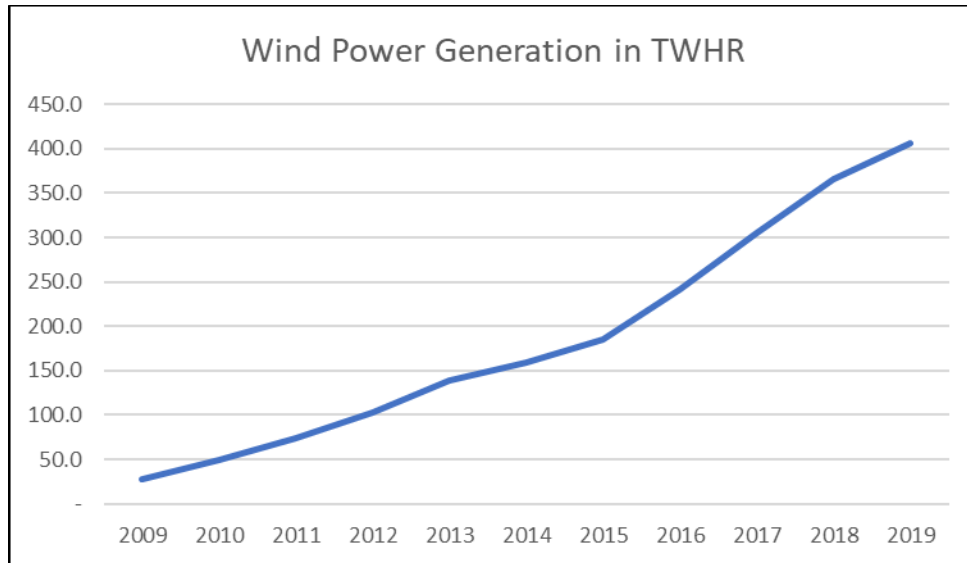


Figure 17. 2009-2019 Wind Power Generation²²⁶

The location of China’s wind resource availability, however, causes difficulties for power distribution. China’s total wind resource potential is approximately three terawatts onshore and 500 gigawatts (GW) offshore (see Figures 18 and 19).²²⁷ A Sino-Danish study estimated that by 2030 China’s wind power would reach 400GW, and by 2050 wind power will reach 1,000GW.²²⁸ The following are China’s wind construction targets by 2050: West Inner Mongolia is 300GW, East Inner Mongolia 90GW, Northeastern China 60GW, Hebei 60GW, Gansu 120GW, Xinjiang 100GW, Eastern and Central China 70GW, near offshore wind 150GW and far offshore wind 50GW.²²⁹ Much like coal, wind energy availability is located in rural areas, whereas the demand for energy is mostly located in the southeastern region and along the coastline. The location of wind energy availability causes difficulties for China to achieve economies of scale for power distribution. Offshore wind, however, could partially alleviate some of this concern for China.

²²⁶ Adapted from: British Petroleum Company, “Statistical Review of World Energy – All Data, 1965–2019.”

²²⁷ “China Wind, Solar, and Bioenergy Roadmap 2050 Short Version” (Beijing, China: China National Renewable Energy Centre, December 2014), 3.

²²⁸ China National Renewable Energy Centre, 3.

²²⁹ China National Renewable Energy Centre, 6.

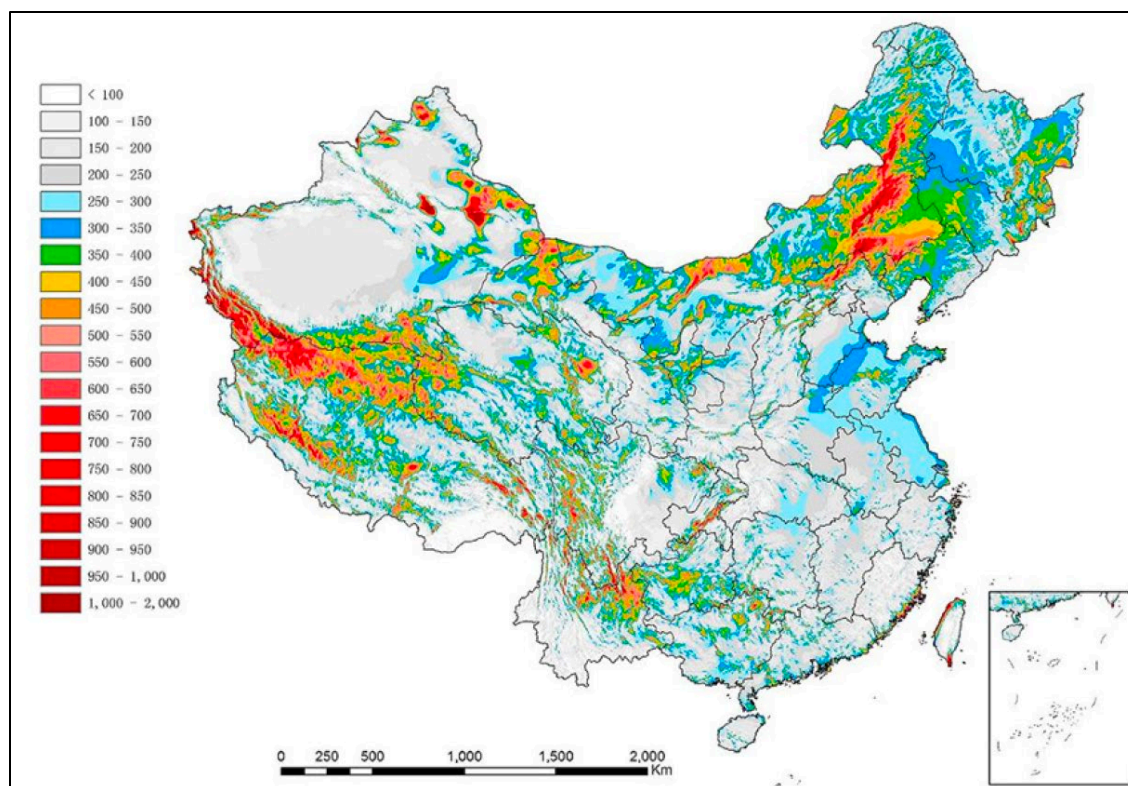


Figure 18. China's Onshore Wind Potential²³⁰

²³⁰ Source: China National Renewable Energy Centre, 4.

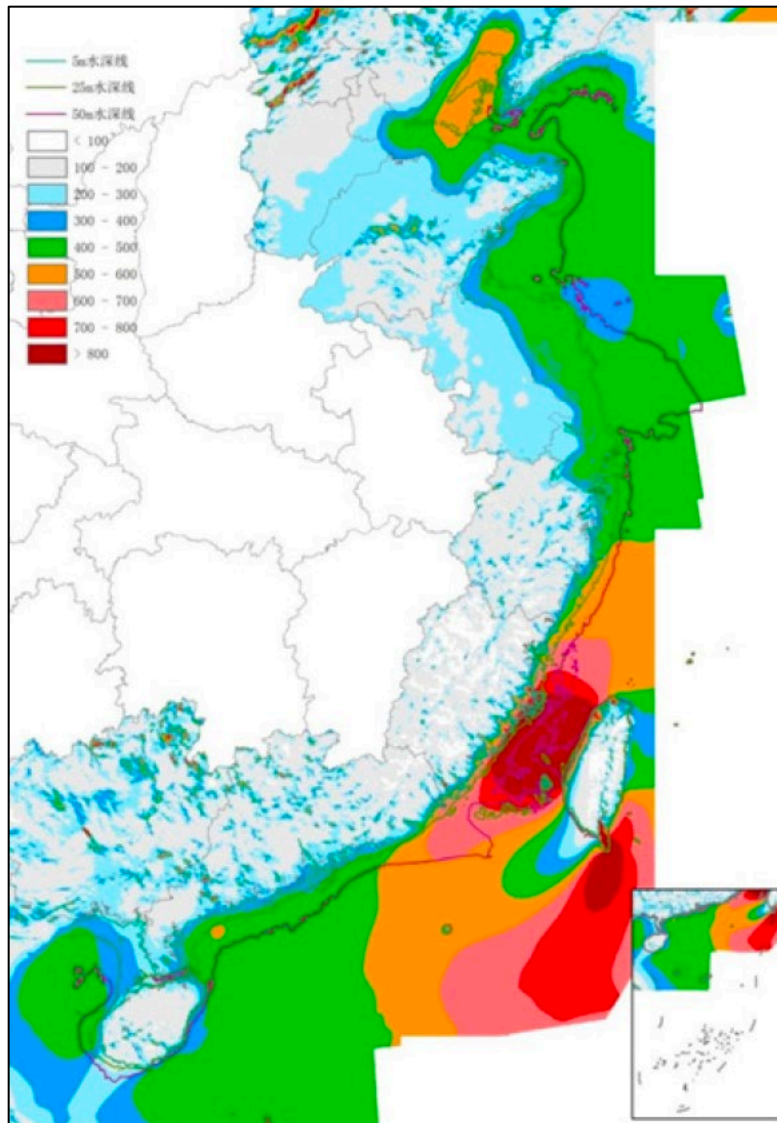


Figure 19. China's Offshore Wind Potential²³¹

3. Solar

Solar power is the second-largest energy source behind wind within the renewable energy sector. Between 2009–2019, solar capacity increased from 27.6 to 223.8 TWhR (see Figure 20).²³² In 2016, China surpassed the United States as the global leader in solar power generation, and in 2019, China's solar generation was twice the amount of the

²³¹ Source: China National Renewable Energy Centre, 4.

²³² British Petroleum Company, "Statistical Review of World Energy – All Data, 1965–2019."

United States.²³³ By 2050, China is estimated to replace 860 MTOE with solar power.²³⁴ Solar power, however, experiences the same problems that wind does with power distribution and the location of available resources. The Tibet region is capable of producing up to 2,000 kilowatts per hour per square meter (kWhm²), whereas the Sichuan area is much lower with the ability of 1,000 kWhm², and some areas around are significantly less (see Figure 21).²³⁵ Tibet and Sichuan are located in western and center inland China, which are far from major population centers. The major population centers are located in southeastern China and along the coast.

While China is the leader in solar energy, it has experienced technical issues that need to be resolved. Solar panels have increased throughout China because of goals to reduce carbon emissions. However, these solar panels are only capable of producing electricity for 20 to 30 years.²³⁶ By 2050 China is expected to produce 20 million tons of solar panels, and most, if not all, of its current solar panels will need to be replaced.²³⁷ The issue is with both the waste and operational life of solar panels.²³⁸ The Chinese public has protested solar companies for improper dumping of solar panel material into rivers, which caused damages to the ecosystem and a potential food supply.²³⁹ China would be able to partially reduce the damages of waste if it could produce solar panels that will have a longer operational life. Increasing operational life in its solar panels would also make Chinese companies more competitive in the solar panel market. This is one issue that China has experienced in renewable energy because of heavy investment in the renewable energy sector.

²³³ British Petroleum Company.

²³⁴ China National Renewable Energy Centre, “China Wind, Solar, and Bioenergy Roadmap 2050 Short Version,” 10.

²³⁵ China National Renewable Energy Centre, 11.

²³⁶ Gozde Celik, “Challenges Facing China’s Key Low-Carbon Energy Industries – Solar and Wind,” EqualOcean, April 29, 2020, <https://equalocean.com/analysis/2020042913932>.

²³⁷ Celik.

²³⁸ Celik.

²³⁹ Celik.

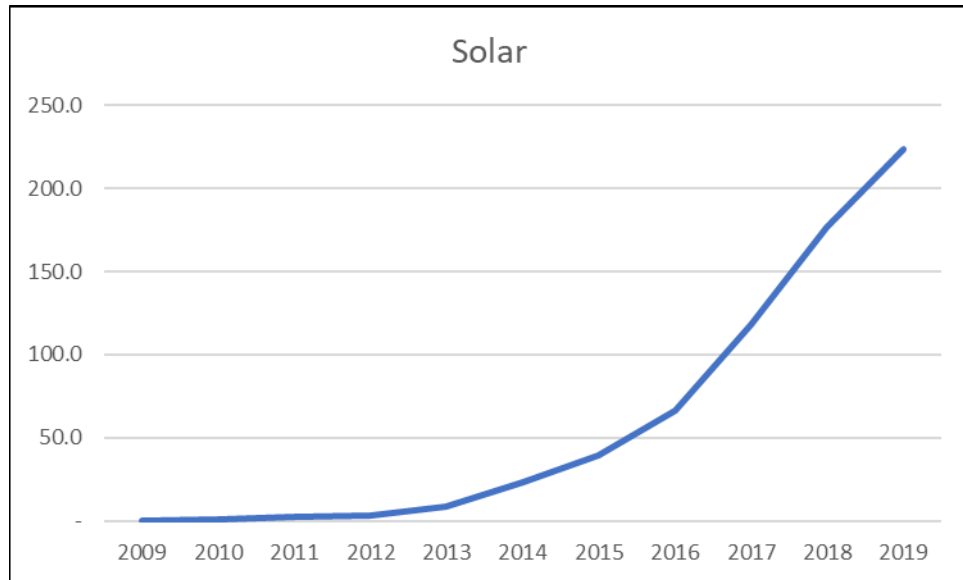


Figure 20. 2009-2019 Solar Power Generation²⁴⁰

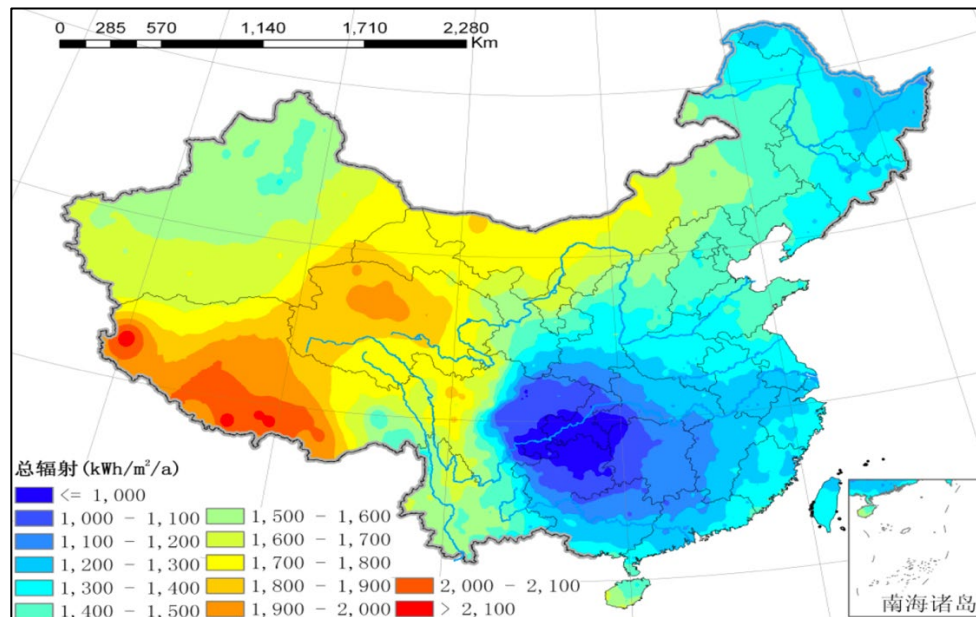


Figure 21. China Solar Radiation Availability²⁴¹

²⁴⁰ Adapted from: British Petroleum Company, “Statistical Review of World Energy – All Data, 1965–2019.”

²⁴¹ Source: China National Renewable Energy Centre, “China Wind, Solar, and Bioenergy Roadmap 2050 Short Version,” 11.

D. INVESTMENT RENEWABLE ENERGY SECTOR

China's drive to reduce pollution, fight climate change, and reduce the socio-economical costs, incentivizes investment in the renewable energy sector. China is the world leader in renewable energy production, innovation, and investments. Out of all renewable energy investments in the world in 2017, 45% are in China.²⁴² Additionally, China owns 29% of patents on renewable energy projects on the globe, approximately 11% more than the second place United States.²⁴³ In 2015, China invested \$103 billion into the renewable energy sector compared to the United States, who invested \$44.1 billion.²⁴⁴ China's heavy investment in renewable energy has made it the leader in renewable energy. During the midst of the coronavirus-19 pandemic, China's renewable energy installations have only dropped 9.3% for the first half of 2020.²⁴⁵

The worldwide leaders in hydropower, wind, solar, and battery technology are all Chinese companies. Between 2015–2021, these companies are expected to construct 36% of the world's hydropower, 40% of wind, and 36% of solar.²⁴⁶ China's Three Gorges Dams Corporation is a state-owned company that is the world leader in hydropower and is involved in projects worldwide.²⁴⁷ Goldwind is the worldwide leader in wind power projects, but it is not state-owned. Goldwind is a privately-owned company listed under the Hong Kong Stock Exchange.²⁴⁸ Four of the top six solar power manufacturers reside in China with an annual production capacity of approximately 21 gigawatts, and the other

²⁴² Global Commission on the Geopolitics of Energy Transformation, *A New World: The Geopolitics of the Energy Transformation*, 2019, 28.

²⁴³ Global Commission on the Geopolitics of Energy Transformation, 41.

²⁴⁴ Institute for Energy Economics and Financial Analysis, "China's Global Renewable Energy Expansion," January 2017.

²⁴⁵ Yuki Yu, "China's Wind & Solar Market 2020 Half-Year Review," Renewable Energy World, August 10, 2020, <https://www.renewableenergyworld.com/2020/08/10/chinas-wind-solar-market-2020-half-year-review/>.

²⁴⁶ Institute for Energy Economics and Financial Analysis, "China's Global Renewable Energy Expansion," Institute for Energy Economics and Financial Analysis, January 2017, 2, https://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion_January-2017.pdf.

²⁴⁷ Institute for Energy Economics and Financial Analysis, 11–13.

²⁴⁸ Institute for Energy Economics and Financial Analysis, 20.

two are Canadian and South Korean.²⁴⁹ In the battery sector, Chinese company Tianqi is the world leader in lithium battery production, and Chinese companies own 90% of rare earth mining and 72% of worldwide processing, which are used for manufacturing battery and solar components.²⁵⁰ China is poised to lead the world in the renewable energy sector because of its comparative advantage and industrial capacity in the renewable energy sector.²⁵¹ Because of China's rapid industrialization in the renewable energy sector, it has experienced infrastructure issues within the renewable energy sector.

E. INFRASTRUCTURE ISSUES WITHIN SOLAR AND WIND GENERATION

The last section reviewed China's investment in the renewable energy sector. This next section will outline some of the issues that China has experienced with its domestic solar and wind sectors. Wind and solar have experienced the same issues within both sectors. High ambitions of supply have exceeded the demands and the capacity of infrastructure. In the Northwest region of China, Xinjiang, and Gansu, the installation of solar has greatly exceeded the demand, which has led to curtailment.²⁵² Curtailment is defined as "the percentage of electricity from wind or solar that could have been produced but which the grid would not accept."²⁵³ Solar project construction in Xinjiang exceeded 23.93% and in Gansu 16.41% of actual capacity.²⁵⁴ Constructing the adequate infrastructure for the energy sector requires long-term planning. Solar power hubs are completed within a short time span of approximately two months; however, ultra-high

²⁴⁹ Institute for Energy Economics and Financial Analysis, 22.

²⁵⁰ Institute for Energy Economics and Financial Analysis, 2.

²⁵¹ While China's renewable energy exports and impact on global institutions is not the purview of this thesis, for more information see Michael Aklin and Johannes Urpelainen, *Renewables: The Politics of a Global Energy Transition* (Cambridge, Massachusetts: The MIT Press, 2018); Global Commission on the Geopolitics of Energy Transformation, *A New World*.

²⁵² Ningning Tang et al., "Solar Energy Curtailment in China: Status Quo, Reasons and Solutions," *Renewable & Sustainable Energy Reviews* 97 (2018): 515, <https://doi.org/10.1016/j.rser.2018.07.021>.

²⁵³ Anders Hove, "Trends and Contradictions in China's Renewable Energy Policy" (New York, New York: Columbia SIPA Center on Global Energy Policy, August 28, 2020), <https://www.energypolicy.columbia.edu/research/commentary/trends-and-contradictions-china-s-renewable-energy-policy>.

²⁵⁴ Tang et al., "Solar Energy Curtailment in China," 515.

voltage lines take upwards of two years to complete.²⁵⁵ Therefore, planning and preparation in Five-Year Plans do not fit well into the energy sector with targets. The long-term aspect of market principles is more effective in providing efficient construction of energy projects.

