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MIND THE POWER GAP

THE AMERICAN ENERGY ARSENAL AND CHINESE INSECURITY

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ABOUT THE CENTER FOR STRATEGIC AND BUDGETARY ASSESSMENTS (CSBA)

The Center for Strategic and Budgetary Assessments is an independent, nonpartisan policy research institute established to promote innovative thinking and debate about national security strategy and investment options. CSBA's analysis focuses on key questions related to existing and emerging threats to U.S. national security, and its goal is to enable policymakers to make informed decisions on matters of strategy, security policy, and resource allocation.

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Executive Summary

The shale revolution, along with energy diversification, has upended nearly a half-century of American energy insecurity. The United States is now the most energy-secure it has been since the 1970s and has returned to its position as the world's leading energy producer. Over a few short years in the 2010s, the United States shifted from being one of the world's largest oil and natural gas importers to instead being the world's largest exporter. Decades of strategic weakness in the energy sector disappeared, upending the United States' energy assumptions and providing a foundation for renewed national confidence and strategic options. In parallel, new technologies and modernized industry sectors have enabled the United States and other developed nations to decouple economic growth (GDP) from energy demand. Less energy is required per unit of economic output, and accordingly, the United States will be able to export its new "American energy arsenal" to key allies and partners around the world.

Meanwhile, China faces long-standing and increasing challenges with energy insecurity. Not yet an advanced economy, China's growth remains tightly coupled to energy consumption. Most of the oil and natural gas its energy sector consumes must be imported from the Middle East, Central Asia, Southeast Asia, and even the United States. Moreover, China struggles to shift away from its long-standing primary energy source—coal. Because of this dependency, China has remained the world's top greenhouse gas emitter since 2005, with an environmental toll that fuels simmering domestic unrest.[1] The consequences of the growing energy disparities between the United States and China are still not fully understood. This study provides a foundation for a comparative diagnostic assessment across the energy dimension of long-term strategic competition between the United States and China while also suggesting some U.S. policy prescriptions derived from the strategic implications of the analytical findings.[2]

1 Hannah Ritchie and Max Roser, "CO2 Emissions," *Our World In Data*, available at https://ourworldindata.org/co2-emissions.

2 See Thomas G. Mahnken, editor, *Net Assessment and Military Strategy: Retrospective and Prospective Essays* (Amherst, New York: Cambria Press, 2020).

Chinese strategists worry about expanding strategic asymmetries between the United States and China. This study also examines Chinese strategists' views about the comparative energy security of the United States and the People's Republic of China (PRC) and the geopolitical effects of the American shale boom. The Chinese Communist Party (CCP) views the energy market as an important and strategic economic sector and believes American energy security will be a defining feature shaping the geopolitics of the 21st century. PRC strategists see China as dangerously energy-insecure and question the feasibility of state efforts to ameliorate its dilemma. They also see the United States as enjoying unrivaled energy security that bolsters its position in every major region of the world. Chinese views reflect the CCP's understanding of and preferences for international relations and China's place in the world.

This study finds that the future trajectory of China's search for energy security is likely to be as complicated as Chinese strategists fear. A decelerating economy and increasing dependence on foreign energy imports challenge China's ability to simultaneously guarantee the security of its energy imports and invest in the green energy technologies of the future. Every yuan that China must spend on shoring up its energy security is a yuan not spent on its military, domestic security, or stabilizing its economy, and vice versa. These challenges for China are crucial for the United States to understand as a key part of long-term strategic competition.

So far, the seismic shift of American energy security has been insufficiently analyzed in relation to the escalating strategic competition between the United States and China. Competing efforts between China and the United States' allies and partners to ensure their energy security will significantly influence the competition between the PRC and the United States across the Indo-Pacific region and globally. As a major energy exporter, the United States now has more policymaking tools and options available than previously acknowledged and can exploit power asymmetries between itself and its incipient competitor. American national security, great power competition, and the environment and climate cannot be successfully decoupled. Despite recurring U.S. political aspirations to do so, energy will prevent any efforts to compartmentalize these three areas in American strategy and foreign policy.

This study recommends the United States consider the following policies derived from the strategic findings of this report:

- use the "American energy arsenal" to foster and expand energy exports to key allies and partners, in support of advancing alliance cohesion and resilience;
- exploit Chinese fears of American abandonment of the Middle East and cause China to expend precious resources and attention outside of its immediate territory and the Indo-Pacific region;

- accelerate divisions in Sino-Russian relations due to expanding Chinese engagements and commitments in Central Asia and the prevalent Chinese leadership attitudes toward Russia;
- continue to build strategic ties with India, capitalizing on the mutual incentive to increase perceived pressure on Chinese energy security;
- assist developing economies and partners in diversifying their own energy portfolios, and create a new approach of Green Energy Technology Diplomacy;
- bolster Taiwan's energy resilience, and support efforts to diversify its energy consumption;
- apply expanded legal mechanisms to halt continued Chinese technology and intellectual property theft in the U.S. and global energy sector;
- highlight China's role as the world's leader in greenhouse gas emissions—far and away—using diplomacy and scientific evidence to undermine China's continued efforts to cultivate a global perception and status as a "green power" without necessary achievements;
- focus and galvanize the international community on the population health crisis caused by pollution, instead of on a more ambiguously defined climate crisis;
- encourage green energy R&D and collaboration, both domestically and also with and for key allies and partners;
- renew U.S. naval strength in order to protect domestic exports and allied energy imports; and
- use energy as an opportunity for domestic innovation, increasing jobs in all energy sectors, supporting energy R&D and technology commercialization, and expanding energy infrastructure and resilience, including refineries, distribution networks, and shipyards.

CHAPTER 1

Introduction: A Seismic Shift

The United States and China are engaged in a regional and global competition for influence. Both the 2021 Interim National Security Guidance and the 2017 U.S. National Security Strategy define the People's Republic of China as an increasingly assertive power capable of using its influence to challenge the international order and call for the United States to use all available tools to sharpen its competitive edge for the 21st century.[3]

China's geopolitical ascent is increasingly recognized as the pacing threat to American power in Asia, the Indo-Pacific, and worldwide. Considering the benefits of a large economy, central geography in Asia, a massive population, an authoritarian regime, and a willingness to use its growing global leverage, some strategists and commentators have resigned themselves to a view of China's eventual and inevitable dominance, in Asia and across the world.

While many assessments look past some of the enduring strategic weaknesses plaguing China's bid to regional and global preeminence, a small but growing body of literature has focused on finding ways to exploit Chinese weaknesses.[4] With decelerating economic growth, a looming demographic crash, a threatening territorial periphery on all sides, and long-lasting damage to its international reputation due to the COVID-19 pandemic, China faces numerous headwinds complicating its rise. Many in the United States and around the world have not yet fully appreciated or taken advantage of these headwinds in the context of sharpening great power competition. To gain a competitive edge over China, the United States must better acknowledge, comprehend, and prepare to exploit these weaknesses.

3 *Interim National Security Guidance* (Washington, DC: the White House, 2021), available at https://www.whitehouse.gov/wp-content/uploads/2021/03/NSC-1v2.pdf; *National Security Strategy of the United States of America* (Washington, DC: the White House, 2017), available at https://trumpwhitehouse.archives.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf.

4 For some examples, see Ross Babbage et al., *Which Way the Dragon? Sharpening Allied Perceptions of China's Strategic Trajectory* (Washington, DC: Center for Strategic and Budgetary Assessments, 2020); Toshi Yoshihara and Jack Bianchi, *Seizing on Weakness: Allied Strategy for Competing With China's Globalizing Military* (Washington, DC: Center for Strategic and Budgetary Assessments, 2021).

Additionally, American strategic planning requires a better understanding of enduring American strengths. These strengths typically do not feature prominently in foreign policy and national security discussions about America's place in the world and the cyclical discussions of American "declinism" that are primarily driven by the imperatives of U.S. domestic politics.[5] While the United States does face dangerous and strengthening great-power challengers in primary regions of interest, American advantages are often underrated across the spectrum of demographic, geographic, economic, and military dimensions.[6]

Harnessing a more nuanced understanding of emerging Chinese weaknesses and continuing American strengths is essential to American strategic planning for the near term and the long-term. The energy sector is a clear example. A massive strategic shift culminated during the 2010s, moving America from the world's largest energy importer to its largest energy exporter. This shift, however, occurred with insufficient debate about its impact on American national security and foreign policy. This is perhaps one of the most consequential cases of American "strategic blindness" in the late 20th and early 21st centuries. Simultaneously, persistent energy insecurity continues to threaten China's development as a global power.

This report seeks to explain how the gap between American energy self-sufficiency and Chinese energy insecurity influences an expanding U.S.–China regional and global competition for influence. This chapter explores some of the commonly understated asymmetries of power between the United States and the PRC and proposes frameworks for examining the energy sector's role in great power competition. Chapters 2 and 3 provide overviews of the American and Chinese energy portfolios and diagnoses the state of each country's energy security. Chapter 4 uses open-source methods to explore CCP perspectives of Chinese and American energy security, illustrating how America's primary strategic competitor views the contours of global energy. Lastly, Chapter 5 derives some strategies and considerations for U.S. policymaking from the findings of the report.

5 See Josef Joffe, *The Myth of America's Decline, and a Half Century of False Prophecies* (New York: Liveright Publishing, 2013); Eric Edelman, *Understanding America's Contested Primacy* (Washington, DC: Center for Strategic and Budgetary Assessments, 2010).

6 For an examination of American economic strategy toward China, see Aaron L. Friedberg, "Rethinking the Economic Dimension of U.S. China Strategy," *American Academy for Strategic Education*, August 2017; for studies that examine enduring American strengths, see Michael Beckley, *Unrivaled: Why America Will Remain the World's Sole Superpower* (Ithaca, New York: Cornell University Press, 2018); Peter Zeihan, *Disunited Nations: The Scramble for Power in an Ungoverned World* (New York: Harper Business Books, 2020); Eric Edelman, *Understanding America's Contested Primacy* (Washington, DC: Center for Strategic and Budgetary Assessments, 2010); Bruce Berkowitz, *Strategic Advantage: Challengers, Competitors, and Threats to America's Future* (Washington, DC: Georgetown University Press, 2008); Matthew Kroenig, *The Return of Great Power Rivalry: Democracy Versus Autocracy from the Ancient World to the U.S. and China* (Oxford: Oxford University Press, 2020); Josef Joffe, *The Myth of America's Decline, and a Half Century of False Prophecies* (New York: Liveright Publishing, 2013); and Aaron L. Friedberg, *A Contest for Supremacy: China, America, and the Struggle for Mastery in Asia* (New York: W.W. Norton Company, 2011). For the most recent in-depth analysis of global energy markets, see Daniel Yergin, *The New Map: Energy, Climate, and the Clash of Nations* (New York, Penguin Press, 2020).

American Strategic Strengths

American advantages in geostrategic competition are often understated by analysts offering declinist narratives of the future of American power. However, a growing body of literature seeks to explore the enduring strengths that the United States brings to the international stage. As highlighted already, these authors include Michael Beckley, Matthew Kroenig, Eric Edelman, Peter Zeihan, Josef Joffe, and Bruce Berkowitz. These counterarguments to the current conventional wisdom span across the spectrum of advantages for the United States. This section briefly summarizes some of these key arguments.

The United States' geography gives it rare advantages. The continental United States is situated between two friendly neighbors and two large oceans, which has largely insulated it from conflicts in the Old World from the early years of the Republic to today. As a global maritime power, the Pacific and the Atlantic Oceans give the United States immediate and continuous access to two primary regions of strategic interest, the Indo-Pacific and Europe.

The United States' demography is also favorable. While the United States' population is not as young as some developing nations, it is very young compared to other developed nations and its strategic competitors. The United States traditionally has attracted talented immigrants from across the world, and it is able to successfully integrate them into American society.[7] Although the country will face a temporary period of heightened resource requirements for elderly care as its Baby Boomers age, its overall demographic burden will continue to remain much lighter than that of its primary strategic competitor, China.

The U.S. economy continues to be the largest in the world, hovering around 25% of global GDP for many decades.[8] While China's economy has risen dramatically and is starting to approach the United States in real GDP, America continues to lead in GDP per capita, accumulated wealth, and innovation. Additionally, the United States still dominates global capital markets, and the dollar remains the currency backbone for the world.[9]

Finally, the United States' system of government is more competitive than autocratic ones. The regular peaceful transition of power, the limited power of government, multi-layered checks on government, and protection of individual liberties and freedoms create the basic and necessary conditions for innovative economic activity and the flourishing of human potential. Americans are not subject to the kind of authoritarian repression that prevents the

7 Although this has largely been true over time, periodic anti-immigration movements have resulted in periods of immigration restrictions.

8 Ruchir Sharma, "The Comeback Nation: U.S. Economic Supremacy Has Repeatedly Proved Declinists Wrong," *Foreign Affairs* 99, no. 3, May/June 2020, 70-81, available at https://www.foreignaffairs.com/articles/united-states/2020-03-31/comeback-nation.

9 Ron Surz, "U.S. Stock Market is Biggest & Most Expensive in the World, But U.S. Economy Is Not The Most Productive," *Nasdaq*, April 2, 2018, available at https://www.nasdaq.com/articles/us-stock-market-biggest-most-expensive-world-us-economy-not-most-productive-2018-04-02.

United States' strategic competitors' from truly excelling over the long-term.[10] Democracy and free-market approaches, however, increase the difficulties of establishing and maintaining a unified set of effective policies to compete with China.

This report seeks to examine and re-contextualize one of America's key advantages, energy, which is closely linked to its geography. For the last half-century, America's insufficient energy production was one of the United States' strategic weaknesses. American attention was consistently directed toward the Middle East, while adversaries like China and Russia steadily advanced their relative advantage in Asia and Europe. In the past decade, renewed energy production has allowed the United States to refocus on these metastasizing regional threats in Asia and Europe. Too few fully appreciate the immense strategic consequences of this change for the United States.

Because of both the shale revolution and energy portfolio diversification, the United States' energy sector is the most secure it has been in five decades. The United States' proven oil and natural gas reserves have more than doubled since 2008. As of 2019, the United States had 47.1 billion barrels of crude oil and lease condensate and 494.9 trillion cubic feet of natural gas in its reserve base.[11] In 2018, the United States became the world's largest global crude oil producer.[12] In 2019, America's overall energy exports surpassed energy imports for the first time in more than half a century.[13] It is difficult to overstate the strategic benefits this change can provide to the United States.

Based on data and projections from the U.S. Energy Information Administration, these benefits are expected to expand even further over time. Fortunately for the United States and other developed nations, GDP growth has become increasingly decoupled from growing energy demand. There are many reasons for this shift, including the transition from an industrial economy to a service-based economy, growing energy efficiencies, and the rise of electrification.[14] As the American economy grows, GDP growth will not automatically require commensurate increases in energy consumption as it has in the past. Additionally, the U.S. Energy Information Administration expects U.S. energy production to continue to grow even more than the record-setting growth of recent years, especially in the natural gas sector. Taken together, this declining energy consumption along with rising energy

10 See Matthew Kroenig, *The Return of Great Power Rivalry*.

11 U.S. Energy Information Administration, *Proved Reserves of Crude Oil and Natural Gas in the United States, Year-End 2019* (Washington, DC: EIA, 2021), p. 3; reserve estimates are influenced by dynamic commodity prices and technological changes.

12 "The United States Is Now the Largest Global Crude Oil Producer," U.S. Energy Information Administration, September 12, 2018, available at https://www.eia.gov/todayinenergy/detail.php?id=37053#.

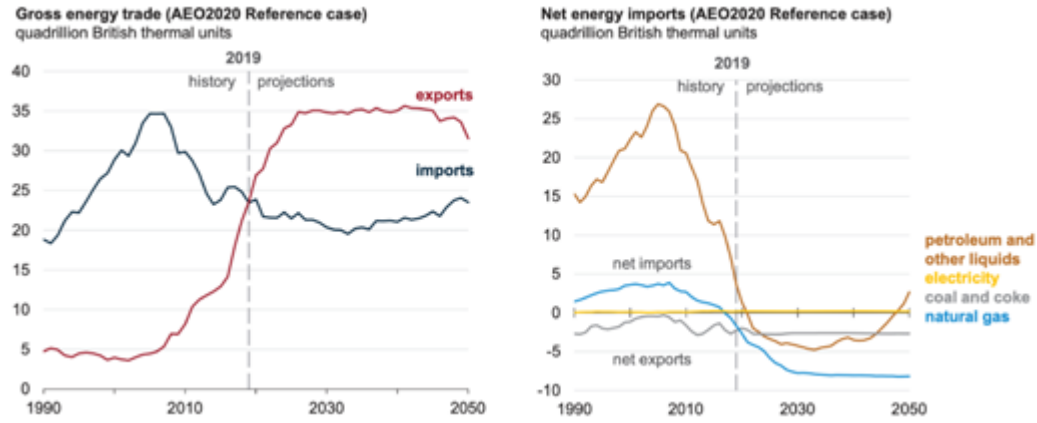
13 "U.S. total energy exports exceed imports in 2019 for the first time in 67 years," U.S. Energy Information Administration, April 20, 2020, available at https://www.eia.gov/todayinenergy/detail.php?id=43395.

14 Namit Sharma, Bram Smeets, and Christer Tryggestad, "The decoupling of GDP and energy growth: A CEO guide," *McKinsey Quarterly*, April 24, 2019, available at https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-decoupling-of-gdp-and-energy-growth-a-ceo-guide.

production means the United States will be able to export an expanding share of its domestic energy production abroad, reaping numerous strategic benefits.

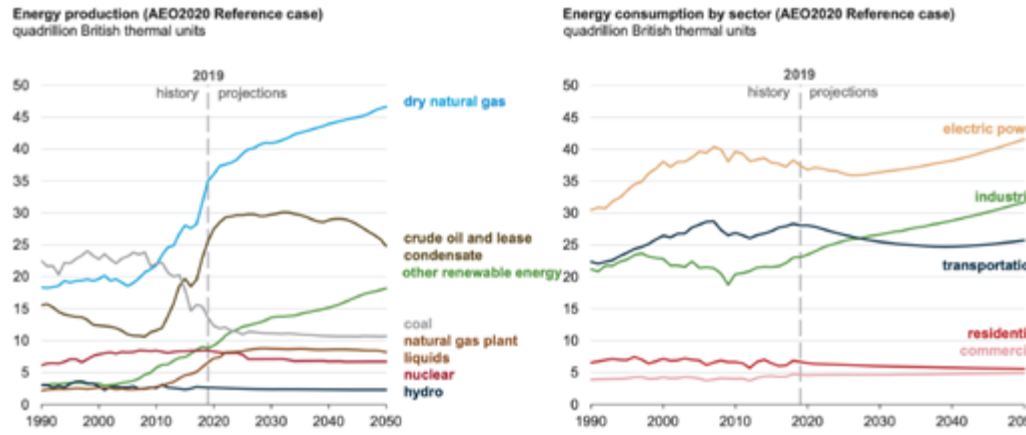
Increasing American exports of oil and gas are a hugely beneficial strategic development for the United States. With it, the "American energy arsenal" can become one of the pillars that powers engines of economic growth around the world. The countries that use American energy will draw closer to the United States diplomatically, economically, and strategically; energy diplomacy can become another device in the American strategic toolkit. Opportunities abound for the United States to think creatively about how best to use its growing hydrocarbon reserves to its strategic benefit.

FIGURE 1: U.S. PROJECTED GROSS ENERGY TRADE AND NET ENERGY IMPORTS



Source: U.S. Energy Information Administration, *Overview of energy markets: Reference case,* (Washington, DC: EIA, 2020), p. 2, available at https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Overview%20of%20Energy%20Markets.pdf.

FIGURE 2: U.S. PROJECTED ENERGY PRODUCTION AND CONSUMPTION



Source: U.S. Energy Information Administration, *Overview of energy markets: Reference case,* (Washington, DC: EIA, 2020), p. 1, available at https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Overview%20of%20Energy%20Markets.pdf.

The United States' geographic advantages for energy extend beyond just the oil and natural gas sectors. The United States has land well suited for both solar and wind energy production. The U.S. Sun Belt region is ideally configured for solar power, as is the Midwest for wind power.[15] The United States will not only have a global edge in traditional energy sources, but also has the potential to lead in emerging green energy technologies. America can use these alternative energy sources to satisfy increasing portions of domestic demand while exporting its surplus traditional carbon-based energy to key allies and partners.

In less than a decade, the United States has transformed from a power perennially dependent upon energy imports, especially from the Middle East, to one that is already, and will continue to be, self-sufficient in energy production. In the context of the deepening U.S.–China strategic competition, this shift boosts American comprehensive national power and affords the United States new tools and advantages. China's ongoing energy weaknesses provide the United States with asymmetric advantages for long-term strategic competition.

Chinese Strategic Weaknesses

China's rapid rise as the United States' strategic competitor has been nothing less than extraordinary. In a few short decades, China's dual explosion of military might and economic power has been one of the most rapid shifts in the global balance of power in history. The CCP is determined to alter the international order in ways inimical to U.S. interests. To craft a competitive strategy to confront its strategic rival, the United States must fully understand the multiple weaknesses that plague the ability of China to achieve its dream of international dominance. This section summarizes some of China's strategic weaknesses that mirror America's advantages, and then discusses China's energy dilemma.

First, China's geography is much less favorable than U.S. geography. China is located in a crowded regional neighborhood and borders 14 countries by land. It has multiple ongoing border disputes with its neighbors that drive tensions along its extended periphery. In the maritime realm, China's coast is littered with nearby islands belonging to regional stalwarts like Japan, the Philippines, and Vietnam. Perhaps most importantly, the CCP remains committed to invading and subjugating the self-governing and democratic island of Taiwan. These issues will exacerbate the difficulties China faces to sustain power projection far from its mainland.

China's demographic picture is also grim. China is just beginning to feel the long-term effects of its one-child policy, and it faces serious challenges to increase its birth rate again.[16] Within a couple of decades, China will become one of the world's oldest nations.

15 Peter Zeihan, *Disunited Nations*, p. 94.

16 "China Needs People to Have More Children. So Why Punish Those Who Do?" *The Economist*, December 7, 2019, available at https://www.economist.com/china/2019/12/05/china-needs-people-to-have-more-children-so-why-punish-those-who-do. China's birth rates in 2019 were the lowest in 70 years. For example, see https://www.bbc.com/news/world-asia-china-51145251

This demographic time bomb will pose significant challenges to China's economic goals, and the state will have to expend massive amounts of resources to take care of its growing retired population.[17]

China's economy, while large, is beset by issues. It sustained dazzling, although perhaps dubiously reported, GDP growth rates for decades. This growth is now slowing more rapidly than the CCP anticipated or desired, however.[18] A massive debt burden (over 300% of GDP), an imminent demographic crisis, simmering trade tensions, high domestic inequality, and a lumbering and staid state sector weigh on the government's growth goals.[19] China will probably settle into more "normal" growth rates for large nations by the end of the 2020s, if not sooner.[20]

Finally, China's system of government makes it less competitive internationally. Its autocratic nature requires levels of repression so high that it may spend more on internal security than it does on its military.[21] The CCP General Secretary, Xi Jinping, has centralized and personalized the power of the state in his control, effectively ending the CCP's collective leadership model and making China's success more dependent upon a single person. Generally, autocratic repression prevents the flourishing of human creativity and ingenuity that make democratic states so competitive over the long-term.[22] This short list only scratches the surface of the roadblocks troubling China's dreams of international influence.

China's energy market also remains fragile. Chinese energy weaknesses are not fully understood in the context of the U.S.-China strategic competition, and this report seeks to begin to address this gap in research. Energy should be understood as a key dimension of the many strategic issues that will make China's ambitions more difficult to achieve.

17 Nicholas Eberstadt, "China's Demographic Prospects to 2040: Opportunities, Constraints, Potential Policy Responses," *Governance In An Emerging World*, Issue 2018, Hoover Institution, October 29, 2018, available at hoover.org/research/chinas-demographic-prospects-2040-opportunities-constraints-potential-policy-responses.

18 "Can China's Reported Growth Be Trusted?" *The Economist*, October 17, 2020, available at https://www.economist.com/finance-and-economics/2020/10/15/can-chinas-reported-growth-be-trusted.

19 This debt figure comes before a massive increase in debt from COVID-19 spending, so the current number is likely much higher. See Reuters staff, "China's debt tops 300% of GDP, now 15% of global total: IIF," *Reuters*, July 18, 2019, available at https://www.reuters.com/article/us-china-economy-debt/chinas-debt-tops-300-of-gdp-now-15-of-global-total-iif-idUSKCN1UD0KD.

20 For more information about long-term risks to the Chinese economy, see George Magnus, *Red Flags: Why Xi's China is in Jeopardy* (New Haven, NJ: Yale University Press, 2018); Michael Pettis, *Avoiding the Fall: China's Economic Restructuring* (Washington, DC: Carnegie Endowment for International Peace, 2013); Carl Minzer, *End of an Era: How China's Authoritarian Revival is Undermining its Rise* (London: Oxford University Press, 2018); and Dinny McMahon, *China's Great Wall of Debt: Shadow Banks, Ghost Cities, Massive Loans and the End of the Chinese Miracle* (London: Abacus, 2018).

21 Josh Chin, "China Spends More on Domestic Security as Xi's Powers Grow," *The Wall Street Journal*, March 6, 2018, available at https://www.wsj.com/articles/china-spends-more-on-domestic-security-as-xis-powers-grow-1520358522.

22 See Matthew Kroenig, *The Return of Great Power Rivalry*.

China's energy portfolio is reliant on high-polluting and externally sourced energy. Coal comprises a majority of its energy consumption, and most of China's coal is domestically produced. Coal is an inherently dirty energy resource. As a result, China continues to be the world's largest greenhouse gas emitter by a wide margin. China's oil and natural gas consumption relies on imports from all over the world, and China's military is not yet capable of guaranteeing the protection of these shipments. While China has made headlines for recent efforts to innovate in green energy, these programs are complex, inefficient, expensive, and largely driven by desperation, not confidence. China is the world's largest energy consumer, consuming more than 20% of total global primary energy use and consuming more than twice as much as the United States.[23] It will continue to demand more energy to support its economic growth and security. As a developing economy, China's energy consumption growth will remain tightly coupled to its GDP growth, compelling China to obtain any sources it can from the global energy markets. The details of China's energy portfolio will be analyzed in depth in Chapter 3.