Wind and solar power curtailment currently represent the most prominent issue within the sector. China has produced more wind power than it was capable of transmitting with existing infrastructure.²⁵⁶ Fitch Solutions stated, “After 2016, curtailment was taken as a serious challenge by the central government and tackled through a combination of transmission optimization [optimization] and regulatory and market reform.”²⁵⁷ Power companies in China have created “interprovincial markets” for renewable energy to transfer power from high producing provinces to locations where demand exists.²⁵⁸ The integrated market alleviates power grid bottlenecks to reduce curtailment while increasing the efficiency of wind power usage.

Curtailment issues partly derive from natural unpredictability in power generation. Wind and solar generation rely on predictable weather for the efficient management of power stations. For solar, production capacity in the summer is greater than it is in the winter, and when it is cloudy, power generation becomes more sporadic,²⁵⁹ and wind power is affected by storms and periods with no wind. Thus, the unpredictability of power generation and issues with curtailment in the renewable sector could be why China is continuing to rely on coal as a dominant source of energy.²⁶⁰

Five-Year Plans conflict with energy market reforms and impact renewable energy because government intervention, short-term targets, constrict the laissez-faire principles of supply and demand. The CCP sets targets for renewable energy construction through

²⁵⁵ Tang et al., 516.

²⁵⁶ Asian Power, “Tech Upgrades to Push China’s Wind Generation to 700TWh by 2028.”

²⁵⁷ Asian Power.

²⁵⁸ Asian Power.

²⁵⁹ Tang et al., “Solar Energy Curtailment in China,” 515.

²⁶⁰ Hove, “Trends and Contradictions in China’s Renewable Energy Policy.”

Five-Year Plans, which are not driven by the market principles. Anders Hove argues, “The future of renewable energy deployment in China will be shaped by an ongoing contradiction within the power sector between long-term market-oriented reforms on the one hand and short-term administrative planning on the other.”²⁶¹ Moreover, China’s socialist market reforms are constricted when the CCP places emphasis on setting short-term five-year targets for local officials. While the CCP has combined environmental policies into Five-Year Plans, other laws and provisions contradict one another. Therefore, local officials likely defer back to the Five-Year Plan guidance. Local officials are focused on Five-Year Plan targets because they are evaluated on their performance in relation to the Five-Year Plan and not on long-term market reform for the overarching energy sector.

The CCP’s inability to manage renewable energy causes issues of curtailment within the sector. While the annual capacity of wind and solar power increased from 2014–2019 (see Figure 22), Anders Hove argues that “Rapid cost declines in wind and solar PV [photovoltaic] had led to cycles of boom and bust in the sector, as policy-makers struggled to adjust feed-in tariffs quickly enough to prevent overheating the market.”²⁶² Feed-in tariffs are designed to act as subsidies for costs incurred for production and are to decrease over time and eventually dissipate. China is ceasing all new feed-in tariffs for projects that are approved after January 1, 2021.²⁶³ The absence of feed-in tariffs will encourage market participation, reduction in prices, and innovation in the sector, all of which will benefit China’s energy security, energy independence, and climate change.

²⁶¹ Hove.

²⁶² Hove, “Current Direction for Renewable Energy in China.”

²⁶³ Joyce Lee and Feng Zhao, “Global Wind Report 2019” (Brussels, Belgium: Global Wind Energy Council, March 25, 2020), 13, https://gwec.net/wp-content/uploads/2020/08/Annual-Wind-Report_2019_digital_final_2r.pdf.

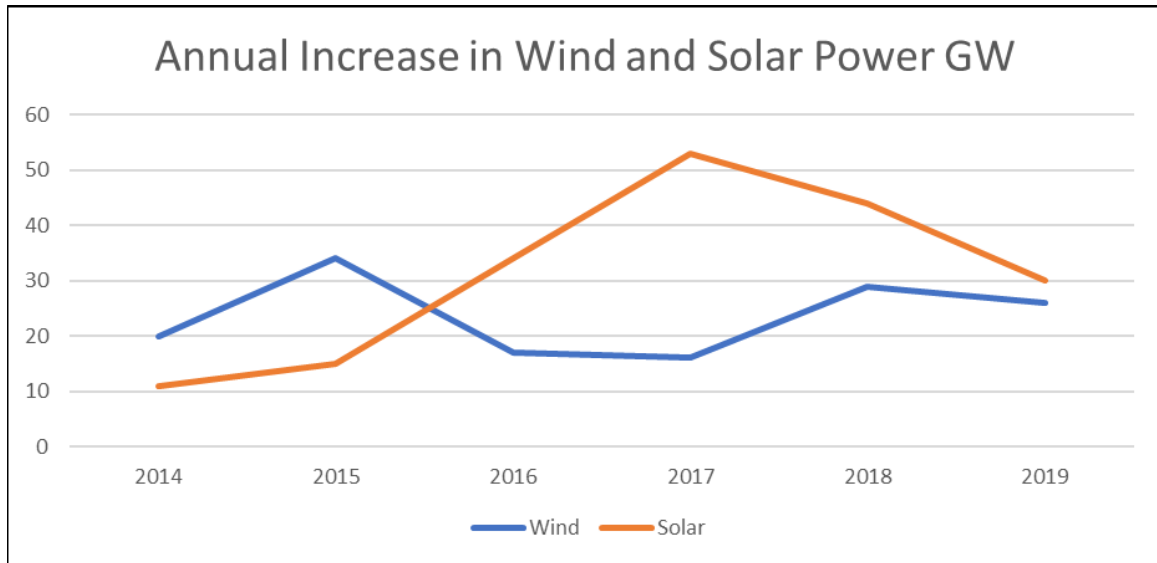


Figure 22. Annual Increase in Wind and Solar Power²⁶⁴

While China has wished to restrict coal plant construction to reduce pollution, renewable energy appears to have not met the capacity that was expected to achieve the people's social and economic demands. Hove states that "policy states that provinces should 'in principle' prioritize renewable energy, demand side management, and imports over new coal, if these sources are insufficient to meet peak load then new coal plants can be permitted."²⁶⁵ The policy has caused a shift from restricting coal plant construction to allowing the majority of the country to continue to build coal power plants because renewable energy projects cannot meet the demands of the people.²⁶⁶ The CCP still permits regions to build coal plants. Even though China has reduced pollution, it still needs to build coal power plants in order to meet social and economic demands. In 2016, the National Energy Administration began a traffic light system that illustrated which provinces were restricted in building new coal plants.²⁶⁷ The 2016 map only listed three green provinces, and the remaining were orange or red, restricting the construction of new

²⁶⁴ Adapted from: Hove, "Current Direction for Renewable Energy in China."

²⁶⁵ Hove.

²⁶⁶ Hove.

²⁶⁷ Hove, "Trends and Contradictions in China's Renewable Energy Policy."

coal plants. A new map was published in 2020, and only five provinces are listed to restrict new coal plant construction (see Figure 23).²⁶⁸ The capacity adequacy index explains which provinces are at capacity for energy in red, and those in green are provinces that are not, while the project economy index explains if the new coal plants will be profitable.²⁶⁹ China is allowing its local prefectures to build more coal plants because renewable energy projects cannot reach the capacity to fulfill social and economic demands.

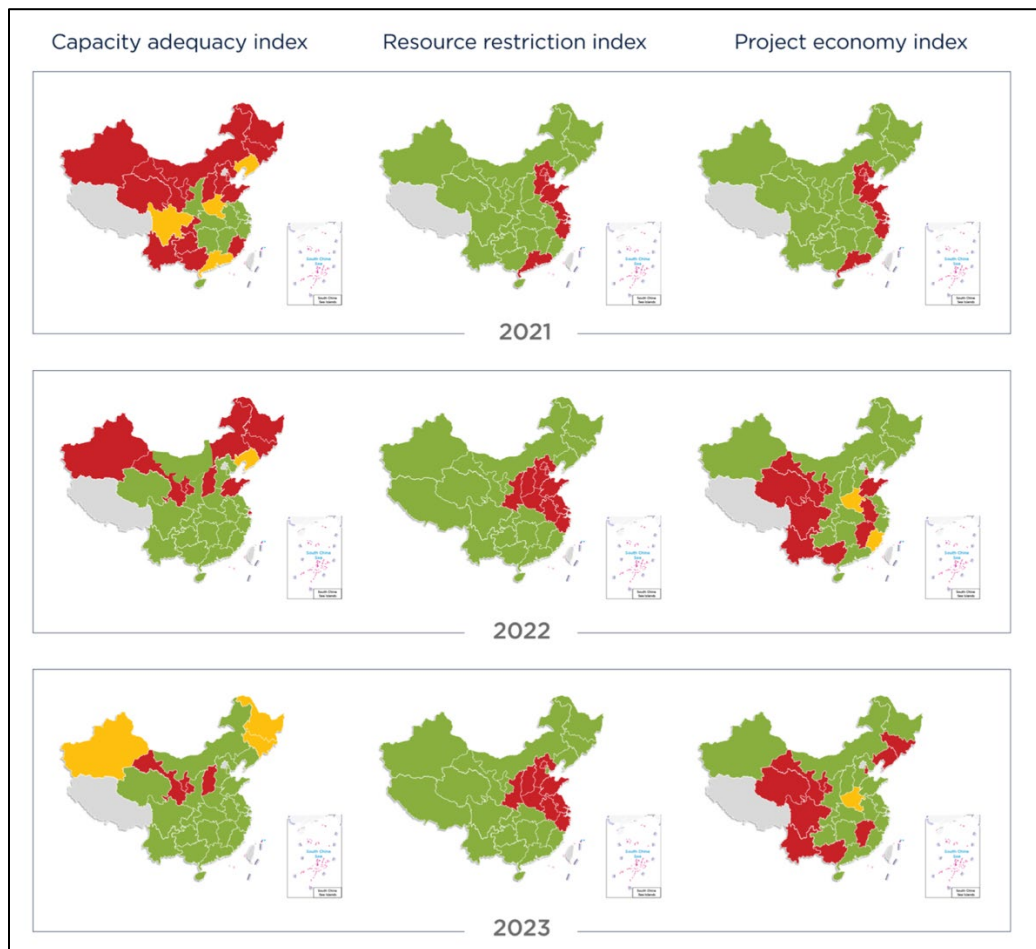


Figure 23. 2021-2023 Coal Plant Restrictions²⁷⁰

²⁶⁸ Hove.

²⁶⁹ Hove.

²⁷⁰ Source: Hove.

While China is building more coal plants to meet economic demands, its cutting-edge coal technology is contributing to a greener and less pollutant country. In 2016, the Center for American Progress conducted a study in China and visited several coal power plant facilities.²⁷¹ Their study analyzed the different types of coal plants—ultra-supercritical, supercritical, subcritical—in China. Ultra-supercritical plants are more efficient and produce less carbon dioxide emissions, while subcritical are less efficient and more pollutant. Their study indicates that out of China’s top 100 coal plants by capacity, 92 are ultra-supercritical plants.²⁷² In comparison, the United States has one ultra-supercritical, 69 supercritical, and 30 subcritical coal plants. Additionally, out of all of China’s coal plants, 19 percent are ultra-supercritical, 25% are supercritical, and 56 are subcritical, and all new coal plants that are constructed are mostly ultra-critical plants.²⁷³ These energy experts proclaim that “the nation is on track to overdeliver on the emissions reduction commitments it put forward under the Paris climate agreement and making coal cleaner is an integral part of the process.”²⁷⁴ China is ensuring that its coal industry is part of the mission of combatting pollution and climate change. While high pollution coal plants still exist, new technology in coal plants will reduce pollution.

China’s utilization of APPCAP 2013 has been successful in conquering pollution. Figure 24 displays the change in pollution from 2013–2016.²⁷⁵ The average decline in pollution from 2013–2018 was 39%, while China’s most polluted area, Beijing-Tianjin-Hebei, reduced pollution by 41%.²⁷⁶ Furthermore, the CCP canceled plans to build 103 new coal power plants, and leaders in Beijing closed the last coal power plant in 2018. While APPCAP 2013 only targeted three areas—Beijing-Tianjin-Hebei, Pearl River Delta,

²⁷¹ Melanie Hart, Luke Bassett, and Blaine Johnson, “Everything You Think You Know About Coal in China Is Wrong,” Center for American Progress, May 15, 2017, <https://www.americanprogress.org/issues/green/reports/2017/05/15/432141/everything-think-know-coal-china-wrong/>.

²⁷² Hart, Bassett, and Johnson.

²⁷³ Hart, Bassett, and Johnson.

²⁷⁴ Hart, Bassett, and Johnson.

²⁷⁵ Air Quality Life Index, “AQLI Policy Impacts—China: National Air Quality Action Plan (2014).”

²⁷⁶ Air Quality Life Index.

Yangtze River Delta—the message was clear to the other provincial leaders that the CCP was valuing environmental protection.

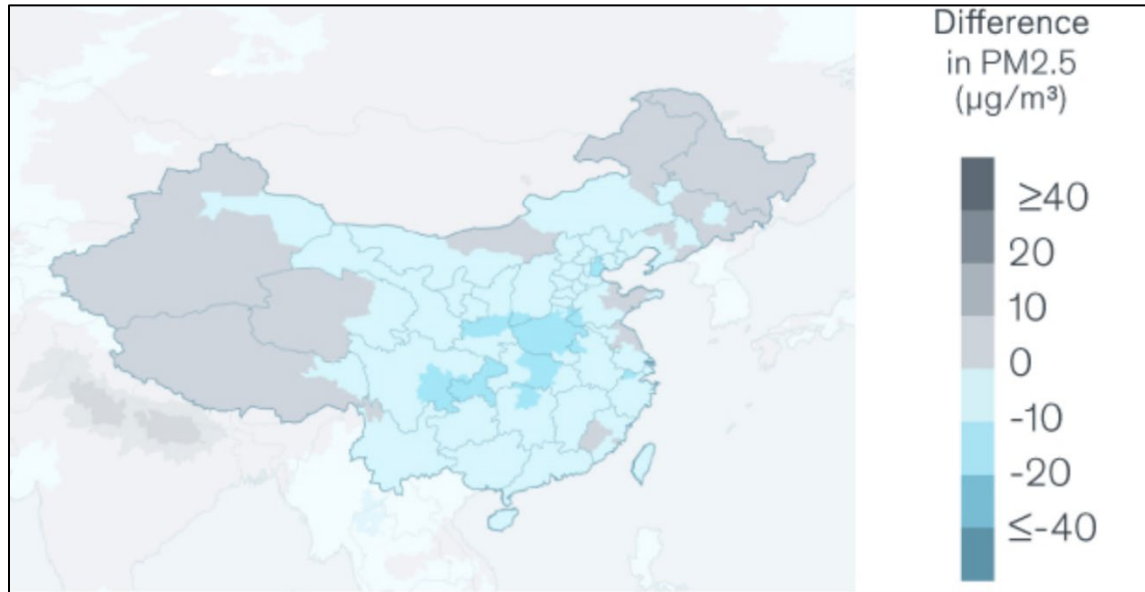


Figure 24. 2013-2016 Change in Pollution²⁷⁷

F. CONCLUSION

This chapter found that the drivers for China’s renewable energy originated from an economy that experienced sustained growth, but which outpaced the government’s ability to manage air pollution, negatively impacting the health of its citizens and leading to environmental protests and general civil society discontent. While the origins are important to understand, it is also vital to explore how China is driving its latest renewable energy policies. At home, China has used its Five-Year Plan in conjunction with various air pollution policies to combat air pollution and climate change but now only uses Five-Year Plan to layout targets to expand domestic renewable energy. The major focus of China’s ambitions is reducing its greenhouse gas emissions, adapting to climate change, and increasing its efforts to collaborate with the international community on environmental issues.

²⁷⁷ Source: Air Quality Life Index.

This study then analyzed how China's policies were transformed into realization. The majority of China could experience an increase in life expectancy if pollution is decreased to the World Health Organization (WHO) standards of PM2.5. In China, 231 cities out of 331 are not in compliance with China's own policies and WHO standards. China, however, leads the world in hydropower, wind, and solar-generated electricity. While hydropower is the dominant renewable source of energy, it has caused the resettlement of citizens and damages to the ecosystem and to the environment. Wind and solar have increased at a faster pace than hydropower because of technological advances and heavy investment. China's heavy investment in the renewable energy sector has elevated it to the world leader in all industrial sectors of renewable energy.

The renewable energy sector has also experienced curtailment issues because of the lack of interconnectedness between provinces and the inability to manage high costs for electricity generated by new technology. China will eliminate feed-in tariffs by 2021, which will allow the prices for renewable energy to be competitive with coal. Onshore wind and solar high-efficient areas are located in northeast and northwest China, which is distanced from major population centers in southeast China and along the coast. The issues of the renewable energy sector have caused China to ease new coal plant construction restrictions. China's new coal plants, however, are less pollutant than any other coal plants in the world. China's efforts to reduce pollution have been successful in many areas. From 2013–2016, the country has reduced pollution on average by 39%, which has reduced most areas in China below the WHO standard.²⁷⁸ Because of China's investment in the renewable energy sector, China could experience a significant decrease in pollution and increase air quality; however, these efforts will come with issues that stall progress. China's domestic production of hydrocarbon, nuclear, and green energy is not sufficient to meet demands causing it to import 20% of its energy, which will be the focus of the next chapter.²⁷⁹

²⁷⁸ Air Quality Life Index.

²⁷⁹ International Energy Charter, "China Energy Efficiency Report," 54.

THIS PAGE INTENTIONALLY LEFT BLANK

IV. DRIVERS OF FOREIGN ENERGY SECURITY POLICIES

China's rapid industrialization, and the inability to keep pace with domestic infrastructure, technology, and energy production, has transitioned China from a model of self-sufficiency to a model that inherently relies on energy imports. This study will analyze geographic and geopolitical considerations that could constrain China's energy imports. Additionally, this study will evaluate China's foreign sources of energy—coal, oil, and natural gas—and will expand each sector by primary countries to investigate issues within each source to explore the primary drivers of China's foreign energy security policy.

This chapter finds that China uses a multipronged approach with multiple sources abroad to diversify its imports to ensure energy security. Geopolitical tensions are one major driver for China's energy security. The trade dispute between Australia and China has the potential to affect coal and LNG imports. Since Sino-Aussie tensions have escalated, an unofficial ban on Australian coal imports has increased coal imports from Indonesia. However, tensions have not affected Australian LNG exports to China, which is why some analysts argue that China is banning Australian coal to protect its domestic coal industry.²⁸⁰ China has the capacity to import less coal because of the capacity of domestic production, but China's domestic natural gas production likely does not have the capability to support banning Australian LNG imports.

China has experienced difficulties importing energy from Iran and Venezuela because of U.S. sanctions. While Chinese interest in Iran and Venezuela remains high, China has significantly decreased energy imports to avoid retribution from the United States. However, in an effort to acquire loan repayments from Venezuela, China has imported oil from Venezuela illegally under the auspice of other states. Iran and China are progressing toward a deal that would involve not only oil but also diplomatic and military relations, but the two countries have yet to establish an official agreement.

²⁸⁰ Neil Hume and Jamie Smyth, "China Expected to Impose Coal Import Restrictions," May 27, 2020, <https://www.ft.com/content/6142f1b9-58cc-47e4-b2fb-8212ad792b2d>.

Another driver of China's energy security is to ensure secure access to energy if vital chokepoints—most notably the Strait of Hormuz and Malacca Strait—controlled by the United States were closed. China heavily relies on the Middle East for oil and Qatar for liquefied natural gas (LNG). China is reducing its risk to this predicament by expanding oil and gas pipelines from neighboring states. The Central-Asia China Gas Pipeline (CACGP) and current and proposed Russian oil and gas pipelines are significant for filling the oil and natural gas demand if conventional seaborne imports are threatened. While the Myanmar pipeline does not have the capacity to fill demands, it gives China direct access to an LNG terminal in the Bay of Bengal.

Market forces and energy availability are other drivers for China's energy security. While South China Sea tensions exist between China, Indonesia, and Malaysia, they do not drive energy relations. China invests heavily in Indonesia's coal sector and imports the majority of its coal from Indonesia. Additionally, China has secured agreements to import LNG from Malaysia and could soon have an agreement in place with Indonesia. Indonesia and Malaysia are closer to China geographically, which reduces transportation costs. China could potentially import Mongolian coal if prices were competitive with seaborne coal. All Mongolian coal imports are transported over roadways. The Russian-built Tavan Togoi railway will reduce coal transport costs. If prices are competitive, Mongolian coal could be a future replacement for seaborne coal when the Tavan Togoi railway is completed. Lastly, an oversupplied global natural gas market is driving China to shift from long-term to short-term gas contracts with Australia.