The Chinese government recognizes these energy challenges. Worries about energy security have permeated government documents and have been a subject of strategic debate for years. For example, Chinese fears of a naval blockade and the vulnerability of sea lines of communication described by Michael Pillsbury's "Sixteen Fears" are intimately tied up with its energy security.[24] The Chinese government's concept for the "Six Ensures," released in 2020, emphasized energy security as one of the government's primary strategic focus areas, along with ensuring employment, basic livelihood, market entities, food security, and basic operations.[25]

The Chinese government continues to pursue multiple efforts to address and solve its energy problem, including promoting domestic conservation, seeking diversified energy supplies, and supporting indigenous technology innovation.[26] These goals have driven China to buy from multiple sources, invest heavily in new technologies, and attempt to import and replicate foreign technologies.

Chinese fears about its energy security are also closely linked to some of its most important geostrategic goals for this century. China's "Blue Economic Passages" concept seeks to secure maritime trade routes to Europe, Africa, and Oceania. It also builds land and sea transportation infrastructure via the Belt and Road Initiative (BRI). Both are intended to

23 Gabriel Collins, "China's Energy Supply and Demand in the 2020s," *Baker Institute* Research Presentation, February 26 2021, Houston, Texas, available at https://www.bakerinstitute.org/media/files/files/a2229a49/collins-ryp-china-energy-supply-and-demand-in-the-2020s-26-february-2021-posting-version.pdf.

24 Michael Pillsbury, "The Sixteen Fears: China's Strategy Psychology," *Survival: Global Politics Strategy*, 54:5, p 152-153.

25 Bill Bishop, "Politburo meeting and the "6 ensures"; Hong Kong crackdown; Wuhan lab; South China Sea," *Sinocism*, April 20, 2020, available at https://sinocism.com/p/politburo-meeting-and-the-6-ensures.

26 Tai Ming Cheung, Thomas Mahnken, Deborah Seligsohn, Kevin Pollpeter, Eric Anderson, and Fan Yang *Planning for Innovation: Understanding China's Plans for Technological, Energy, Industrial, and Defense Development*, A report prepared for the U.S.-China Economic and Security Review Commission, 28 July 2016, p. 72-73.

help guarantee its energy imports, along with other strategic goals.[27] China's investments in port infrastructure along the Indian Ocean, Middle East, Caribbean, and the Arctic reflect this imperative.

FIGURE 3: CHINESE INVESTMENTS IN GLOBAL PORTS, 2020

Source: CSBA graphic, inspired by James Kynge, Chris Campbell, Amy Kazmin, and Farhan Bokhari, "How China Rules the Waves," *Financial Times*, January 12, 2017. Note: red dots represent major Chinese investments in global ports, either through Mainland Chinese companies or Hong Kong companies; shaded countries represent nations that officially signed up for the Belt and Road Initiative.

Chinese commentators are acutely aware of China's energy insecurity. Perhaps most importantly, the asymmetry of strengths between the United States and China in the energy sector accentuates its problem. In the context of the competition between the United States and China, the PRC will have to pay increasing costs to address and mitigate its energy challenges.[28] China sits at a disadvantage in the energy dimension of strategic competition with the United States. This study will place these strategic trends in the energy sector in a comparative assessment framework to maximize the utility of the report's findings for policymakers.

27 Toshi Yoshihara and Jack Bianchi, *Seizing on Weakness,* pp. 85-86.

28 To understand the nature of strategic weakness, see Toshi Yoshihara and Jack Bianchi, *Seizing on Weakness,* pp. 22-25.

Comparative Assessment and U.S.-China Competition

Energy is an understudied and fundamental component of national power crucial to the global competition for influence between the United States and China. As the engine of economic growth, energy is one of the key enablers of domestic prosperity and international power. Energy security, or the lack thereof, will play a pivotal role in setting the conditions for potential success for both the United States and China in the 21st century. American strategists, however, have not fully analyzed the influence of energy on the U.S.–China competition to date, depriving U.S. policymakers of multiple strategic options available to them. This study, therefore, seeks to describe the relative energy security of the United States and China, explore how energy may change the competition between the states, and introduce strategic frameworks for American policymakers.

At the core of this analysis lies the comparative assessment of the energy security of the United States and the PRC. Chapters 2 and 3 seek to provide an overview of the energy portfolios of both countries to give policymakers an understanding of the forces driving the state of energy security for both. A comparative assessment allows American strategists to grasp the energy dynamics of the United States and China in broad terms so that policymakers can understand how these dynamics will influence competition between the two countries. This study emulates the well-known practice of net assessment, which compares the military capabilities between the United States and potential adversaries over time.[29] Instead, this report will compare the energy security of the United States and China to advise American policymakers on how it may influence the balance of power in the 21st century.

To properly analyze the state of American and Chinese energy security, we need a consistent definition of "energy security." Today, analysts use a wide variety of definitions of energy security that are highly dependent on contextual considerations and policy intent. American efforts to establish a precise definition of energy security first appeared after the oil crises of the 1970s, with a focus on ensuring the security of oil imports. Over time, American definitions of energy security have expanded to account for the diversifying components. Energy security has become commonly defined as the consistent "availability of sufficient supplies at affordable prices."[30] Other common definitions focus on the "Four A's," availability (geological factors), accessibility (geopolitical factors), affordability (economic factors), and acceptability (environmental or social factors).[31] Still others focus on the variety of risks to

29 See Thomas G. Mahnken, editor, *Net Assessment and Military Strategy* (Amherst, NY: Cambria Press, 2020).

30 Daniel Yergin, "Ensuring Energy Security," *Foreign Affairs*, March/April 2006, available at https://www.foreignaffairs.com/articles/2006-03-01/ensuring-energy-security.

31 See *A Quest for Energy Security in the 21st Century*, (Tokyo, Japan: Asia Pacific Energy Research Centre, 2007); and Bert Kruyt, D.P. van Vuuren, H.J.M. de Vries, and H. Groenenberg, "Indicators for energy security," *Energy Policy,* no. 37, 2009.

energy supply and the factors that contribute to resilience of supply.[32] These different definitions show that understandings of energy security continue to depend on a variety of factors.

This study uses a definition of energy security that reflects the intent of the report. For the purposes of this study, energy security is considered within the context of the deepening competition for geopolitical influence between the United States and the PRC. This report defines energy security as the ability of a state to minimize risks to stable energy supplies. In this context, the importance of energy security lies in the extent to which existing and possible threats to each country's energy supply can influence the nation's ability to marshal resources for economic output, military campaigns, and other activities indicative of great-power status. This definition focuses on the balance between risks to the energy supply and the energy system's resilience to these risks. Risks can be geological, geopolitical, infrastructural, economic, environmental, social, and technical, among others. The emphasis on risk highlights an understanding that international power is inherently fragile, and energy is a critical factor in the ability of a state to accumulate and manifest power, especially in the economic realm, but also in the military dimension and others.

As stated above, energy security varies widely by context, especially concerning differences between countries. This study rests on the assumption that the differences in strategic culture and political economy, among other factors, between the United States and China alter the perceptions of energy security and the balance of power. To avoid potential issues stemming from American policymakers misinterpreting the U.S.–China competition from not understanding Chinese strategists' worldview, like mirror imaging, this study explains how Chinese analysts perceive the energy security of both the United States and the PRC.[33] Chapter 4 explores Chinese attitudes to inform the rest of the study's conclusions. The chapter searches for flaws in Chinese thinking for application in Chapter 5.

In total, this study intends on merging two sometimes unfamiliar fields: energy and strategy. It is becoming clear that the contest for dominance in the Indo-Pacific and across the world between the United States and the PRC will include facets of competition that may be unexpected, including energy. American strategists have tended to only think about energy's place in American strategy when U.S. energy security was under threat. In this era of rising revisionist challenges to American power, the United States must begin to consider how American energy security and Chinese insecurity can be an instrument for policymakers. This study seeks to be a part of a much broader discussion of how to implement American energy power into U.S. strategy.

32 See Christian Wizner, "Conceptualizing energy security," *Energy Policy,* no. 46, 2012, p. 36-48; and Aleh Cherp and Jessica Jewell, "The concept of energy security: Beyond the four A's," *Energy Policy,* no. 75, 2014, 415-471.

33 See Thomas G. Mahnken, editor, *Net Assessment and Military Strategy,* Chapter 8.

CHAPTER 2

Understanding American Energy Security

The United States has undergone a revolution in the energy industry since the late 2000s without comprehensive consideration of the strategic implications of the change. In a little over a decade since this shift, American oil and natural gas production has surged, and long-standing worries about the security of energy imports to the United States dissipated. This chapter examines in detail how the diversification of sources, combined with the shale revolution, has changed the state of American energy security, and assesses that security today.

The purpose of this chapter is to sketch an overview of the drivers of American energy security and the prospects of its future, not to delve into the specifics of each part of the U.S. energy industry. Doing so is meant to provide policymakers with a relevant understanding of the parts of the energy economy that are crucially relevant to American strategy, specifically in the context of the U.S.-China global competition for influence.

The United States, as this chapter will show, has returned to a historical norm of being energy secure after a four-decade hiatus. The growth of its energy production capabilities has reduced the risks to its energy supply via external imports, as the majority of its consumed energy is now domestically sourced. Geopolitical, economic, and geological risks to energy security—like those that plague Chinese energy supplies—have been drastically reduced in the past decade. The U.S. energy supply, however, is potentially threatened by infrastructural, environmental, economic, and ecological problems, as this chapter will show. In total, the United States is energy secure with some risk.

This chapter will proceed in three parts. The first will describe the origins of the shale revolution, including the technologies that drove the transformation of the American energy portfolio and its progression. It will also explain the drivers of growing American energy self-sufficiency. The second section summarizes the U.S. energy portfolio to better understand which energies fuel the American economy and the prospects for the

future of American energy security. The final section provides an overall assessment of American energy security to introduce the implications of the U.S. energy portfolio on American strategy.

Origins of the Shale Revolution

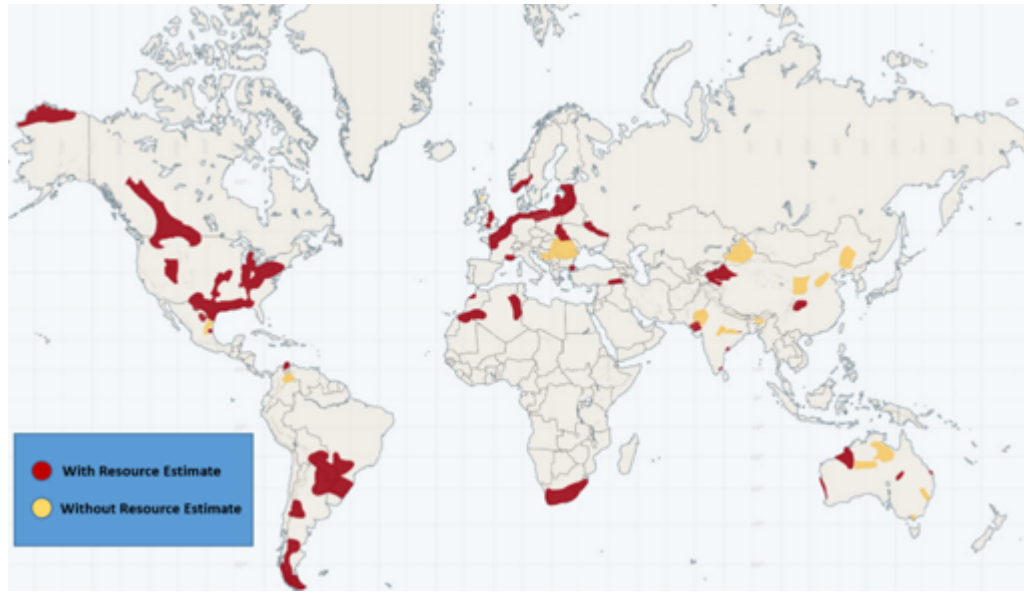
American energy security became an enticing possibility after the rapid proliferation of the shale revolution in the early 2010s. After peaking as the world's largest oil producer in the 1970s, many observers assumed America's share of global oil production would wane. For the subsequent decades, the United States' dependence on energy sources from the Middle East dominated its foreign policy concerns. Because of the widespread application and refinement of a couple of key technologies, the United States' energy production exploded seemingly overnight in the popular consciousness.

For decades, American foreign policy was dominated by seemingly perennial concerns about energy insecurity. Although the United States began the age of oil in the 19th century as a leading producer and exporter, spare American capacity for oil production began to dry up in the 1970s. Skyrocketing energy prices during the 1973 Oil Crisis made emerging American insecurity clear. The crisis spurred American concern about its energy imports and drove much of its domestic and foreign policy. In certain periods prior to the 2010s, the United States imported more than half of its oil. As a result, the United States had a significant interest in ensuring the stability of these global imports. The United States quickly became more interested in Middle Eastern stability.[34] For example, U.S. concerns about Iraqi aggression through the 1990s were partially driven by the need to keep oil trade from the Gulf open. Additionally, in the 2000s, it was widely believed that as the United States increased its natural gas consumption, its dependence on gas imports would inevitably expand with time.[35] With the advent of the shale revolution, these concerns about the international sourcing of American fuels faded.

34 See "Oil Dependence and U.S. Foreign Policy 1850-2017," *The Council on Foreign Relations*, available at https://www.cfr.org/timeline/oil-dependence-and-us-foreign-policy.

35 Daniel Yergin, *The New Map*, p. 9.

FIGURE 4: GLOBAL SHALE GAS DEPOSITS



Source: CSBA graphic, with data from U.S. Energy Administration. Map underlay courtesy of Mapbox.

A few critical technologies converged to drive America's shale revolution: hydraulic fracturing, horizontal drilling, proppants, and walking rigs, which enabled pad drilling. Hydraulic fracturing, or "fracking," uses pressurized water, sand, and chemicals to blast loose stored oil or gas within a shale formation. Horizontal drilling exposes a greater area of oil within a rock. Proppants, a part of fracking, help keep fissures within a shale formation open to keep the oil or gas flowing. Walking rigs allow drillers to quickly relocate from one source to another.[36] Taken together, these technologies allowed the profitable exploitation of U.S. shale deposits, including the Bakken, Permian Basin, Eagle Ford, Marcellus, and Utica, among others.

These new technologies combined with America's favorable geological conditions to create an unprecedented rebound in American oil and natural gas production. In 2005, American natural gas production hit a 15-year low of 18 trillion cubic feet, followed by a 50-year low of field crude oil production of 5 million barrels per day (b/d) in 2008. By 2015, just seven years later, American oil production had more than doubled from this low point.[37] Amid this frenzied growth in production, the United States lifted a 40-year ban on crude oil export in December 2015.[38] By 2019, U.S. natural gas production had also nearly doubled from its

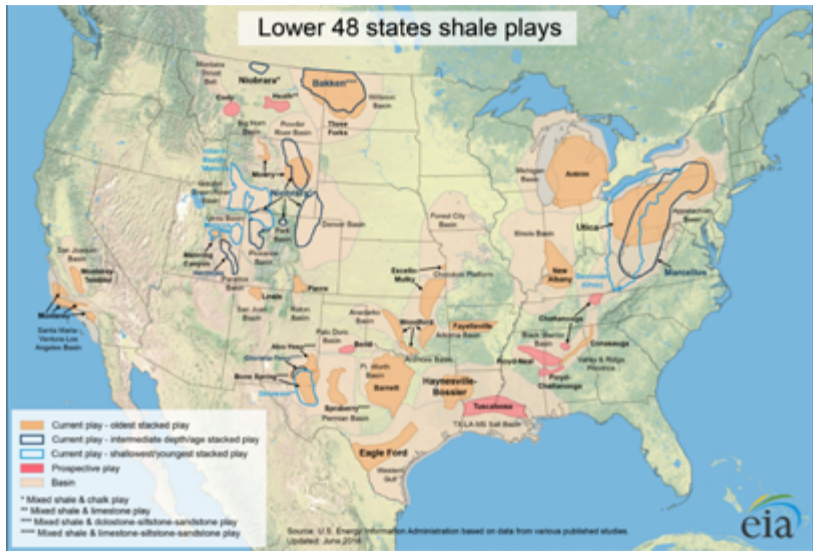
36 Ed Crooks, "The US Shale Revolution," *Financial Times*. April 24, 2015, https://www.ft.com/content/2ded7416-e930-11e4-a71a-00144feab7de

37 "U.S. Field Production of Crude Oil," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFPUS2&f=A.

38 "US spending bill lifts 40 year ban on crude oil exports," December 18, 2015, available at https://www.bbc.com/news/business-35136831#:~:text=US%20politicians%20have%20approved%20a,the%20US%20government%20until%202016.

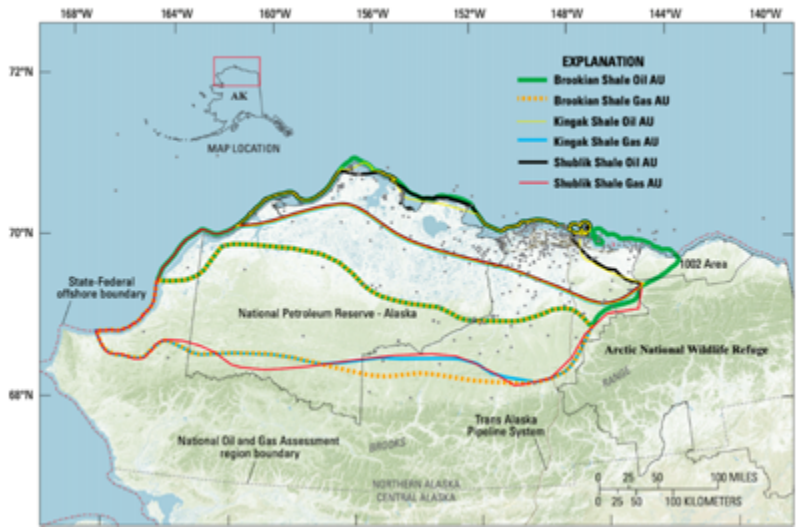
2005 low.[39] These trends will be explained in-depth in the next section. As a result of the shale revolution, the United States is more energy-secure than it has been in decades.

FIGURE 5: SHALE PLAYS IN THE CONTINENTAL UNITED STATES



Source: "Maps: Oil and Gas Exploration, Resources, and Production," U.S. Energy Information Administration, available at https://www.eia.gov/maps/maps.htm.

FIGURE 6: SHALE PLAYS IN ALASKA



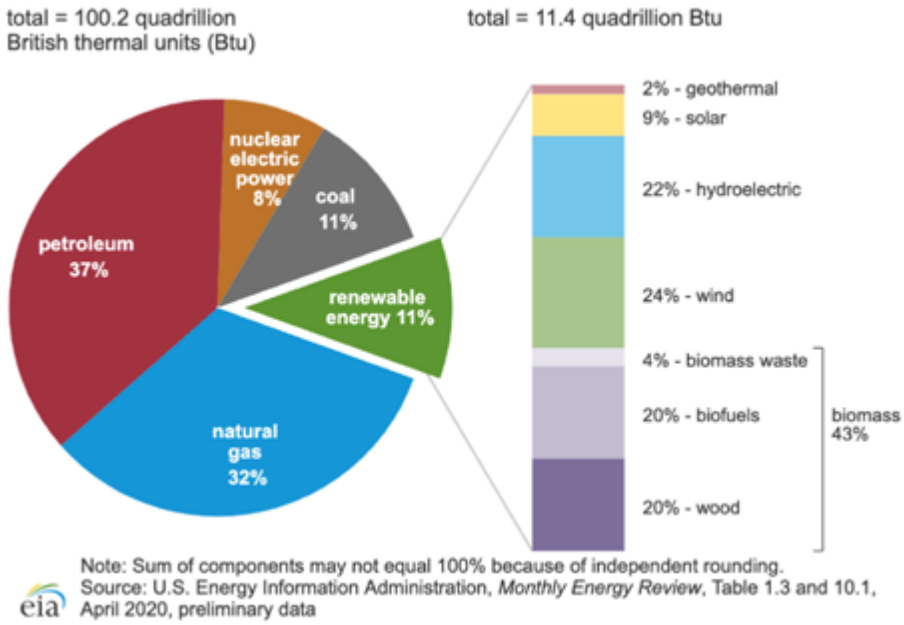
Source: "Assessment of Potential Oil and Gas Resources in Source Rocks of the Alaska North Slope, 2012," United States Geological Survey, available at https://pubs.usgs.gov/fs/2012/3013/pdf/fs2012-3013_2-28-2012.pdf.

39 "U.S. Natural Gas Marketed Production," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/ng/hist/n9050us2a.htm.

The American Energy Portfolio

Since the advent of the shale revolution, the portfolio of energy that fuels the American economy has shifted drastically. Newly discovered oil and natural gas sources made the United States self-sufficient in petroleum and made natural gas a major source of U.S. energy. Simultaneously, coal's once-important place for the economy has faded with time. The rapid arrival of wind and solar power provides enticing opportunities for the green economy, as well. Together, these changes have produced a United States that is much more energy secure than it was just a little over a decade ago. This section will summarize the composition and change of the U.S. energy portfolio to explain the sources of strengthening U.S. energy security and point out potential weaknesses in the U.S. energy sector.

FIGURE 7: THE AMERICAN ENERGY PORTFOLIO

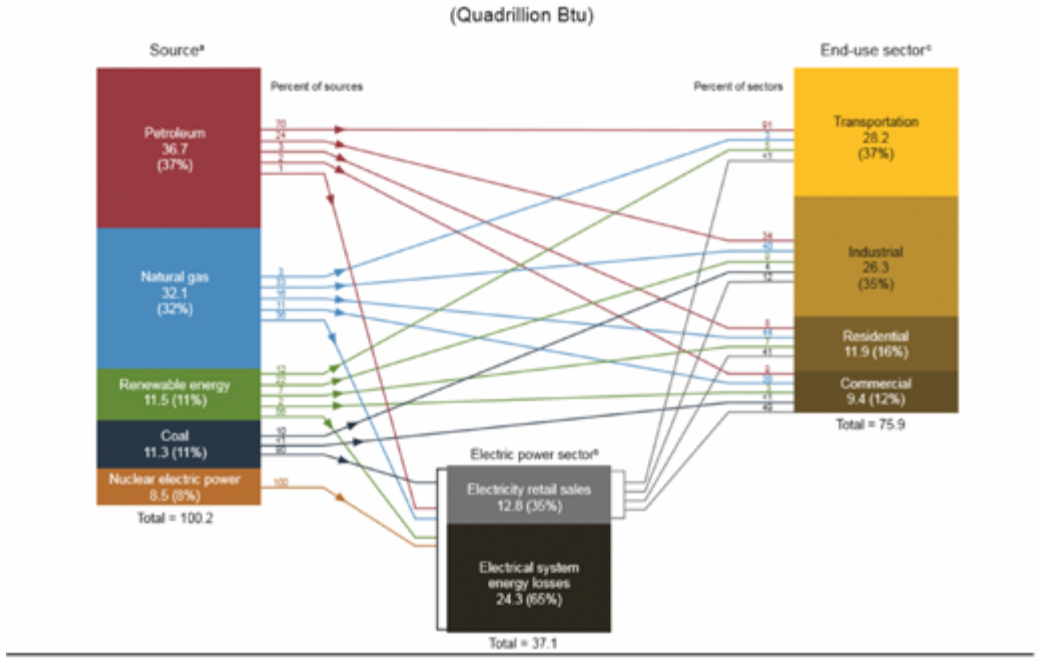


Source: "U.S. energy facts explained," the U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/us-energy-facts/.

The United States has increasingly diversified its energy portfolio among a variety of fossil fuels and green energy sources. The primary energy sources essential to the functioning of the American economy are petroleum/oil (37%), natural gas (32%), coal (11%), renewable energy (11%), and nuclear power (8%).[40]

40 "U.S. energy facts explained," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/us-energy-facts/.

FIGURE 8: U.S. ENERGY CONSUMPTION BY SECTOR, 2019



[a] Primary energy consumption. Each energy source is measured in different physical units and converted to common British thermal units (Btu). See U.S. Energy Information Administration (EIA), *Monthly Energy Review*, Appendix A. Noncombustible renewable energy sources are converted to Btu using the "Fossil Fuel Equivalency Approach", see EIA's *Monthly Energy Review*, Appendix E.

[b] The electric power sector includes electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Energy consumed by these plants reflects the approximate heat rates for electricity in EIA's *Monthly Energy Review*, Appendix A. The total includes the heat content of electricity net imports, not shown separately. Electrical system energy losses are calculated as the primary energy consumed by the electric power sector minus the heat content of electricity retail sales. See Note 1, "Electrical System Energy Losses," at the end of EIA's *Monthly Energy Review*, Section 2.

[c] End-use sector consumption of primary energy and electricity retail sales, excluding electrical system energy losses from electricity retail sales. Industrial and commercial sectors consumption includes primary energy consumption by combined-heat-and-power (CHP) and electricity-only plants contained within the sector.

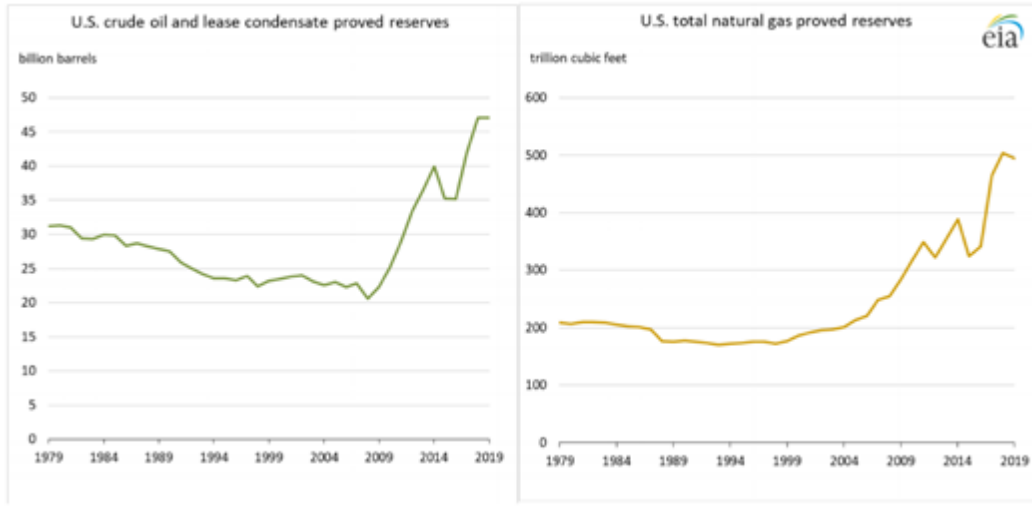
Note: Sum of components may not equal total due to independent rounding. All source and end-use sector consumption data include other energy losses from energy use, transformation, and distribution not separately identified. See "Extended Chart Notes" on next page.

Sources: EIA, *Monthly Energy Review* (April 2020), Tables 1.3 and 2.1-2.6.

Source: "U.S. energy facts explained," the U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/us-energy-facts/.

U.S. reserves, production, and exports of oil have expanded rapidly as a result of the shale revolution. In 2019, the United States had more than 45 billion barrels of proved reserves of crude oil, some of the highest in the world. These reserves are more than twice as high as estimated when the U.S. oil reached its nadir before 2009.

FIGURE 9: U.S. OIL AND NATURAL GAS RESERVES, 1979-2019



Source: U.S. Energy Information Administration, *Proved Reserves of Crude Oil and Natural Gas in the United States, Year-End 2019* (Washington, DC: EIA, 2021), p. 3.

American oil production is consequently the highest in the entire world. In 2020, it produced an average of 18.6 million b/d, or 20% of production of global oil and related liquids. America produced 40.9% more oil than Saudi Arabia and 43.5% more oil than Russia in 2020.[41] This production is concentrated in a couple of states: Texas (41.4%), North Dakota (11.6%), New Mexico (7.4%), Oklahoma (4.7%), and Colorado (4.2%).[42] Unlike most other oil-producing countries, American oil production solely comes from private enterprises.

Oil is the United States' most significant energy source, accounting for 37% of America's total energy consumption in 2019.[43] 70% of American oil consumption is used in the transportation sector, and the vast majority of that sector's energy use is in oil. Nearly a quarter of its consumption is used in the industrial sector.[44] U.S. oil consumption, which had been stable for the decade before the effects of the coronavirus pandemic, is concentrated in four products. Gasoline accounts for about 45% of oil consumption. Distillate fuel oil takes up about 20% of American oil consumption, and these fuels include diesel fuel and heating oil. The third-most-used oil product category is hydrocarbon gas liquids: propane, ethane, butane, and others. Jet fuel makes up the smallest category of American oil consumption.[45]

41 "What countries are the top producers and consumers of oil?," U.S. Energy Information Administration, available at https://www.eia.gov/tools/faqs/faq.php?id=709&t=6.

42 "Oil and petroleum products explained: where our oil comes from," U.S. Energy Information Administration," available at https://www.eia.gov/energyexplained/oil-and-petroleum-products/where-our-oil-comes-from.php.

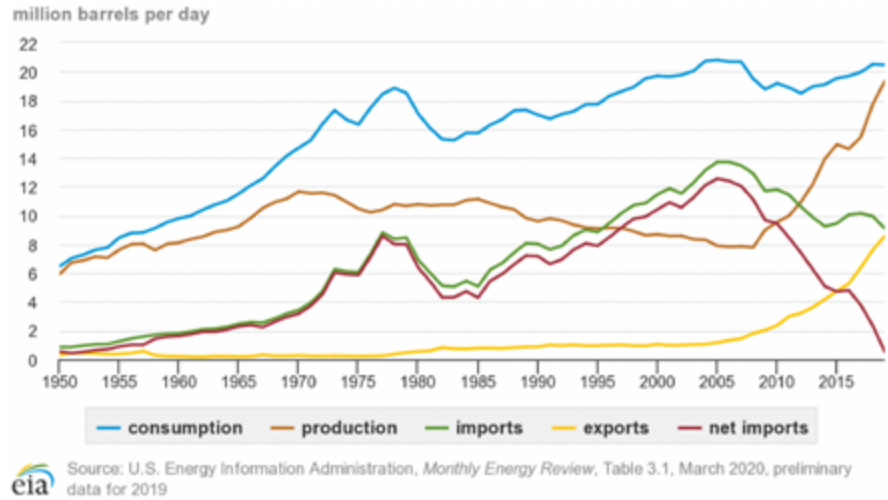
43 U.S. consumption in 2019 averaged 20.54 million b/d; "U.S. energy facts explained," U.S. Energy Information Administration.

44 "U.S. energy facts explained," U.S. Energy Information Administration.

45 "Oil and petroleum products explained: use of oil," U.S. Energy Information Administration," available at https://www.eia.gov/energyexplained/oil-and-petroleum-products/use-of-oil.php.

U.S. oil trade has shifted rapidly due to the shale revolution; exports have surged, while imports have dropped. In 2007, the United States exported 1.4 million b/d, and American exports expanded to 8.5 million b/d by 2019.[46] The top five export destinations in 2019 were Mexico (14%), Canada (12%), Japan (7%), South Korea (7%), and Brazil (6%). Simultaneously, American imports have dropped significantly since the late 2000s. In 2006, the United States imported 13.71 million b/d, and by 2019 that figure dropped to 9.1 million b/d. Import cuts have come from dropping purchases of oil from OPEC states and the Persian Gulf region. About half of American oil imports came from Canada in 2019. With the United States only importing 0.53 million b/d more than it exported in 2019, The United States has effectively become self-sufficient in oil production.[47]

FIGURE 10: U.S. PETROLEUM CONSUMPTION, PRODUCTION, IMPORTS, EXPORTS, AND NET IMPORTS, 1950-2019



Source: "U.S. oil and petroleum products explained," the U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php.

Over the past twelve years, U.S. gas reserves, production, exports, and consumption have risen. In 2019, America's proven natural gas reserves were 494 trillion cubic feet. These reserves are spread across the United States, with the highest concentrations in Texas (25.4%), Pennsylvania (21.7%), West Virginia (8%), Louisiana (7.4%), Oklahoma (7.2%), and Ohio (7%).[48] In 2009, the United States produced 20.6 Tcf of natural gas, and American

46 "U.S. Exports of Crude Oil and Petroleum Products," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MTTEXUS2&f=A.

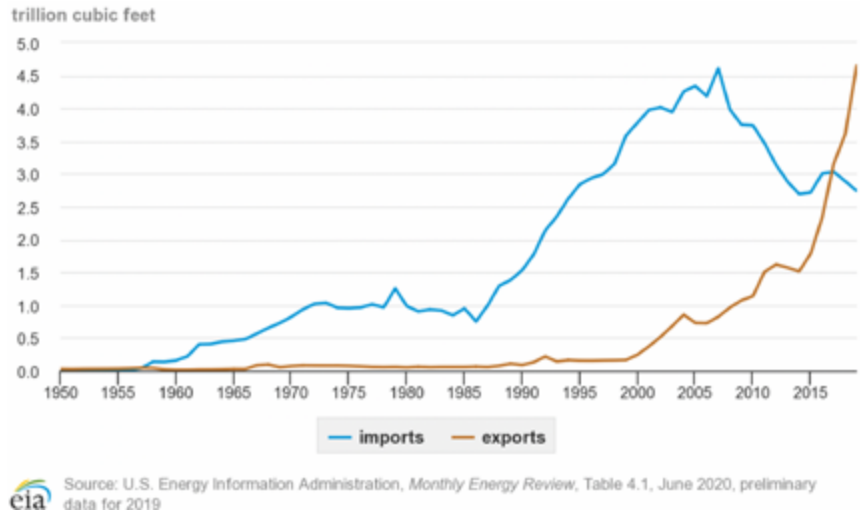
47 "Oil and petroleum products explained: use of oil," U.S. Energy Information Administration.

48 "Natural Gas Explained: How Much Natural Gas Is Left," U.S. Energy Information Administration, available at https://https://www.eia.gov/energyexplained/natural-gas/how-much-gas-is-left.php.

production rose to 34 Tcf by 2019.[49] It is the world's largest producer by a wide margin, producing 23.4% more gas than Russia in 2019.[50]

Growing reserves and production have resulted in a tremendous increase in natural gas exports, rising over sixfold from 723 billion cubic feet in 2006 to 4.7 Tcf in 2019. The top U.S. export destinations are Mexico (43%), Canada (20%), South Korea (6%), Japan (4%), and Spain (2.5%).[51] America's natural gas exports exceeded imports in 2017, and its net exports were 1.91 Tcf in 2019. The Energy Information Administration (EIA) predicts that American gas exports will continue to surge in the 2020s and eventually approach 10 Tcf of natural gas exports per day by mid-century.[52] Most U.S. gas exports are sea-based, meaning they must be exported as Liquefied Natural Gas (LNG). Converting natural gas to LNG requires facilities to cool the gas for international export. Most of these LNG export plants are in Texas or Louisiana along the Gulf Coast.[53]

FIGURE 11: U.S. NATURAL GAS IMPORTS AND EXPORTS, 1950-2019



Source: "Natural gas explained," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/natural-gas/imports-and-exports.php#:~:text=In%202019%2C%20total%20annual%20U.S.%20natural%20gas%20exports%20were%204.66,third%20year%20in%20a%20row.&text=About%2061%25%20of%20the%20total,and%2034%25%20went%20to%20Canada.

49 "U.S. Dry Natural Gas Production," U.S. Energy Information Administration," https://www.eia.gov/dnav/ng/hist/n9070us2A.htm.

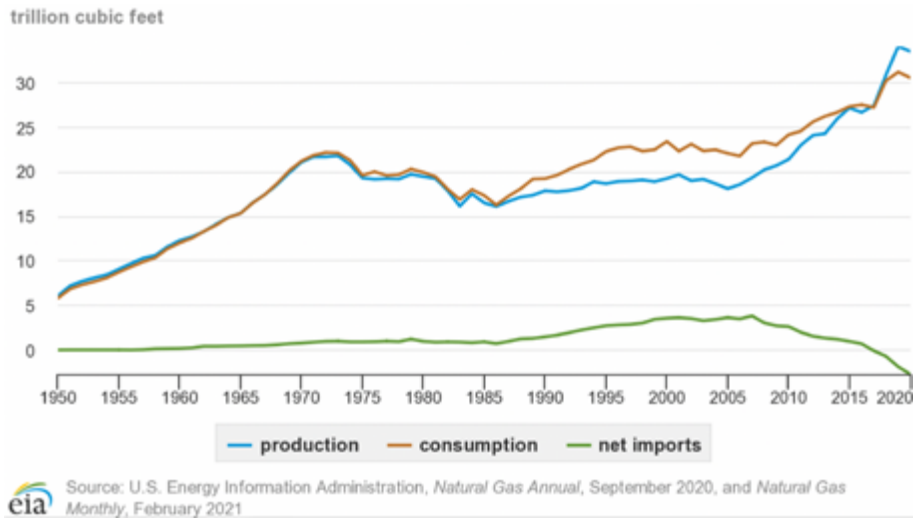
50 "INTERNATIONAL: Natural Gas," U.S. Energy Information Administration, available at https://www.eia.gov/international/data/world/natural-gas/dry-natural-gas-production?pd=3002&p=00g&u=0&f=A&v=mapbubble&a=-&i=none&vo=value&&t=C&g=00000000000000000000000000000000000000000000000000001&l=249-ruvvvvvfvtvnvv1vrvvvvfvvvvvvfvvvou20evvvvvvvvvvvnvvvs0008&s=315532800000&e=1546300800000.

51 "U.S. Natural Gas Exports and Re-Exports by Country," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/ng/ng_move_expc_s1_a.htm.

52 U.S. Energy Information Administration, *Energy Outlook 2021: Natural Gas* (Washington, DC, EIA, 2021), p. 10, available at https://www.eia.gov/outlooks/aeo/pdf/03%20AEO2021%20Natural%20gas.pdf.

53 Daniel Yergin, *The New Map*, p. 24.

FIGURE 12: U.S. NATURAL GAS PRODUCTION, CONSUMPTION, AND NET IMPORTS, 1950-2019



Source: "Natural gas explained," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/natural-gas/imports-and-exports.php#:~:text=In%202019%2C%20total%20annual%20U.S.%20natural%20gas%20exports%20were%204.66,third%20year%20in%20a%20row.&text=About%2061%25%20of%20the%20total,and%2034%25%20went%20to%20Canada.

U.S. natural gas consumption has risen along with its production and exports. In 2009, the United States consumed 22.9 Tcf of gas, or 24.9% of total U.S. energy consumption; in 2019, it consumed 31.1 Tcf, or 32% of total consumption.[54] This energy is distributed across various sectors of the American economy. 36% of gas does to the electric power sector, 33% to the industrial sector, 16% to the residential sector, and 11% to the commercial sector.[55]

These developments stemming from surging natural gas production show that natural gas may become one of America's most important energy sources. Its growth has already assisted the United States in stepping away from its coal usage, and it is relatively cleaner than oil. As U.S. production continues to exceed its demand, its capacity to secure the energy future of its allies and partners will only grow with time. Natural gas will make up a critical part of the U.S. energy arsenal in the coming years.

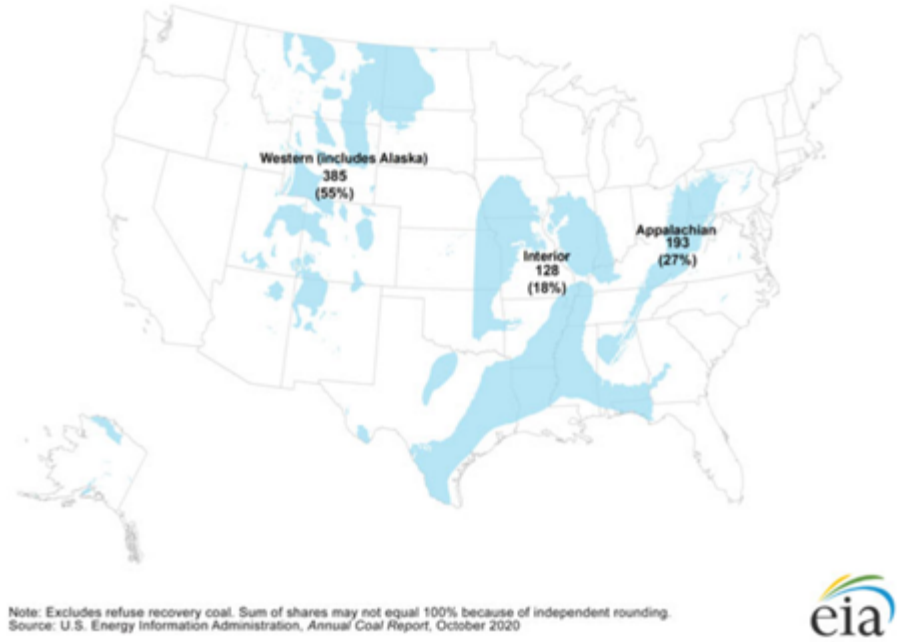
The United States has abundant coal resources, yet its consumption has roughly halved in the past decade due to rising natural gas consumption. American coal reserves are estimated to be the largest in the world, with 22% of global reserves. The EIA estimates that current production rates would last the United States about 357 years.[56]

54 "U.S. Natural Gas Total Consumption," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/ng/hist/n9140us2a.htm.

55 "U.S. energy facts explained," U.S. Energy Information Administration.

56 "Coal explained: how much coal is left," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/coal/how-much-coal-is-left.php.

FIGURE 13: U.S. COAL PRODUCTION BY SHORT TONS AND SHARE OF TOTAL



Source: Coal explained: Where our coal comes from," U.S."Energy Information Administration, available at https://www.eia.gov/energyexplained/coal/where-our-coal-comes-from.php#:~:text=The%20Interior%20coal%20region%20includes,in%20the%20Interior%20coal%20region..

U.S. coal trade is insignificant, as production closely tracks its consumption. In 2019, coal imports accounted for 1% of consumption. The vast majority of these imports come from Colombia. American coal exports totaled 93 million short tons in 2019, or 13% of America's total production. The top export destinations were India (14%), Japan (12%), The Netherlands (11%), Brazil (8%), and South Korea (8%).[57]

Although coal was traditionally a dominant energy source for the United States, growing natural gas consumption has sidelined the resource. U.S. consumption of coal peaked in 2007 at 1.13 billion short tons, or 22.5% of total U.S. energy consumption for that year. In 2019, the United States consumed 587 million short tons of coal, 11.3% of that year's energy consumption.[58] 90% of coal consumption is used for electricity. The EIA predicts that U.S.

57 "Coal explained: Coal imports and exports," U.S. Energy Information Administration," https://www.eia.gov/energyexplained/coal/imports-and-exports.php#:~:text=U.S.%20coal%20exports%20reached%20a,exports%20went%20to%20five%20countries.

58 "Monthly Energy Review March 2021: Coal Consumption by Sector," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/us-energy-facts/; https://www.eia.gov/totalenergy/data/monthly/pdf/sec6_4.pdf.

coal consumption will slowly fade with time.[59] In sum, coal is an abundant resource with declining importance for the American economy.

Renewable energy is a relatively small—yet growing—portion of the American energy diet. In 2019, renewables produced 11% of total U.S. energy consumption. These energies included biomass resources (43%), wind power (24%), hydroelectric power (22%), solar power (9%), and geothermal power (2%).[60] Biomass fuel sources were dominant globally before the industrial revolution and are still popular in the United States as carbon-neutral energy sources. Biomass sources include wood and wood-derived sources (46%), biofuels such as ethanol (45%), and municipal waste (9%). These fuels are used primarily in the industrial (49%), transportation (28%), and residential (9%) sectors.[61] While the biomass energy sector is not a growing industry, it remains the largest renewable energy source in the United States.

Hydroelectric power is an important yet relatively declining power source for the United States. U.S. hydroelectric power peaked in the 1970s and has been stagnant since then, with its share in total energy consumption decreasing every year. In 1974, U.S. hydroelectric generation was 304 billion kilowatt-hours (kWh), which accounted for 16% of all electricity generation; in 2019, the United States produced 274 kWh, or 7% of total generation. It was surpassed by wind power in electricity generation in 2019. The stagnation of American hydroelectric generation is mainly due to both the lack of additional ideal real estate for dams and sharpening competition with other sources of electricity.

Nuclear energy takes up 8% of U.S. energy consumption, and its production is exclusively used for the electric power sector. After rapidly rising from the 1970s until the turn of the century onward, the industry has stagnated in the past two decades, as the source has proven to be less profitable than other energy sources. In 2019, the United States had 96 active commercial nuclear reactors. Although 17 nuclear plants have closed, and 16 are at various stages of decommissioning, plant upgrades and advanced technology have increased the capacity of each reactor, keeping U.S. nuclear output stable despite fewer overall nuclear plants.[62] The nuclear sector's stagnation may only worsen with time as growing American production of energy from oil, natural gas, solar, and wind power will make U.S. energy markets more competitive. The EIA projects that U.S. nuclear energy production will fade in the coming decades and slowly lose its share of total U.S. energy production.[63]

59 U.S. Energy Information Administration, *Annual Energy Outlook 2021 Electricity* (Washington, DC: EIA, 2021), p. 2, available at https://www.eia.gov/outlooks/aeo/pdf/04%20AEO2021%20Electricity.pdf.

60 "U.S. energy facts explained," U.S. Energy Information Administration. In common discourse, many refer to "renewables" as only wind and solar, which together produce 3.63% of American total energy consumption.

61 "Biomass explained," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/biomass/.

62 "Nuclear explained: U.S. nuclear industry," U.S. Information Administration," https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php.

63 U.S. Energy Information Administration, *Annual Energy Outlook 2021 Electricity,* p. 1.

FIGURE 14: U.S. NUCLEAR POWER PLANTS

Source: "Nuclear explained: U.S. nuclear industry," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php

Wind power is a rapidly growing energy source in the United States. Since 2007, American wind power output has increased from 34 billion kWh, or 0.8% of total electricity generation, to 338 billion kWh, or 8.4% of electricity generation.[64] The United States is now the world's second-largest wind power producer, with 21% of global generation (China leads with 29% of global generation).[65] The EIA predicts that wind power will begin to grow more slowly in this decade.[66] While wind power is favorable for its limited carbon footprint, output fluctuates widely depending on the time of day and season. Wind power growth is driven by favorable geography and industry incentives.

The profitability of wind power depends on ideally configured geography, meaning average wind speeds of at least 9 miles per hour. Large swaths of the United States meet the conditions required for profitable wind power. The top wind-producing states include Texas (27.5%), Iowa (10.1%), Oklahoma (8.7%), Kansas (6.9%), and California (4%).[67] For some

64 "Wind explained: Electricity generation from wind," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/wind/electricity-generation-from-wind.php.

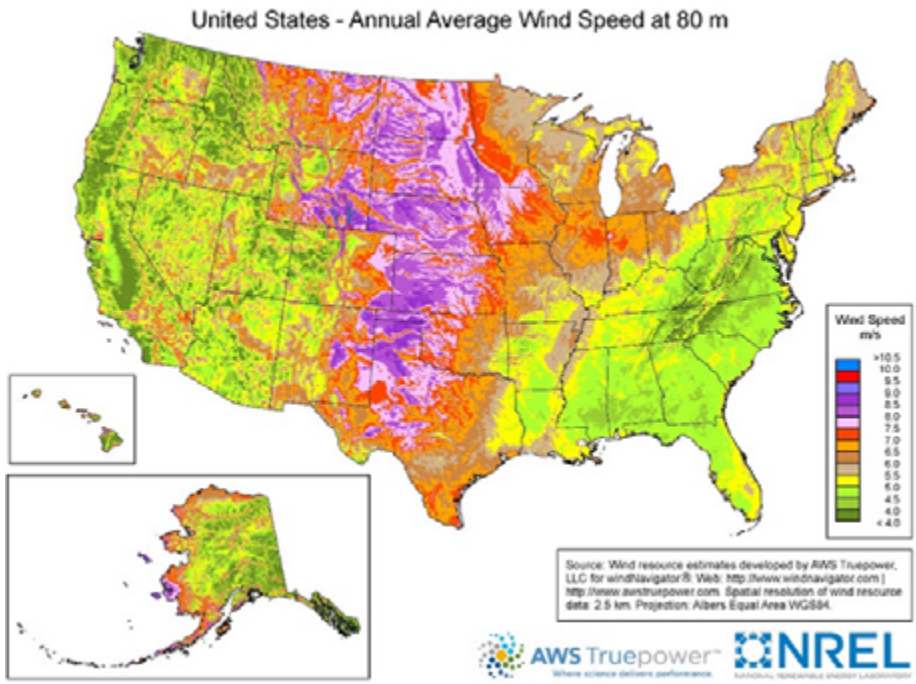
65 "Wind explained: Where wind power is harnessed," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/wind/where-wind-power-is-harnessed.php.

66 See U.S. Energy Information Administration, *Annual Energy Outlook 2021 Electricity*.

67 "Wind explained: Where wind power is harnessed," U.S. Energy Information Administration; and "Wind explained: Electricity generation from wind," U.S. Energy Information Administration.

states, wind power is crucial in statewide electricity generation, like Iowa (58%) and Kansas (43%).[68]

FIGURE 15: U.S. ANNUAL WIND SPEEDS AT 80 METERS



Source: "Wind explained: Where wind power is harnessed," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/wind/where-wind-power-is-harnessed.php.

Solar power shares many similar attributes to wind power. In 2010, the United States produced 3.6 billion kWh of solar power, and in 2020 that figure increased to 132 billion kWh. Solar electricity generation is split between large utility-scale power (68.5%) and smaller, distributed generation systems (31.5%).[69] America is the second-largest solar power producer in the world, with 15% of global electricity generation (second to China, with 32% of global generation).[70] Like wind, solar power fluctuates greatly depending on the time of day and the season, among other factors. The growth of solar power has depended on favorable geography and policy incentives.

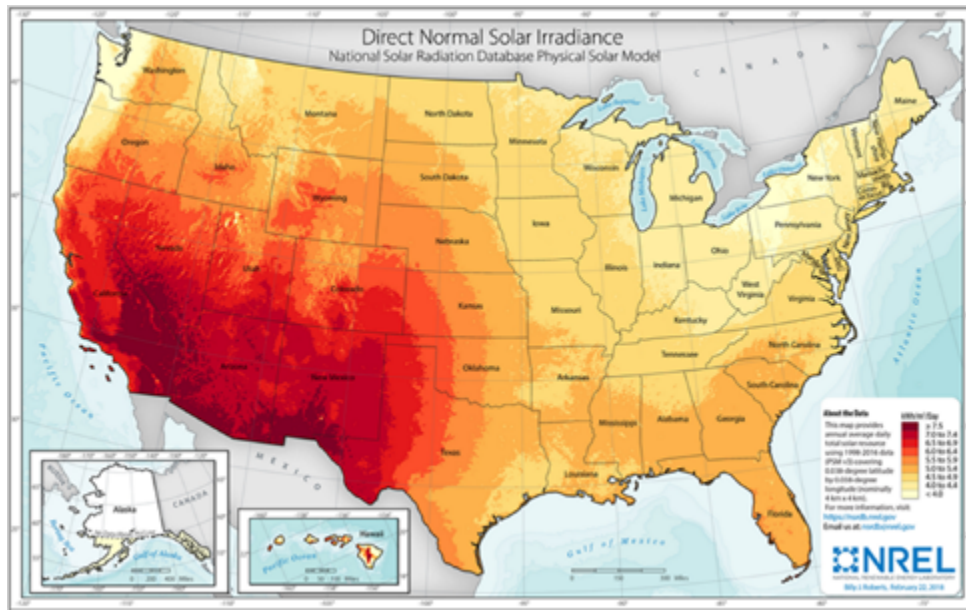
68 Richard Bowers and Owen Comstock, "The United States installed more wind turbine capacity in 2020 than any other year," U.S. Energy Information Administration, available at https://www.eia.gov/todayinenergy/detail.php?id=46976#:~:text=According%20to%20data%20recently%20published,13.2%20GW%20added%20in%202012..

69 "Total Energy: Solar electricity net generation," U.S. Energy Information Administration, available at https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T10.06#/?f=A&start=1984&end=2020&charted=0-4-9-10.

70 "Solar explained: Where solar is found and used," U.S. Energy Information Administration, https://www.eia.gov/energyexplained/solar/where-solar-is-found.php.