A. INFLUENCES OF ENERGY SECURITY ABROAD

China is prepared for short-term issues or conflicts that could disrupt foreign energy sources. In 2019, China's strategic petroleum reserves contained an estimated 80 days of imports.²⁸¹ China's National Energy Administration director Zhang Jianhua stated, "It is not that we depend on one certain country or region. Looking at the current situation, even

²⁸¹ Tom Daly, "China Has Enough Oil Inventories to Last about 80 Days: NEA," *Reuters*, September 20, 2019, <https://www.reuters.com/article/us-china-energy-idUSKBN1W514V>.

if Saudi Arabia is attacked, it will not affect China's crude oil supply."²⁸² China's strategic reserves would give time to reallocate its energy mix; however, if China were in a long-term conflict with the United States, the United States Navy would blockade key chokepoints surrounding the first island chain. Therefore, China would need to import more oil overland through pipelines from Central Asia and Russia to sustain economic growth.

The Malacca dilemma shadows over the future of China's economic and energy security. The Malacca Strait is a strategic chokepoint that is significant for China's maritime trade, specifically China's oil and natural gas imports. While imports could navigate around the Malacca Strait, if closed or blockaded by the U.S. Navy, it would prevent or delay 80% of China's oil and 11% of natural gas imports (see Figure 25), significantly impacting China's energy security mix and China's economy.²⁸³ Maritime shipping could utilize alternative routes through the Lombok Strait or Makassar Strait, but shipping costs could increase by \$84-250 billion per year.²⁸⁴ Not only would imports from the Middle East be threatened, but also imports from Africa. China's imports travel through the Malacca Strait under the security umbrella of the U.S. Navy. The U.S. Navy routinely conducts naval exercises with Singapore in the Malacca Strait and could rapidly control the chokepoint. The Malacca dilemma is part of China's motivations for diversifying its energy mix to reduce its energy security threats.

²⁸² Daly.

²⁸³ "Military and Security Developments Involving the People's Republic of China 2017," Office of the Secretary of Defense, May 15, 2017, 44, https://dod.defense.gov/Portals/1/Documents/pubs/2017_China_Military_Power_Report.PDF.

²⁸⁴ Mohd Rusli, "Maritime Highways of Southeast Asia: Alternative Straits?" (Singapore: Nanyang Technological University, February 10, 2012), 2, <https://www.rsis.edu.sg/rsis-publication/rsis/1686-maritime-highways-of-southeast/#.X3KBs117IZJ>.

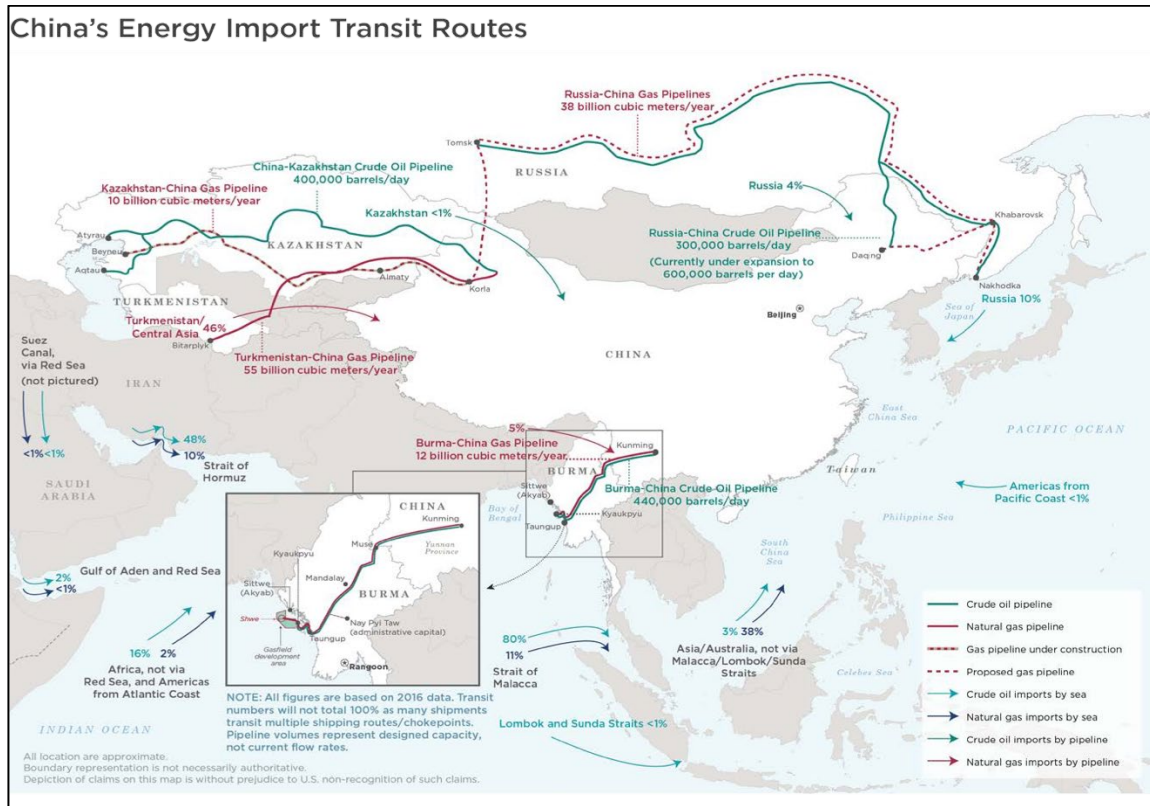


Figure 25. China Energy Import Routes²⁸⁵

The Strait of Hormuz is another chokepoint that is a high risk to China's energy security. Iran periodically threatens to close the Strait of Hormuz because of oil sanctions placed on it by the United States.²⁸⁶ The Islamic Revolutionary Guard Corps (Navy) conducts routine training exercises for rapidly closing and securing the Strait of Hormuz. The exercises consist of rocket launches, mining, and swarm tactics against vessels in the strait.²⁸⁷ If Iran were to close the Strait of Hormuz, approximately 48% of oil imports and

²⁸⁵ Source: Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China 2017," 44.

²⁸⁶ Arsalan Shahla and Ladane Nasser, "Iran Raises Stakes in U.S. Showdown With Threat to Close Hormuz," April 22, 2019, <https://www.bloomberg.com/news/articles/2019-04-22/iran-will-close-strait-of-hormuz-if-it-can-t-use-it-fars>.

²⁸⁷ Edward Chang, "The Real Iran Military Threat: Close the Strait of Hormuz (Watch Oil Prices Jump)," Text, The National Interest (The Center for the National Interest, May 16, 2019), <https://nationalinterest.org/blog/buzz/real-iran-military-threat-close-strait-hormuz-watch-oil-prices-jump-57862>.

10% of natural gas imports would be affected.²⁸⁸ It can be argued that China's energy dilemma with the Strait of Hormuz is one reason for the increase of China's naval presence in the Middle East.

China's naval presence in the Middle East represents soft power diplomacy for BRI and protection for maritime trade from state and non-state actors. The Center for Naval Analyses argues that protecting seaborne trade near vital chokepoints is the primary driver for increased Chinese naval operations in the Middle East.²⁸⁹ In the early 2000s, China did not have a naval presence in the region, but China has modernized its naval capacity to support rotating presence operations since then.²⁹⁰ Furthermore, China established a naval base in Djibouti as a command and control hub and is planning to open a naval base in Pakistan to support naval operations further.²⁹¹ China's primary naval mission is its counterpiracy task force. Since 2008, China has deployed a three-ship rotating Naval Expeditionary Task Force (NETF) to the Gulf of Aden, which conducts escort operations for China's maritime trade, including oil and natural gas imports from Africa and the Middle East.²⁹² While China's NETF operations support China's soft power mission, its naval activities are driven toward defending oil and natural gas maritime trade.

B. FOREIGN SOURCES—COAL

China became a net importer of coal in 2009 and needed to tap into the world's supply of coal to fulfill its demands. In 2019, China imported 6.40 EJ of coal, 18% of the world's share of imports.²⁹³ Since 2009, China's coal imports increased by 95%. Of the 6.40 EJ, 34% was imported from Indonesia, 32% was imported from Australia, and 15% from Mongolia. However, in 2019 China closed the gap between domestic production

²⁸⁸ Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China 2017," 44.

²⁸⁹ Jeffrey Becker, Erica Downs, and Ben DeThomas, "China's Presence in the Middle East and Western Indian Ocean: Beyond Belt and Road," February 2019, 65.

²⁹⁰ Becker, Downs, and DeThomas, 65.

²⁹¹ Becker, Downs, and DeThomas, 112.

²⁹² Becker, Downs, and DeThomas, IV.

²⁹³ British Petroleum Company, "BP Statistical Review of World Energy 2020," 49.

and consumption to 1.85 EJ or 2.3% of the overall output. The main drivers for coal imports are transportation bottlenecks, environmental concerns, and domestic resource depletion, such as coking coal, a rare type of coal used in the steel and iron industry.²⁹⁴ China produced 455 megatons (MT) and imported 48 MT of coking coal.²⁹⁵ China will continue to import coal to diversify its energy mix to further to balance domestic production and consumption.

1. Indonesia—Coal

Sino-Indonesian relations are bound on energy, specifically coal. In 2019, Indonesia was the second-largest coal exporter globally, and China was Indonesia's second-largest importer of coal.²⁹⁶ The global recession of 2008 caused coal producers to reduce prices. Therefore, China increased its imports from Indonesia because it is less expensive to import coal to its southern coast rather than transporting domestic coal from the northern part of China.²⁹⁷ In 2017, China imported 109 million tons of coal, and in 2019 coal imports increased to 139 million tons.²⁹⁸ As coal consumption increases in China, Indonesia will continue to be a vital source of coal imports. The relationship between the two countries is based on economics, energy, and trade.

While territory disputes shadow Sino-Indonesian relations, Belt and Road Initiative (BRI) and coal trade are crucial for state relations. The Nantuna Islands are disputed

²⁹⁴ Kevin Tu and Sabine Johnson-Reiser, "Understanding China's Rising Coal Imports," Carnegie Endowment for International Peace, February 16, 2012, <https://carnegieendowment.org/2012/02/16/understanding-china-s-rising-coal-imports-pub-47215>.

²⁹⁵ Tu and Johnson-Reiser.

²⁹⁶ British Petroleum Company, "BP Statistical Review of World Energy 2020," 49.

²⁹⁷ Yao Lixia, Philip Andrews-Speed, and Mohammad Zia, "China-Indonesia Coal Relationship: A New Phase under the Belt & Road Initiative," *Energy Security Institute* 23 (May 10, 2018): 3, <https://esi.nus.edu.sg/docs/default-source/doc/china-indonesia-coal-relationship--a-new-phase-under-the-belt-road-ini-.pdf?sfvrsn=2>.

²⁹⁸ Ghee Peh, "Indonesian Coal at the Mercy of the Dragon and Tiger," June 2020, 5, https://ieefa.org/wp-content/uploads/2020/06/Indonesian-Coal-at-the-Mercy-of-the-Dragon-and-Tiger_June-2020.pdf.

between Indonesia and China.²⁹⁹ Yet, China invested in three coal powerplants in Indonesia, which will provide Indonesia with 3100 megawatts (MW) of energy.³⁰⁰ Additionally, the first of three went into operation in December 2019 and provided 1050MW of energy. While Indonesian coal plants are part of BRI and money-driven, these investments improve Sino-Indonesian relations. Coal imports from Indonesia are secure to continue to feed China's coal demand.

2. Australia—Coal

Australia is the second-largest exporter of coal to China and the largest exporter of coal in the world.³⁰¹ Between 2018–2019, China decreased Australian imports by 3% and increased Indonesian imports by 3%.³⁰² While 3% is a small change in imports, in 2019, Indonesia overtook Australia as the leading exporter of coal to China. Since 2017, tensions between China and Australia have increased because of a trade dispute.³⁰³ In 2020, because Australia insisted on an inquiry into the root cause of the 2019 coronavirus pandemic, China placed tariffs on Australian produce and wine and advised five state power companies to shift from purchasing Australian coal to domestic coal.³⁰⁴ Some analysts claim that an unofficial ban on coal imports was put into place in 2019 because of the trade dispute; however, others argue that the ban was to protect China's domestic coal industry.³⁰⁵ The likelihood of China officially banning all Australian coal imports is arguable low because trade dispute tensions have yet to increase to levels where China

²⁹⁹ Ankit Panda, "Indonesia's Latest Natuna Islands Spat With China Should Be a Wake-Up Call for Southeast Asia – The Diplomat," *The Diplomat*, January 28, 2020, <https://thediplomat.com/2020/01/indonesias-latest-natuna-islands-spat-with-china-should-be-a-wake-up-call-for-southeast-asia/>.

³⁰⁰ Liang Jun Bianji, "China-Built Coal-Fired Power Plant Starts Operation in Indonesia - People's Daily Online," December 16, 2019, <http://en.people.cn/n3/2019/1216/c90000-9640968.html>.

³⁰¹ British Petroleum Company, "BP Statistical Review of World Energy 2020," 49.

³⁰² British Petroleum Company, 49; British Petroleum Company, "BP Statistical Review of World Energy: 2019," 47.

³⁰³ Sun-Lin Tan, "Why Has the China-Australia Relationship Deteriorated into 'Trade War 2.0'?", *South China Morning Post*, July 1, 2020, <https://www.scmp.com/economy/china-economy/article/3091182/why-has-china-australia-relationship-deteriorated-what-some>.

³⁰⁴ Hume and Smyth, "China Expected to Impose Coal Import Restrictions."

³⁰⁵ Hume and Smyth.

would forgo losing an important source for coal. However, China can argue that it is protecting its domestic coal industry to avoid escalating tensions between Australia.

The trade dispute between China and Australia could shift China's imports to be more reliant on Indonesia or Mongolia to fulfill coal demands. Coal and other energy exports from Australia were slightly affected by China's minor trade dispute and coal ban in 2019. While an official ban has yet to be realized, unofficially banning Australian coal imports is easily justifiable to protect the domestic coal industry because of the trade dispute. China will likely import coal from other countries such as Indonesia or Mongolia or could defer back to a self-sustainability model to rely on domestic coal production while a trade dispute exists.

3. Mongolia—Coal

In 2018 and 2019, Mongolian coal exports accounted for 16% of China's coal imports. Mongolia is a landlocked country and can only transport coal with trucks. Mongolia is constructing the Tavan Tolgoi railway to increase coal imports to China. Tavan Tolgoi is estimated to have over 7 billion metric tons of proven deposits of coal and will provide 30 million metric tons of coal each year.³⁰⁶ Additionally, a Russian company is constructing the railway and should be completed by 2021. The railway will feed off a Russian rail system to the west to the Tavan Tolgoi coal mine and then south to connect to China's existing railways (see Figure 26).³⁰⁷

³⁰⁶ "Tavan Tolgoi Coal Line Accord Signed," *Railway Gazette International*, December 4, 2019, <https://www.railwaygazette.com/infrastructure/tavan-tolgoi-coal-line-accord-signed/55277.article>.

³⁰⁷ Stefano Pozzebon, "Mongolia Has To Change Its Railroads To Account For An 85 Millimetre Difference In Track Spacing," October 2, 2014, <https://www.businessinsider.com.au/mongolia-extends-trans-border-railway-to-china-russia-2014-10>.



Figure 26. Mongolia Railway Infrastructure³⁰⁸

Market forces directly impact Mongolian coal exports. Since Mongolia is a landlocked country, coal can only be delivered overland at a higher cost. In early 2020, seaborne coal reached all-time low prices.³⁰⁹ Mongolian coal has issues competing with coal imports from maritime trade routes. While China can import coal from Mongolia at a higher cost in case of war or conflict that would cause maritime sea routes to close, the daily use of Mongolian coal will all depend on how competitive Mongolia can make its coal prices. Additionally, China will have a cheap reliable source of coal when the Tavan Tolgoi railway is completed. The railway is likely to help Mongolia drive down the coal price to compete with seaborne coal sources. While coal is crucial to China's industrial sector, oil imports are significant for energizing the transport sector.

³⁰⁸ Source: Pozzebon.

³⁰⁹ "Feature: Room for Mongolia's Coal Exports to Grow but with Caveat," S&P Global, July 24, 2020, <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/072420-feature-room-for-mongolias-coal-exports-to-grow-but-with-caveat>.

C. FOREIGN SOURCES—OIL

In 2019, China imported 507.2 million metric tons, produced 191 million metric tons but consumed 718 million metric tons of oil.³¹⁰ Since 2009, China doubled its oil imports and doubled its imports from South and Central America, Russia, and the Middle East (see Figure 27).³¹¹ Out of all of China's oil imports, 44% originated from the Middle East, 17% from Saudi Arabia, and 10% from Iraq. While China relied on the Middle East for the majority of its imports, by percentage, the fastest growing suppliers of oil are the United Kingdom, Saudi Arabia, and Brazil (see Figure 28).³¹² The losers in China's oil import game were Iran and Venezuela because of increased pressure from U.S. sanctions. Between 2014–2019, the prevalent changes in China's imports were that China decreased Iranian imports by 6%, Venezuela by 2%, and increased imports from Brazil by 6% and Russia by 4% (see Figures 29 and 30).³¹³

³¹⁰ British Petroleum Company, "BP Statistical Review of World Energy 2020," 17, 21, 30.

³¹¹ "BP Statistical Review of World Energy 2010" (London, England: British Petroleum Company, June 2010), 20; "BP Statistical Review of World Energy 2020," 30.

³¹² Daniel Workman, "Top 15 Crude Oil Suppliers to China," World's Top Exports, August 20, 2020, 15, <http://www.worldstopexports.com/top-15-crude-oil-suppliers-to-china/>.

³¹³ British Petroleum Company, "BP Statistical Review of World Energy 2020," 30; Energy Information Administration, "China - International Energy Data and Analysis," 11.

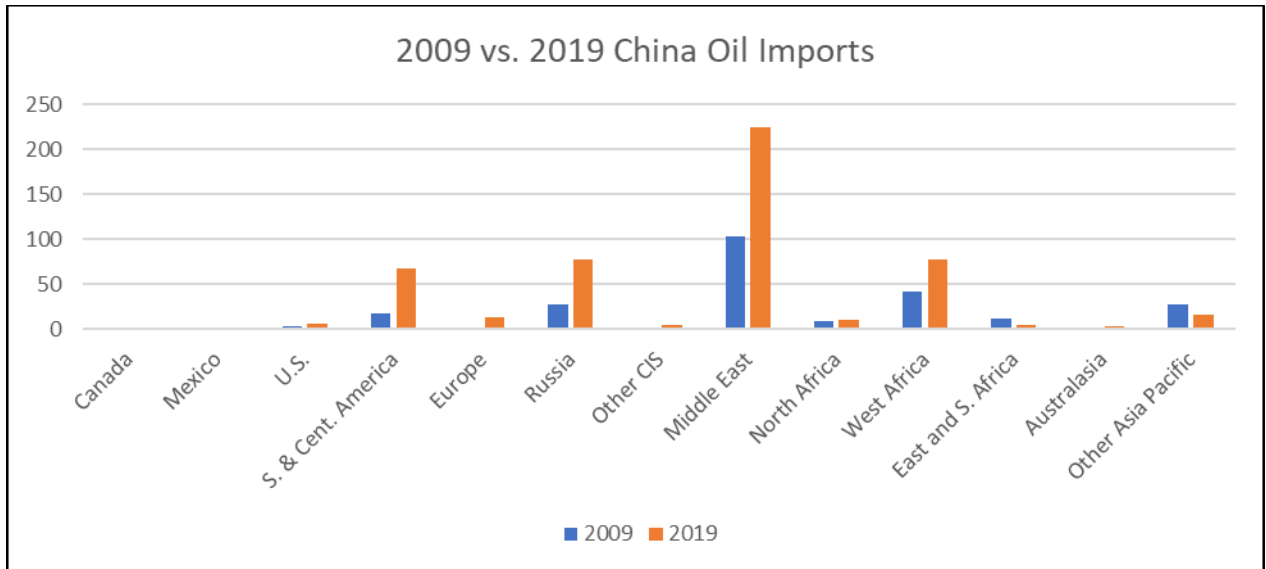


Figure 27. China Oil Imports 2009 vs. 2019 in Million Metric Tons³¹⁴

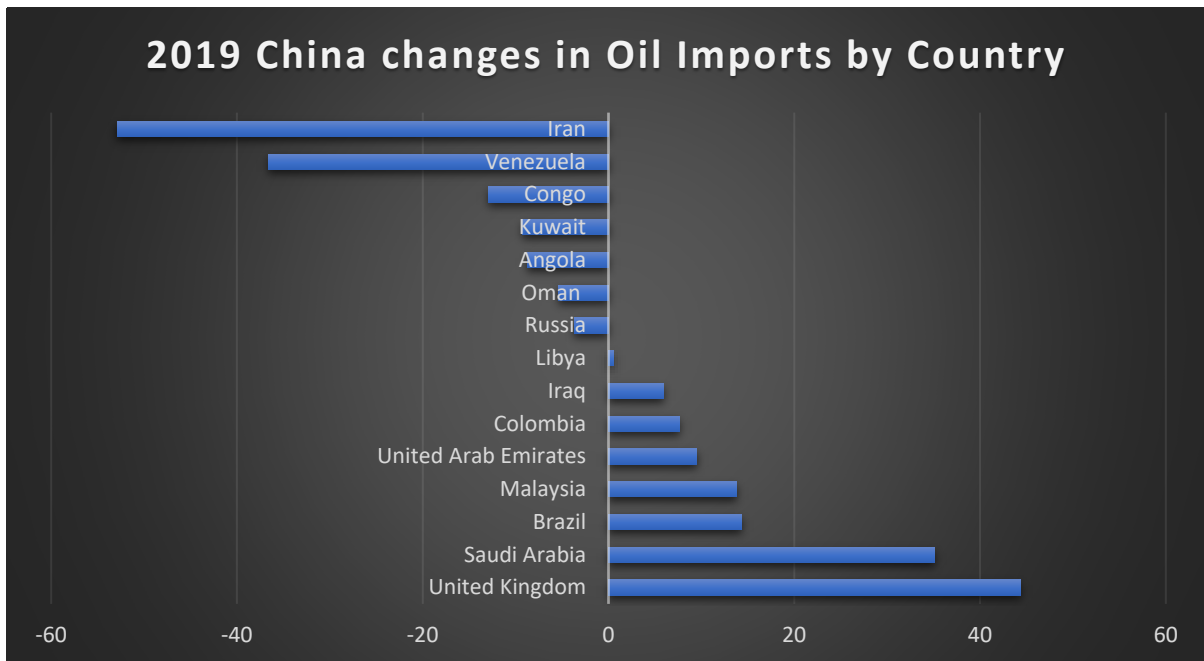


Figure 28. 2018-2019 China changes in Oil Imports by Percentage³¹⁵

³¹⁴ Adapted from: British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 20; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 30.

³¹⁵ Adapted from: Workman, “Top 15 Crude Oil Suppliers to China.”

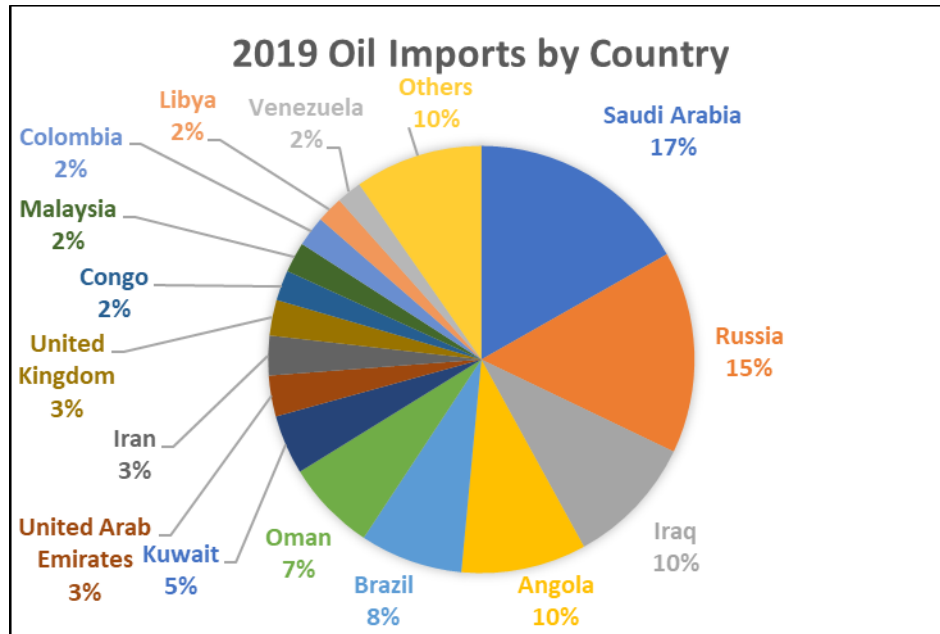


Figure 29. 2019 China's Oil Import by Country by Percentage³¹⁶

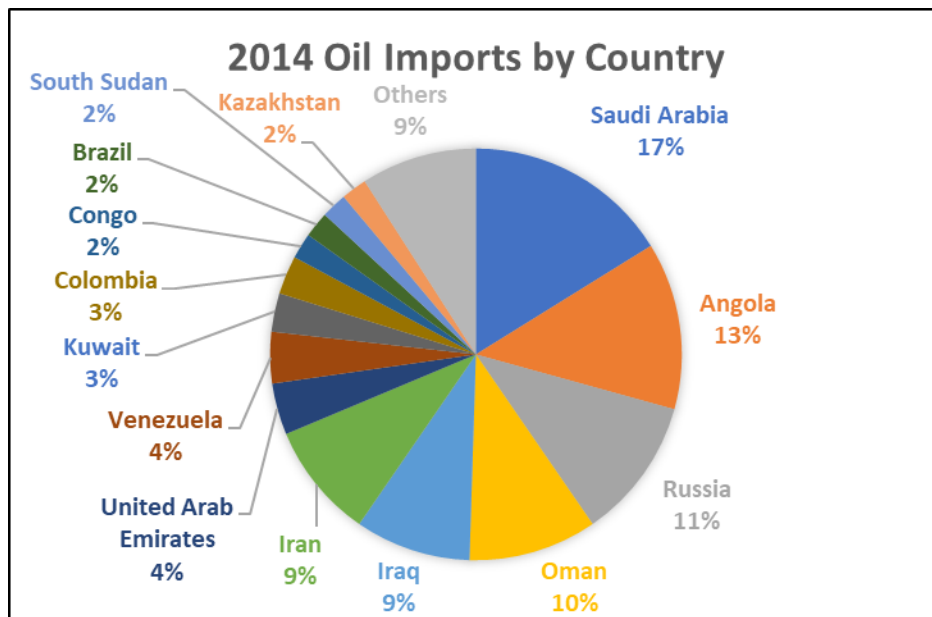


Figure 30. 2014 China's Oil Import by Country by Percentage³¹⁷

³¹⁶ Adapted from: Workman.

³¹⁷ Adapted from: Energy Information Administration, "China - International Energy Data and Analysis," 11.

1. Saudi Arabia—Oil

Saudi Arabia dominates China's oil import market. Saudi Arabia is the largest exporter of oil in the world, and conversely, China imports more oil from Saudi Arabia than any other country. Saudi Arabia has participated in joint venture projects and agreements with China to project its downstream refining technical expertise to increase crude upstream demand. While Saudi Arabia owns 25% of Fujian Refining and Petrochemical Company Limited and 22.5% of Sinopec SenMei (Fujian) Petroleum Company Limited, it continues to implore in China's oil industry.³¹⁸ In 2016, Saudi Arabia acquired China National Offshore Oil Corporation (CNOOC) as a customer for its sour crude oil, used in diesel and heavy oils.³¹⁹ CNOOC upgraded its Huizhou facility in Guangdong province to receive Saudi sour crude and increase production from 240,000 BPD to 440,000 BPD. An Aramco press release stated that "the MoU came in the context of intergovernmental efforts to further energy cooperation and forge closer synergies between Saudi Vision 2030 and China's "Belt and Road" initiative."³²⁰ The consistent commitments and investments in China are a priority for Saudi Arabian oil. While Saudi Arabia is a close ally of the United States, the relationship between China and Saudi Arabia is arguably pragmatic to support Saudi Arabia's oil exports and China's economy. If tensions between China and the United States were to intensify, it could affect China's oil imports.

2. Iran—Oil

With the fourth-largest oil reserves in the world, geopolitical tensions prevent foreign investors, including China, from exporting Iranian oil.³²¹ Between 2014–2019, oil imports from Iran to China decreased by 6%, likely from the absence of expected direct

³¹⁸ "Aramco Annual Report 2019," Aramco, March 17, 2020, 163, <https://www.aramco.com/-/media/publications/corporate-reports/saudi-aramco-ara-2019-english.pdf>.

³¹⁹ "CNOOC Receives First Cargo from Saudi Aramco," Aramco, August 20, 2017, <https://www.aramco.com/en/news-media/news/2017/cnooc-receives-first-cargo-from-saudi-aramco>.

³²⁰ Aramco.

³²¹ Benoit Faucon, "Iran's Oil Boom Hasn't Showed Up; Many International Companies Are Hesitant to Invest as the Trump Administration Threatens to Reimpose Sanctions - ProQuest," March 7, 2018, http://search.proquest.com/docview/2011279984?rfr_id=info%3Axri%2Fsid%3Aprimo.

investment in Iran's oil industry and U.S. sanctions after withdrawing from the 2016 Joint Comprehensive Plan of Action (JCPOA).³²² Following the 2016 JCPOA agreement, Iran expected an increase in foreign investment because of lifted pressure from western countries but accused the United States of spreading doubt and fear in foreign investors. Investors were worried if the United States vacated JCPOA and invoked sanctions on Iran, their companies and long-term investments would be affected.

In an era of great power competition between the United States, China, and Russia, China is pursuing a 25-year deal with Iran, which encompasses political, security, and economic benefits for both parties.³²³ The agreement appears to be more economical than military-related. While the deal contains joint military training, weapons development, and exercises, China would buy oil at a discounted rate over 25 years, adding to its diversified thirst for oil. The deal has yet to be approved by the CCP or the Iranian parliament.³²⁴ An agreement between China and Iran causes concern in Washington. While the United States is implementing a non-nuclear proliferation strategy against Iran, China views Iran as an opportunity for investment and natural resources. The deal arguably is on hold until the 2020 U.S. Presidential Election, as the Democratic Party's stance is "returning to mutual compliance" with JCPOA.³²⁵

3. Russia—Oil

China imports Russian oil from overland pipelines and through maritime shipping. The Eastern Siberia-Pacific Ocean (ESPO) pipeline transports 800,000 barrels of oil per day (BPD) to China.³²⁶ ESPO phase one has provided China with 600,000 BPD for the

³²² Faucon.

³²³ Farnaz Fassihi and Steven Lee Myers, "Defying U.S., China and Iran Near Trade and Military Partnership," *The New York Times*, July 22, 2020, sec. World, <https://www.nytimes.com/2020/07/11/world/asia/china-iran-trade-military-deal.html>.

³²⁴ Fassihi and Myers.

³²⁵ Joseph Hinchey, "What China's New Deal with Iran Says About Its Ambitions in the Region," *Time*, July 29, 2020, <https://time.com/5872771/china-iran-deal/>.

³²⁶ "ESPO Pipeline Expansion Nears Completion, Asia-Pacific Counts for a Third of Russian Oil Shipments," *Pipeline & Gas Journal*, November 21, 2019, <https://pgjonline.com/news/2019/11-nov/espo-pipeline-expansion-nears-completion-asia-pacific-counts-for-a-third-of-russian-oil-shipments>.

last decade. ESPO phase two became operational in late 2019, increasing oil imports by 200,000 BPD.³²⁷ ESPO phase 2 connects Daqing Oil Field to the ESPO phase 1 pipeline.³²⁸ In 2013, China and Russia signed an oil deal worth \$270 billion that spans 25 years and increases Russian imports from 30 million metric tons to 50 million metric tons per year.³²⁹ What cannot be delivered through pipelines is provided by sea from Kozmino Port near Vladivostok and transported through the Tsushima Strait between South Korea and Japan. A long-term diverse oil agreement will increase Russian oil imports to China and decrease China's risk of being affected by U.S. sanctions, the Strait of Hormuz situation, and the Malacca dilemma. Because of increased Sino-Russian relations, Russia will likely overtake Saudi Arabia as China's lead importer of oil.

4. Brazil—Oil

Brazil has overtaken Venezuela as the number one oil exporter to China in South America because of China's amenability with U.S. sanctions on Venezuela. Since 2014, China has increased Brazilian oil imports from 2% to 8% of total imports. Chinese National Oil Companies (NOC) are heavily invested in Brazilian energy infrastructure. Since 2007, China has loaned Brazil \$28.9 billion.³³⁰ Of that \$28.9 billion, \$26.1 billion is in Brazil's energy sector.³³¹ In 2016, Petrobras, a Brazilian state-owned oil firm, borrowed \$10 billion from China Development Bank, and in exchange for the loan, Chinese NOCs had preferential terms to 100,000 barrels of oil per day.³³² However, in attempts to privatize

³²⁷ Pipeline & Gas Journal.

³²⁸ "Russia - International - U.S. Energy Information Administration (EIA)," Energy Information Administration, October 31, 2017, <https://www.eia.gov/international/analysis/country/RUS>.

³²⁹ Courtney Weaver and Neil Buckley, "Russia and China Agree \$270bn Energy Deal," *Financial Times*, June 21, 2013, <https://infoweb.newsbank.com/resources/doc/nb/news/147244EC0BD54818?p=AFNB>.

³³⁰ "China-Latin America Finance Database," The Dialogue, March 13, 2020, https://www.thedialogue.org/map_list/.

³³¹ The Dialogue.

³³² Irina Slav, "Why Brazil's Oil Major Is Rapidly Paying Off Its Chinese Debt," December 17, 2019, <https://oilprice.com/Latest-Energy-News/World-News/Why-Brazils-Oil-Major-Is-Rapidly-Paying-Off-Its-Chinese-Debt.html>.

Petrobras, Brazil quickly repaid its debt to China to end its oil obligation.³³³ While Brazilian oil exports to China have increased over the past five years, since the loans are repaid, it is likely to decrease back to pre-2014 levels. The price of Brazilian oil will increase for China because they no longer have privileged prices. While China could continue to import oil from Brazil, the price change will likely cause Chinese companies to import cheaper oil from other countries.

5. Venezuela—Oil

Between 2014–2019, Venezuelan oil exports to China decreased by 2%, which could derive from China’s cooperation with U.S. sanctions against Venezuela. As part of China’s “oil for loan” strategy, China loaned Venezuela \$50 billion in exchange for crude oil shipments.³³⁴ In August 2019, the United States increased sanctions on Venezuela and cautioned foreign companies from conducting business with Venezuelan oil companies.³³⁵ In late 2019, Chinese NOCs suddenly stopped all oil shipments from Venezuela, illustrating compliance with U.S. sanctions. However, oil was indirectly shipped from Venezuela to China through a Russian third-party company Rosneft. Rosneft received Venezuelan oil via ship-to-ship transfers at sea and relabeled it as Malaysian oil. Peter Harrel from the Center for a New American Security claims that this falls into a ‘gray zone’ tactic used by China to continue to receive loan repayment through oil.³³⁶ While China is not dependent on Venezuelan oil, it seeks to gain compensation for its “oil for loan” strategy. Venezuelan oil might seem to be statistically decreasing, but oil continues to flow to China.

³³³ Slav.

³³⁴ Gabe Collins, “China’s Oil-Backed Loans to Venezuela Appear Headed for a Haircut,” Text, The National Interest (The Center for the National Interest, February 10, 2019), <https://nationalinterest.org/blog/buzz/china%E2%80%99s-oil-backed-loans-venezuela-appear-headed-haircut-43992>.

³³⁵ Luc Cohen Parraga Marianna, “Special Report: How China Got Shipments of Venezuelan Oil despite U.S. Sanctions,” *Reuters*, June 12, 2020, <https://www.reuters.com/article/us-venezuela-oil-deals-specialreport-idUSKBN23J1N1>.

³³⁶ Parraga.

6. Angola—Oil

While China's oil imports from Angola increased by 3% between 2014–2019, Angola's oil fields are rapidly declining in production. Belarmino Chitangueleca, an executive board member for Angola's regulator for oil, natural gas, and biofuels, asserted that Angola's oilfields are, on average, declining 10–15% per year.³³⁷ Angola is part of China's "oil for loans" program. Angola owes China \$20 billion in loans that were used to improve infrastructure, highways, and schools in Angola and to be repaid with oil.³³⁸ Some analysts claim that Angola might not repay its debt with oil, and China will pursue other means to secure its payment.³³⁹ While oil imports from Angola will arguably decrease in the long-term, China will need to secure compensation for its debt and explore other avenues for oil.

D. FOREIGN SOURCES—LNG

China became a net importer of natural gas in 2007.³⁴⁰ By 2024, analysts suggest that China will overtake Japan as the world's largest importer of LNG.³⁴¹ In 2019, China's imported 84.8 billion cubic meters (BCM) of LNG from at least 21 different countries (see Figure 31).³⁴² However, out of those 21 countries, four countries, Australia, Qatar, Malaysia, and Indonesia, accounted for 79% of all LNG imports (see Figure 32). China imported 39.8 BCM from Australia, 11.4 BCM from Qatar, 10 BCM of LNG from Malaysia, and 6.2 BCM from Indonesia.³⁴³ Since 2009, China has increased LNG imports

³³⁷ "Interview: Angola Reforms Bearing Fruit, but Exploration Drive Needed: Oil and Gas Regulator," S&P Global, February 7, 2020, <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/020620-interview-angola-reforms-bearing-fruit-but-exploration-drive-needed-oil-and-gas-regulator>.

³³⁸ Julia Payne Zhdannikov Dmitry, "Exclusive: Angola Cuts Oil Shipments to China as It Seeks Debt Relief," *Reuters*, June 5, 2020, <https://www.reuters.com/article/us-angola-china-debt-oil-exclusive-idUSKBN23C1LY>.

³³⁹ Alarco Yigal Chazan, "Angola's Debt Reliance on China May Leave It Short-Changed," June 13, 2018, <https://www.ft.com/content/fb9f8528-6f03-11e8-92d3-6c13e5c92914>.

³⁴⁰ Energy Information Administration, "China - International Energy Data and Analysis," 15.

³⁴¹ "U.S., China Will Be World's Biggest LNG Exporter and Importer in 2024: IEA," *Reuters*, July 16, 2019, <https://www.reuters.com/article/us-china-usa-lng-iea-idUSKCN1UB2EA>.

³⁴² British Petroleum Company, "BP Statistical Review of World Energy 2020," 42.

³⁴³ British Petroleum Company, 42.

tenfold from 8 BCM to 84.8 BCM.³⁴⁴ Australia is China's most importing trading partner for LNG because Australia alone accounted for 47% of LNG imports in 2019. Australia gained the leader of China's LNG market from Qatar in 2015.³⁴⁵ Since then, Australia's market share has increased from 28% to 47%, while Qatar's has decreased from 25% to 13%. Diversification of natural gas imports is vital for China's energy mix. In 2009, China imported LNG from 11 countries, and meanwhile, in 2019, China more than doubled its LNG importers to 23.

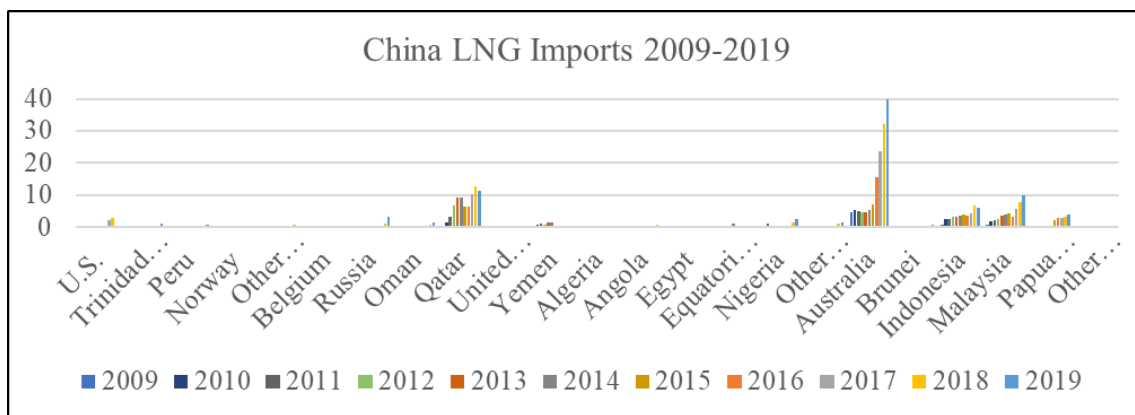


Figure 31. China LNG Imports 2009–2019 in BCM³⁴⁶

³⁴⁴ British Petroleum Company, 41.