U.S. geography is favorable to the cultivation of solar power. The American Southwest and the Sunbelt are ideally configured for solar electricity generation, given high levels of solar irradiance. The top solar-producing states are California (36.1%), Texas (7%), North Carolina (6.9%), Arizona (6.7%), Florida (5.8%), and Nevada (4.6%).[71]

FIGURE 16: U.S. DIRECT NORMAL SOLAR IRRADIANCE



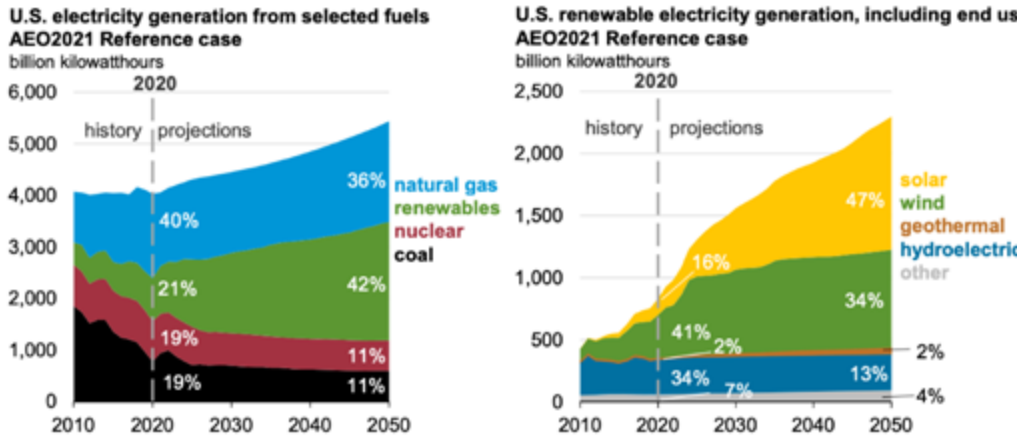
Source: "Solar explained: Where solar is found and used," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/solar/where-solar-is-found.php.

The EIA predicts that although solar power has grown more slowly than wind power in the past, it will explode in popularity starting in this decade. By mid-century, the EIA expects that 47% of all American electricity production will come from solar power. These predictions come from the idea that solar power will soon become competitive with other energy sources, such as natural gas.[72]

71 "Solar explained: Where solar is found and used," U.S. Energy Information Administration.

72 See U.S. Energy Information Administration, *Annual Energy Outlook 2021 Electricity*.

FIGURE 17: PROJECTED U.S. ELECTRICITY GENERATION



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (Washington, DC: U.S. EIA, 2021).

Federal, state, and local governments have various policy incentives designed to increase the production and consumption of green energy, especially wind and solar energy. While these policies vary across the United States, some include financial incentives, requirements on minimum percentages of renewable power production, net metering, ethanol incentives, feed-in tariffs, and renewable energy credits, among others.[73] For the purposes of this report, it is sufficient to understand that these policies have helped the wind and solar power industries grow quickly.

A crucial factor in the growing green energy industry is the rise of electric vehicles. These vehicles and the lithium-ion batteries that power them hold the opportunity for the United States to reduce the transportation sector's current dependency on oil. 91% of the American transportation sector was fueled by oil in 2019.[74] With the prospect of electric vehicles, more American cars can be fueled by cleaner energy sources like natural gas, nuclear, wind, and solar power. Two important points should be made about electric vehicles and the future of the transportation industry. First, the United States is far behind in the global race to secure the mineral resources required to build lithium-ion batteries. The United States is dependent on external sources for lithium, cobalt, nickel, and graphite. Few lithium-ion battery factories under construction globally are located in the United States.[75] Second, while the United States is behind in the global lithium-ion battery race, the U.S. Energy Information Administration (EIA) predicts that fossil fuel-based vehicles will remain dominant in the United States for the foreseeable future, with gasoline and flex-fuel vehicles taking up a vast

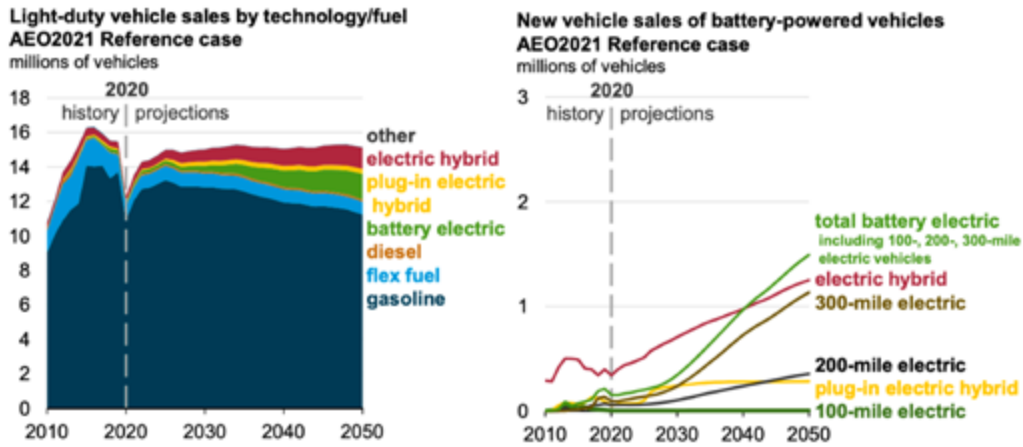
73 "Renewable energy explained: Incentives," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/renewable-sources/incentives.php.

74 "U.S. energy facts explained," U.S. Energy Information Administration.

75 See Simon Moores, Managing Director, Benchmark Mineral Intelligence, "Written Testimony to the US Senate Committee on Energy and Natural Resources Committee, Hearing on Outlook for Energy and Minerals Markets," February 5, 2019.

majority of projected car sales in 2050.[76] Although these predictions could be incorrect, the transition toward electric vehicles will likely have a more marginal impact on American energy security than some might expect.

FIGURE 18: U.S. PROJECTED LIGHT-DUTY VEHICLE SALES BY TECHNOLOGY/FUEL TYPE



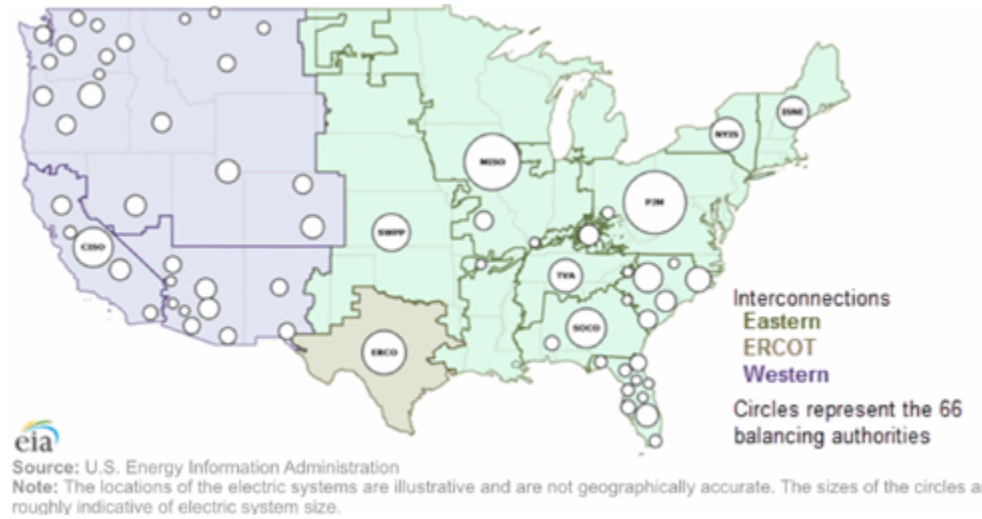
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (Washington, DC: U.S. EIA, 2021).

The American energy grid is a crucial institution for the stability of U.S. energy security, specifically in electricity. Its importance lies in the grid's ability (or lack thereof) to transport energy from the production location to its consumers, handle fluctuations in energy output from sources like wind and solar, and store extra energy when possible. This section will briefly summarize the structure of the American energy grid and some of the issues it faces. The American grid system comprises three major "Interconnections," which are blocs that of linked grids creating a single unit. The three major Interconnections are the Eastern Interconnection, the Western Interconnection, and the Texas Interconnection. The Eastern Interconnection stretches from the east coast in the east, the eastern border of Colorado in the west, Florida in the south, and central Canada in the north.[77] The Western Connection runs from the Rockies to the West Coast and north toward the border of Alaska and Canada. The Texas Interconnection covers the state. These Interconnections are managed at lower levels by balancing authorities, which are usually electric utilities, that direct the flow of energy within the system. The Interconnections are meant to supply redundancy to the grid to prevent outages in crises.

76 U.S. Energy Information Administration, *Annual Energy Outlook 2021: Transportation* (Washington, DC: EIA, 2021), p. 14, https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Transportation.pdf.

77 "Learn More About Interconnections," Office of Electricity, Department of Energy, available at https://www.energy.gov/oe/services/electricity-policy-coordination-and-implementation/transmission-planning/recovery-act-0.

FIGURE 19: U.S. ELECTRIC POWER REGIONS AND INTERCONNECTIONS



Source: Sara Hoff, "U.S. electric system is made up of interconnections and balancing authorities," U.S. Energy Information Administration, July 20, 2016, available at https://www.eia.gov/todayinenergy/detail.php?id=27152.

One of the more pressing issues with the American electrical grid, as currently configured, is that Texas has its own Interconnection. Public awareness of this issue increased during the Winter 2021 Texas power crisis. Texas's freezing temperatures caused the state's infrastructure, which had not been winterized, to effectively shut down for about a week.[78] It was impossible for nearby states to relieve crippled Texan electricity systems during the crisis, as they were not connected. This issue is related to a wider potential problem in the United States' energy structure: Texas is dominant in U.S. energy production. As explained above, the state is home to 41.4% of America's oil and 23.9% of its dry gas production, which leaves the United States vulnerable to localized crises in Texas.[79] During the Texas power crisis, for example, natural gas production in the state dropped by nearly half.[80] Not only is Texas' electricity grid secluded, but also much of current U.S. energy export infrastructure is also located in the state. American oil and natural gas export infrastructure lies on the Gulf Coast, in cities in Texas and Louisiana such as Corpus Christi, Port Arthur, Freeport, Sabine Pass, and Cameron.[81] Particularly in recent years, these cities have been damaged

78 Alex Meier, "69 deaths, 44 hours of freezing, $18 billion in damage: This week's winter storm, by the numbers," *ABC 13*, February 21, 2021, available at https://abc13.com/2021-texas-winter-storm-weather-how-many-people-lost-power-boil-water-advisory/10356914/.

79 "Which states consume and produce the most natural gas?," U.S. Energy Information Administration, available at https://www.eia.gov/tools/faqs/faq.php?id=46&t=8; and "Oil and petroleum products explained: Where our oil comes from," U.S. Energy Information Administration, available at https://www.eia.gov/energyexplained/oil-and-petroleum-products/where-our-oil-comes-from.php.

80 Stephen York, "Texas natural gas production fell by almost half during recent cold snap," U.S. Information Administration, available at https://www.eia.gov/todayinenergy/detail.php?id=46896.

81 Daniel Yergin, *The New Map*, p. 24, 50.

by powerful hurricanes that not only halt exports but also damage the energy infrastructure. Just as Texas' energy consumption is vulnerable to crises, the concentration of energy production in the region will affect wider U.S. oil and gas consumption and exports during such crises. Texan vulnerability may be one of the major threats to ensuring American energy security today and in the long-term.

Assessing American Energy Security

The rapid ascension of the United States as the world's premiere energy producer strengthened U.S. energy security in multiple respects. As a result, this study assesses that the United States is energy secure, with a couple of existing and potential risks. The risks to the U.S. energy industry are infrastructural, environmental, economic, and ecological. This part of the chapter will first describe the ongoing risks to U.S. energy security and then summarize the drivers of American energy security.

As described above, U.S. energy infrastructure weighs down the U.S. ability to translate its energy potential to reality. First, American energy production and export facilities are concentrated in Texas and on the Gulf Coast. This infrastructure faces risks from various potential sources, including natural disasters. This concentration leaves U.S. energy production potential at risk of a crisis in the state. To make matters worse, the Texan electrical grid is disconnected from the rest of the country, reducing the U.S. federal government's ability to resolve a crisis in Texas.

U.S. green energy production is a potential long-term risk to U.S. energy security. As pressure grows to expand the green energy sector due to the consequences of pollution, U.S. energy security may later depend on the speed at which the United States can cultivate green energy. The United States is currently falling behind the PRC in deploying green energy.

As the United States trades freely in global energy markets, the price of U.S. oil and natural gas is still inevitably tied to the supply of and demand for energy from the rest of the world. While this risk may appear obvious, it is worth pointing out the interconnected nature of the global energy market.

Lastly, market conditions and the nature of shale oil and gas production leave the U.S. shale industry more vulnerable to lower prices and price wars than countries with state-controlled oil and gas production.[82] The United States experienced the effects of these conditions in 2020 with the Saudi-Russian oil-price war, and policymakers will need to be aware of foreign states' future attempts to drown American shale production.[83]

82 See Daniel Yergin, *The New Map*, chapter 36.

83 Javier Blas, Salma El Wardany, and Grant Smith, "Saudi Arabia and Russia End Their Oil-price War with Output Cut agreement," *World Oil*, April 9, 2020, available at https://www.worldoil.com/news/2020/4/9/saudi-arabia-and-russia-end-their-oil-price-war-with-output-cut-agreement.

Altogether, these issues show that the United States' energy security is not absolute and that the United States is not "energy independent." Increasing production, however, has made its energy markets remarkably resilient to global fluctuations.[84] The United States is currently energy secure due to the increasing resilience of its energy supply driven by the shale revolution.

First, the U.S. energy market is now more self-sufficient than it has ever been, as much of the overall energy that the United States consumes is produced domestically. Petroleum and natural gas net imports are both either near-zero or negative, signaling self-sufficiency. Unlike the period from the 1970s–2000s, the United States can now trust that its energy will come, for the most part, from the continental United States.

Second, the U.S. energy market now has a significant potential for diversification. With the advent of shale, the U.S. energy sector can now reliably produce oil and gas, along with an increasing supply of green energy. Additionally, the United States can lean on substitute energy sources if required, like coal. A more diverse energy portfolio gives the U.S. energy supply greater resilience to unexpected shocks.

Third, the United States' share of the global oil and natural gas markets is now larger than it has been in half a century. Because of this share, global energy prices will likely be able to absorb fluctuations in energy supply without debilitating changes in energy prices. For example, the success of the U.S. "maximum pressure" campaign against Iran beginning in 2018 depended on the stability of global energy prices, which were underwritten by U.S. energy production. These major changes are indicative of a United States that is more "energy secure." The U.S. economy is less dependent on global energy markets than it was during the decades before the shale revolution. As a result, the United States is less strategically reliant on or influenced by global energy-producing centers, like the Middle East.

As the United States becomes more energy secure, some of the strategic impediments previously driven by energy insecurity will no longer weigh on its policy approaches and global posture. Its decades-long preoccupation with the Middle East to the periodic detriment of its other regional policies will dissipate. With a fading primary focus on the Middle East, the United States can direct its talent and focus on other policy imperatives. For example, it can reserve more resources and intellectual capital for pressing issues like the rise of China and shoring up U.S. domestic strengths. The shale revolution may bolster and enable a long-desired restructuring of U.S. material and intellectual commitments toward the Indo-Pacific, its primary region of strategic interest and threat.

84 For more discussion of American energy independence, see David Blackmon, "The Key Distinction Between U.S. Energy Independence and Energy Security," *Forbes*, January 7, 2020, available at https://www.forbes.com/sites/davidblackmon/2020/01/07/the-key-distinction-between-us-energy-independence-and-energy-security/?sh=34ab6e2f7859; Jason Bordoff, "The Myth of U.S. Energy Independence Goes Up in Smoke," *Foreign Policy*, Septmber 18, 2019, available at https://foreignpolicy.com/2019/09/18/the-myth-of-u-s-energy-independence-has-gone-up-in-smoke/; Jeff Spross, "The myth of energy independence," *The Week*, September 17, 2019, available at https://theweek.com/articles/865174/myth-energy-independence.

Lastly, historical perceptions of U.S. energy consumption must be recalibrated. U.S. energy consumption stopped growing in the early 2000s because U.S. GDP growth became increasingly decoupled from energy consumption demand. There are many reasons for this shift in the United States and other developed nations, including the transition from an industrial economy to a service-based economy, growing energy efficiencies, and the rise of electrification.[85] As the American economy grows, GDP growth will not automatically require commensurate increases in energy consumption, as it has in the past. This trend strengthens the United States' potential to become a crucial global energy supplier. Growing American shale energy production, especially in natural gas, provides the United States with a rare opportunity to become a key provider of energy to its allies and partners. Not only is it increasingly self-sufficient in its energy supply, but it can also assist other countries struggling with import dependency issues by supplying them with high-quality and safe oil and gas. This opportunity will be discussed in further detail in Chapter 5.

In conclusion, the United States has become and will remain remarkably energy secure. Although the U.S. energy industry still faces ongoing risks, its overall energy supplies are self-sufficient, diversified, and resilient. In the broader context of this study, this means that energy security is not a crucial threat to the United States' strategic posture, its ability to project power abroad, nor its continued economic potential. Conversely, China faces serious risks to its energy supplies, as detailed in the next chapter.

85 Namit Sharma, Bram Smeets, and Christer Tryggestad, "The decoupling of GDP and energy growth."

CHAPTER 3

China's Energy Market and its Future Trajectory

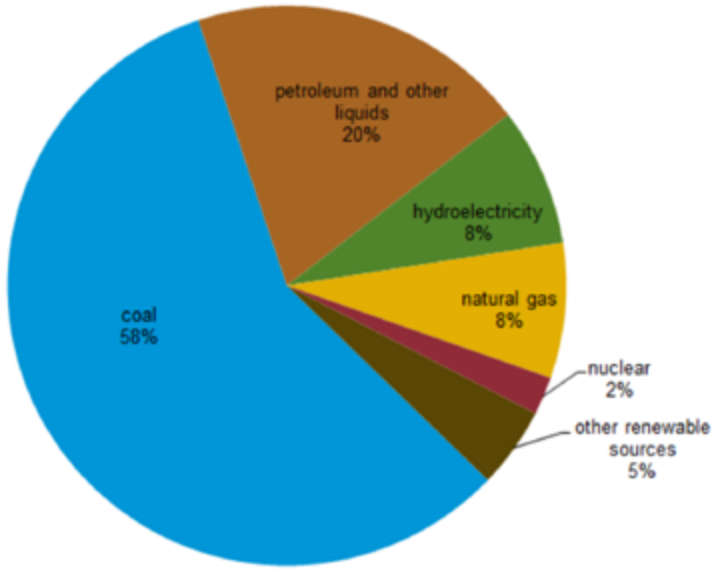
This chapter describes China's energy portfolio and reveals the structural impediments causing China's energy insecurity. China's energy market is highly reliant on coal and external sources of oil and natural gas. While it has made serious attempts to diversify its portfolio away from coal and toward green energy, the costs of widespread transition to these technologies may only increase with time. China's energy security is riddled with risks, and they are geological, geopolitical, infrastructural, economic, environmental, social, and technical in nature. In total, this chapter concludes that China is energy insecure in the short and medium term at least, with opportunities to minimize risks over the long-term depending on the success of state policy and the international environment.

The chapter examines how the future of China's energy market is tied to the future of its whole economy. The first section surveys China's current energy resources, consumption, and energy trade. The second section analyzes recent Chinese policies to address some of its underlying energy challenges. The third section reviews the anticipated trajectory of China's energy market in the long-term.

China's Energy Portfolio

As a developing economy, China still depends on heavy industry for much of its growth. It is the largest energy consumer in the world, buying substantial energy from global energy markets to continue functioning. It primarily relies on coal (58%), along with oil (20%), natural gas (8%), hydroelectricity (8%), and other renewable resources (7%). Of these, only coal is in abundance within China's borders. This abundance, coupled with energy demands, resulted in China becoming the world's largest emitter of greenhouse gases beginning in 2006.

FIGURE 20: CHINA'S ENERGY CONSUMPTION BY FUEL TYPE, 2019



Source: Country Analysis Executive Summary: China (Washington, DC: U.S. Energy Information Administration, 2020), p. 2, available at https://www.eia.gov/international/content/analysis/countries_long/China/china.pdf.

China has some of the largest reserves of coal in the entire world. It is estimated to have 138.8 billion tons of coal, 13.2% of the global total.[86] The majority of these reserves are concentrated in China's northern provinces, including Shanxi, Inner Mongolia, Shaanxi, and Xinjiang.[87] As a result, Chinese coal is usually shipped across the country by train to the population and manufacturing centers clustered in the eastern provinces. Coal is China's primary energy source, which is one of the main reasons China is the world's top carbon dioxide emitter. Because of its vast reserves, most of its coal consumption is locally extracted, with less than 10% imported.[88]

Coal is the only fossil fuel that China can produce to satisfy the majority of its consumption, explaining its dominance in Chinese energy markets. China has been working to reduce dependence on coal for years, however.

The location of domestic coal deposits poses two problems for China. First, since its reserves are concentrated in its landlocked north and northwest, China must expend more resources—nearly half of its rail capacity—to transport and deliver it across the country, especially to the

86 "BP Statistical Review of World Energy: Coal, 68th edition, 2019," *BP*, p. 42, available at https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-coal.pdf.

87 "Top 3 provinces contribute 70% of China's coal output in Jan-May," *The Coal Hub*, available at https://thecoalhub.com/top-3-provinces-contribute-70-of-chinas-coal-output-in-jan-may.html.

88 *Country Analysis Executive Summary: China (*Washington, DC: U.S. Energy Information Administration, 2020), p. 12, available at https://www.eia.gov/international/content/analysis/countries_long/China/china.pdf.

manufacturing and population centers in the east and south.[89] Land-based transportation is costly compared to shipping by sea. While most countries with domestic energy production can keep their industrial centers close to their energy sources, China's sources are far apart, requiring the energy sector to transport coal across vast swaths of its territory. These costs undoubtedly reduce the convenience of China's only plentiful fossil fuel.

Second, the coal mine locations are politically risky. Some of its highest coal-producing provinces, Inner Mongolia and Xinjiang, have large non-Chinese ethnic minority groups that chafe under Beijing's heavy-handed domestic security efforts. Inner Mongolia produced 27% of China's coal in June 2019, more than any other province. While Xinjiang produced 5.5% of China's coal in June 2019, it still sits among the top four coal-producing provinces.[90] Inner Mongolians protested in 2020 against an official plan to only teach in Mandarin in local schools.[91] The Chinese Communist Party's campaign to crack down on Uyghur culture and religion by imprisonment and "re-education" has become an apparent genocidal effort, to the horror of the world. These perceived pressures on China's domestic coal production are another source of weakness for China's energy market.

Although over 90% of China's coal usage is domestically sourced, its coal energy production remains remarkably fragile, as demonstrated by China's electricity blackouts in the winter of 2020–2021. Higher industrial output, domestic supply issues, and bans on Australian coal (which accounts for about 2% of total coal consumption) resulted in the worst energy blackout in a decade.[92] The outage stemmed from coal shortages, which should have been the most reliable and secure energy source for China. China's energy market will be vulnerable to outside shocks moving forward.

China's coal mines are also dangerous by global standards. Hundreds of Chinese miners die in accidents every year, and the Chinese coal market is known for its sparse and loosely enforced regulations. The coal industry is a major employer of migrant workers, potentially adding to the sector's instability.[93]

89 "Nuclear Power in China," *World Nuclear Association*, updated January 2021, available at https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx.

90 "2020年上半年全国分省区原煤产量排名公布 [National raw coal production rankings announced by provinces in the first half of 2020]," 中国煤炭市场网 [*China Coal Market Net*], July 20, 2020, available at https://www.cctd.com.cn/show-361-204515-1.html.

91 Helen Davidson, "Inner Mongolia protests at China's plans to bring in Mandarin-only lessons," *The Guardian*, September 1, 2020, available at https://www.theguardian.com/world/2020/sep/01/inner-mongolia-protests-china-mandarin-schools-language.

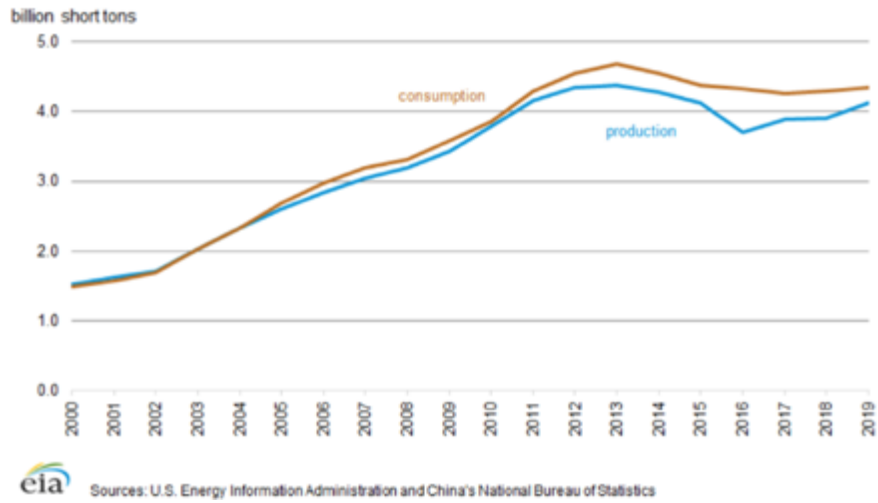
92 *China,* U.S. Energy Information Administration, p. 11-12; Elizabeth Chen, "Winter Coal Shortages Reveal Chinese Energy Vulnerabilities," *China Brief*, vol. 21, issue 1, available at https://jamestown.org/program/winter-coal-shortages-reveal-chinese-energy-vulnerabilities/.

93 Elizabeth Law, "Mining in China fraught with danger, but higher pay draws workers to the industry," *The Straits Times*, January 30, 2021, available at https://www.straitstimes.com/asia/east-asia/mining-in-china-fraught-with-danger-but-higher-pay-draws-workers-to-the-industry; and Mark Gregory, "Why are China's mines so dangerous?," *BBC World Service*, October 7, 2010, available at https://www.bbc.com/news/business-11497070.