³⁴⁵ British Petroleum Company, "BP Statistical Review of World Energy 2016" (London, England: British Petroleum Company, June 2016), 28; British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁴⁶ Adapted from: "BP Statistical Review of World Energy 2010," 2010, 31–32; "BP Statistical Review of World Energy 2011" (London, England: British Petroleum Company, June 2011), 28; "BP Statistical Review of World Energy 2012" (London, England: British Petroleum Company, June 2012), 28; "BP Statistical Review of World Energy 2013" (London, England: British Petroleum Company, June 2013), 28; "BP Statistical Review of World Energy 2014" (London, England: British Petroleum Company, June 2014), 28; "BP Statistical Review of World Energy 2015" (London, England: British Petroleum Company, June 2015), 28; "BP Statistical Review of World Energy 2016," 28; "BP Statistical Review of World Energy 2017" (London, England: British Petroleum Company, June 2017), 34; "BP Statistical Review of World Energy: 2018" (London: British Petroleum Company), 34, accessed April 14, 2020, <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf>; "BP Statistical Review of World Energy: 2019," 40–41; "BP Statistical Review of World Energy 2010," 2010, 42–43.

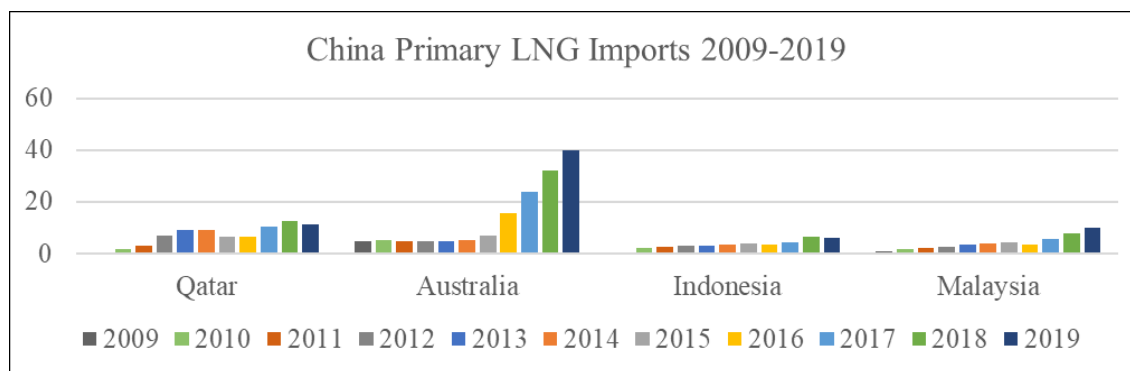


Figure 32. China Primary LNG Imports 2009–2019 in BCM³⁴⁷

1. Australia—LNG

China is dependent on Australian LNG, but tensions and an oversupplied market could change future trends and reliance on Australian LNG. China could move from long-term to short-term contracts for LNG to free itself from commitments when geopolitical tensions are high and lower costs are available in the market.³⁴⁸ The natural gas market is oversupplied, which has caused prices to decrease.³⁴⁹ Numerous analysts argue that the oversupply in the LNG market is caused by an increase in production and not from the 2019 coronavirus pandemic.³⁵⁰ Short-term contracts would allow China’s LNG importers to purchase LNG at a much lower price and reduce energy costs.

³⁴⁷ Adapted from: British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2011,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2012,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2013,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2015,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2016,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2017,” 34; British Petroleum Company, “BP Statistical Review of World Energy 2018” (London, England: British Petroleum Company, June 2018), 34; British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

³⁴⁸ Michael Smith and Angela Macdonald-Smith, “Trade Fallout Sours China’s Taste for Australian LNG,” *Australian Financial Review*, August 12, 2020, <https://www.afr.com/companies/energy/trade-fallout-sours-china-s-taste-for-australian-lng-20200801-p55hlw>.

³⁴⁹ Clyde Russell, “China Targets Australian Barley, but What Matters Is Coal, LNG, Iron Ore - Russell,” *Reuters*, May 19, 2020, <https://www.reuters.com/article/us-column-russell-china-australia-trade-idUSKBN22V0FU>.

³⁵⁰ Russell.

While immediate LNG imports will likely be unaffected by the Sino-Aussie trade war, Chinese companies will reevaluate their long-term LNG imports when current long-term contracts expire. A senior energy scholar from Xiamen University claims that “the current tense relationship between China and Australia could potentially be a big obstacle for Chinese companies to sign up LNG long-term purchase contracts from the new proposed projects around in Australia.”³⁵¹ China’s natural gas demand is expected to increase by 12% for the next three years.³⁵² The CCP will likely attempt to wean its economy off of Australian LNG and further diversify LNG worldwide, but reducing dependence on Australian LNG is unlikely. Domestic production of natural gas is not capable of maintaining pace with the demand, which is why LNG exports from Australia are likely to remain the same or increase. China could lean on Qatar, Malaysia, and Indonesia for increased LNG imports while Sino-Aussie tensions are high.

2. Qatar—LNG

Qatar holds the second-largest LNG market share in China. China and Qatar have cooperated mostly, if not all, through LNG trade. Between 2009–2019, China increased Qatari LNG from 0.55 BCM to 11.4 BCM.³⁵³ Both China and Qatar relish the comparative advantages of each country. While Australia dominates the Chinese LNG market, China continues to sign long-term contracts for Qatari LNG. In 2008, China and Qatar signed a 25-year LNG that would supply China with 3 million metric tons per year.³⁵⁴ Since then, Qatar has invested in LNG terminals in China. In 2015, Chinese and Qatari state-owned companies invested \$5 billion to build an LNG terminal that processes 3 million metric tons per year.³⁵⁵

³⁵¹ Smith and Macdonald-Smith, “Trade Fallout Sours China’s Taste for Australian LNG.”

³⁵² Smith and Macdonald-Smith.

³⁵³ British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

³⁵⁴ “PetroChina, Qatargas and Shell Sign First Long-Term Qatar–China LNG Deal,” *Europetrole*, April 11, 2008, <https://www.euro-petrole.com/petrochina-qatargas-and-shell-sign-first-long-term-qatar-china-lng-deal-n-f-2373>.

³⁵⁵ Mohammed Sergie, “Qatar Companies to Invest \$5 Billion in China for LNG Projects,” *Bloomberg.Com*, March 30, 2015, <https://www.bloomberg.com/news/articles/2015-03-30/qatar-qatra-jv-to-build-1-000-filling-stations-in-china-ceo>.

While Qatar expands its natural gas exploration, China is building ships for Qatari LNG transport. In 2020, Qatar Petroleum signed a deal with China State Shipbuilding Corporation for 60 LNG ships.³⁵⁶ At least 16 are capable of transporting 176,000 cubic meters of LNG each. The agreement puts Hudong's LNG ship construction near capacity out to 2027. Qatar is expanding its natural gas exploration as part of phase two of the North Field development project, which will increase Qatari LNG output to 126 million tons per year. Saad Sherida Al-Kabi, Chief Executive of Qatar Petroleum, stated that this deal puts Qatar Petroleum on "the right track to ensuring that the company's future fleet requirements will be met in due time to support its increasing LNG production capacity."³⁵⁷

3. Malaysia—LNG

Malaysia ranks third in LNG imports into China and is the third-largest exporter of LNG in the world.³⁵⁸ In 2019, Malaysia held 12% of China's LNG market.³⁵⁹ Malaysia is in a strategic geographic position surrounded by the Malacca Strait and the South China Sea. Malaysia's geographical position reduces transportation costs for Malaysian LNG tankers destined for China, compared to Qatar or Australia. In 2006, a subsidiary of Petronas, Malaysia LNG, signed the first LNG deal with China's Shanghai LNG Company.³⁶⁰ The agreement supplies China with 3.03 million metric tons of LNG annually for 25 years. In 2020, a 12-year deal was signed between Petronas and Shenergy in China and will increase Malaysian LNG imports to China by 1.5 million metric tons per

³⁵⁶ Mirza Duran, "Qatar Petroleum Inks Huge China LNG Carrier Deal," *Offshore Energy* (blog), April 22, 2020, <https://www.offshore-energy.biz/qatar-petroleum-inks-huge-china-lng-carrier-deal/>.

³⁵⁷ Duran.

³⁵⁸ "International - U.S. Energy Information Administration (EIA) Malaysia," Energy Information Administration, April 26, 2017, <https://www.eia.gov/international/overview/country/MYS>.

³⁵⁹ British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁶⁰ Eric Watkins, "Petronas Signs Deals to Sell LNG in China," *Oil & Gas Journal*, October 30, 2006, <https://www.ogj.com/pipelines-transportation/article/17281388/petronas-signs-deals-to-sell-lng-in-china>.

year.³⁶¹ The agreement also encompasses a contract between the two countries for constructing and chartering LNG tankers.

Malaysia plans to import LNG access to remote areas of China. In May 2020, Petronas signed a deal with China's Tiger Clean Energy Limited to import LNG tanks to be transported to remote regions of China.³⁶² Petronas Vice President Ahmad Adly Alias stated that "through this modern approach in delivering LNG, we established a virtual pipeline that effectively enables LNG to reach off-grid customers who are not directly served by the natural gas distribution system in China."³⁶³ While these tanks will increase LNG imports slightly, they will provide a stopgap measure while China improves its pipeline infrastructure to support remote areas of China. Malaysia and China have cooperated financially through LNG deals. Without regard to long-standing issues in the South China Sea, relations between the two countries appear to be in good standing.

4. Indonesia—LNG

Indonesia is the fourth largest importer of LNG to China. In 2019, Indonesia imported 6.2 BCM of LNG to China, increasing from 0.72 BCM in 2009 but decreased from 6.7 BCM in 2019.³⁶⁴ While Indonesia only held a 7% market share of China's LNG imports, it provides China with further diversification of imports.³⁶⁵ Indonesia's proven LNG reserves are 103.4 trillion cubic feet and are geographically positioned to provide cheap LNG to China.³⁶⁶ In 2002, CNOOC signed a contract with Indonesia's Tangguh LNG development to provide China with 2.6 million metric tons of natural gas per year for

³⁶¹ "Malaysia's Petronas Inks 20-Year LNG Supply Deal with Shenergy in China," NS Energy, January 20, 2020, <https://www.nsenergybusiness.com/news/petronas-shenergy-china/>.

³⁶² Lydia Woellwarth, "PETRONAS Inks LNG Deal with Tiger Clean Energy Limited," LNG Industry, May 20, 2020, <https://www.lngindustry.com/liquid-natural-gas/20052020/petronas-inks-lng-deal-with-tiger-clean-energy-limited/>.

³⁶³ Woellwarth.

³⁶⁴ British Petroleum Company, "BP Statistical Review of World Energy 2010," 2010, 31–32; British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁶⁵ British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁶⁶ "International - U.S. Energy Information Administration (EIA) - Indonesia," Energy Information Administration, October 7, 2015, <https://www.eia.gov/international/analysis/country/IDN>.

25 years, which started in 2007 and 12.5% ownership.³⁶⁷ Since then, Indonesia has provided China with 40.67 BCM of LNG.³⁶⁸ PGN signed a deal with Sinopec in June 2020.³⁶⁹ However, Indonesia is seeking new deals with China, specifically Sinopec, to secure long-term contracts that expire in 2021.³⁷⁰ While contracts are set to expire, China will likely stray away from long-term LNG contracts because of the recent oversupplied market. Spot and medium-term agreements are likely to be signed with Indonesia to secure cheap LNG to support China's resource diversification.

E. FOREIGN SOURCES—PIPELINE NATURAL GAS

Natural gas pipelines are significant to fill China's natural gas demands and reduce risk to the Malacca dilemma. In 2019, from natural gas pipelines, China imported 47.7 BCM of natural gas from five countries: 31.6 BCM from Turkmenistan, 6.5 BCM from Kazakhstan, 4.9 from Uzbekistan, 4.4 BCM from Myanmar, and 0.3 BCM from Russia (see Figure 33).³⁷¹ In 2019, China had three operational natural gas pipelines with an operating capacity of 105 BCM of natural gas per year.³⁷² Additionally, two additional pipelines are planned: Line D that is part of the Central Asia-China Pipeline and the Power

³⁶⁷ Nikos Tsafos, "How Is China Securing Its LNG Needs?," *Center for Strategic & International Studies*, January 2019, 4.

³⁶⁸ British Petroleum Company, "BP Statistical Review of World Energy 2010," 2010, 31–32; British Petroleum Company, "BP Statistical Review of World Energy 2011," 28; British Petroleum Company, "BP Statistical Review of World Energy 2012," 28; British Petroleum Company, "BP Statistical Review of World Energy 2013," 28; British Petroleum Company, "BP Statistical Review of World Energy 2014," 28; British Petroleum Company, "BP Statistical Review of World Energy 2015," 28; British Petroleum Company, "BP Statistical Review of World Energy 2016," 28; British Petroleum Company, "BP Statistical Review of World Energy 2017," 34; British Petroleum Company, "BP Statistical Review of World Energy 2018," June 2018, 34; British Petroleum Company, "BP Statistical Review of World Energy: 2019," 40–41; British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁶⁹ "Indonesia's Pertamina to Transfer LNG Trade Business," *Gas Processing & LNG*, July 24, 2020, <http://gasprocessingnews.com/news/indonesias-pertamina-to-transfer-lng-trade-business.aspx>.

³⁷⁰ *Gas Processing & LNG*.

³⁷¹ British Petroleum Company, "BP Statistical Review of World Energy 2020," 43.

³⁷² "Opportunities and Challenges of China's LNG Expansion," *S&P Global*, March 28, 2018, <https://www.spglobal.com/en/research-insights/articles/opportunities-and-challenges-of-chinas-lng-expansion>.

of Siberia-2 (see Figure 34).³⁷³ Between 2009–2019, Turkmenistan, Kazakhstan, and Uzbekistan provided China with 277.45 BCM of natural gas.³⁷⁴ Turkmenistan has led pipeline imports and has imported 242.75 BCM of natural gas to China. Kazakhstan began importing natural gas through the pipeline in 2013 and has imported 14.3 BCM of natural gas to China, while Uzbekistan started importing in 2016 and has provided 20.4 BCM. Since 2015, the natural gas pipeline from Myanmar has provided 21.4 BCM to China.³⁷⁵ Russian Power of Siberia-1 pipeline became operational in December 2019 and imported 0.3 BCM of natural gas.³⁷⁶

³⁷³ Marcelo Duhalde, Adolfo Arranz, and Marco Hernandez, “Belt and Road Initiative The Central Asian Gas Pipeline,” *South China Morning Post*, May 12, 2017, <http://multimedia.scmp.com/news/china/article/One-Belt-One-Road/gasPipeline.html>.

³⁷⁴ British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2011,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2012,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2013,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2015,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2016,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2017,” 34; British Petroleum Company, “BP Statistical Review of World Energy 2018,” June 2018, 34; British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

³⁷⁵ British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2011,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2012,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2013,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2015,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2016,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2017,” 34; British Petroleum Company, “BP Statistical Review of World Energy 2018,” June 2018, 34; British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

³⁷⁶ Ariel Cohen, “The Strategic Upside Behind Russia’s \$55 Billion ‘Power Of Siberia’ Pipeline To China,” *Forbes*, December 6, 2019, <https://www.forbes.com/sites/arielcohen/2019/12/06/is-there-strength-behind-russia-and-chinas-new-power-of-siberia-pipeline/>.

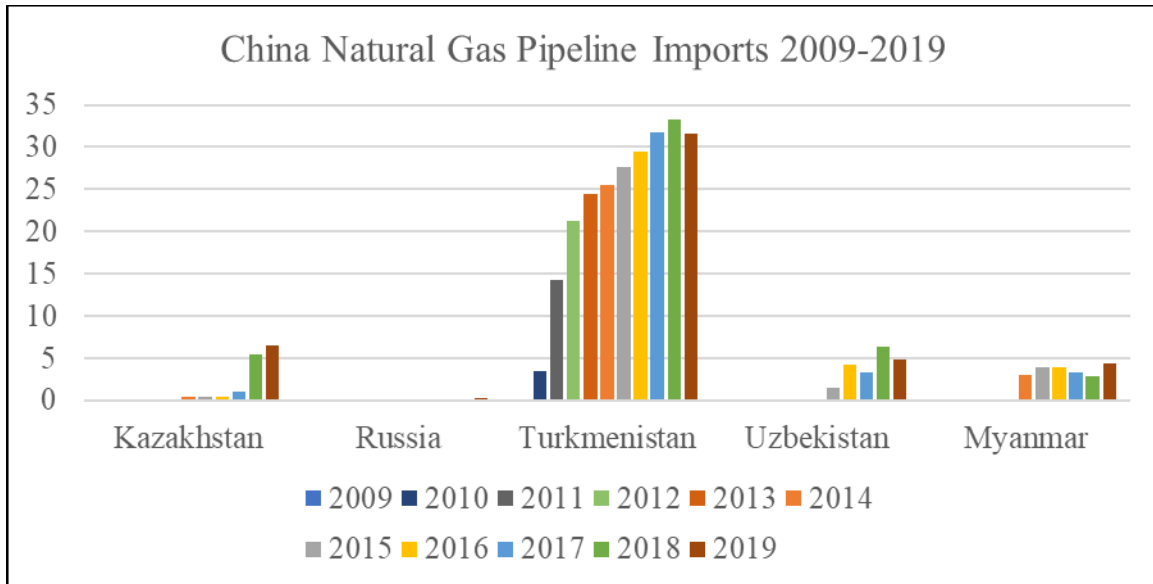


Figure 33. China Pipeline Imports 2009–2019 in BCM³⁷⁷

³⁷⁷ Adapted from: British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2011,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2012,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2013,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2015,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2016,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2017,” 34; British Petroleum Company, “BP Statistical Review of World Energy 2018,” June 2018, 34; British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.



Figure 34. CACGP Current and Projected Pipelines³⁷⁸

1. Central Asia–China Gas Pipeline

The CACGP became operational on December 14h, 2009.³⁷⁹ Since the launch of the pipeline, it has provided China with 280.55 BCM of natural gas.³⁸⁰ The pipeline, known as Line A, was the first pipeline to transport natural gas into China and began production in 2010. Line B became operational in 2010, lifting the capacity to 30 BCM per

³⁷⁸ Source: Duhalde, Arranz, and Hernandez, “Belt and Road Initiative The Central Asian Gas Pipeline.”

³⁷⁹ “Central Asia-China Gas Pipeline,” China National Petroleum Corporation, September 29, 2020, https://www.cnpc.com.cn/en/CentralAsia/CentralAsia_index.shtml.

³⁸⁰ British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2011,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2012,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2013,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2015,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2016,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2017,” 34; British Petroleum Company, “BP Statistical Review of World Energy 2018,” June 2018, 34; British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

year. However, 30 BCM per year was not reached until 2015.³⁸¹ In 2014, Line C, which was constructed parallel to Line A and B, became operational, which increased the Central Asia-China Pipeline capacity to 55 BCM of natural gas per year.³⁸² All three pipelines travel from Turkmenistan, Uzbekistan, Kazakhstan, and end in China and connect to China's West-East pipeline that transports natural gas from Xianjing province to China's southeastern region.

China's BRI and thirst for natural gas has led to the possible expansion of CACGP. The addition of Line D would provide an additional 30 BCM of natural gas, increasing CACGP capacity to 85 BCM per year.³⁸³ The project has struggled to progress because of multiple delays between Tajikistan, Kyrgyzstan, and China; however, tunnels and the pipeline are under construction. Line D is the only pipeline part of CACGP that will provide natural gas from only Turkmenistan and is estimated to be complete by 2022.³⁸⁴

2. Turkmenistan

Chinese and Turkmenistan relations are deeply rooted in energy and China's BRI. Turkmen and Chinese bilateral ties are increasing through the alignment of BRI and increased cooperation with tourism, technology, and economic trade integration.³⁸⁵ The current pipeline gas deal began in 2009 for Turkmenistan to import 30 BCM of natural gas

³⁸¹ British Petroleum Company, "BP Statistical Review of World Energy 2010," 2010, 31–32; British Petroleum Company, "BP Statistical Review of World Energy 2011," 28; British Petroleum Company, "BP Statistical Review of World Energy 2012," 28; British Petroleum Company, "BP Statistical Review of World Energy 2013," 28; British Petroleum Company, "BP Statistical Review of World Energy 2014," 28; British Petroleum Company, "BP Statistical Review of World Energy 2015," 28; British Petroleum Company, "BP Statistical Review of World Energy 2016," 28; British Petroleum Company, "BP Statistical Review of World Energy 2017," 34; British Petroleum Company, "BP Statistical Review of World Energy 2018," June 2018, 34; British Petroleum Company, "BP Statistical Review of World Energy: 2019," 40–41; British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁸² "China, Central Asian Countries Open 3rd Gas Line," China Daily, June 16, 2014, http://www.chinadaily.com.cn/business/2014-06/16/content_17589545.htm.

³⁸³ S&P Global, "Opportunities and Challenges of China's LNG Expansion," 3.

³⁸⁴ Niva Yau, "Chinese Business Briefing: Yuan Welcome, but Flights Cancelled," February 4, 2020, <https://eurasianet.org/chinese-business-briefing-yuan-welcome-but-flights-cancelled>.

³⁸⁵ "China-Turkmenistan Relations Should Run Forward Rapidly and Steadily Like Ferghana Horses," Ministry of Foreign Affairs of the People's Republic of China, October 15, 2019, https://www.fmprc.gov.cn/mfa_eng/wjbxw/t1708525.shtml.

to China for 30 years.³⁸⁶ Since the inception of the pipeline, Turkmenistan has exported more natural gas through pipelines than the leading LNG importer Australia. Between 2010–2019, Turkmenistan imported 242 BCM, while Australia imported 148 BCM of natural gas.³⁸⁷ Turkmen’s gas supply is a vital artery for China’s natural gas consumption and fueled its economic growth.

3. Kazakhstan

Tensions are high between Kazakhstan and China because of Chinese oppression and assimilation of Uyghurs in Xianjing province, but that has not affected the natural gas trade. In 2013, although in small amounts, 0.1 BCM, Kazakhstan began exporting natural gas via the CACGP.³⁸⁸ China and Kazakhstan signed a five-year deal in 2018 for exports to increase exports twice the amount of natural gas up to 10 BCM per year.³⁸⁹ Exports in 2018 reached 5.4 BCM and increased to 6.5 BCM in 2019.³⁹⁰ Chinese oppression in Xianjing concerns Kazakh citizens about China’s involvement in Kazakhstan.³⁹¹ Native Kazakhs are affected by Chinese policies in Xianjing province; however, the Kazakh government has yet to condemn Chinese policies and instead is requesting the release of Kazakh citizens and those who were seeking citizenship.³⁹² Chinese investment in

³⁸⁶ “CNPC in Turkmenistan,” China National Petroleum Corporation, November 26, 2016, https://www.cnpc.com.cn/en/Turkmenistan/country_index.shtml.

³⁸⁷ British Petroleum Company, “BP Statistical Review of World Energy 2010,” 2010, 31–32; British Petroleum Company, “BP Statistical Review of World Energy 2011,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2012,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2013,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2015,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2016,” 28; British Petroleum Company, “BP Statistical Review of World Energy 2017,” 34; British Petroleum Company, “BP Statistical Review of World Energy 2018,” June 2018, 34; British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

³⁸⁸ British Petroleum Company, “BP Statistical Review of World Energy 2014,” 28.

³⁸⁹ Gaukhar Erubaeva, “Kazakhstan Expands Gas Exports To China,” November 30, 2018, <https://caspiannews.com/news-detail/kazakhstan-expands-gas-exports-to-china-2018-11-29-42/>.

³⁹⁰ British Petroleum Company, “BP Statistical Review of World Energy: 2019,” 40–41; British Petroleum Company, “BP Statistical Review of World Energy 2020,” 42–43.

³⁹¹ “Kazakhstan Summons Chinese Ambassador in Protest over Article,” Reuters, April 15, 2020, <https://www.reuters.com/article/us-kazakhstan-china-idUSKCN21W1AH>.

³⁹² Reuters.

Kazakhstan will likely refrain the Kazakh government from criticizing Chinese policies in Xianjing, and Kazakh natural gas will continue to contribute to China's energy security portfolio.

4. Russia—Pipeline Natural Gas

Natural gas pipelines increase relations between a torn Russian economy and prosperous China. The first Russian natural gas pipeline became operational in December 2019.³⁹³ The 30-year deal between China and Russia will boost China's natural gas imports by 38 BCM. The Power of Siberia-1 pipeline marks a significant milestone for Sino-Russian relations. In an era of great power competition, Russia and China have ambitions to create a substitute for the U.S.-led world order.³⁹⁴ China and Russia are feeding off of one another's comparative advantages. While Russia views China as a cornerstone for securing revenue, China is fortifying its natural gas portfolio.

Russia and China are planning on constructing another pipeline to strengthen ties, revenue, and energy security. The Power of Siberia-2 pipeline, although not contracted yet, could increase China's pipeline natural gas by 50 BCM per year.³⁹⁵ The proposed pipeline will travel from Russia, Mongolia, and into the Inner Mongolia province of China (see Figure 35). Analysts estimate that the deal will take a similar timeline as Power of Siberia-1 and forecast the Power of Siberia-2 will become operational around 2030.³⁹⁶

³⁹³ Cohen, "The Strategic Upside Behind Russia's \$55 Billion 'Power Of Siberia' Pipeline To China."

³⁹⁴ Cohen.

³⁹⁵ Vanand Meliksetian, "Russia Eyes Another Massive Gas Pipeline To China," OilPrice.com, July 8, 2020, <https://oilprice.com/Energy/Natural-Gas/Russia-Eyes-Another-Massive-Gas-Pipeline-To-China.html>.

³⁹⁶ Meliksetian.

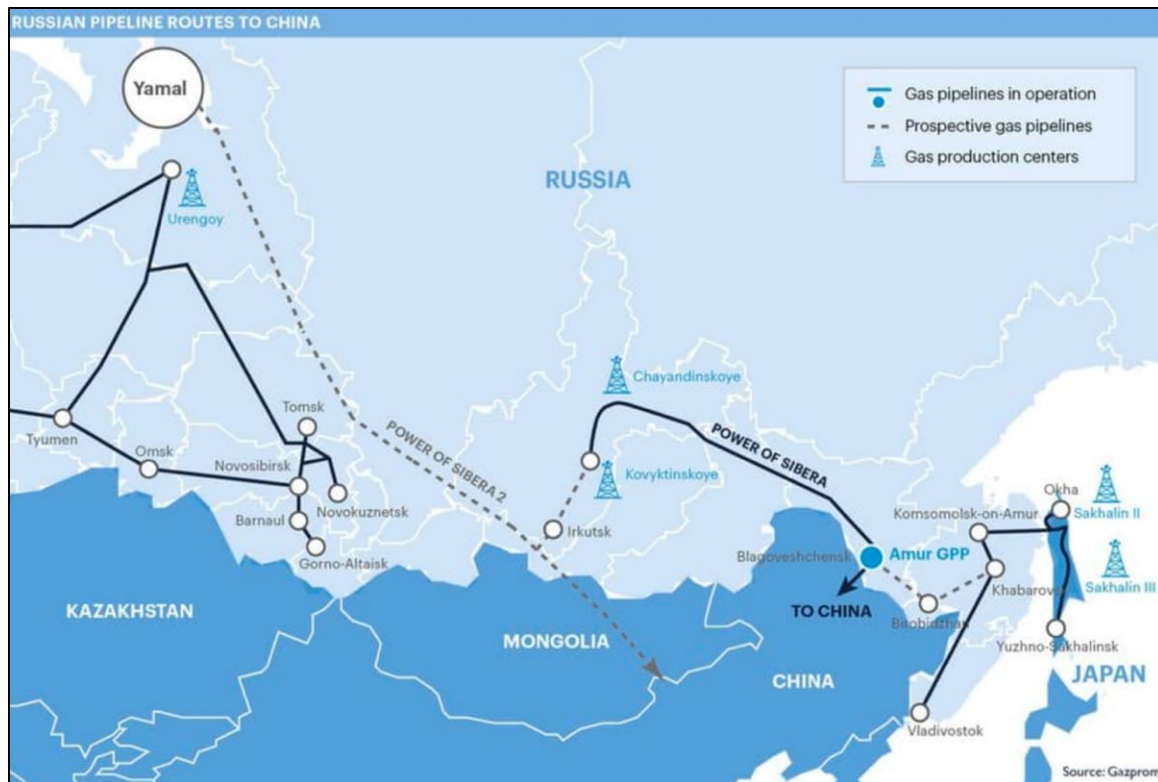


Figure 35. Russian Power of Siberia Pipelines³⁹⁷

5. Myanmar

The Myanmar-China natural gas pipeline is an additional prong in China's multifaceted approach for diversifying natural gas pipeline imports. In 2013, the pipeline began production with the capacity of 12 BCM per year. However, the maximum that the pipeline has imported is 4.4 BCM in 2019.³⁹⁸ The pipeline connects China's southwestern region with a cleaner and more reliable alternative to coal. Additionally, the pipeline connects China with the Bay of Bengal. China could use the gas terminal to import seaborne LNG through the pipeline to avoid the Malacca dilemma (see Figure 36).³⁹⁹

³⁹⁷ Source: Meliksetian.

³⁹⁸ British Petroleum Company, "BP Statistical Review of World Energy 2020," 42–43.

³⁹⁹ "Sino-Myanmar Pipelines," DeepResource, November 10, 2015, <https://deepresource.wordpress.com/2015/11/10/sino-myanmar-pipelines/>.

While the pipeline is not operating at full capacity, China could also divert its Middle East imports to the terminal to reduce transportation costs.

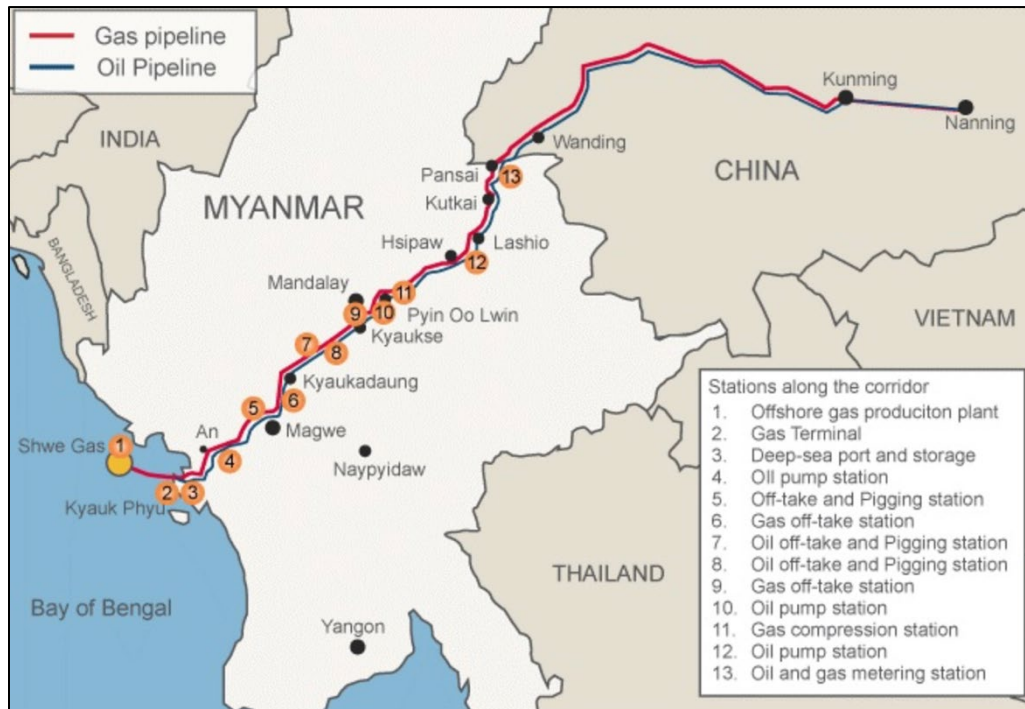


Figure 36. China-Myanmar Oil and Gas Pipeline⁴⁰⁰

F. CONCLUSION

This chapter concludes that one major driver for China's foreign energy security policies is geopolitical tensions. China has been indirectly affected by U.S. sanctions on Iran and Venezuela. While China has attempted to illegally acquire resources by importing Iranian and Venezuelan oil under different state flags; however, China cannot legitimately rely on illegal imports for long periods of time. Because of U.S. influence on China's energy sources, China's thirst for oil, and increased Sino-Russian relations, China will likely transition some of its oil and natural gas imports from seaborne imports to Russian pipeline imports. The pipelines provide an alternative conduit to seaborne imports and less risk to the Malacca dilemma. China could avoid flashpoints between the U.S. and Iran if

⁴⁰⁰ Source: DeepResource.

Iran decides to close the Strait of Hormuz and also avoid the Malacca Strait. Additionally, it provides China with another source of energy to rely on if the U.S. pressures countries that import energy to China. Lastly, Sino-Aussie energy relations are affected by the current trade dispute, which has caused a partial unofficial ban on coal exports from Australia

Market forces is another driver for China's energy security policy. China, Indonesia, and Malaysia compete within the South China Sea dispute but are cordial with energy relations. China seeks to take advantage of the oversupplied LNG market and is not renewing long-term contracts with Australia. Mongolia faces issues with competing with China's seaborne imports because of transportation costs. However, when the Tavan Togoi railway is completed, Mongolia will be able to reduce transportation costs to reduce costs in hopes of increasing coal imports to China.

V. CONCLUSION

This chapter will review the aims of this thesis, a summary of its findings, and assess the future trends of China's energy security policies. This thesis aimed to advance scholarship on the drivers of China's energy security policies. It tested three hypotheses: diversification of resources due to foreign pressures, development of green energy, and an increase in economic growth and urbanization, all of which this study determined to be guiding China's energy security policies. This study examined China's energy consumption, production, and imports to determine how these different influenced China's energy security policies.

Chapter I setup this study by outlining its significance of research, literature review, and defined hypotheses. Chapter II examined the motivations for China's domestic energy security policies and reviewed China's energy consumption by source—industrial, residential, transport—and its domestic energy portfolio—coal, oil, natural gas, nuclear—and complications within each source of energy. Then Chapter III reviewed the drivers of China's green energy policies and broadly examined the resources of the renewable energy sector. Lastly, Chapter IV reviewed the drivers of China's foreign energy security policies, specifically reviewed energy imports—coal, oil, natural gas—and analyzed geopolitical issues between China and export countries.

A. SUMMARY OF FINDINGS

One driver of China's energy security policy is a significant increase in growth, consumption, and urbanization. The largest population in the world resides in China, and its population is transitioning from rural areas to urban population centers. The increase in growth and consumption translates to energy usage. China is the largest consumer of energy in the world. The largest consumer of energy in China is the industrial sector, and the second is the residential sector, which both primarily consume coal. China, however, in an effort to decrease carbon emissions, is slowly replacing coal with natural gas.

Additionally, because of the increase in urbanization, oil consumption also grew by 52% between 2010–2017 due to the increase in automobile usage.⁴⁰¹

While China's population rate of increase is declining and is expected to be negative by 2035, mass urbanization is occurring, which will surge electricity consumption in urban population centers. Urbanization is assessed to grow from 2018 values of 59.58% to 70% by 2035.⁴⁰² Urbanization also intensifies the number of automobiles on the roads in China. Because of urbanization, oil consumption is expected to rise. The increase in growth and urbanization has led to transportation bottlenecks in the coal sector. While the major population centers in China are located in southeast China and along the coast, its domestic energy resources are located in the northern and northwestern provinces. In the oil sector, consumption continues to grow while production remains stagnant because of the depletion of oil reserves. Natural gas production, however, is growing slightly but cannot keep pace with consumption because it lacks the technology to extract deep shale gas, which is why China continues to rely on coal as a primary source of energy. Coal, however, is a major pollutant and causes domestic concerns for China's population.

Air pollution, climate change, and major health issues have also caused China to pursue green energy policies. China is the number one greenhouse gas polluter in the world. Air pollution has increased significantly in China because of its sustained period of economic growth. Air pollution and climate change have caused major health issues, which has led to mass protests from the Chinese people and world leaders.⁴⁰³ The CCP has increased its awareness of this issue. President Xi Jinping stated that China will “peak CO₂ emissions by 2030 and achieve carbon neutrality by 2060.”⁴⁰⁴ The CCP utilizes its Five-Year Plan to deliver its goals to local officials for the renewable energy sector, which has led to heavy investment in the renewable energy sector. Renewable energy in China is 45%

⁴⁰¹ International Energy Agency, “China - Countries & Regions.”

⁴⁰² China Statistical Yearbook, “China Statistical Yearbook 2019”; Jie, “Urbanization Rate to Reach 70% by 2035: Study.”

⁴⁰³ Albert and Xu, “China's Environmental Crisis.”

⁴⁰⁴ Ministry of Foreign Affairs of the People's Republic of China, “Xi Addresses 3rd Paris Peace Forum.”

of the world's investment in the sector.⁴⁰⁵ China's investment has led to the creation of companies that have become worldwide leaders in hydropower, wind, solar, and battery technology.

While China is the world leader in renewable energy, it has experienced issues that are inherent to the CCP. China's five-year targets restrain laissez-faire market principles. Because of government intervention, the renewable energy sector experienced boom and bust cycles, which has contributed to curtailment. The CCP, however, has attempted to alleviate its contribution to curtailment by eliminating feed-in tariffs on January 1, 2021, which current data does not reflect the effects of this. The elimination of feed-in tariffs will likely increase market participation, research and development, and the reduction in prices. The CCP emphasizes new renewable energy construction but allows local officials to build coal plants when the capacity cannot be met by renewables. Additionally, while some provincial electric grids are integrated, China lacks the infrastructure to connect all provinces to an integrated electricity grid. An integrated electric grid, less government intervention, and less expensive renewable energy could factor into whether a local official decides to build a new coal plant, solar or wind farms, or purchase excess energy from neighboring provinces. While China is a major coal producer and is innovating green energy, it cannot keep pace with the current energy demand and has to imports foreign sources.

This thesis finds that China is forced to diversify its energy portfolio due to a myriad of both domestic and international challenges: inability to self-sustain from domestic resources, geopolitical tensions, lack of control over strategic chokepoints, and the unpredictability of the energy market. While China is abundant in coal, it lacks sufficient domestic oil and natural gas to meet its demand. China cannot maintain sufficient oil production to meet domestic usage. China's oil production capacity remained stagnant from 2009–2019; however, its consumption has increased by 67.3%.⁴⁰⁶ If China's oil

⁴⁰⁵ Global Commission on the Geopolitics of Energy Transformation, *A New World*, 28.

⁴⁰⁶ British Petroleum Company, "BP Statistical Review of World Energy 2020," 16–22.

consumption were to remain the same, it would only have enough oil to last 18.7 years.⁴⁰⁷ China has the most untapped shale gas in the world, but its technology is still at the elementary stage because shale gas is found deeper in the ground than in the United States.⁴⁰⁸

Geopolitical tensions, exemplified by U.S. sanctions, have directly and negatively impacted China's energy portfolio, while a Sino-Aussie trade war arguably has produced a minor impact. China's compliance with U.S. sanctions after the United States withdrew from the JCPOA has resulted in a decrease in oil imports from Iran.⁴⁰⁹ In 2019, the United States placed sanctions on Venezuela, and, again, in response, China ceased importing Venezuelan oil.⁴¹⁰ While China's compliance with U.S. sanctions appears legitimate, China has illegally imported oil from Iran and Venezuela but cannot rely on illegal imports for a sustained period of time. Australia and China are currently in a trade war, but tariffs have only been placed on produce and wine, and the energy sector has yet to be impacted by the trade dispute. China placed an unofficial ban on Australian coal, but some analysts argued that the ban was placed to protect China's domestic coal industry.⁴¹¹ In order for China to diversify its energy portfolio, it has sought to secure access to resources abroad but has faced significant challenges. The Malacca dilemma and the insecurity of the Strait of Hormuz have driven China to secure viable access to energy resources. The U.S. Navy primarily controls the Malacca Strait, and over 80% of China's oil and 11% of its LNG imports travel through the Malacca Strait.⁴¹² In the event that the Malacca Strait was ever blockaded, it would disrupt all shipping, which would significantly China's access to its energy imports. The Strait of Hormuz is another chokepoint that causes concern for China. China is heavily reliant on the Middle East for oil. Out of all of China's imports, 48% of

⁴⁰⁷ British Petroleum Company, 14.