Importantly, coal is a dirty energy source. 80% of China's world-leading CO2 emissions come from burning coal.[94] Chinese air quality is one of the worst in the world due to its use of coal and other polluting factors, and it negatively impacts the air quality of all of its neighboring countries. Lung cancer is one of the leading causes of death in China, attributable to air quality (and smoking, among other causes).[95] This pollution problem is one of the key ingredients driving domestic unrest.[96] These issues have driven the Chinese government to seek to limit, although unsuccessfully, the increase of coal consumption; the government has also worked to move coal smokestacks away from metropolises when possible.[97]

Coal is the paradoxical nexus of two of China's pressing energy priorities: reducing pollution and decreasing reliance on external energy sources. If the Chinese government is serious about reducing its pollution and related domestic unrest, it must further reduce coal consumption. However, doing so would demand that it increase its energy imports and/or increase investment in expensive green energy projects and energy infrastructure transformation. The conflict between emissions reductions and energy imports lies at the heart of China's energy insecurity dilemma.

FIGURE 21: CHINA'S COAL CONSUMPTION AND PRODUCTION, 2000-2019



Source: *China*, U.S. Energy Information Administration, p. 12.

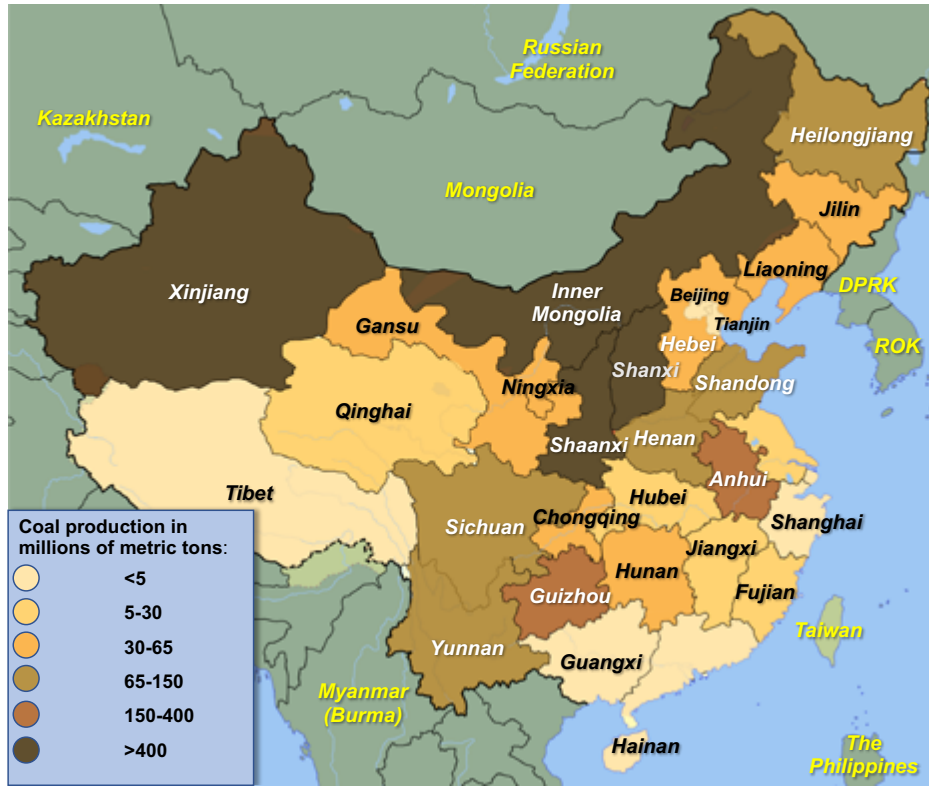
94 I.E.A, "Data and Statistics: CO2 Emissions by Source, People's Republic of China," available at https://www.iea.org/data-and-statistics?country=CHINAREG&fuel=CO2%20emissions&indicator=CO2BySource.

95 "Cancer in China: More Than 7500 Deaths Per Day Estimated," *The Cancer Atlas*, January 28, 2016, available at https://canceratlas.cancer.org/news/cancer-in-china-more-than-7500-deaths-per-day-estimated/.

96 James Griffiths, "China has made progress on air pollution. Wuhan protests show there's still a long way to go," *CNN*, July 11, 2019, available at https://www.cnn.com/2019/07/10/asia/china-wuhan-pollution-problems-intl-hnk/index.html; Salvatore Babones, "Red Alert for China's pollution protestors," *Aljazeera*, February 20, 2017, available at https://www.aljazeera.com/opinions/2017/2/20/red-alert-for-chinas-pollution-protesters.

97 Andrew S. Erickson and Gabriel Collins, "Competition With China Can Save the Planet: Pressure, Not Partnership, Will Spur Progress on Climate Change," *Foreign Affairs*, May/June 2021, available at https://www.foreignaffairs.com/articles/united-states/2021-04-13/competition-china-can-save-planet.

FIGURE 22: CHINA'S COAL PRODUCTION BY PROVINCE



Source: CSBA graphic, inspired by Elizabeth Chen, "Winter Coal Shortages Reveal Chinese Energy Vulnerabilities," *China Brief*, Jamestown Foundation, January 12, 2021, available at https://jamestown.org/program/winter-coal-shortages-reveal-chinese-energy-vulnerabilities/. Map underlay courtesy of Wikimedia. From lightest to darkest, shading indicates coal production in millions of metric tons as follows: less than 5, 5-30, 30-65, 65-150, 150-400, more than 400.

Oil is another problem for China. In 2019, China had 1.5% of the world's proven oil reserves, amounting to 26.2 billion barrels.[98] That same year, it produced 4.9 million b/d of oil. Although this is a high production rate, both by global standards and China's low reserves, its production is relatively expensive because it comes from legacy fields and older technologies.[99] China's oil production does not satisfy its growing consumption needs—China consumed 14.5 million b/d of oil in 2019. In total, petroleum accounts for 20% of China's total energy consumption.

China imported 10.1 million b/d of crude oil in 2019. A large plurality (44%) of its oil imports come from the Middle East, namely Saudi Arabia (16%), Iraq (10%), and Oman (7%). Russia (15%), Angola (9%), and Brazil (8%) are also major sources of its oil. While most of its oil imports are shipped by sea, those from Russia cross borders via pipeline.[100]

98 "Statistical Review of World Energy: Oil," *BP*, 2020, available at https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-oil.pdf.

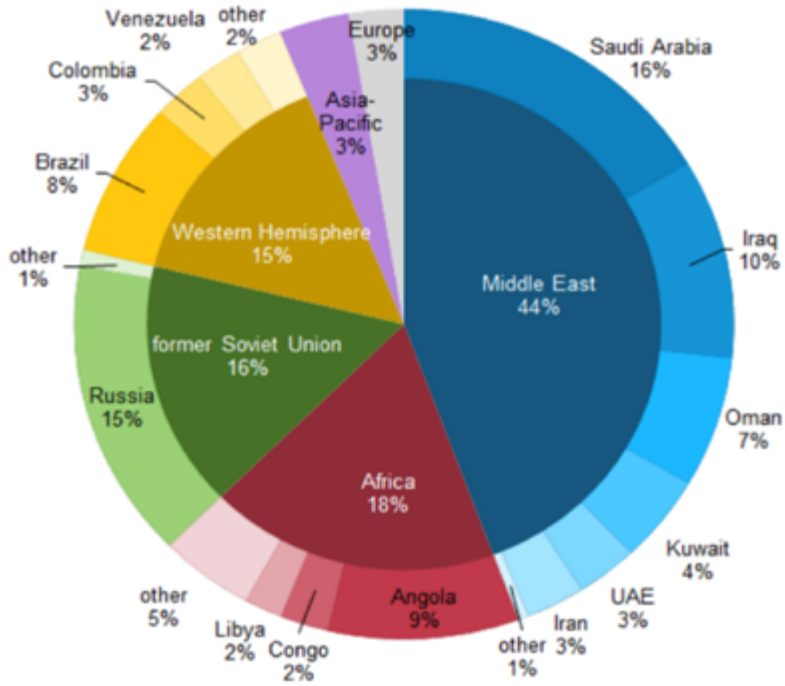
99 *China*, U.S. Energy Information Administration, p. 3.

100 *China*, U.S. Energy Information Administration, pp. 5-6.

China's high imports of Middle Eastern oil, especially from U.S. partners like Saudi Arabia and Iraq, clarifies Chinese strategists' anxiety about the United States' options to influence the region. Additionally, China has struggled to adapt and master deep-water offshore drilling technology.

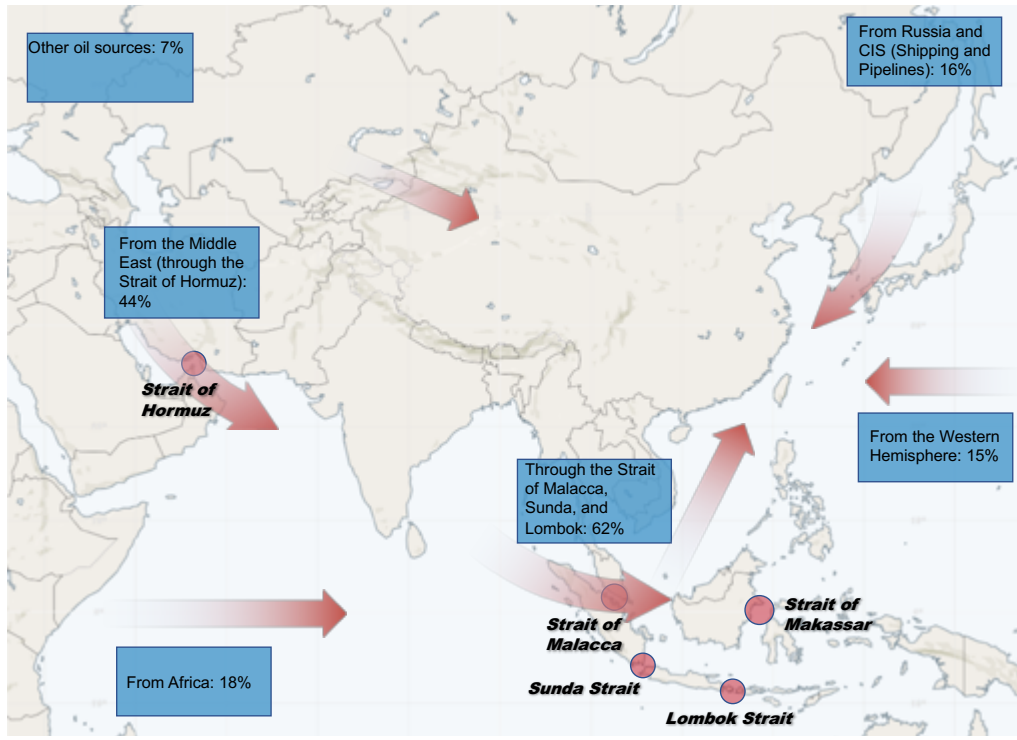
Oil's domination of the domestic Chinese transportation sector is one of the primary reasons oil remains such a weakness for China's economy. Whereas coal and natural gas dominate the industrial sector, oil fuels China's rapidly expanding car market, rendering the Chinese transportation sector uniquely susceptible to outside shocks. This challenge mirrors the U.S. transportation sector's vulnerabilities before the shale revolution.

FIGURE 23: CHINA'S CRUDE OIL IMPORTS BY SOURCE, 2019



Source: *China*, U.S. Energy Information Administration, p. 6.

FIGURE 24: CHINESE GLOBAL OIL IMPORTS, 2019



Source: CSBA graphic, with data from *China*, U.S. Energy Information Administration, p. 6.

China has accelerated building up its Strategic Petroleum Reserves (SPR) since 2016, intending to have at least 90 days of reserve fuel. The government has an estimated 290–370 million barrels in 12 SPR facilities as of the end of 2020. At the 2019 consumption rates of 14.5 million b/d, the reserve could last at most 26 days. In 2019, China had an estimated 600 million barrels in commercial storage capacity. Together, the SPR and commercial reserves could last for about 67 days.[101] During a crisis, consumption would inevitably decrease, making these reserves last longer than these estimates. With these reserves, China can weather a short-term shock to its oil imports but would have difficulty adapting to longer-term disruption.

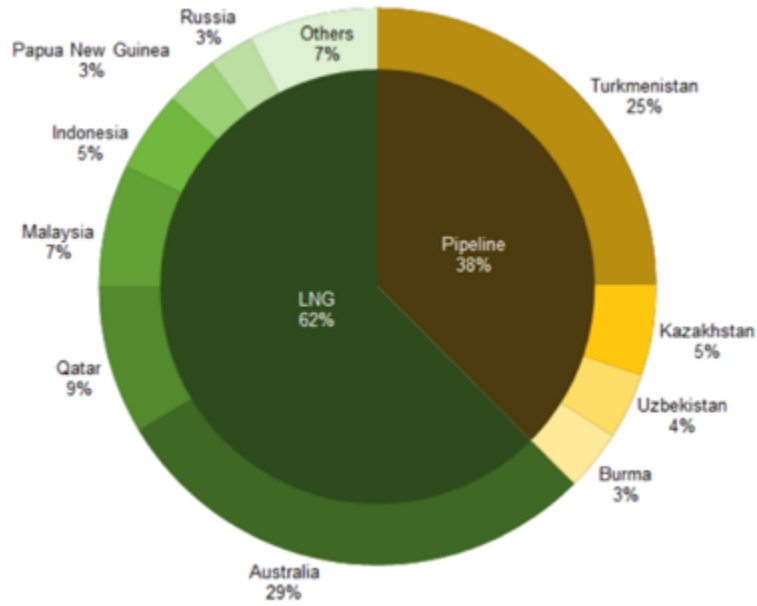
There has been an interest in potential oil or gas development in the South China Sea, within China's "9-Dash Line" of claimed maritime territory. While China has come into conflict with its southern neighbors over the potential resources in the area, these reserves are more meager than initially expected by the Chinese government. These resources also mostly fall outside China's territorial claims and would be technically complex to extract in

101 Reuters Staff, "FACTBOX-China's top independent crude oil storage operators, SPR updates," *Reuters,* available at https://www.reuters.com/article/china-oil-storage/factbox-chinas-top-independent-crude-oil-storage-operators-spr-updates-idUSL4N2HS1CV.

contested waters. These resources, if exploited, would likely not significantly change China's energy issues.[102]

China's natural gas is similarly dependent on outside sources. While natural gas is increasingly used for electricity and transportation, it is primarily used in industry, mining, and oil and gas extraction.[103] China has 296.6 trillion cubic feet (Tcf) of natural gas in its reserves, or 4.2% of the world total.[104] In 2019, China produced 6.3 Tcf of natural gas, and it consumed 10.8 Tcf that same year. It is currently the world's third-largest natural gas consumer, and its consumption is increasing quickly.[105] To make up for lagging domestic production, China imported 4.6 Tcf of natural gas. It imported 62% of the natural gas through sea-based shipping from Australia (29%), Qatar (9%), Malaysia (7%), and Indonesia (5%). 38% of China's natural gas imports come from Central Asia, with Turkmenistan supplying the majority of those imports.[106] As China's imports of natural gas grow, it will have to increasingly rely on sea-based imports to fulfill that demand.

FIGURE 25: CHINA'S NATURAL GAS IMPORTS BY SOURCE, 2019



Source: *China*, U.S. Energy Information Administration, p. 10.

102 Daniel Yergin, *The New Map*, p. 160.

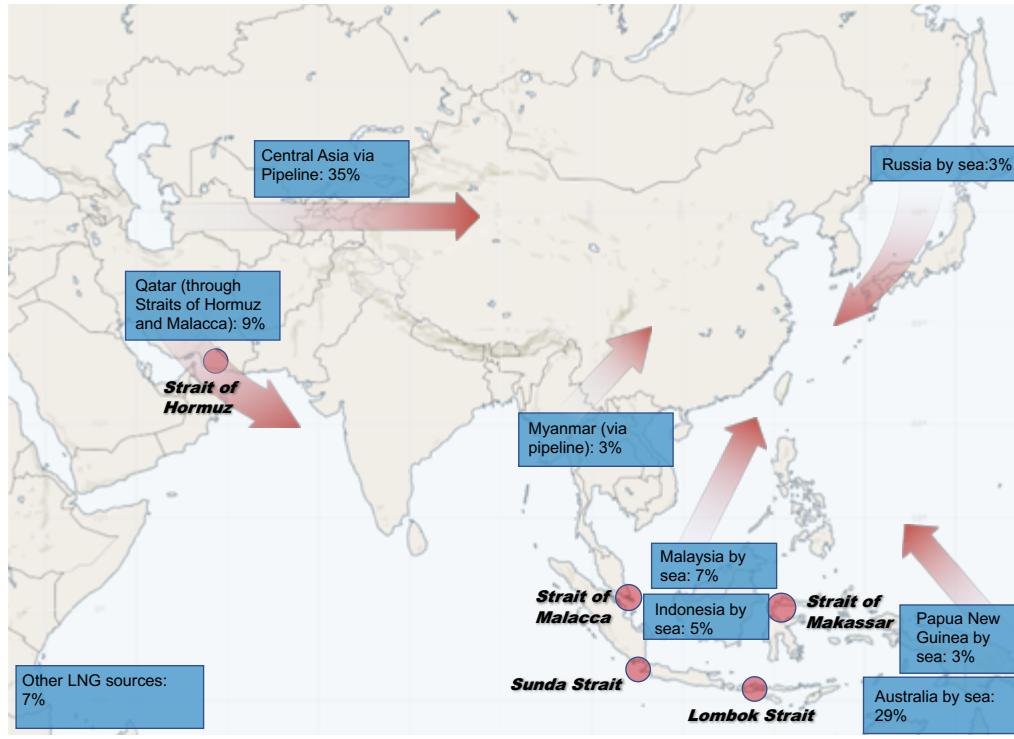
103 *China*, U.S. Energy Information Administration, p. 7.

104 "Statistical Review of World Energy: Natural Gas," *BP*, 2020, available at https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-natural-gas.pdf.

105 *China*, U.S. Energy Information Administration, p. 7.

106 Ibid, p. 10.

FIGURE 26: CHINESE GLOBAL NATURAL GAS IMPORTS, 2019



Source: CSBA graphic, with data from *China*, U.S. Energy Information Administration, p. 10.

Oil and natural gas imports are one of China's primary energy vulnerabilities. Coming from all over the world, these imports are vulnerable by both land and sea. In a crisis, crucial energy supplies could dry up quickly, which worries Chinese strategists. China's sea-based energy imports are more convenient for its nominal costs and China's industrial centers on its east coast. Sea-based shipping is much cheaper than land-based shipping. These supplies can arrive by sea directly to China's primary economic centers, like Shanghai.

While cheap and convenient, the delivery routes for these supplies are insecure. First, they flow through maritime chokepoints. Nearly half of China's oil imports run through the Strait of Hormuz,[107] and 80% of China's oil imports shipped through the Strait of Malacca in 2016.[108] Second, the People's Liberation Army Navy (PLAN) is not equipped to protect these shipments. The PLAN aspires to build its power-projection capabilities in the coming decades, but in the short- and medium-term, China will not be able to reliably guarantee the

107 *China*, U.S. Energy Information Administration, p. 6.

108 "How Much Trade Transits the South China Sea?" *ChinaPower*, the Center for Strategic and International Studies available at https://chinapower.csis.org/much-trade-transits-south-china-sea/#:~:text=This%20is%20especially%20true%20for,via%20the%20Strait%20of%20Malacca..

safety of its oil imports.[109] This insecurity of sea-based imports is often referred to as the "Malacca Dilemma."

Inland waterway transportation options are limited. China's land-based oil and natural gas shipping faces similar problems as coal. China has multiple long pipelines that are indefensible along their entirety. These pipelines are most important for natural gas imports, as 38% of China's imports come through them. The most important by far is the Central Asia-China gas pipeline, which stretches 8046km from Turkmenistan to Shanghai.[110] Other, less important pipelines include the Power of Siberia and the Myanmar-China Oil & Gas Pipeline. Russian exports of gas may increase when the Altai gas pipeline is completed. The Myanmar–China Oil & Gas Pipeline is insecure because of regional ethnic tensions and crime along the Myanmar–China border, not to mention the ongoing post-coup unrest in the country.[111]

Understanding its insecurity in fossil fuels, the Chinese government is committed to developing green energy. Hydropower is China's best-performing green energy source. In 2019, hydropower produced 8% of China's total energy consumption and 19% of its electricity capacity.[112] China is the world's largest producer of hydroelectricity. China's mountainous terrain and long rivers grant it numerous locations for dams; however, the dam infrastructure locations are often in regions susceptible to flooding and seismic activity.[113]

The rest of China's green energy sources are currently insignificant portions of consumption compared to other modes. Solar power, wind power, nuclear power, and other sources combined produce only 7% of China's total energy consumption. These energies and China's efforts to introduce these alternative energy types will be discussed in the following section.

China's energy portfolio is dirty and externally dependent. Its only plentiful internal source of energy, coal, is tied to its pollution crisis. China also must rely on external sources of coal, oil, and natural gas. These sources are vulnerable to external shocks. For all of the recent

109 See Andrew S. Erickson and Gabriel S. Collins, "China's Oil Security Pipe Dream: The Reality, and Strategic Consequences, of Seaborne Imports," *Naval War College Review*, 63.2 (Spring 2010): 88-111.

110 "Central Asia-China Gas Pipeline, Turkmenistan to China," *Hydrocarbons Technology*, available at https://www.hydrocarbons-technology.com/projects/centralasiachinagasp/; CNPC, *West-East Pipeline Project (2002-2013) Special Report on Social Responsibility* (Beijing, CNPC, 2013), p. 6, available at https://www.cnpc.com.cn/en/cs2012en/201407/3d2ccb479ad94ef4a6c54ce4d78685fa/files/8440f95e4b454eb082d557b5261d667c.pdf.

111 Neslihan Topcu, "A Relationship on a Pipeline: China and Myanmar," *China Research Center*, October 12, 2020, available at https://www.chinacenter.net/2020/china_currents/19-3/a-relationship-on-a-pipeline-china-and-myanmar/; "Myanmar Rohingya: What you need to know about the crisis," *The BBC*, January 23, 2020, available at https://www.bbc.com/news/world-asia-41566561; and Ralph Jennings, "Casinos, COVID or Drugs? Why China is Building a Fence on Myanmar Border," December 23, 2020, available at https://www.voanews.com/east-asia-pacific/casinos-covid-or-drugs-why-china-building-fence-myanmar-border.

112 U.S. Energy Information Administration (EIA), *Country Analysis Executive Summary: China* (Washington, DC: EIA, 2020), pp. 2, 15, available at https://www.eia.gov/international/content/analysis/countries_long/China/china.pdf.

113 Grace Qi, "Thousands evacuated as floods threaten a massive dam and a treasured Buddha in China," *CBS News*, August 20, 2020, available at https://www.cbsnews.com/news/three-gorges-dam-china-floods-evacuations-deaths-leshan-giant-buddha-unesco-site/.

excitement about China's proclamations of leadership in green energy, coal remains the majority of the country's energy production. This assortment of challenges come together to present China with an energy dilemma, wherein the PRC faces few good paths to simultaneously solve its pollution crisis and reliance on external sources of energy without endangering the Chinese economy. Despite this dilemma, the Chinese government has instituted a broad suite of policies to reduce these energy weaknesses.

Chinese Policy to Address its Energy Dilemma

The Chinese government recognizes its energy dilemma. It has sometimes taken extraordinary measures to ameliorate its pollution and reliance on outside sources of energy. Nevertheless, geographic, technical, institutional, and budgetary challenges may start to hold back its future energy gains. Overall, the PRC's goal is to reduce its reliance on environmentally harmful coal and externally sourced oil and gas so that more of its energy portfolio is environmentally friendly and internally produced. These efforts produce a PRC striving to become an "electro-state," wherein all of China's power is produced locally by sources such as nuclear, wind, and solar, and is connected to a comprehensive electric grid. China's recent official government plans to achieve these goals have focused on two simultaneous efforts: energy conservation and alternative energy production.[114] Both of these policy directions reduce Chinese reliance on coal, oil, and gas. These efforts are shown in the 12th Five-Year Plan (FYP), 13th Five-Year Plan, Made in China 2025 (MIC 2025), the government's opinion on strategic emerging industries, and, most recently, the 14th Five-Year Plan.

Energy conservation has been a high priority of the Chinese government for decades. By reducing the amount of energy that Chinese industry requires, the economy would become less dependent on foreign sources of energy and less reliant on coal production over time. China has primarily targeted New Energy Vehicles (NEVs) and advanced energy-saving equipment to accomplish this goal. The previous 863 applied research plan had the NEV slogan "3 Vertical, 3 Horizontal" (三纵三横), referring to hybrid cars, pure EVs, and fuel cell vehicles; and batteries, motors, and control systems, respectively.[115] Both the 13th Five-Year Plan and the MIC 2025 plan highlight two specific energy priorities: NEVs and advanced energy-saving technologies and equipment.[116] More recently, the "Guiding Opinions on Expanding Investment in Strategic Emerging Industries and Cultivating Strengthened New Growth Points and Poles" (Opinion on Strategic Emerging Industries) was released ahead of

114 See Tai Ming Cheung et al, *Planning for Innovation*, pp. 68-117.

115 Tai Ming Cheung et al, *Planning for Innovation*, p. 105.

116 Katherine Koleski, *The 13th Five-Year Plan* (Washington, DC: U.S.-China Economic and Security Review Commission, 2017), p. 21, available at https://www.uscc.gov/sites/default/files/Research/The%2013th%20Five-Year%20Plan_Final_2.14.17_Updated%20(002).pdf; Karen M. Sutter, *"Made in China 2025" Industrial Policies: Issues for Congress* (Washington, DC: Congressional Research Service, 2020), p. 1, available at https://crsreports.congress.gov/product/pdf/IF/IF10964/6.

the writing of the 14th FYP calls for additional investment in supporting infrastructure for NEVs and advanced energy-saving equipment. [117]

Indeed, China has made substantial progress in both efforts. China now has the world's largest electric vehicle (EV) market, manufacturing 60% of global electric vehicles.[118] EVs carry the benefit of reducing oil reliance, possibly reducing pollution, and decreasing Chinese dependence on Western technology.[119] The State Council projected in 2020 that the new energy vehicle market would take up 20% of China's new car sales in 2025.[120] To build its world-leading EV market, China has taken the global lead in producing the lithium-ion batteries at the heart of electric vehicles. The PRC currently produces more than 70% of global lithium-ion batteries.[121] To do so, it has sought to dominate the global markets for the materials required to produce lithium-ion batteries: lithium, cobalt, bauxite, nickel, and graphite, among others. Nearly 30% of the global lithium supply is owned by China, with about half of those supplies sourced from foreign acquisitions.[122] The Democratic Republic of the Congo holds 69% of global raw cobalt supplies, and China invests in mining in the country.[123] Almost 35% of global bauxite is produced by China, either domestically or through its international investments. As nickel's importance in EV production increases, China has invested in Indonesia and the Philippines to acquire stores.[124] Lastly, the PRC holds 56% of global raw graphite supplies and 100% of global spherical graphite.[125] China's energy efficiency stemming from technologies like energy-saving equipment has developed rapidly as well; it has primarily reduced inefficiency in the industry and services sectors of the

117 Elsa Kania, Ngor Luong, Caroline Meinhardt, Ben Murphy, Dahlia Peterson, Helen Toner, Graham Webster, and Emily Weinstein, "New Chinese Ambitions for 'Strategic Emerging Industries,' Translated," *Center for Security and Emerging Technology* and *DigiChina Project*, September 29, 2020, pp. 6-8, available at https://cset.georgetown.edu/wp-content/uploads/t0222_emerging_industry_opinions_EN.pdf.

118 See Gavin Thompson, Huang Miaoru, and Zhou Yanting, *Tectonic Shift: China's world-changing push for energy independence* (Edinburgh, United Kingdom: Wood Mackenzie, 2021), p. 8.

119 Scott Kennedy, "The Coming NEV War? Implications of China's Advances in Electric Vehicles," *CSIS Briefs*, Center for Strategic and International Studies, November 18, 2020, available at https://www.csis.org/analysis/coming-nev-war-implications-chinas-advances-electric-vehicles; Chinese EVs don't reduce pollution as much as in Western countries, as Chinese EVs receive their power generation from coal. See Gabriel Collins, "China's Evolving Oil Demand: Slowing Overall Growth, Gasoline Replacing Diesel as Demand Driver, Refined Product Exports Rising Substantially, Working Paper," *Baker Institute for Public Policy*, available at https://www.bakerinstitute.org/media/files/files/e0b5a496/WorkingPaper-ChinaOil-093016.pdf.

120 Reuters Staff, "New Energy Vehicles to Make Up 20% of China's New Car Sales in 2025," *Reuters*, November 2, 2020, available at https://www.reuters.com/article/us-china-autos-electric/new-energy-vehicles-to-make-up-20-of-chinas-new-car-sales-by-2025-idUSKBN27I0W9.

121 Gavin Thompson, Huang Miaoru, and Zhou Yanting, *Tectonic Shift,* p. 8.

122 Gavin Thompson, Huang Miaoru, and Zhou Yanting, *Tectonic Shift,* p. 8.

123 Simon Moores, "Written Testimony of the US Senate Committee on Energy and Natural Resources Committee, Hearing on Outlook for Energy and Minerals Markets," February 5, 2019, pp. 4-5.

124 Simon Moores, "Hearing on Outlook for Energy and Minerals Markets," pp. 5-6; and Gavin Thompson, Huang Miaoru, and Zhou Yanting, *Tectonic Shift,* p. 8.

125 Simon Moores, "Hearing on Outlook for Energy and Minerals Markets," p. 8.

economy.[126] Through these policy efforts, the Chinese state hopes to reduce oil consumption and thus oil reliance.

China has similarly focused on increasing the share of alternative energy in its portfolio. This alternative energy comes from the development of both shale gas and green energy, or renewables. The 13th FYP (2016-2020) targeted 15% of China's total energy consumption to come from non-fossil fuel sources by 2020 and 20% by 2030.[127] The FYP targeted growth in shale gas, nuclear energy, hydropower, solar power, and wind power as major approaches for energy production growth. The FYP set several goals for 2020, including jumpstarting China's shale gas industry, doubling its nuclear energy capacity to 58 gigawatts (GW), adding 60 GW of hydropower capacity to reach 380 GW, increasing solar electricity production from 43.2 GW to 110GW, and boosting wind power from 150GW in 2015 to 210GW.[128] As of early 2021, China appeared to have missed its goals for shale gas production, nuclear energy capacity, and hydropower capacity.

The 13th FYP called for China to increase its shale gas production to 30 billion cubic meters by 2020. To achieve this ambitious goal, China sought to master shale drilling below 3,500m depths, build market competition, welcome foreign investment, and encourage joint partnerships.[129] China would follow America's path to build a shale revolution in the eastern hemisphere. By 2030, the CCP called for 80-100 billion cubic meters of shale gas production per year.[130] China has some of the world's largest confirmed shale deposits, but most of it is not yet cost-effective to reach using existing technology. For example, 80% of its technically recoverable shale gas is in the Sichuan basin.[131] Sichuan's mountainous terrain makes drilling incredibly difficult.

126 Energy Efficiency in China," *International Energy Agency*, November 14, 2018, available at https://www.iea.org/articles/energy-efficiency-in-china.

127 "China Renewable Energy Development Five Year Plan (2016-2020), *International Energy Agency*, June 1, 2018, available at https://www.iea.org/policies/6277-china-13th-renewable-energy-development-five-year-plan-2016-2020?page=4&sector=Multi-sector.

128 David Stanway and Kathy Chen, "China to Boost Nuclear Fuel Reserves to Feed New Reactors," *Reuters*, March 11, 2016, available at https://www.reuters.com/article/us-china-uranium/china-to-boost-nuclear-fuel-reserves-to-feed-new-reactors-idUSKCN0WD0D7; "Hydropower: Guide to Chinese Climate Policy," *Center on Global Energy Policy, Columbia University*, available at https://chineseclimatepolicy.energypolicy.columbia.edu/en/hydropower#:~:text=The%2013th%20Five%2DYear%20Plan%20includes%20a%20target%20of%2060,of%20hydropower%20capacity%20by%202025.&text=The%2013th%20Five%2DYear%20Plan%20also%20contains%20a%20goal%20of,and%2090%20GW%20by%202025; Anders Hove, "Understanding China's Latest Solar Five-Year Plan," *Paulson Institute*, March 6, 2017, available at https://www.paulsoninstitute.org/archives/understanding-chinas-latest-solar-five-year-plan/; Jorrit Gosens, Tomas Kåberger, and Yufei Wang, "China's next renewable energy revolution: goals and mechanisms in the 13th Five Year Plan for energy," *Energy Science and Engineering*, volume 5, issue 3, June 26, 2017.

129 Calls for foreign investment and joint partnerships align with the strategies to import the shale revolution examined in Chapter 2.

130 "国家能源局关于印发页岩气发展规划 [National Energy Administration on Developing and Distributing Shale Gas Development Plan]," 国家能源局 [*National Energy Administration*], September 14, 2016, available at http://zfxxgk.nea.gov.cn/auto86/201609/t20160930_2306.htm.

131 Sebastian Lewis, "Insight from Shanghai: Can shale gas secure China's energy security?" *S&P Global Platts*, April 28, 2020, available at https://www.spglobal.com/platts/en/market-insights/blogs/natural-gas/042820-insight-from-shanghai-can-shale-gas-secure-chinas-energy-security.

China's shale dreams have not come true thus far, and there is no reason to believe they will.[132] In 2019, it reached a little over half its 2020 goal, producing 15.5 billion cubic meters of shale gas. Several factors contribute to this slow development. First, the market is dominated by state-run energy giants, China National Petroleum Corporation (CNPC) and Sinopec, preventing the growth of competitive market conditions like the ones crucial to the United States' shale revolution. Second, the shale in the Sichuan basin is geologically daunting, with so much of the gas stored more than 4,000m below the earth's surface. Under current conditions and technologies, Chinese shale gas is not commercially viable. Even drastically increased Chinese shale production is unlikely to fully remedy its dependency challenges on external energy sources.

FIGURE 27: CHINA'S SHALE GAS DEPOSITS

Source: CSBA graphic, with data from Wayne Ma, "China's Shale-Gas Boom Slow to Start," *The Wall Street Journal*, December 3, 2012, available at https://www.wsj.com/articles/SB10001424127887323401904578156710038647662.

Hydropower is China's leading green energy source today, producing 8% of its total energy consumption. China's mountainous geography and long rivers allow it to scatter dams across

132 It is worth noting that the CCP often sets lofty and unrealistic goals. For example, China's poverty alleviation goal of 2020 led to questionable standards and policy procedures. See Alice Su, "China fulfills a dream to end poverty. Not all poor people feel better off," *LA Times*, November 27, 2020, available at https://www.latimes.com/world-nation/story/2020-11-27/china-2020-poverty-eradication-dream.

its massive internal territory. In 2019, China's installed hydropower capacity was 356.4 GW, with the Three Gorges Dam—the world's largest hydroelectric dam–alone producing a stunning 22.5GW of electricity per year. [133] The PRC recently launched the Baihetan hydropower plant on the Yangtze River, which is projected to be China's second most powerful hydro plant.[134] China plans to continue to grow its hydropower capacity, and it announced plans in 2021 for a massive dam in Tibet that would rival the Three Gorges.[135] It is worth noting, however, the natural limits of continuing massive hydroelectric projects. As China has already built dams on the most promising sites, the return on investment for new hydroelectric plants will decrease with time.[136] This issue is similar to the United States' hydropower situation. The EIA projects that China's hydroelectric growth will slow, and its hydroelectricity production will stop growing at all after 2025.[137]

The PRC is a global leader in nuclear energy, and this is an ideal energy source for Chinese policymakers. Nuclear energy can reduce pollution by replacing coal, and the power plants can be located much closer to economic centers than coal, wind, and solar power. Nuclear fuel can also more easily be stockpiled, and China already has the reserves to keep its nuclear plants running for many years, reducing its exposure to outside shocks.[138] Although China has made progress in increasing its nuclear power capacity, it only makes up 2% of China's domestic energy consumption.[139] China did not reach the 13th FYP's goals for nuclear energy, with only 46GW achieved instead of the targeted 58GW. The primary roadblock that China will face as it continues to build up its nuclear energy capacity is the high upfront capital costs nuclear plants require.[140] Any fiscal issues China faces in the future would weigh heavily on its ability to grow its nuclear power capacity. Lastly, Chinese fears about nuclear catastrophe may slow down additional construction of plants, as discussed in the next Chapter.

133 International Hydropower Association (I.H.A.), *2020 Hydropower Status Report: Sector Trends and Insights* (London, United Kingdom: I.H.A), p. 10.

134 "China starts Baihetan hydro project, biggest since Three Gorges," *Reuters*, June 28, 2021, available at https://www.reuters.com/business/energy/chinas-giant-baihetan-hydro-plant-begins-generating-power-cctv-2021-06-28/.

135 "China's plan for Himalayan super dam stokes fears in India," *The Straits Times*, April 12, 2021, available at https://www.straitstimes.com/asia/east-asia/chinas-plan-for-himalayan-super-dam-stokes-fears-in-india.

136 "China's Era of Mega-Dams Is Ending as Solar and Wind Power Rise," *Bloomberg*, July 3, 2020, available at https://www.bloomberg.com/news/articles/2020-07-03/china-s-era-of-mega-dams-is-ending-as-solar-and-wind-power-rise.

137 U.S. Energy Information Administration, *International Energy Outlook 2020, Installed generating capacity by fuel type: China, Comparative Reference Case* (Washington, DC: E.I.A, 2020), available at https://www.eia.gov/outlooks/ieo/side/pdf/ieo_table17_asia.pdf.

138 David Stanway and Kathy Chen, "China to boost nuclear fuel reserves to feed new reactors."

139 *China*, U.S. Energy Information Administration, p. 2.

140 See *The Economics of Nuclear Power* (London: World Nuclear Association, 2008), available at http://www.world-nuclear.org/uploadedfiles/org/info/pdf/economicsnp.pdf.

Solar energy has grown considerably in recent years. The Chinese solar energy market initially focused on international exports, yet it shifted to a domestic focus after the 2008 global financial crisis.[141] The 12th FYP, like wind, targeted the solar sector for growth. The FYP had a slogan called "1 goal, 2 breakthroughs, 3 technologies, and 4 directions."[142] China has built far beyond its 13th FYP goals for solar power. Its solar energy capacity in 2019 was nearly five times that in 2015, with 205GW.[143]

Wind power has made similar gains. Both the 12th and the 13th FYP sought to boost wind power development.[144] From 2016-2019, China added 90.4GW of wind capacity, far exceeding the 13th FYP plan goal of 210GW by the end of 2018. [145] These increases have been fueled by generous subsidies from the Chinese government. More recent numbers have been impressive yet questionable. China announced that its wind capacity increased by 71.7GW in 2020, with 48GW of the total built in December alone —more than twice as much as had been built throughout 2018.[146] It is unclear how China added this much production capacity considering the effects of the COVID-19 pandemic.[147]

Adding to their dismal outlook, China's green energy industries are threatened by insecure supplies of the metals required for production. Copper is essential to the production of wind turbines and the electricity transmission that brings the valuable energy from the wind farms to China's east coast. Currently, China's domestic sources and international mine ownership provide only 16% of the copper that the PRC requires, but its copper smelting capacity is one of the best in the world. It has attempted to acquire international assets to reduce this dependence on the open market, yet it has lost out to western firms. It could use aluminum instead, but it is less efficient than copper, and domestic sources are of low

141 Tai Ming Cheung et al, *Planning for Innovation*, p. 107.

142 Ibid. The full slogan is "One goal (large-scale generation and break-even cost with conventional power), two breakthroughs (scale of production and of technology application), three technologies (crystal- line silicon cells, thin film, and new cell technology), and four directions (deployment of materials, devices, systems and equipment).

143 International Renewable Energy Agency (IRENA), *Renewable Energy Statistics 2020* (Abu Dhabi: IRENA, 2020), p. 21.

144 See Tai Ming Cheung et al, *Planning for Innovation*, p. 106.

145 Dan Murtaugh, "China Blows Past Clean Energy Record With Wind Capacity Jump," *Bloomberg Green*, January 20, 2021, available at https://www.bloomberg.com/news/articles/2021-01-20/china-blows-past-clean-energy-record-with-extra-wind-capacity.

146 "2020年全社会用电量同比增长3.1% [Electricity consumption increased by 3.1% in 2020], 国家能源局 [National Energy Administration], January 20, 2021, available at http://www.nea.gov.cn/2021-01/20/c_139682386.htm; Dan Murtaugh, "China Blows Past Clean Energy Record With Wind Capacity Jump."

147 It may be the case that increased loans across the Chinese economy were used to fund additional wind projects, yet this is speculative. Some analysts wondered if the Chinese government changed its method of counting wind power upon hearing the news that wind power increased so miraculously in 2020. The spike in reported construction in the last month of the year may be due to reporting deadlines but does not explain how so many were built in one year. See Frank Tang, "What Does China's Loan Data Mean for the Economy and the Yuan?" *The South China Morning Post*, October 14, 2020; and Dan Murtaugh, "China Blows Past Clean Energy Record With Wind Capacity Jump."

quality.[148] China's external dependence on copper and high-quality aluminum shows that green energy technology shares some of the same issues that fossil fuels have for China.

While solar and wind power have proliferated in the past couple of years, both face severe geographic headwinds that constrain their usefulness for China's energy demands. From the few places within China that can best generate solar and wind power, the energy must be transmitted across the country to reach its economic and population centers on the eastern coast, similar to its coal and pipeline imports. The long distances between energy production and consumption lead to transmission losses and underutilization.[149]

Issues in the Chinese solar and wind power systems are closely related to the structure and efficiency of the country's electrical grid. Transporting electricity across the massive Chinese landmass, the PRC's electricity grid is disconnected and unstable. Currently, China has six electrical grids at various levels of interconnectivity.[150] The government's solution is to build dozens of ultrahigh-voltage (UHV) direct current (DC) lines to connect each of China's regional alternating current (AC) grids. This massive effort began in 2009, and by 2019, State Grid had completed 19 of 30 planned UHV lines.[151] In its ideal form, thousands of miles of UHV DC lines would span across China's vast landmass and convert to AC at their eastern destination, maximizing solar and wind power consumption.

This plan carries various challenges and risks. First is the massive size of the project. China is the first country to attempt a UHV DC connected grid, and completing the project carries technical and budgetary challenges. Second, the project could increase the fragility of China's grid system; with all of China's six grids connected, blackouts in one region can quickly spread across the country. Part of this issue is driven by the difficultly of balancing between DC and AC lines. Lastly, State Grid, the government-run firm undertaking this project, faces various roadblocks from local political interests.[152] Beyond this state effort, China's grid system faces fundamental challenges: interconnectivity and fragility.[153] If China does not fully connect its six grids, it will lose precious green power from wind, solar, and hydro. If it does, the fragility of its electricity grids increases. These risks decrease the expected benefits of new energy like solar and wind power.

148 See Gavin Thompson, Huang Miaoru, and Zhou Yanting, *Tectonic Shift*.

149 Eric Ng, "China's under-utilized ultra-high-voltage power lines no silver bullet to rid grid of bottlenecks," *South China Morning Post*, February 16, 2020, available at https://www.scmp.com/business/article/1912878/chinas-under-utilised-ultra-high-voltage-power-lines-no-silver-bullet-rid.

150 "China's Bid for Grid Supremacy: Upping the Ante to 1 Megavolt," *IEEE Spectrum*, Institute of Electrical and Electronics Engineers, March 2019, p. 38.

151 "China's Bid for Grid Supremacy," p. 39.

152 "China's Bid for Grid Supremacy," p. 40-41.

153 For more information about State Grid and electricity, see Yi-chong Xu, *Sinews of Power: the Politics of the State Grid Corporation of China* (Oxford: Oxford University Press, 2016).

Most recently, the 14th Five-Year Plan (2021-2025) released in March 2021 signals a continuation of the trend of the previous FYPs. It emphasizes energy conservation, technological advancement, and solving the country's health crisis stemming from its energy production. While it does not target specific goals for green energy in the same depth that previous FYPs have, it does mark specific goals. It calls for increasing green energy's proportion of energy consumption to 20% from 15% in 2019. The FYP demands that energy consumption per unit of GDP decrease by 13.5% and the carbon dioxide emissions per unit of GDP decrease by 18%. It would do so by innovating in power equipment, solar and wind power, offshore energy, hydropower, and nuclear power. Interestingly, the FYP includes a graphic depicting green power bases in the west funneling energy toward the industrial centers on the east coast. In the "battle for key technologies," China will advance oil and gas development. Although the document calls for lowering emissions across the board, it says that China should "reasonably control" its development of coal power. Through these efforts, the FYP projects that by 2035, "carbon emissions have reached a peak and have been steadily reduced, the ecological environment has been fundamentally improved, and the goal of building a beautiful China will have been achieved."[154] These goals should be generally understood as a continuation of previous policy. While the Chinese government will continue to focus on advancing its energy goals, the institutions underpinning its energy market will continue to hold it back.

More broadly, the institutions governing China's energy markets demonstrate their ability to improve its energy situation. The central government institutions that run energy policy are the National Development and Reform Commission (国家发展和改革委员会), the National Energy Commission (国家能源委员会), and various Leading Small Groups (LSGs) that coordinate policy across the vast state bureaucracy. Initially, the energy sector was run by ministries of energy, but they were broken up into powerful State-Owned Enterprises (SOEs) in the 1980s. As strategic industries, these SOEs dominate the Chinese energy market. However, the relative dominance of SOEs for each energy type depends on the sector. The coal sector is the most open, with private companies competing with SOEs under free pricing. The petroleum market, on the other hand, is completely dominated by three SOEs: Sinopec, CNPC, and China National Offshore Oil Corporation (CNOOC). As for electricity production, half of the market is dominated by a handful of SOEs, but China only has two grid companies, State Grid and Southern Grid (both SOEs). SOEs have exclusive access to hydropower construction, and only two SOEs handle China's nuclear production. Other

154 中华人民共和国国民经济和社会发展第十四个五年规划和2035年远景目标纲要 [The Fourteenth Five-Year Plan for the National Economic and Social Development of the People's Republic of China and the Outline of the Long-term Goals for 2035], Baidu, March 14, 2021, available at https://baike.baidu.com/item/%E4%B8%AD%E5%8D%8E%E4%BA%BA%E6%B0%91%E5%85%B1%E5%92%8C%E5%9B%BD%E5%9B%BD%E6%B0%91%E7%BB%8F%E6%B5%8E%E5%92%8C%E7%A4%BE%E4%BC%9A%E5%8F%91%E5%B1%95%E7%AC%AC%E5%8D%81%E5%9B%9B%E4%B8%AA%E4%BA%94%E5%B9%B4%E8%A7%84%E5%88%92%E5%92%8C2035%E5%B9%B4%E8%BF%9C%E6%99%AF%E7%9B%AE%E6%A0%87%E7%BA%B2%E8%A6%81/56266255?fromtitle=%E5%8D%81%E5%9B%9B%E4%BA%94%E8%A7%84%E5%88%92&fromid=4322373#reference-[6]-31709062-wrap.

renewables, like wind and solar, are primarily composed of private industries that thrive off government subsidies.[155]

Such government control over the energy sector has a range of adverse effects on the industry. The SOEs are typically politically influential in Beijing, representing institutional interests that can raise stiff resistance to meaningful reform. Powerful figures like these likely set up daunting institutional roadblocks to reform. This challenge is especially pertinent during Xi Jinping's rule, as he has privileged the "princelings" that represent the interests of the Red Aristocracy.[156] The dominance of SOEs also stifles innovation in some sectors. For example, China's efforts to jump-start its microgrid market have been held back partly by the bureaucracy of the national grid companies.[157] Issues such as these are more crucial in holding back China's energy development than just its technological goals.[158] Institutional problems will continue to weigh down China's energy ambitions and are representative of wider roadblocks that its system of government poses in China's economic development.

The Chinese government has focused on the conservation of energy and a shift to new energy sources. These efforts have dampened some of China's energy insecurity issues. Observers should understand that the Chinese government is fully committed to solving its energy vulnerabilities, yet there are geographic, technical, and institutional barriers to smooth development. Experts may not fully understand that energy source diversification is much costlier for China than for the United States, specifically in shale, wind power, and solar power. Over time, Chinese attempts to confront its domestic energy dilemma may also run into budgetary and resource roadblocks that it cannot easily resolve. Fundamentally, the trajectory of the entire Chinese economy depends on the extent to which China can handle the contradictory negative implications of dirty coal and externally-sourced oil and natural gas.

155 Tai Ming Cheung et al, *Planning for Innovation*, pp. 76-85.

156 For a brief explanation of Xi Jinping and the princelings, see Bo Zhiyue, "Who Are China's 'Princelings'?," *The Diplomat*, November 24, 2015, available at https://thediplomat.com/2015/11/who-are-chinas-princelings/. Li Peng and his family exemplify the clout that political figures hold in the energy sector. The descendants of Li Peng, the former premier, are known to be intimately involved in the Chinese energy sector. Li Xiaopeng was formally the chairman of Huaneng Power, an important Chinese electric power company; Li Xiaolin is the vice-president of the China Datang Corporation, a power generation SOE. See "Transportation Minister Li Xiaopeng," *The US-China Business Council,* available at https://www.uschina.org/transportation-minister-li-xiaopeng; Nectar Gan, "Top power industry industry job for Li Xiaolin, daughter of former Chinese premier," *The South China Morning Post*, July 8, 2015, available at https://www.scmp.com/news/china/policies-politics/article/1834390/top-power-industry-job-li-xiaolin-daughter-former.

157 Tai Ming Cheung et al, *Planning for Innovation*, p. 108.

158 Tai Ming Cheung et al, *Planning for Innovation*, p. 111.

China's Energy Trajectory

China's energy future must be considered within the context of the wider potential development of the PRC. Since Xi Jinping rose to power, his vision of the "China Dream" has colored the country's expanding goals on the world stage. As Xi's ambitions for China's future meet reality, some analysts have offered a scenario-based understanding of China's fate. Several possible futures include: where the "China Dream" is fulfilled and China's dominance of Asia becomes a reality; where domestic and international costs dampen expectations of China's rise; where hyper-nationalism is stoked by the CCP; and where China's authoritarian system mellows and relaxes.[159]

The overall trajectory of China's political economy and international position is inextricably linked with its energy portfolio. In this section, two potential scenarios about the future of Chinese energy security are presented, which nest within the broader scenario-based analysis summarized above.

Beginning in the mid-2000s, developed economies no longer require energy to match growth, instead showing a decoupling of energy demand from GDP growth.[160] This trend is especially pronounced for advanced developed economies when energy efficiencies across all sectors are accounted for, further reducing energy demands while continuing economic growth.

For developing economies, however, the GDP growth rate is sustained by a corresponding increase in demand for more energy. China's future energy consumption will closely parallel its GDP growth. The EIA predicts that China's energy consumption growth and balance between energy sources will continue to be closely coupled to the country's overall GDP growth.[161] The China National Petroleum Corporation (CNPC) agrees. In its 2050 outlook report in August 2019, CNPC predicted that driven by a strong national economy, Chinese primary energy demand would rise by two percent per year over the next decade.[162]

Under these growth conditions, it is unclear how much China will be able to diversify its energy portfolio away from its current reliance on more domestically plentiful but dirtier energy sources, such as coal. Interestingly, the EIA predicts that China will continue to burn the same amount of coal, but its relative position in China's total consumption will shrink. In this scenario, China will successfully increase its production of nuclear, wind, and solar

159 See Ross Babbage et al, *Which Way the Dragon?*; and Andrew Scobell et al, *China's Grand Strategy: Trends, Trajectories, and Long-Term Competition* (Washington, DC: RAND Corporation, 2020), available at https://www.rand.org/pubs/research_reports/RR2798.html.

160 Namit Sharma, Bram Smeets, and Christer Tryggestad, "The decoupling of GDP and energy growth."

161 Vipin Arora, George Pantazopoulos, and Henry Tolchard, "China's projected energy consumption mainly depends on its overall growth rate," U.S. Energy Information Administration, July 25, 2018, https://www.eia.gov/todayinenergy/detail.php?id=36752.