⁴⁰⁸ Energy Information Administration, "China - International Energy Data and Analysis," 19–20.

⁴⁰⁹ Faucon, "Iran's Oil Boom Hasn't Showed Up; Many International Companies Are Hesitant to Invest as the Trump Administration Threatens to Reimpose Sanctions - ProQuest."

⁴¹⁰ Parraga, "Special Report."

⁴¹¹ Hume and Smyth, "China Expected to Impose Coal Import Restrictions."

⁴¹² Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China 2017," 44.

its oil and 10% of its natural gas derived from the Middle East.⁴¹³ China has responded by an increased naval presence in the Middle East to protect its seaborne trade.⁴¹⁴ China has also secured access to Russian oil and natural gas via pipelines. In 2013, China and Russian signed a 25-year oil deal, and in 2019, they signed a 30-year natural gas deal that provides secure access to oil and natural gas.⁴¹⁵ China has also incorporated the Central Asia-China Gas Pipeline to avoid the Malacca dilemma and security issues with the Strait of Hormuz.

The energy marketplace has affected the diversification of China's energy mix. China imports coal primarily from Indonesia, Australia, and Mongolia. While China has the largest amount of coal deposits in the world, it is sometimes cheaper to import coal to its urban population centers from Indonesia and Australia and to preserve its domestic resources. While the completion of the Tavan Togoi railway will provide China with secure and inexpensive access to Mongolia's coal resources, Mongolia is not yet able to compete with seaborne coal prices.⁴¹⁶ China is dependent on Australian LNG. When China's long-term contracts with Australia expire and with the current Sino-Aussie trade war, Australia is likely to pursue short-term contracts to diversify its LNG market with less expensive providers.⁴¹⁷ Market forces are significant in this scenario because China does not want to commit to long-term contracts with Australia, while LNG prices are low in an oversupplied market. While reducing its dependence entirely on Australia is unlikely, China could diversify its LNG market for Qatari, Malaysian, or Indonesian exports.

B. FUTURE TRENDS

China is coal-dependent, and this trend will continue because China does not have an alternate source of energy to replace coal. Coal will continue to be the dominant source of energy in China. China does not have a sufficient amount of natural gas or renewable

⁴¹³ Office of the Secretary of Defense, 44.

⁴¹⁴ Becker, Downs, and DeThomas, "China's Presence in the Middle East and Western Indian Ocean: Beyond Belt and Road," 65.

⁴¹⁵ Weaver and Buckley, "Russia and China Agree \$270bn Energy Deal"; Meliksetian, "Russia Eyes Another Massive Gas Pipeline To China."

⁴¹⁶ S&P Global, "Feature."

⁴¹⁷ Smith and Macdonald-Smith, "Trade Fallout Sours China's Taste for Australian LNG."

energy to replace the pollutant energy to meet social demands. The main issue with coal is that it is not environmentally friendly and that China's coal distribution is located in the north and northwestern parts of China, which has caused energy blackouts in the past. China has somewhat alleviated the bottleneck issue with transportation by building the Hanoi railway, but as urbanization increases, so will energy demand. While China emphasizes renewable energy, it continues to build coal plants. China's coal technology, however, is cutting edge and is more efficient and less pollutant than its former technology.⁴¹⁸ The transition from subcritical to ultra-supercritical coal plants will contribute to a decrease in pollution. Coal will likely continue to be a primary source of energy until China is able to replace coal plants with natural gas, renewable energy, or nuclear power if China reverses its negative stance caused by the 2011 Fukushima incident.

China will continue to secure overland access to both foreign oil and natural gas so that it can fulfill its energy demands. China will also continue to diversify its seaborne energy imports to reduce its reliance on any one country to reduce the potential impacts of geopolitical tensions. Pipelines significantly reduce China's risk to the Malacca dilemma and uncertainty of the Strait of Hormuz. China will likely continue to seek pipelines from west Asia and Russia to secure access to resources that are not impacted by the United States Navy.

As the leader in renewable energy, China will continue to innovate and eventually replace some of its coal plants to reduce carbon emissions and reduce the negative effects of climate change. The transition from hydrocarbons to renewables will cause several challenges, such as market reform, energy distribution, and curtailment. However, the CCP generally supports decreasing air pollution throughout the country because of its domestic concerns about the negative impacts of air pollution. China is the leader in all sectors of renewable energy—hydroelectricity, solar, wind—and will continue to innovate the sector. China's heavy pursuance of renewable energy, combined with the U.S. withdrawal from the Paris Climate Agreement, provide China with an opportunity to lead the world in green energy development amid growing great power competition.

⁴¹⁸ Hart, Bassett, and Johnson, "Everything You Think You Know About Coal in China Is Wrong."

LIST OF REFERENCES

- Air Quality Life Index. “AQLI Policy Impacts—China: National Air Quality Action Plan (2014).” 2019. <https://aqli.epic.uchicago.edu/policy-impacts/china-national-air-quality-action-plan-2014/>.
- Aizu, Chen, and Marianna Parraga. “China CNPC Suspends Venezuelan Oil Loading, Worried about U.S. Sanctions: Sources.” *Reuters*, August 19, 2019. <https://www.reuters.com/article/us-china-venezuela-oil-cnpc-idUSKCN1V909C>.
- Aizu, Chen, and Muyu Xu. “China Opens up Oil and Gas Exploration, Production for Foreign, Domestic Firms.” *Reuters*, January 9, 2020. <https://www.reuters.com/article/us-china-oil-mining-idUSKBN1Z806Q>.
- Aklin, Michael, and Johannes Urpelainen. *Renewables: The Politics of a Global Energy Transition*. Cambridge, Massachusetts: The MIT Press, 2018.
- Albert, Eleanor, and Beina Xu. “China’s Environmental Crisis.” Council on Foreign Relations, January 18, 2016. <https://www.cfr.org/background/chinas-environmental-crisis>.
- APCO Worldwide. “China’s 12th Five Year Plan.” Washington, D.C: December 10, 2010. http://www.export.gov.il/UploadFiles/03_2012/Chinas12thFive-YearPlan.pdf.
- Aramco. “Aramco Annual Report 2019.” March 17, 2020. <https://www.aramco.com/-/media/publications/corporate-reports/saudi-aramco-ara-2019-english.pdf>.
- . “CNOOC Receives First Cargo from Saudi Aramco.” August 20, 2017. <https://www.aramco.com/en/news-media/news/2017/cnooc-receives-first-cargo-from-saudi-aramco>.
- Asia Dialogue. “China’s ‘Malacca Dilemma’ and the Future of the PLA.” November 21, 2014. <https://theasiadialogue.com/2014/11/21/chinas-malacca-dilemma-and-the-future-of-the-pla/>.
- Asian Power. “Tech Upgrades to Push China’s Wind Generation to 700TWh by 2028.” February 5, 2020. <https://asian-power.com/power-utility/news/tech-upgrades-push-chinas-wind-generation-700twh-2028>.
- Bajpai, Prableen. “China’s GDP Examined: A Service-Sector Surge.” Investopedia, April 22, 2020. <https://www.investopedia.com/articles/investing/103114/chinas-gdp-examined-servicesector-surge.asp>.

- Baker Institute. "Open-Source Mapping Of China's Energy Infrastructure." July 25, 2020. <https://www.bakerinstitute.org/opensource-mapping-of-chinas-energy-infrastructure/>.
- Balderrama, Renato, and Amado Trejo. "Made in China 2025." *Revista (Cambridge)* 18, no. 1 (2018): 63–65.
- Barron, Jeff. "China Surpassed the United States as the World's Largest Crude Oil Importer in 2017 - Today in Energy - U.S. Energy Information Administration (EIA)," February 5, 2018. <https://www.eia.gov/todayinenergy/detail.php?id=34812>.
- Becker, Jeffrey, Erica Downs, and Ben DeThomas. "China's Presence in the Middle East and Western Indian Ocean: Beyond Belt and Road," February 2019, 180.
- Beech, Hannah. "China Ties Officials' Promotions to Saving the Environment." *Time*, May 6, 2020. <https://time.com/3848171/china-environment-promotions/>.
- Bianji, Liang Jun. "China-Built Coal-Fired Power Plant Starts Operation in Indonesia - People's Daily Online," December 16, 2019. <http://en.people.cn/n3/2019/1216/c90000-9640968.html>.
- Bloomberg. "China's Energy Game Plan Features a Giant Coal-Hauling Rail Line - Bloomberg." September 19, 2019. <https://www.bloomberg.com/news/articles/2019-09-19/china-s-energy-gameplan-features-a-giant-coal-hauling-rail-line>.
- British Petroleum Company. "BP Statistical Review of World Energy 2010," 2010, 50.
- . "BP Statistical Review of World Energy 2010." London, England: British Petroleum Company, June 2010.
- . "BP Statistical Review of World Energy 2011." London, England: British Petroleum Company, June 2011.
- . "BP Statistical Review of World Energy 2012." London, England: British Petroleum Company, June 2012.
- . "BP Statistical Review of World Energy 2013." London, England: British Petroleum Company, June 2013.
- . "BP Statistical Review of World Energy 2014." London, England: British Petroleum Company, June 2014.
- . "BP Statistical Review of World Energy 2015." London, England: British Petroleum Company, June 2015.

- . “BP Statistical Review of World Energy 2016.” London, England: British Petroleum Company, June 2016.
- . “BP Statistical Review of World Energy 2017.” London, England: British Petroleum Company, June 2017.
- . “BP Statistical Review of World Energy 2018.” London, England: British Petroleum Company, June 2018.
- . “BP Statistical Review of World Energy 2018.” London, England: British Petroleum Company, June 2018.
- . “BP Statistical Review of World Energy: 2018.” London: British Petroleum Company. Accessed April 14, 2020. <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf>.
- . “BP Statistical Review of World Energy: 2019.” London: British Petroleum Company, 2019.
- . “BP Statistical Review of World Energy 2020.” London, England: British Petroleum Company, June 2020.
- . “Statistical Review of World Energy – All Data, 1965–2019.” London, England: British Petroleum Company, June 2020. <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2020-all-data.xlsx>.
- Carnegie Endowment for International Peace. “China’s Oil Future.” May 6, 2014. <https://carnegieendowment.org/2014/05/06/china-s-oil-future-pub-55437>.
- Celik, Gozde. “Challenges Facing China’s Key Low-Carbon Energy Industries – Solar and Wind.” EqualOcean, April 29, 2020. <https://equalocean.com/analysis/2020042913932>.
- Chang, Edward. “The Real Iran Military Threat: Close the Strait of Hormuz (Watch Oil Prices Jump).” Text. The National Interest. The Center for the National Interest, May 16, 2019. <https://nationalinterest.org/blog/buzz/real-iran-military-threat-close-strait-hormuz-watch-oil-prices-jump-57862>.
- China Briefing News. “China’s GDP Growth - More Shocks Ahead.” October 26, 2015. <https://www.china-briefing.com/news/chinas-gdp-growth-more-shocks-ahead/>.
- China Daily. “China, Central Asian Countries Open 3rd Gas Line.” June 16, 2014. http://www.chinadaily.com.cn/business////2014-06/16/content_17589545.htm.

- China Direct. "China's Twelfth Five Year Plan (2011-2015) - the Full English Version." May 11, 2011. https://cbi.typepad.com/china_direct/2011/05/chinas-twelfth-five-new-plan-the-full-english-version.html.
- China National Petroleum Corporation. "Central Asia-China Gas Pipeline." September 29, 2020. https://www.cnpc.com.cn/en/CentralAsia/CentralAsia_index.shtml.
- . "CNPC in Turkmenistan." November 26, 2016. https://www.cnpc.com.cn/en/Turkmenistan/country_index.shtml.
- China National Renewable Energy Centre. "China Wind, Solar, and Bioenergy Roadmap 2050 Short Version." Beijing, China: December 2014.
- China Statistical Yearbook. "China Statistical Yearbook 2019." 2019. <http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>.
- Chinese National Offshore Oil Corporation. "2015 Annual Results Release." March 24, 2016. <https://www.cnooltd.com/attach/0/1603301051157661645.pdf>.
- . "2019 Annual Results Release." March 25, 2020. <https://www.cnooltd.com/attach/0/aa2dd9ad20da47bc9ad119383e49d805.pdf>.
- Cimino-Isaacs, Cathleen D., and Kenneth Katzman. "Iran's Expanding Economic Relations with Asia." *Current Politics and Economics of the Middle East; Hauppauge* 10, no. 2 (2019): 149–52.
- Climate Action Tracker. "Pledges and Targets." September 21, 2020. <https://climateactiontracker.org/countries/china/pledges-and-targets/>.
- Cohen, Ariel. "The Strategic Upside Behind Russia's \$55 Billion 'Power Of Siberia' Pipeline To China." *Forbes*, December 6, 2019. <https://www.forbes.com/sites/arielcohen/2019/12/06/is-there-strength-behind-russia-and-chinas-new-power-of-siberia-pipeline/>.
- Collins, Gabe. "China's Oil-Backed Loans to Venezuela Appear Headed for a Haircut." Text. *The National Interest*. The Center for the National Interest, February 10, 2019. <https://nationalinterest.org/blog/buzz/china%E2%80%99s-oil-backed-loans-venezuela-appear-headed-haircut-43992>.
- Cornot-Gandolphe, Sylvie. "China's Coal Market: Can Beijing Tame 'King Coal'?" Oxford, United Kingdom: Oxford Institute for Energy Studies, December 2014. <https://doi.org/10.26889/9781784670177>.
- Daly, Tom. "China Has Enough Oil Inventories to Last about 80 Days: NEA." *Reuters*, September 20, 2019. <https://www.reuters.com/article/us-china-energy-idUSKBN1W514V>.

- DeepResource. "Sino-Myanmar Pipelines." November 10, 2015.
<https://deepresource.wordpress.com/2015/11/10/sino-myanmar-pipelines/>.
- Downs, Erica Strecker. *Asia's Energy Security and China's Belt and Road Initiative*. NBR Special Report ; #68. Baltimore, Maryland: Project Muse, 2017.
- . *China's Quest for Energy Security*. Santa Monica, CA: Rand, 2000.
- Duggan, Jennifer. "China's Polluters to Face Large Fines under Law Change." the Guardian, April 25, 2014. <http://www.theguardian.com/environment/chinas-choice/2014/apr/25/china-environment-law-fines-for-pollution>.
- Duhalde, Marcelo, Adolfo Arranz, and Marco Hernandez. "Belt and Road Initiative The Central Asian Gas Pipeline." South China Morning Post, May 12, 2017.
<http://multimedia.scmp.com/news/china/article/One-Belt-One-Road/gasPipeline.html>.
- Duran, Mirza. "Qatar Petroleum Inks Huge China LNG Carrier Deal." *Offshore Energy* (blog), April 22, 2020. <https://www.offshore-energy.biz/qatar-petroleum-inks-huge-china-lng-carrier-deal/>.
- Energy Information Administration. "China - International Energy Data and Analysis," May 14, 2015. <https://www.eia.gov/international/analysis/country/CHN>.
- . "International - U.S. Energy Information Administration (EIA) - Indonesia." October 7, 2015. <https://www.eia.gov/international/analysis/country/IDN>.
- . "International - U.S. Energy Information Administration (EIA) Malaysia." April 26, 2017. <https://www.eia.gov/international/overview/country/MYS>.
- . "Russia - International - U.S. Energy Information Administration (EIA)." October 31, 2017. <https://www.eia.gov/international/analysis/country/RUS>.
- . "South China Sea - International - Analysis - U.S. Energy Information Administration (EIA)." February 7, 2013. <https://www.eia.gov/beta/international/regions-topics.php?RegionTopicID=SCS>.
- . "Technically Recoverable Shale Oil and Shale Gas Resources: China." Washington, D.C: 2015.
- Erubaeva, Gaukhar. "Kazakhstan Expands Gas Exports To China," November 30, 2018.
<https://caspiannews.com/news-detail/kazakhstan-expands-gas-exports-to-china-2018-11-29-42/>.
- European Wind Energy Association. "Oceans of Opportunity." September 2009.
http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/Offshore_Report_2009.pdf.

- Europetrole. "PetroChina, Qatargas and Shell Sign First Long-Term Qatar–China LNG Deal." April 11, 2008. <https://www.euro-petrole.com/petrochina-qatargas-and-shell-sign-first-long-term-qatar-china-lng-deal-n-f-2373>.
- Fassihi, Farnaz, and Steven Lee Myers. "Defying U.S., China and Iran Near Trade and Military Partnership." *The New York Times*, July 22, 2020, sec. World. <https://www.nytimes.com/2020/07/11/world/asia/china-iran-trade-military-deal.html>.
- Faucon, Benoit. "Iran's Oil Boom Hasn't Showed Up; Many International Companies Are Hesitant to Invest as the Trump Administration Threatens to Reimpose Sanctions - ProQuest," March 7, 2018. http://search.proquest.com/docview/2011279984?rfr_id=info%3Axri%2Fsid%3Aprimo.
- Finamore, Barbara. "China as the World's Number One Energy Consumer... and World Leader in Clean Energy." NRDC, August 4, 2010. <https://www.nrdc.org/experts/barbara-finamore/china-worlds-number-one-energy-consumer-and-world-leader-clean-energy>.
- Gas Processing & LNG. "Indonesia's Pertamina to Transfer LNG Trade Business." July 24, 2020. <http://gasprocessingnews.com/news/indonesias-pertamina-to-transfer-lng-trade-business.aspx>.
- Geall, Sam, and Adrian Ely. "Narratives and Pathways towards an Ecological Civilization in Contemporary China." *The China Quarterly* 236 (2018): 1175–96. <https://doi.org/10.1017/S0305741018001315>.
- Global Commission on the Geopolitics of Energy Transformation. *A New World: The Geopolitics of the Energy Transformation*, 2019.
- Global Conflict Tracker. "Territorial Disputes in the South China Sea." April 27, 2018. <https://cfr.org/interactive/global-conflict-tracker/conflict/territorial-disputes-south-china-sea>.
- Hao, Feng. "China Releases 2020 Action Plan for Air Pollution." *China Dialogue* (blog), July 6, 2018. <https://chinadialogue.net/en/pollution/10711-china-releases-2-2-action-plan-for-air-pollution/>.
- Hart, Melanie, Luke Bassett, and Blaine Johnson. "Everything You Think You Know About Coal in China Is Wrong." Center for American Progress, May 15, 2017. <https://www.americanprogress.org/issues/green/reports/2017/05/15/432141/everything-think-know-coal-china-wrong/>.
- Hibbs, Mark. "The Future of Nuclear Power in China." Washington, D.C: Carnegie Endowment for International Peace, 2018.

- Hinches, Joseph. "What China's New Deal with Iran Says About Its Ambitions in the Region." *Time*, July 29, 2020. <https://time.com/5872771/china-iran-deal/>.
- Hongtao, Shi. "Energy Security Runs Up against the 'Malacca Dilemma': Will China, Japan and Korea Cooperate?" *China Youth Daily*, June 15, 2004. http://zqb.cyol.com/content/2004-06/15/content_888233.htm.
- Hove, Anders. "Current Direction for Renewable Energy in China." *The Oxford Institute for Energy Studies*, June 2020, 8.
- . "Trends and Contradictions in China's Renewable Energy Policy." New York, New York: Columbia SIPA Center on Global Energy Policy, August 28, 2020. <https://www.energypolicy.columbia.edu/research/commentary/trends-and-contradictions-china-s-renewable-energy-policy>.
- Hua, Helen. "China - Oil and Gas," July 30, 2019. <https://www.export.gov/article?id=China-Oil-and-Gas>.
- Huang, Lei, Ying Zhou, Yuting Han, James K. Hammitt, Jun Bi, and Yang Liu. "Effect of the Fukushima Nuclear Accident on the Risk Perception of Residents near a Nuclear Power Plant in China." *Proceedings of the National Academy of Sciences* 110, no. 49 (December 3, 2013): 19742–47. <https://doi.org/10.1073/pnas.1313825110>.
- Hui, Lu. "China Reports Losses Caused by Natural Disasters - Xinhua," January 18, 2020. http://www.xinhuanet.com/english/2020-01/18/c_138715415.htm.
- Hume, Neil, and Jamie Smyth. "China Expected to Impose Coal Import Restrictions," May 27, 2020. <https://www.ft.com/content/6142f1b9-58cc-47e4-b2fb-8212ad792b2d>.
- Institute for Energy Economics and Financial Analysis. "China's Global Renewable Energy Expansion." January 2017. https://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion_January-2017.pdf.
- . "China's Global Renewable Energy Expansion." January 2017. https://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion_January-2017.pdf.
- International Energy Agency. "Asia Pacific – Countries & Regions - Energy Consumption by Sector." October 29, 2019. <https://www.iea.org/regions/asia-pacific>.
- . "China - Countries & Regions." December 4, 2019. <https://www.iea.org/countries/china>.
- . "Energy Balances of Non-OECD Countries 2015." Paris, France: OECD, 2015.