162 Michal Meidan, *Glimpses of China's Energy Future* (Oxford: The Oxford Institute for Energy Studies, September 2019), p. 3.

power to account for its growing economy.[163] This projection assumes continued economic growth for China, as well as the ability to introduce and scale other diversified energy sources rapidly. This scenario may be the best case for China since it assumes continued resource availability and economic growth.

These statistics set up two basic trajectories for the likely future of China's energy economy. The first is a situation in which China's economy continues to grow rapidly in the coming decades, between 4-6% GDP growth (or more) per year. In this circumstance, China's energy demands will continue to grow, and increasing revenues from expansive growth will allow the Chinese government to invest in energy conservation technologies and alternative energy sources. With increasing financial resources, the state could continue to lavish money on expensive energy modernization projects. This situation would be ideal for Chinese strategists and the CCP's leadership. While China would continue to depend on coal, oil, and natural gas as dominant sources, it could gradually minimize the risks to its external energy supply by increasing subsidies of domestic renewable and alternative sources. Additionally, internal discontent stemming from the country's long-standing pollution issues would likely fade with time as more alternatives to coal are activated. This scenario would contribute to the most favorable conditions under which Xi Jinping's "China Dream" could come to fruition.

In the second scenario, the Chinese economy could slow to the extent that its energy modernization goals may not be achievable. This scenario would entail slow growth, or even stagnation, of China's GDP in the coming years and decades. With tightening budgets, energy modernization goals would compete with other CCP strategic priorities for increasingly scarce state resources. Ultimately, the state would have to choose priorities among its energy goals, a growing military budget, Belt and Road Initiative spending, domestic economic revitalization, an increased demographic burden, and other potential projects. China would struggle to diversify its energy portfolio, and non-renewable resources would continue to dominate its energy markets for decades to come. In this situation, China's existing dependencies on external energy sources would persist, and internal costs stemming from the health crisis related to dirty energy sources would simmer or even worsen with time. This scenario could compound the internal and external costs of China's ambitions, contributing to the strategic conditions where China is merely attempting to muddle through the coming decades.

Of course, relative probabilities for either trajectory will remain a question of intense debate. Chinese commentators believe that the economy will continue to grow at impressive rates. External observers, however, are increasingly coming to different conclusions. In recent years, the Chinese economy has faced several headwinds that could collectively damage the

163 U.S. Energy Information Administration, *International Energy Outlook 2020, Installed generating capacity by fuel type: China, Comparative Reference Case* (Washington, DC: E.I.A, 2020), available at https://www.eia.gov/outlooks/ieo/side/pdf/ieo_table17_asia.pdf.

country's long-term economic prospects for continued high growth. Issues like the emerging and accelerating demographic crisis, surging debt, ongoing trade tensions, the leadership's statist preferences, and the domestic and international impacts of the global coronavirus pandemic will challenge the Chinese government in the short and long-term.[164] Under these conditions, it would not be surprising for China to settle into "normal" economic growth rates for a large economy. In this scenario, the concerns outlined by Chinese strategists in this study will come into even starker relief. As the Chinese government struggles to advance its energy goals, it would still confront the external energy dependence that drives its anxiety regarding major asymmetric disadvantages compared to America's energy security.

Predicting the long-term future of the Chinese energy portfolio does not change the PRC's immediate energy security, however. Even if China's energy security policies continue to bring successes and produce conditions ideal for the "China dream," it will take decades for China to reach a level of energy security that begins to approach the United States, if it is possible. It is important to keep in mind that although China's new energy sources have grown at dazzling rates and lead the world, these sources still produce less than a fifth of China's consumed energy. This study assesses that China is energy insecure in the short-to-medium term due to a multitude of geological, geopolitical, infrastructural, economic, environmental, social, and technical risks. Any of these risks carry the potential to weigh on the PRC's ability to accrue international power that underwrites its ambitions to challenge the United States in the Indo-Pacific and across the world. The asymmetry between American energy security and Chinese insecurity provides multiple policymaking opportunities for the United States that will be analyzed in Chapter 5.

164 For more information about long-term risks to the Chinese economy, see George Magnus, *Red Flags: Why Xi's China is in Jeopardy* (New Haven, NJ: Yale University Press, 2018); Michael Pettis, *Avoiding the Fall: China's Economic Restructuring* (Washington, DC: Carnegie Endowment for International Peace, 2013); Carl Minzer, *End of an Era: How China's Authoritarian Revival is Undermining its Rise* (London: Oxford University Press, 2018); and Dinny McMahon, *China's Great Wall of Debt: Shadow Banks, Ghost Cities, Massive Loans and the End of the Chinese Miracle* (London: Abacus, 2018).

CHAPTER 4

Chinese Views of PRC and American Energy Security

This chapter of the report explores how Chinese commentators perceive the relative balance in energy security between the United States and China. Understanding the views that Chinese strategists have about the competition between the two countries reveals potential misperceptions that the United States can exploit. Perhaps more importantly, assessing the Chinese perspective shows how the American and Chinese worldviews differ, showing how American strategists' biases may influence how the United States perceives China's energy security.

This study used open-source materials to illuminate elite Chinese views on PRC and American energy security. The study surveyed a wide selection of Chinese publications that address the subject and identified illustrative examples. These journals include *Theoretical Horizon, Chinese Cadres Tribune, the Zhejiang Party Committee School Journal, The Leadership Collection, The Party and Government Forum, Contemporary World, Sino-Global Energy, Policy Research and Exploration, Energy,* and *International Petroleum Economics*, among others. This research seeks to portray and analyze an accurate cross-section of CCP views as much as possible.

Capturing various CCP views is a difficult process. The authority and influence within the Party vary for the references used in this report. For example, the *Chinese Cadres Tribune* is sponsored by the Central Party School, but the *Zhejiang Party Committee School Journal* is presumably less authoritative because it is lower in the Party hierarchy.[165] Additionally, it is unclear how influential publications affiliated with the Party organs but not directly managed by it are in CCP thinking. As a result, it remains challenging to assess which opinions are more representative and are closer to the Party line, and when differences might

165 The Central Party School is highly influential, and its opinions are often considered representative of the official Party line.

be significant and indicative. Although the CCP governs with an outward perception of consensus, interpreting the internal thinking, debates, and differing factions of perspective and opinion in the CCP is difficult due to the Party's opacity. Nevertheless, this research attempts to show where Chinese elite opinions clearly converge and diverge.

This chapter is divided into three parts. The first summarizes PRC assessments of China's energy security, and the second does the same for the United States. The third section will analyze Chinese views to clarify when and how Chinese views may be wrong, leaving an opportunity for the United States to exploit in the context of strategic competition.

Chinese strategists have been conducting open-source strategic assessments of the PRC's energy security for years, if not longer. More recently, however, PRC writers have begun to more seriously contemplate the implications of the disparity in energy security between the United States and China, especially as U.S.–China relations soured. Some authors have conducted comparative assessments of the relative energy security of the United States and the PRC. In contrast, others have simply investigated Chinese energy insecurity in the context of a threatening global environment. Analyses such as these summarize the resource endowments, energy needs, and projected shifts in each country's security to rank how each country's energy industries will weigh on the strategic competition between the United States and China. PRC authors predicate this analysis on the assumption that energy is a strategically crucial resource that has significant implications for the comprehensive national power of both countries.

Their comparative assessments of Chinese and American energy security find that the United States is relatively more energy secure than China. This conclusion is based on a couple of factors. First, the United States' landmass contains more energy resources than the PRC, especially oil and natural gas. This difference means that whereas China must depend on coal as its primary energy source, the United States can select between coal, oil, and natural gas. Second, China's growing energy appetite means that it must continue to import more energy every year, while the United States does not face this problem. These two reasons show that—in the eyes of Chinese analysts—the United States is energy secure, even energy independent, while China is energy insecure.

Their analysis, however, also reaches into the future. Chinese strategists believe that the global race to shift away from fossil fuels and toward green energy is a factor in strategic competition. This "energy transition" is a factor in both countries' long-term energy security and comprehensive national power. Chinese strategists assess that the United States and China are close in this race. Although the United States started producing green energy earlier than the PRC, China has recently become the leading global green energy producer. This confidence is tempered by residual doubts about the extent to which new energy can resolve China's fundamental energy insecurity, however.

Chinese analysis of the United States and the PRC's comparative energy security is grounded in Chinese commentators' definitions of "energy security." Many Chinese authors begin by

reviewing American definitions of the term. Yuan Yi and Shu Zhan of Fuzhou University's School of Marxism provide an in-depth examination of their perception of Western definitions of energy security. They believe that three definitions of energy security are prevalent in the United States:

> The first type of definition highlight[s] the meaning of military security and national security in the definition of energy security, which is mainly prevalent in the military departments and research institutions of the U.S. government…The second type of definition [is] based on the global commercialization and financialization of energy. It focuses on defining energy security from the perspective of energy economics and finance… The third type of definition…discusses energy security in a broader scope, highlighting the role of climate and social factors in energy security.[166]

In the context of this understanding and broader Chinese discourse on energy security, the authors draw their own interpretation of energy security:

> China's energy security…[seeks] a continuous and complete energy supply chain, and obtaining energy that is reasonably priced, stable in supply, and meeting demand. Resources and services [should] have the ability…to prevent and resolve energy threats and crises, and ultimately achieve the ability to ensure the overall security of the economy, politics, society, and national defense of socialism with Chinese characteristics. China's energy security emphasizes the ability to meet its own needs and guarantee its security…[167]

This definition is representative of other Chinese definitions of energy security because it explicitly requires that the supply of energy must meet demand, be stable, and be reasonable in supply, which are common themes in Chinese discourse surrounding energy security. The Chinese understanding of their energy security is the starting point that these strategists use to define China's security in the energy sector.

Chinese Energy Insecurity

Chinese strategists believe that the PRC is dangerously energy insecure. In their writings about Chinese energy markets, PRC authors are worried that energy insecurity is one of China's most critical strategic weaknesses. Chinese authors describe their energy insecurity as stemming from four sources, in decreasing importance: insufficient oil and natural gas supplies, environmental damage due to coal use, continuing technological difficulties, and institutional barriers weighing on energy development.

166 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," 中外能源 [*Sino-Global Energy*], no. 2, 2019, pp. 1-2. *Sino-Global Energy* is sponsored by the China Energy Research Society, which is affiliated with the National Energy Administration [国家能源局].

167 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 2.

PRC strategists are worried about China's increasing reliance on foreign sources of oil and natural gas. This issue is captured by the common phrase "rich in coal, deficient in oil and gas."[168] This worry is the most widespread concern regarding China's energy security. To these strategists, Chinese transportation, industry, and its military are dependent on unreliable foreign imports. Oil is seen as more insecure than natural gas, as China imports a higher proportion of its consumed oil. Zhang Shuai and Li Lei of Shandong Normal University's School of Economics and the Central Party School write in *Theoretical Horizon*,

> There are many external oil risks in our country. For example, the stability of oil-importing regions is related to whether oil-importing countries can obtain continuous and stable oil supply; the ability to control oil transportation channels (control capabilities of important straits, a country's naval power, etc.) is related to whether oil-importing countries can smoothly transport imported oil back to the country; for example, oil prices affected by geopolitical and diplomatic factors are related to whether oil-importing countries can afford oil…the external oil risk can be basically judged by analyzing the degree of external oil dependence.[169]

To these analysts, China's external dependence on foreign oil and gas sources is especially perilous due to ideological threats and geostrategic rivalry from the West. Wang Haibin of the Sinochem Corporation wrote that

> In theory, a high degree of external dependence does not necessarily mean that [your] energy is insecure. However, because China is quite different from Western powers such as the United States in terms of socio-political system and ideology, the increase in China's energy dependence on foreign sources means an increase in security risks in most periods.[170]

Ma Shengjian of North Minzu University notes that

> 80% of my country's marine transportation routes pass through the Straits of Hormuz and the Straits of Malacca. The routes are very simple, and the maritime routes are within the zone of military deterrence by the United States and other Western powers. Within this, once a political and military conflict occurs between China and the United States, it will pose a great threat to the security of maritime transport channels.[171]

168 张帅 李蕾 [Zhang Shuai and Li Lei], "对我国能源经济安全问题的思考 [Thoughts on the Energy Security Economy in China]," 理论视野 [*Theoretical Horizon*], no. 3, 2020, p. 54. *Theoretical Horizon* is sponsored by China Marxist Research Foundation [中国马克思主义研究基金会], a part of the Central Party School [中共中央党校].

169 张帅 李蕾 [Zhang Shuai and Li Lei], "对我国能源经济安全问题的思考 [Thoughts on the Energy Security Economy in China]," p. 56

170 王海滨 [Wang Haibin], "解开死结/中国能源安全困局及应对之策[Unlocking the Deadlock: The Dilemmas of China's Energy Security and Their Solutions]," 云梦学刊 [*Journal of Yunmeng*], no. 2, 2021, p. 2. The *Journal of Yunmeng* is sponsored by the Hunan Institute of Technology.

171 马生坚 [Ma Shengjian],"一带一路"倡议下中国能源安全策略研究 [Research on China's Energy Security Strategy under the "One Belt and One Road" Initiative]," 决策探索(中) [*Policy Research and Exploration*]," no. 12, 2019, p. 1. *Policy Research and Exploration* is sponsored by the Henan Provincial government.

To these analysts, any Chinese imports that traverse the global maritime commons are ripe for blockade from the United States and its allies. This worry gets to the heart of the "Malacca Dilemma."[172] These beliefs demonstrate a lack of faith in the ability of the growing People's Liberation Army Navy (PLAN) to secure its sea imports. Land-based pipelines, on the other hand, are seen as safer, but they are not without potential issues. Chen Jiansheng and Ding Junbo from the Central Party School's School of Marxism and the Chinese Academy of Fiscal Sciences detail their views of pipelines:

> Sea channels are currently the main channel for oil imports, but China lacks the dominant power in the control of oil tankers and transportation routes. 90% of the transportation is still undertaken by foreign tanker fleets, and the main transportation routes pass through the Strait of Malacca. The pipeline channel is relatively safe, but there are also political risks that cannot be ignored. In recent years, relations between Ukraine and Russia have deteriorated sharply, and cutting off oil and gas pipelines has become a weight in the struggle between the two sides.[173]

Taken together, Chinese strategists believe that the PRC's most important source of energy insecurity is its reliance on imports of oil and natural gas.

Chinese authors' second most common concern about energy security is the relationship between coal use and environmental damage. While Chinese strategists are pleased that China has ample coal resources to draw on, it still has important drawbacks. For example, Peng Xiaoxian of Guangdong University of Foreign Studies writes in *Business News*:

> In terms of energy safety, the most prominent problem is that my country's coal-based energy structure has caused tremendous pressure on the ecological environment, which has restricted economic development and destroyed the living environment…My country's carbon emissions exceeded 100 million tons in 2018, exceeding the total of developed countries in Europe and the United States. Internationally, China is facing tremendous pressure to reduce emissions, which is in stark contradiction with China's growing demand for energy. Carbon emission restrictions have severely restricted China's use of energy. On the one hand, it forces China to develop a low-carbon economy. On the other hand, it also promotes the development and innovation of clean energy technologies.[174]

Chinese worries about coal use are partially driven by their understanding of the nature of the process of change in the energy economy. These authors appear to believe that the global transition toward green energy and away from high-polluting sources such as coal is a natural process that China must follow because of international public opinion and

172 See 王海滨 [Wang Haibin], "解开死结/中国能源安全困局及应对之策[Unlocking the Deadlock: The Dilemmas of China's Energy Security and Their Solutions]," no. 2, 2021.

173 陈江生 丁俊波 [Chen Jiangsheng and Ding Junbo], "当前我国能源安全面临的挑战及应对 [Challenges and countermeasures facing my country's energy security at present]," 中国党政干部论坛 [*Chinese Cadres Tribune*], no. 7, 2020, p. 67. The *Chinese Cadres Tribune* is sponsored by the Central Party School.

174 彭小娴 [Peng Xiaoxian], "试论中国能源安全 [On China's Energy Security]," 商讯 [*Business News*], no. 3, 2020, p. 129. *Business News* is sponsored by Manager Magazine [经理人杂志社].

the similarity of this transition to previous energy shifts. The first reason holds that China should not push against international public opinion, often explaining that "the concept of clean, low-carbon, green, and efficient development is deeply rooted in the hearts of the people."[175] Additionally, Wang Zhouyu from the School of Political Science and Public Administration compares the green energy shift to ones from the past:

> The process of energy transformation and upgrading is a process of civilization and progress. Human society has achieved two major energy transitions. The first energy transition took place in the middle and late 18th century. Traditional biomass energy such as firewood and straw was replaced by coal…This transformation created the success of the industrial revolution and directly brought mankind into the period of industrialization…the entire process lasted roughly 200 years. The second transformation took place from the end of the 19th century to the beginning of the 20th century, when coal was replaced by oil…oil became the blood of industry, promoted the development of industrialization and electrification worldwide, accelerated the new industrial revolution, and brought tremendous power technology progress and material prosperity. The energy transition that is currently underway began in the 1950s and 1960s.[176]

This explanation shows that Chinese strategists view the global shift to green energy as an inevitable process reflecting the cyclical change in global energy markets.[177] Since the global shift away from coal is viewed as unavoidable, Chinese strategists believe that measures must be taken to reduce China's coal use. As a result, the perceived energy security afforded by China's abundant coal is substantially reduced.

The first two drivers of China's perceived energy insecurity stem from China's resource endowment. On the other hand, the second two reasons for energy insecurity stem from weaknesses in the PRC's economy or political system. The first of these two is the widely held concern that China still falls far behind the United States in technology, amplifying the severity of every other issue weighing on Chinese energy security. Chen Jiansheng and Ding Junbo believe that technological issues prevent China from producing more energy:

> Although the expansion of my country's energy production capacity is not slow, breakthrough production technologies have been delayed, and energy production technology cannot be

175 王珺 曹阳 王玉生 饶建业 [Wang Jun, Cao Yang, Wang Yusheng, and Rao Jianye], "能源国际合作保障我国能源安全探讨 [Ensuring Energy Security in China through International Energy Cooperation]," 中国工程科学 [*Strategic Study of Chinese Academy of Engineering*], no. 1, 2021, p. 120. This journal is sponsored by the Chinese Academy of Engineering.

176 王卓宇 [Wang Zhouyu], "世界能源转型的漫长进程及其启示 [The Long Process of World Energy Transformation]," 现代国际关系 [*Contemporary International Relations*], no. 7, 2019, p. 52. *Contemporary International Relations* is sponsored by the China Institutes for Modern International Relations, a national think-tank.

177 This view is an example of the dialectical materialist worldview that commonly colors the thinking of many Chinese strategists.

> produced. Therefore, energy production cannot be achieved. With the current technology, we can only rely heavily on imported energy to balance demand.[178]

Peking University's Yin Xiong connects China's technological backwardness with U.S.–China strategic competition:

> Progress in energy technology has been curbed. China's energy-related technology still lags behind developed countries. With the escalation and prolongation of the Sino-U.S. trade war, the United States is showing an attempt to decouple from China's compulsory technology. The restrictions and blockades on China's energy technology will inevitably become more severe.[179]

These quotes capture Chinese concern that their economy is not equipped to handle the production challenges required to fix its energy dilemma, such as producing more oil and increasing wind power production, among other challenges. Worries about Chinese technological issues are one of the most commonly cited reasons driving energy insecurity.

The final reason for China's perceived insecurity is more contentious than the others. Some authors believe that state dominance over Chinese energy markets and insufficient reform of the industry is the foundation of China's energy issues. This view is not stated by all of the authors analyzed in this report, and it presumably is against the Party line given Xi Jinping's statist inclinations.[180] Authors that cite this issue call for thorough reform of the institutions guiding China's energy markets:

> There are also bloated structures, overcapacity, and serious pollution. It is urgent to improve the adaptability of the supply structure. For issues such as flexibility, we must seize the golden opportunity of a lifetime to promote supply-side structural reforms…my country's…energy development and security are facing many problems. These problems are, in the final analysis, institutional problems. It is recommended to…establish the State Energy Administration and the State Energy Supervision Administration, independent of the National Development and Reform Commission, to make them a government department with independent decision-making powers, executive powers, and regulatory powers to truly transform government functions and realize the transition from administrative control to a market economy.[181]

178 陈江生 丁俊波 [Chen Jiangsheng and Ding Junbo], "当前我国能源安全面临的挑战及应对 [Challenges and countermeasures facing my country's energy security at present]," p. 69.

179 殷雄 [Yin Xiong], "能源安全:复杂多变形势下的中国政策选择 [Energy Security: China's Policy Choice under Complex and Multi-deformation Trends]," 能源 [*Energy*], no. 1, 2020, p. 91. *Energy* is sponsored by the Beijing Linghang International Media Development Company [北京领航国际传媒发展有限公司].

180 See Margaret Pearson, Meg Rithmire, and Kellee S. Tsai, *Party-State Capitalism in China* (Cambridge, Massachusetts: Harvard Business School, 2020).

181 杨名舟 [Yang Mingzhou], "建设现代能源强国应抓住十大创新机遇 [Ten Major Innovation Opportunities Should Be Seized to Build a Powerful Modern Energy Country]," 中国党政干部论坛 [*Chinese Cadres Tribune*], no. 7, 2016, p. 45-46.

It is impossible to know how influential views like these are within the Party. Given this author's calls for extensive political reforms, it is likely against the Party line. It is worth noting, however, that other authors surveyed also expressed a desire to increase the influence of market forces in the energy industry. Attitudes like these show the extent to which some observers in China believe that bloated state institutions prevent China from reaching energy security.

In sum, Chinese strategists see the PRC as energy insecure. One author pithily summarizes China's situation: "the challenges outweigh the opportunities."[182] Fundamentally, China's resource endowment leaves China reliant on imports for its oil and gas and forces the PRC to shift away from its high-polluting coal. As a result, Chinese strategists see the vast majority of the energy the country consumes as a threat to China's energy security. These energy security fears drive the strategists' determination to ameliorate their insecurity in any way possible.

PRC authors discuss various methods to relieve China's energy insecurity. This report divides these proposed solutions into two types: those that seek to reduce the risks stemming from current energy sources and those that introduce new types of energy. The first group of policy recommendations is a set of short-term fixes to the issues posed by oil, gas, and coal, while the second group of prescriptions seeks to replace fossil fuels altogether in the long-term.

Chinese strategists' proposed solutions to reduce the harm from oil, gas, and coal include:

- increasing production of oil and gas;
- producing more pipelines to reduce reliance on sea-based imports;
- cooperating with energy-producing states;
- increasing energy efficiency;
- building up China's electric vehicle industry;
- and continuing to grow China's strategic oil reserve.

First, Chinese authors recommend that China increase its oil and natural gas production, including its shale reserves. While this solution sounds simple, Chinese strategists mention two issues in implementing this policy: technological problems and institutional impediments. As noted above, these two problems weigh down Chinese energy ambitions across the board. To overcome these challenges, Chinese strategists recommend that the PRC copy American technology to jumpstart its struggling oil and gas industries, especially its fledgling shale resources. This strategy is typically framed as a "win-win" solution wherein

182 王海滨 [Wang Haibin], "解开死结/中国能源安全困局及应对之策[Unlocking the Deadlock: The Dilemmas of China's Energy Security and Their Solutions]," 云梦学刊 [*Journal of Yunmeng*], no. 2, 2021. p.1

American companies profit from participating in China's economy, and the PRC gleans American technology. They describe an "introducing in" strategy where U.S. firms do business in China, bringing their technology for more widespread use. Zhou Yunheng of Zhejiang University's School of Public Affairs writes:

> In order to master the development technology and management experience of U.S. unconventional oil and gas, Chinese state-owned oil companies actively invest in U.S. oil and gas assets, hoping to understand and master the macro-to-micro technology, management, and infrastructure through the establishment of joint ventures or cooperative operations… active implementation of the "introducing in" strategy may be a more effective way to enhance China's energy security.[183]

There are some notable examples of Chinese businesses attempting to partner with American energy producers in order to obtain both technology and know-how. In 2010, the China National Offshore Oil Corporation invested $2.16 billion in Chesapeake Energy Corporation's production in Texas.[184] In 2015, a Chinese investment firm bought oil assets in the Permian Basin for $1.3 billion.[185] The Chinese government loosened regulations and offered subsidies for international firms exploring shale gas in Sichuan in 2020.[186] These technology copying strategies have become the standard operating procedure for Chinese firms across multiple industries.

These writers believe that this practice has come under threat recently. They think that tougher American policy toward China may restrict their ability to copy American technology:

> Progress in energy technology has been curbed…With the escalation and prolongation of the Sino-U.S. trade war, the United States is showing an attempt to decouple from China's compulsory technology. The restrictions and blockades on China's energy technology will inevitably become more severe.[187]

While they see deteriorating relations between the PRC and the United States as a potential barrier to technological development, American strategists should expect PRC technology theft in the energy sector.

183 周云亭 [Zhou Yunheng], "美国能源独立前景及对中国的影响 [The prospect of U.S. energy independence and its impact on China]," 中共浙江省委党校学报 [Journal of the Zhejiang Party School], no. 6, 2013, pp. 64-65.

184 Angel Gonzalez, "China Turns to Texas for Drilling Know-How," *The Wall Street Journal*, October 12, 2020, available at https://www.wsj.com/articles/SB10001424052748703358504575545183782651388.

185 Sophia Yan, "Chinese company to buy Texas oil fields in $1.3 billion deal," *CNN Business*, October 26, 2015, available at https://money.cnn.com/2015/10/26/news/companies/china-texas-oilfields/index.html.

186 "China aims to attract shale gas investment," *Argus Media*, December 11, 2020, available at https://www.argusmedia.com/en/news/2168131-china-aims-to-attract-shale-gas-investment.