- . “Strategic Action Plan for Energy Development (2014 - 2020) – Policies.” November 5, 2017. <https://www.iea.org/policies/1543-strategic-action-plan-for-energy-development-2014-2020>.
- International Energy Charter. “China Energy Efficiency Report.” 2018. https://www.energycharter.org/fileadmin/DocumentsMedia/EERR/EER-China_ENG.pdf.
- International Hydropower Association. “China International Hydropower Association.” July 5, 2019. <https://www.hydropower.org/country-profiles/china>.
- . “China Three Gorges Corporation.” July 24, 2014. <https://www.hydropower.org/companies/china-three-gorges-corporation>.
- International Monetary Fund. “World Economic Outlook (October 2019) - GDP, Current Prices.” October 2019. <https://www.imf.org/external/datamapper/PPPGDP@WEO>.
- Jaganathan, Jessica. “China Imports Record LNG Volumes in Dec, Overtakes Japan for Second Month,” January 6, 2020. <https://www.nasdaq.com/articles/china-imports-record-lng-volumes-in-dec-overtakes-japan-for-second-month-2020-01-06>.
- Jie, Zhang. “Urbanization Rate to Reach 70% by 2035: Study.” China Daily, June 24, 2019. <https://www.chinadaily.com.cn/a/201906/24/WS5d1089b0a3103dbf14329ea7.html>.
- Jing, Lu, and Wang Yao. “A Safety Assessment of China’s Crude Oil Import Based on G1 Method.” *Procedia - Social and Behavioral Sciences* 96, no. C (2013): 1738–44. <https://doi.org/10.1016/j.sbspro.2013.08.197>.
- Lansang, Darrell M. West and Christian. “Global Manufacturing Scorecard: How the U.S. Compares to 18 Other Nations.” *Brookings* (blog), July 10, 2018. <https://www.brookings.edu/research/global-manufacturing-scorecard-how-the-us-compares-to-18-other-nations/>.
- Lee, Joyce, and Feng Zhao. “Global Wind Report 2019.” Brussels, Belgium: Global Wind Energy Council, March 25, 2020. https://gwec.net/wp-content/uploads/2020/08/Annual-Wind-Report_2019_digital_final_2r.pdf.
- Lin, Bo-Qiang, and Jiang-Hua Liu. “Estimating Coal Production Peak and Trends of Coal Imports in China.” *Energy Policy* 38, no. 1 (2010): 512–19. <https://doi.org/10.1016/j.enpol.2009.09.042>.
- Lin, Boqiang, and Ting Wang. “Forecasting Natural Gas Supply in China: Production Peak and Import Trends.” *Energy Policy* 49 (2012): 225–33.

- Lixia, Yao, Philip Andrews-Speed, and Mohammad Zia. "China-Indonesia Coal Relationship: A New Phase under the Belt & Road Initiative." *Energy Security Institute* 23 (May 10, 2018). <https://esi.nus.edu.sg/docs/default-source/doc/china-indonesia-coal-relationship--a-new-phase-under-the-belt-road-ini-.pdf?sfvrsn=2>.
- Marks, Robert B. *China: Its Environment and History*. Lanham, Md: Rowman & Littlefield Publishers, 2011.
- Mattis, Jim. "Summary of the 2018 National Defense Strategy," January 19, 2018, 14.
- McKinsey Global Institute. "China and the World: Inside the Dynamics of a Changing Relationship." July 2019. <https://www.mckinsey.com/~media/mckinsey/featured%20insights/china/china%20and%20the%20world%20inside%20the%20dynamics%20of%20a%20changing%20relationship/mgi-china-and-the-world-full-report-june-2019-vf.ashx>.
- Meliksetian, Vanand. "Russia Eyes Another Massive Gas Pipeline To China." OilPrice.com, July 8, 2020. <https://oilprice.com/Energy/Natural-Gas/Russia-Eyes-Another-Massive-Gas-Pipeline-To-China.html>.
- Mercator Institute for China Studies. "Mapping the Belt and Road Initiative: This Is Where We Stand." June 7, 2018. <https://www.merics.org/en/bri-tracker/mapping-the-belt-and-road-initiative>.
- Ministry of Foreign Affairs of the People's Republic of China. "China-Turkmenistan Relations Should Run Forward Rapidly and Steadily Like Ferghana Horses." October 15, 2019. https://www.fmprc.gov.cn/mfa_eng/wjbxw/t1708525.shtml.
- . "Xi Addresses 3rd Paris Peace Forum." November 12, 2020. https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1831895.shtml.
- Morrison, Wayne M. "China's Economic Rise: History, Trends, Challenges, and Implications for the United States," June 25, 2019. <https://fas.org/sgp/crs/row/RL33534.pdf>.
- Mount Holyoke College. "The Three Gorges Dam Project Environmental Impacts." March 7, 2006. <https://www.mtholyoke.edu/~lpohara/Pol%20116/enviro.html>.
- . "The Three Gorges Dam Project Social Impacts." March 7, 2006. <https://www.mtholyoke.edu/~lpohara/Pol%20116/social.html>.
- National Development and Reform Commission (NRDC), and Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China (PRC). "Vision and Actions on Energy Cooperation in Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road." March 18, 2015. https://www.followingthemoney.org/wp-content/uploads/2017/06/2017_NDR-NEA_Vision-and-Actions-on-Energy-Cooperation-in-BRI_E.pdf.

- National People's Congress. "The 13th Five-Year Plan (2016–2020)." 2015.
https://en.ndrc.gov.cn/newsrelease_8232/201612/P020191101481868235378.pdf.
- NS Energy. "Malaysia's Petronas Inks 20-Year LNG Supply Deal with Shenergy in China." January 20, 2020. <https://www.nsenergybusiness.com/news/petronas-shenergy-china/>.
- Odgaard, Ole, and Jørgen Delman. "China's Energy Security and Its Challenges towards 2035." *Energy Policy* 71 (August 1, 2014): 107–17. <https://doi.org/10.1016/j.enpol.2014.03.040>.
- Office of the Secretary of Defense. "Military and Security Developments Involving the People's Republic of China 2017." May 15, 2017. https://dod.defense.gov/Portals/1/Documents/pubs/2017_China_Military_Power_Report.PDF.
- O'Sullivan, Meghan. *Windfall: How the New Energy Abundance Upends Global Politics and Strengthens America's Power*. New York, New York: Simon & Schuster, 2017.
- Panda, Ankit. "Indonesia's Latest Natuna Islands Spat With China Should Be a Wake-Up Call for Southeast Asia – The Diplomat." *The Diplomat*, January 28, 2020. <https://thediplomat.com/2020/01/indonesias-latest-natuna-islands-spat-with-china-should-be-a-wake-up-call-for-southeast-asia/>.
- Parraga, Luc Cohen, Marianna. "Special Report: How China Got Shipments of Venezuelan Oil despite U.S. Sanctions." *Reuters*, June 12, 2020. <https://www.reuters.com/article/us-venezuela-oil-deals-specialreport-idUSKBN23J1N1>.
- Peh, Ghee. "Indonesian Coal at the Mercy of the Dragon and Tiger," June 2020. https://ieefa.org/wp-content/uploads/2020/06/Indonesian-Coal-at-the-Mercy-of-the-Dragon-and-Tiger_June-2020.pdf.
- Petroleum Economist. "China Spurns Venezuelan Exports." 2019. <https://www.petroleum-economist.com/articles/politics-economics/south-central-america/2019/china-spurns-venezuelan-exports>.
- Pipeline & Gas Journal. "ESPO Pipeline Expansion Nears Completion, Asia-Pacific Counts for a Third of Russian Oil Shipments." November 21, 2019. <https://pgjonline.com/news/2019/11-nov/espo-pipeline-expansion-nears-completion-asia-pacific-counts-for-a-third-of-russian-oil-shipments>.
- Pozzebon, Stefano. "Mongolia Has To Change Its Railroads To Account For An 85 Millimetre Difference In Track Spacing," October 2, 2014. <https://www.businessinsider.com.au/mongolia-extends-trans-border-railway-to-china-russia-2014-10>.

- Railway Gazette International. "Tavan Tolgoi Coal Line Accord Signed." December 4, 2019. <https://www.railwaygazette.com/infrastructure/tavan-tolgoi-coal-line-accord-signed/55277.article>.
- Rao Qasim Idrees, Rohimi Shapiee, and Haniff Ahamat. "Energy Cost Saving and Economic Prospective of China Pakistan Economic Corridor." *International Journal of Energy Economics and Policy* 8, no. 6 (2018): 217–26. <https://doi.org/10.32479/ijeep.6713>.
- Reuters. "Kazakhstan Summons Chinese Ambassador in Protest over Article." April 15, 2020. <https://www.reuters.com/article/us-kazakhstan-china-idUSKCN21W1AH>.
- . "U.S., China Will Be World's Biggest LNG Exporter and Importer in 2024: IEA." July 16, 2019. <https://www.reuters.com/article/us-china-usa-lng-iea-idUSKCN1UB2EA>.
- Roberts, David. "By 2020, Every Chinese Coal Plant Will Be More Efficient than Every U.S. Coal Plant." *Vox*, May 15, 2017. <https://www.vox.com/energy-and-environment/2017/5/15/15634538/china-coal-cleaner>.
- Rusli, Mohd. "Maritime Highways of Southeast Asia: Alternative Straits?" Singapore: Nanyang Technological University, February 10, 2012. <https://www.rsis.edu.sg/rsis-publication/rsis/1686-maritime-highways-of-southeast/#.X3KBs117lZJ>.
- Russell, Clyde. "China Targets Australian Barley, but What Matters Is Coal, LNG, Iron Ore - Russell." *Reuters*, May 19, 2020. <https://www.reuters.com/article/us-column-russell-china-australia-trade-idUSKBN22V0FU>.
- Sergie, Mohammed. "Qatar Companies to Invest \$5 Billion in China for LNG Projects." *Bloomberg.Com*, March 30, 2015. <https://www.bloomberg.com/news/articles/2015-03-30/qatar-qatra-jv-to-build-1-000-filling-stations-in-china-ceo>.
- Shahla, Arsalan, and Ladane Nasser. "Iran Raises Stakes in U.S. Showdown With Threat to Close Hormuz," April 22, 2019. <https://www.bloomberg.com/news/articles/2019-04-22/iran-will-close-strait-of-hormuz-if-it-can-t-use-it-fars>.
- Slav, Irina. "Here's Why China Won't Have a Shale Boom - Business Insider." *Business Insider*, April 23, 2018. <https://www.businessinsider.com/heres-why-china-wont-have-a-shale-boom-2018-4>.
- . "Why Brazil's Oil Major Is Rapidly Paying Off Its Chinese Debt," December 17, 2019. <https://oilprice.com/Latest-Energy-News/World-News/Why-Brazils-Oil-Major-Is-Rapidly-Paying-Off-Its-Chinese-Debt.html>.

- Smil, Vaclav. "A Critical Look at Claims for Green Technologies - IEEE Spectrum." IEEE Spectrum: Technology, Engineering, and Science News, June 3, 2018. <https://spectrum.ieee.org/energy/environment/a-critical-look-at-claims-for-green-technologies>.
- Smith, Michael, and Angela Macdonald-Smith. "Trade Fallout Sours China's Taste for Australian LNG." Australian Financial Review, August 12, 2020. <https://www.afr.com/companies/energy/trade-fallout-sours-china-s-taste-for-australian-lng-20200801-p55hlw>.
- S&P Global. "As U.S. Sanctions Increase, China Remains Iran's Top Crude, Condensate Importer." January 10, 2020. <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/011020-as-us-sanctions-increase-china-remains-irans-top-crude-condensate-importer>.
- . "Feature: Room for Mongolia's Coal Exports to Grow but with Caveat." July 24, 2020. <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/072420-feature-room-for-mongolias-coal-exports-to-grow-but-with-caveat>.
- . "Interview: Angola Reforms Bearing Fruit, but Exploration Drive Needed: Oil and Gas Regulator." February 7, 2020. <https://www.spglobal.com/platts/en/market-insights/latest-news/oil/020620-interview-angola-reforms-bearing-fruit-but-exploration-drive-needed-oil-and-gas-regulator>.
- . "Opportunities and Challenges of China's LNG Expansion." March 28, 2018. <https://www.spglobal.com/en/research-insights/articles/opportunities-and-challenges-of-chinas-lng-expansion>.
- Stanway, David. "China's Climate 'ambition' Pledge Could Lead to Tougher CO2 Targets: Experts." *Reuters*, July 2, 2019. <https://www.reuters.com/article/us-climatechange-china-idUSKCN1TX0SY>.
- Statista. "China: Number of Cars 2019." 2019. <https://www.statista.com/statistics/285306/number-of-car-owners-in-china/>.
- . "Estimated Electric Vehicles in Use in Selected Countries." Accessed August 26, 2020. <https://www.statista.com/statistics/244292/number-of-electric-vehicles-by-country/>.
- Tan, Sun-Lin. "Why Has the China-Australia Relationship Deteriorated into 'Trade War 2.0'?" South China Morning Post, July 1, 2020. <https://www.scmp.com/economy/china-economy/article/3091182/why-has-china-australia-relationship-deteriorated-what-some>.

- Tang, Ningning, Yuning Zhang, Yuguang Niu, and Xiaoze Du. “Solar Energy Curtailment in China: Status Quo, Reasons and Solutions.” *Renewable & Sustainable Energy Reviews* 97 (2018): 509–28. <https://doi.org/10.1016/j.rser.2018.07.021>.
- The Dialogue. “China-Latin America Finance Database.” March 13, 2020. https://www.thedialogue.org/map_list/.
- Tsafos, Nikos. “How Is China Securing Its LNG Needs?” *Center for Strategic & International Studies*, January 2019, 14.
- Tu, Kevin, and Sabine Johnson-Reiser. “Understanding China’s Rising Coal Imports.” Carnegie Endowment for International Peace, February 16, 2012. <https://carnegieendowment.org/2012/02/16/understanding-china-s-rising-coal-imports-pub-47215>.
- U.S. Department of the Treasury. “Treasury Further Targets Entities and Vessels Moving Venezuelan Oil to Cuba.” September 14, 2019. <https://home.treasury.gov/news/press-releases/sm784>.
- U.S. Environmental Protection Agency. “Global Greenhouse Gas Emissions Data.” Overviews and Factsheets. January 12, 2016. <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>.
- Wang, Bing, Qian Wang, Yi-Ming Wei, and Zhi-Ping Li. “Role of Renewable Energy in China’s Energy Security and Climate Change Mitigation: An Index Decomposition Analysis.” *Renewable and Sustainable Energy Reviews* 90 (July 1, 2018): 187–94. <https://doi.org/10.1016/j.rser.2018.03.012>.
- Watkins, Eric. “Petronas Signs Deals to Sell LNG in China.” *Oil & Gas Journal*, October 30, 2006. <https://www.ogj.com/pipelines-transportation/article/17281388/petronas-signs-deals-to-sell-lng-in-china>.
- Weaver, Courtney, and Neil Buckley. “Russia and China Agree \$270bn Energy Deal.” *Financial Times*. June 21, 2013. <https://infoweb.newsbank.com/resources/doc/nb/news/147244EC0BD54818?p=AFNB>.
- Whitman, Jamie N. “An Analysis Of The Primary Driver For China’s Belt And Road Initiative—Security Versus Economics.” Monterey, CA; Naval Postgraduate School, 2018.
- White House. “2017 National Security Strategy.” Accessed October 28, 2019. <https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905-2.pdf>.

- . “President Donald J. Trump Is Reimposing Sanctions Lifted Under the Horrible Iran Deal.” The White House, August 6, 2018. <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-reimposing-sanctions-lifted-horrible-iran-deal/>.
- . “Statement by President Trump on the Paris Climate Accord.” The White House, June 1, 2017. <https://www.whitehouse.gov/briefings-statements/statement-president-trump-paris-climate-accord/>.
- Woellwarth, Lydia. “PETRONAS Inks LNG Deal with Tiger Clean Energy Limited.” LNG Industry, May 20, 2020. <https://www.lngindustry.com/liquid-natural-gas/20052020/petronas-inks-lng-deal-with-tiger-clean-energy-limited/>.
- Workman, Daniel. “Top 15 Crude Oil Suppliers to China.” World’s Top Exports, August 20, 2020. <http://www.worldstopexports.com/top-15-crude-oil-suppliers-to-china/>.
- World Bank. “Agriculture, Forestry, and Fishing, Value Added (% of GDP) - China.” 2020. <https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=CN>.
- . “Belt and Road Economics: Opportunities and Risks of Transport Corridors.” Washington, D.C: March 18, 2019.
- . “GDP (Current US\$) - China.” 2020. <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2001&locations=CN&start=1978>.
- . “Industry (Including Construction), Value Added (% of GDP) - China.” 2020. <https://data.worldbank.org/indicator/NV.IND.TOTL.ZS?locations=CN>.
- . “Services, Value Added (% of GDP) - China.” 2020. <https://data.worldbank.org/indicator/NV.SRV.TOTL.ZS?locations=CN>.
- World Bank and the Development Research Center of the State Council, P.R. China. *China 2030: Building a Modern, Harmonious, and Creative Society*. Washington, D.C: 2013. <https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-9545-5>.
- World Energy Council. “WEC Trilemma: Country Profile.” Accessed April 13, 2020. <https://trilemma.worldenergy.org/#!/country-profile?country=China&year=2020>.
- . “World Energy Trilemma Index World Energy Council.” 2020. <https://www.worldenergy.org/transition-toolkit/world-energy-trilemma-index>.
- World Health Organization. “Ambient (Outdoor) Air Pollution.” May 2, 2018. [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health).

- World Nuclear Association. "Nuclear Power in China." August 2020. <https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx>.
- World Population Review. "China Population 2020 (Demographics, Maps, Graphs)." 2020. <https://worldpopulationreview.com/countries/china-population>.
- Wu, Kang. "China's Energy Security: Oil and Gas." *Energy Policy* 73 (October 1, 2014): 4–11. <https://doi.org/10.1016/j.enpol.2014.05.040>.
- Yau, Niva. "Chinese Business Briefing: Yuan Welcome, but Flights Cancelled," February 4, 2020. <https://eurasianet.org/chinese-business-briefing-yuan-welcome-but-flights-cancelled>.
- Yigal Chazan, Alarco. "Angola's Debt Reliance on China May Leave It Short-Changed," June 13, 2018. <https://www.ft.com/content/fb9f8528-6f03-11e8-92d3-6c13e5c92914>.
- Yu, Katrina, and Dan Sagalyn. "How China Is Driving the Future of Electric Cars." PBS NewsHour, October 2, 2019. <https://www.pbs.org/newshour/show/how-china-is-driving-the-future-of-electric-cars>.
- Yu, Yuki. "China's Wind & Solar Market 2020 Half-Year Review." Renewable Energy World, August 10, 2020. <https://www.renewableenergyworld.com/2020/08/10/chinas-wind-solar-market-2020-half-year-review/>.
- Zhao, Zhen-Yu, Rui-Dong Chang, and George Zillante. "Challenges for China's Energy Conservation and Emission Reduction." *Energy Policy* 74 (November 1, 2014): 709–13. <https://doi.org/10.1016/j.enpol.2014.07.004>.
- Zhdannikov, Julia Payne, Dmitry. "Exclusive: Angola Cuts Oil Shipments to China as It Seeks Debt Relief." *Reuters*, June 5, 2020. <https://www.reuters.com/article/us-angola-china-debt-oil-exclusive-idUSKBN23C1LY>.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California