187 殷雄 [Yin Xiong], "能源安全:复杂多变形势下的中国政策选择 [Energy Security: China's Policy Choice under Complex and Multi-deformation Trends]," p. 91

As described above, Chinese strategists think that sea-based energy imports are less secure than land-based imports; therefore, China should increase the number of pipelines supplying Chinese energy. By doing so, China would be able to increase the diversification of its imports and reduce the amount of energy flowing through the Strait of Malacca. Specifically, one author calls countries that ship oil and gas to China via pipelines "strategic passageways," and another says that these boost China's oil and gas "safeguarding capacity."[188]

Chinese writers believe that their government should boost international cooperation with energy-producing states to secure their energy imports. They suggest that positive international cooperation can come in the form of either increasing the diversity of energy sources by bringing more energy supplies to the market or securing the political reliability of its existing energy sources. These recommendations span from assisting developing countries in expanding their energy production, sealing economic deals under the aegis of the Belt and Road Initiative, and buying ownership of foreign energy supplies. For example, Shi Ze of the China Institute of International Studies describes the Belt and Road Initiative as having energy-centric intentions:

> Three distinct energy industry cooperation blocks have gradually formed along the "Belt and Road": one is to form a full industrial chain cooperation with Russia, Central Asia, West Asia and North Africa, the core areas of global oil and gas resources; the other is in cooperation with Southeast Asia and South Asia in the construction of cross-border power transmission channels and regional power grid upgrading and transformation, China's abundant hydropower and local demand complement each other; the third is to develop cooperation with Central and Eastern Europe and EU countries in new energy and development technology.[189]

Efforts like these are seen as ways to reduce the Western powers' ability to cut off China's energy imports. Many authors believe that China should spend generous amounts of diplomatic capital on securing its oil and gas.

These strategists believe that China should increase the efficiency of oil and gas consumption as much as possible. Wang Guanghui from the School of Economics at Remin University of China describes current state policy related to energy efficiency:

> In order to improve oil safety and protect the ecological environment, China has increased the development and utilization of clean energy, focusing on the following three aspects: first, it has formulated more environmentally friendly oil product standards…The second is to support and guide petroleum companies to produce fuel ethanol and biodiesel from

188 殷雄 [Yin Xiong], "能源安全:复杂多变形势下的中国政策选择 [Energy Security: China's Policy Choice under Complex and Multi-deformation Trends]," p. 93; 石泽 [Shi Ze], "从"一带一路"能源合作看国家能源安全 [National energy security from the perspective of the Belt and Road energy cooperation]," 国际石油经济 [*International Petroleum Economics*], no. , 2019, p. 2. *International Petroleum Economics* is sponsored by Sinopec.

189 石泽 [Shi Ze], "从"一带一路"能源合作看国家能源安全 [National energy security from the perspective of the Belt and Road energy cooperation]," p. 2.

> non-food materials…The third is to formulate higher standards for energy conservation and emission reduction[190]

Similar to increasing efficiency, PRC commentators argue that China's burgeoning electric vehicle industry has the potential to greatly reduce China's reliance on oil and gas:

> It can be seen that transportation consumes nearly 40% of my country's oil. Currently, new energy vehicle technology is making major breakthroughs. The state can increase funding support and rewards for technological innovation in this area, guide social funds to engage in related research and development and production, and promote the technological progress of new energy vehicles. With the improvement of the performance of new energy vehicles…there will be fewer and fewer traditional gasoline vehicles. My country's oil consumption in transportation will be greatly reduced, which will increase my country's oil security.[191]

Chinese attempts to grow its electric vehicle industry is seen as coinciding with the expanding green energy industry, as the PRC's transportation sector can begin to rely more on renewable energy and less on oil.

Lastly, Chinese authors strongly emphasize the importance of growing China's strategic oil reserve. This suggestion was one of the most commonly mentioned policy recommendations due to the perception that China's current reserves were dangerously insufficient. Yuan Yi and Shu Zhan lament that China's oil reserves are far behind that of the United States:

> By 2020, the entire second phase of the construction of eight strategic reserve bases will be completed, and China's strategic oil reserve capacity will reach about 100 days…But even so, China's strategic oil reserve system is still far from that of Western countries, from a lack of legislative support, lack of a complete reserve system including government reserves, corporate commercial reserves, and corporate obligatory reserves, etc. Therefore, China's energy strategic reserve capacity still needs to continue to improve.[192]

This consideration aligns with the almost exclusive focus of most of these policy recommendations described thus far on reducing China's energy insecurity stemming from its oil and gas imports. These policy ideas from Chinese strategists are intended to create short-term solutions to China's energy insecurity. While solutions like a larger oil reserve and more land-based pipelines will partially mitigate the dangers of China's reliance on energy imports, they are not enough fundamentally fix China's dilemma.

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190 王光辉 [Wang Guanghui], "中美贸易摩擦背景下的中国能源安全 [China's energy security under the background of Sino-US trade frictions]," 现代管理科学 [*Modern Management Science*], no. 2, 2020, p. 10. *Modern Management Science* is sponsored by the Jiangsu Institute of Economic and Information Technology.

191 王光辉 [Wang Guanghui], "中美贸易摩擦背景下的中国能源安全 [China's energy security under the background of Sino-US trade frictions]," p. 11.

192 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 5.

Chinese strategists believe that developing new, green energy sources may be the key to supporting China's energy security. Authors that provide comparative assessments of American and Chinese energy security appear to be surprised by the speed at which China's new energy industries have grown to become global leaders. These new energy sources are hydropower, wind power, solar power, and nuclear power. While these four sources are seen as promising and push China's energy security in a positive direction, these writers urge patience as it will take decades or more for these technologies to mature.

Among the new energy sources, hydropower is viewed as the most important, as it already has progressed quickly in the previous decades. After entering the new century, the "rising star" China has achieved significant results and advantages in hydropower development, which also means that it will have more resource potential and competitiveness in the future Sino–U.S. competition.[193] While PRC writers express optimism about the future of hydropower, it is not often discussed within the Chinese literature on energy security. Instead, more attention is given to wind power and solar power. Wind power is viewed with a mix of early confidence and acknowledgment of several flaws. Showing confidence in current progress, one study observes,

> Since the 21st century, the gap between China and the United States in wind power development has been increasing…after 2010, China's wind power strength has increased, surpassing the United States for the first time in 2012 and the gap has widened rapidly. Since then, China has made new breakthroughs in wind power technology, and has increasingly shown its dual advantages in quality and quantity.[194]

This lead over the United States, however, is complicated by an understanding of a series of problems that may hold back China's future wind power development. To Chinese analysts, the two flaws in China's wind power are the distance between wind farms and centers of energy consumption and the fragility of China's power grid system. One study documented what it called a crisis in "wind abandonment," wherein harvested wind energy was left unused. China's locations ideal for harvesting wind power are believed to be in the "three norths:" the northeast, northwest, and central north. These locations are far from the coastal industrial centers. Still worse, the grid system is not fully interconnected, making it difficult to transport this energy across the country. Additionally, wind power by nature provides large swings in power generation, putting stress on an ill-suited grid system. These

193 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 10.

194 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 9.

issues resulted in a "wind curtailment rate" as high as 39% in some provinces.[195] Some of the problems detailed in the study are mentioned in other reports.[196]

While the studies cited above reveal Chinese concerns about the fragility and disconnected nature of the energy grid, it is unclear to what extent these views are prevalent across Party circles. Studies like these are published in technical journals that are dominated by scientists and engineers. The literature that assesses Chinese energy insecurity does not go into enough detail to mention grid issues like those above, so it is unclear if Party-state readers would understand the issues facing China's grid in-depth. Nonetheless, it is clear that Chinese strategists question the efficacy of new energy sources.

Studies like these recommend that wind energy should be distributed to nearby areas, yet the locations that have the best wind potential do not require high amounts of energy. These issues leave difficult questions for Chinese strategists' hopes for the future of wind energy.

In response to these concerns about lost wind energy, some authors believe China should boost its energy storage capacity. For example, one writer proposes pairing expanded energy storage with China's growing wind power: "Whether it is wind power consumption or disaster recovery power, the reasonable combination of "wind power + energy storage" can solve possible problems."[197]

Like wind power, solar power is also viewed positively yet tempered by measured skepticism concerning the extent to which it can relieve China's energy problems. One strategist is impressed by China's progress in solar power:

> Although China's solar energy development started late, it has developed rapidly and has achieved remarkable results…in 2015, China's solar energy consumption surpassed that of the United States for the first time, and then further widened the gap with the United States (see Table 8). In terms of development speed, the growth rate of solar energy consumption in China in 2017 was 75.9%, and that of the United States was 40.9%…This shows that both China and the United States attach great importance to the development and utilization of solar energy, which is an important aspect of promoting the transformation of the energy structure of the two countries.[198]

195 See 张宏 王礼茂 张英卓 牟初夫 方叶兵 杨慧敏 [Zhang Hong, Wang Limao, Zhang Yingzhuo, Mou Chufu, Fang Yebing, and Yang Huimin], "低碳经济背景下中国风力发电跨区并网研究 [Analysis of cross-regional grid integration of wind power under a low carbon economy]," 资源科学 [*Resource Science*], no. 12, 2017. *Resource Science* is sponsored by the Institute of Geographic Sciences and Natural Resources Research, of the Chinese Academy of Science.

196 See 王伟胜 [Wang Weisheng], "我国新能源消纳面临的挑战与思考 [The Challenge and Thinking of my Country's New Energy Consumption], 新能源科技 [*New Energy Technology*], no. 12, 2020.

197 孙茜 [Sun Qian], "应对电力负荷告急"风电+储能"寻新路 ["Wind power + energy storage" finds a new way to deal with the urgent power load]," 新能源科技 [*New Energy Technology*], no. 1, 2021, p. 13.

198 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 8.

While the PRC's solar market has grown quickly, some doubt its safety. Feng Chujian and Chen Hongbo from Huazhong University of Science & Technology and the University of Science and Technology of China School of Public Affairs believes that the intensive process for building solar power harms China's environment:

> At present, the world's largest photovoltaic manufacturing country is China. However, due to backward technology and incomplete systems, the development of China's photovoltaic industry not only cannot effectively guarantee national energy security, but also further aggravates the pressure on energy conservation and emission reduction.[199]

Lastly, Chinese commentators generally appear to dismiss the potential of nuclear energy. These authors are primarily concerned about the safety of the power source. Wang Zhouyu wrote that

> The huge risks of nuclear energy make its limitations more prominent. The possibility of nuclear leakage and the catastrophic consequences of a nuclear accident can be said to have become a curse in the development of nuclear energy…After the Fukushima nuclear leak in Japan in 2011, Germany, Switzerland, Italy and other countries accelerated their "nuclear weapons abandonment"…doubts and concerns about the safety of nuclear energy still have a restrictive effect. Even if there is no nuclear leakage problem, nuclear pollution caused by the development and utilization of nuclear energy and the disposal of high-level radioactive nuclear waste are always difficult problems.[200]

China's specific conditions sharpen these safety concerns. Yang Mingzhou warns, "As our country is densely populated, we must be cautious in developing nuclear power in the interior."[201] Beyond worries about nuclear safety, nuclear energy is believed to be uncompetitive and facing various economic difficulties:

> In recent years, due to the adjustment of the national industrial structure, the slowdown in demand for electricity growth, and competition from the development of wind power and solar energy, the problem of nuclear power load reduction and power price reduction has caused certain difficulties for nuclear power operators…the number of nuclear power projects started has decreased, and the current overall situation of overcapacity has brought pressure on business operations. The public's acceptance of nuclear power is facing challenges…[202]

199 冯楚建 陈宏波 [Feng Chujian and Chen Hongbo], "能源安全视域下的光伏清洁利用:国际动态与中国出路 [International Trend and China's Outlet of Clean Use of Photovoltaic Resources from the Perspective of Energy Security]," 科技管理研究 [*Science and Technology Management Research*], no. 9, 2019, p. 53. *Science and Technology Management Research* is sponsored by the Guangdong Association of Science of Science and Science and Technology Management Research (sic) [广东省科学学与科技管理研究会].

200 王卓宇 [Wang Zhouyu], "世界能源转型的漫长进程及其启示 [The Long Process of World Energy Transformation]," p. 58.

201 杨名舟 [Yang Mingzhou], "建设现代能源强国应抓住十大创新机遇 [Ten Major Innovation Opportunities Should Be Seized to Build a Powerful Modern Energy Country]," p. 48.

202 赵成昆 [Zhao Chengkun], "中国核电发展现状与展望 [Development Status and Outlook for Nuclear Power in China]," 核动力工程 [*Nuclear Power Engineering*], no. 5, 2018, p. 3.

Chinese antipathy toward nuclear energy appears so deep that many authors that analyze China's new energy potential do not even mention nuclear power. PRC strategists do not seem to think nuclear power has a viable future.

Hydropower, wind power, and solar power are all seen as opportunities to reduce China's energy insecurity, while nuclear energy's potential is dismissed. As its new energy industry grows, the Chinese economy will be able to use less coal, oil, and natural gas, the resources at the heart of China's energy predicament. These strategists, however, make it clear that these new energy sources are not a panacea, and progress will take decades, if not longer. These attitudes fit into Chinese strategists' broader pessimism about the PRC's energy predicament.

In summary, when Chinese strategists assess the comparative strength of their country's energy security, they conclude that China is energy insecure. Its energy endowment provides China with a surplus of coal and a deficit in oil and natural gas. Since coal is a heavy contributor to China's pollution issues, Chinese analysts feel intense pressure to transition the economy away from the resource. Simultaneously, external reliance for oil and gas leaves China's economy vulnerable to disruption. In their view, China has to move away from the resources that provide the majority of its energy. PRC strategists propose various policies to either ameliorate the short-term effects of China's use of coal, oil, and gas; or long-term solutions based on shifting to new energies.

American Energy Security & the Shale Revolution

PRC strategists believe that the United States is energy secure. In their view, the shale revolution upended the U.S. strategic situation and made the country energy independent in oil, natural gas, and coal.

Chinese analysis of American energy security begins with its understanding of the U.S. energy endowment. They see that the United States has massive stores of oil, natural gas, and coal. As a result, the United States does not need to depend heavily on any single resource or import significant amounts of energy. They write that American industry is "oil-based."[203] Beyond basic analysis, current Chinese commentary on the American energy industry is brief. Since the United States is self-sufficient in the fossil fuels it consumes, PRC authors conclude that the United States is energy independent and refrain from further analysis. They do, however, spend some time explaining U.S. progress in developing new energy sources.

203 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 6.

To Chinese strategists, the United States and China are roughly comparable in green energy technologies, although the PRC has taken a recent lead. One author describes the situation in new energy:

> In terms of energy transition and renewable energy technology, the United States was aware of and acted earlier than China. The current level of development and utilization of renewable energy is better than that of China. However, after recognizing the carrying capacity of resources and the environment and the necessity of economic transformation, China has started the process of energy revolution and accelerated the development of renewable energy.[204]

Part of why Chinese strategists may think the United States is falling behind in green energy technology is that America has fewer reasons to undertake the transition in energy than China. As described above, Chinese strategists feel immense domestic and international pressure to shift toward green energy. On the other hand, America's "preference" for oil and its stagnating emissions means that the United States is less compelled to invest in green energy.[205]

As a result, Chinese commentators see the United States as energy-independent but beginning to lag behind the PRC in new energy technologies. Besides brief analysis, Chinese commentators have not discussed American energy security in-depth recently. The Chinese literature of comparative assessments between American and Chinese energy security is terse regarding America's situation. Given the fears about China's energy insecurity, it makes sense that these strategists would not further examine U.S. energy security.

While recent discussion has not been in-depth, Chinese energy analysts examined the relationship between the burgeoning shale revolution and America's geostrategic position in the early 2010s. As the American shale revolution rapidly transformed the U.S. energy endowment, Chinese strategists wrote prolifically about how America joining the ranks of energy powers would change the global landscape. Many of them came to grand conclusions about the potential trajectory of the 21st century. This section will scrutinize this Chinese debate for multiple reasons. Beyond solely revealing Chinese views about the global energy market, these discussions also elucidate how the Party-state views the relationships between energy, trade, geography, and politics. By reading these debates, the United States can better understand how the comparative assessment of American and Chinese energy security influences the strategic competition between the two countries.

Chinese authors saw the prospect of growing American energy production as a crucial strategic trend in the 21st century. In their view, America's comprehensive national power was

204 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 7.

205 See 袁益 舒展 [Yuan Yi and Shu Zhan], "中美能源安全现状比较与启示 [Comparison of Energy Security of China and the US and the Inspirations]," p. 7.

bolstered across the world. This development stemmed from: (1) the United States reducing its reliance on the Middle East, (2) bringing its allies closer into its sphere of influence, (3) reducing Russia to an insignificant player on the world stage, (4) shoring up the U.S. dollar's place in the global financial system, (5) displaying its ideological dominance, and (6) assisting the United States in climate change negotiations.

When Chinese strategists describe the impact of the shale revolution on the strategic landscape, they begin by sketching a simplified model of the global energy market. In their conception, the world energy market is underpinned by a series of export-import relationships, further characterized and defined by transactions and dependencies. Before the shale revolution occurred in the United States, there were two major exporting centers—the Middle East and Russia—and three major import markets: the United States, Asia (specifically Northeast and South Asia), and Europe.[206] Within this system, the Middle East was the primary exporter to the United States and Asia, while Russia was the leading energy provider for Europe.

With the rise of the shale revolution, however, the United States surpassed the world's primary energy producers in the Middle East and Russia. As a result, the traditional export-import relationships underpinning global energy markets became endangered in the Chinese view.[207] A typical description of this phenomenon is the "Westward Shift," wherein the center of gravity of global hydrocarbon production is moving from the Middle East to the Western Hemisphere, with the United States at the center.[208] As a result, the United States started as an importer from the Middle East and then shifted to become an exporter to both Europe and Asia. These authors conclude that this shift would make the United States energy independent. Unlike many American analysts, Chinese strategists do not appear to precisely define "energy independence" or question the limits of American energy power. Chinese authors' primary concern with this new configuration of the global energy order was the United States' relationship with the Middle East.

Chinese strategists believe that surging American energy production would remove the United States' structural incentives to continue its engagement and military posture in the Middle Eastern region. These sources describe China's strategy in the region as centered upon using the American military to stabilize Middle Eastern oil production and exports to ensure a secure and growing supply to China. In other words, they free ride on the global public goods provided by the U.S. military. As American oil and natural gas output increased, the U.S. would no longer need to depend on the Middle Eastern region for its energy and could also increase supplies to key allies and partners. Most commonly, Chinese

206 Of course, this description of global energy markets is simplified and incomplete. Chinese sources target the energy trading relationships that matter most for influencing the strategic behaviors of the great powers globally.

207 潜旭明 [Qian Xuming], "美国"能源独立"的影响及对我国的启示 [The Influence of American "energy independence" and its Influence on my Country]," 理论视野 [*Theoretical Horizon*], no. 12, 2014, p. 62.

208 林利民 [Lin Limin], "世界油气中心"西移"及其地缘政治影响 [The "Westward Movement" of the Oil and Gas Center and its Geopolitical Influence]," 现代国际关系 [*Contemporary International Relations*], no. 9, 2012.

writers describe the United States as holding greater "flexibility" in the Middle East. It should be noted that concerns about the United States' position in the region dominated the Chinese discourse on the American shale revolution. These strategists disagree, however, on what America will do with that newfound strategic latitude.

One CCP view holds that the United States will use the strategic space afforded by the shale revolution to disengage from the Middle East and end its regional stabilization efforts. Lin Limin of the China Institutes of Contemporary International Relations describes why the United States would leave the region:

> The current decline in the United States power is largely due to the United States' excessive investment in the greater Middle East, excessive bloodshed, and excessive consumption of strength. In view of this, the current "shale gas revolution" that originated in the United States and the shift of the world's oil and gas resource centers from the greater Middle East to the Western Hemisphere will obviously let the United States stop regarding the Middle East as an important part of its global chess game. From then on, the United States may end the "nightmare" in the Middle East, and may no longer arrange its global strategy in accordance with the idea of ensuring the Middle East and its oil and gas resources, thereby obtaining more freedom of action and strategic breathing room.[209]

Lin's view is a neutral one, meaning that it did not seem to be associated with related attitudes about the United States that appear from other authors in the Chinese literature.[210] This view appears to be the most common within the articles analyzed within the survey. Still, it should be noted that often authors do not specify what they think the U.S. will do with its flexibility in the Middle East, leaving it to readers to ascertain.

Cui Nannan, an economist affiliated with Peking University, takes a more cynical view. He postulates that the United States will use the opportunity to endanger Chinese energy imports by fueling instability in the Middle East:

> Since the security situation in the Middle East will not endanger U.S. interests, the U.S. strategy in the Middle East will change from maintaining the status quo to inciting chaos. Based on logical reasoning, the future situation in the Middle East, which is my country's main source of oil, will become more turbulent.[211]

209 林利民 [Lin Limin], "世界油气中心"西移"及其地缘政治影响 [The "Westward Movement" of the Oil and Gas Center and its Geopolitical Influence]," p. 53.

210 Various sources fall into different groups of how they view the United States. Those with a negative ideological view of America naturally think that the U.S. will do what is worst for China at all times, while the opposite side sees opportunities for cooperative and gives America the benefit of the doubt, or at least understanding that America prioritizes her own self-interest.

211 崔楠楠 [Cui Nannan], "奥巴马政府的"能源独立"战略 [The Obama Administration's "Energy Independence Strategy"]," 理论参考 [*The Journal of Theoretical Reference*], no. 5, 2013, p. 46. *The Journal of Theoretical Reference* is sponsored by the Fujian Party School [中共福建省委党校].

Those that espouse this view also tend to describe other hardline views throughout their analysis, highlighting deep-seated insecurities about energy flows and supplies to China. This group appears to express a minority view, or is at least less vocal about these key insecurities than other analysts.[212]

Lastly, some authors believe America's role in the Middle East will be more nuanced than suggested above. They argue that although the United States will likely focus less on the Middle East, the United States will continue to play an important role in the region. For example, Zhou Yunheng argues:

> Compared with the United States being increasingly able to stay out of conflicts in the Middle East, China may find that it has to be involved in more regional conflicts…For its own interests, the United States will still be committed to the stability of the Middle East and the safe passage [of energy] on the high seas, but China can hardly expect the United States to put China's national interests first.[213]

Zhou does not explain what interests he believes the United States would protect by continuing its posture in the Middle East. He does accept, however, the idea that China may have to assume greater responsibility in the region as a result of relatively reduced and less favorable American engagement (from China's vantage point). Wu Zhengwan of the China National Offshore Oil Corporation (CNOOC), on the other hand, thinks that America's engagement will continue with a different face:

> The United States' multiple interests in the Middle East make it difficult to "abandon" the Middle East. However, the U.S. that has shed its "oil burden" and may make concessions on some complex issues and reduce power consumption…For countries such as Iran that are "disobedient", the United States can strengthen sanctions against them without worrying about shocks in the world oil market.[214]

Although there is disagreement over the extent to which the United States will retain its strategic posture in the Middle East, the authors agree that China's engagement in the Middle East will have to change. As the United States draws down in the region, China will face the prospect of its primary regional source of oil collapsing into anarchy or at least requiring substantially more Chinese engagement and intervention than has previously been necessary. For example, Lin Limin worries that the Middle East as we know it today may disintegrate:

212 Only one article explicitly described this view. One may conclude this group is small and less influential, but it is impossible to confirm from public sources.

213 周云亨 [Zhou Yunheng], "美国能源独立前景及对中国的影响 [The prospect of U.S. energy independence and its impact on China]," pp. 63-64.

214 武正弯 [Wu Zhengwan], "美国"能源独立"的地缘政治影响分析 [Analysis of the Geopolitical Influence of American "Energy Independence"]," 国际论坛 [*International Forum*], no. 4, 2014, p. 10. *International Forum* is sponsored by the Beijing Foreign Studies University [北京国语大学]

> Will Afghanistan return to a warlord melee? Will Iran break the nuclear threshold and push Egypt, Saudi Arabia, Turkey, and other countries to follow suit? Will the Gulf monarchy countries fall into turmoil? Will there be renewed conflict between Iran, the Gulf monarchies, and the various Muslim factions?...Will Israel's security crisis deepen and repeat its first five wars in the Middle East? Does Turkey have regional ambitions? Can the oil production and exports of Gulf countries remain stable? Can the Strait of Hormuz remain open?[215]

Amid this uncertainty, China may have to shoulder more of the burden of keeping the region together or at least ensuring sufficient energy flows out of the region to China. Usually, these authors do not give exact policy prescriptions about what China should do in the Middle East. Still, they imply that China's current position will be untenable into the future, and more Chinese engagement will be required. Zhou Yunheng writes that if China's strategy in the Middle East remains the same, it will become more dependent on the United States:

> China may find that it has to be involved in more regional conflicts...China will be more likely to be in a strategically passive position. To meet domestic energy demand, China will have to import more oil from the Persian Gulf. Due to the country's increasing dependence on foreign energy, China is actually increasingly relying on the United States to consolidate regional security and maintain unimpeded high seas energy channels. In view of the acceleration of the country's energy independence process, the United States may become increasingly impatient with China's "free-riding" behavior.[216]

From a potential policy perspective, Zhou may be advocating for China to have a more active presence in the region. Wu Zhengwan, however, does make it clear that China will have to replace the United States' global governance functions in some respects:

> China may have to undertake more obligations to provide global public goods. The United States' global strategic contraction objectively provides space for China to intervene in international security affairs. As China's sources of overseas energy imports continue to increase, China's international perspective will gradually increase from the regional level to the global level. China intends to gradually change its role of "free-riding" in international security affairs, and more proactively assume the international obligations of maintaining channel security and regional security. Finally, China will have a greater say in the global governance system.[217]

Outside of the Middle East, Chinese sources also debate what the United States will do with its increased energy production. Most agree that American energy exports will be crucial in buttressing its alliance system and dominant global position. Some authors believe that America will look to stabilize its dominant position in the Western Hemisphere before

215 林利民 [Lin Limin],"世界油气中心"西移"及其地缘政治影响 [The "Westward Movement" of the Oil and Gas Center and its Geopolitical Influence]," pp. 53-54.

216 周云亨 [Zhou Yunheng], "美国能源独立前景及对中国的影响 [The prospect of U.S. energy independence and its impact on China]," p. 64.

217 武正弯 [Wu Zhengwan],"美国"能源独立"的地缘政治影响分析 [Analysis of the Geopolitical Influence of American "Energy Independence"]," p. 11-12.

expanding further. They assume that the shale revolution will spread from America to countries like Canada, Brazil, and Mexico, so the US will have to shore up its local position and ensure friendly relations. In the *Journal of Theoretical Reference*, Li Tianxing writes:

> The US energy policy will increasingly focus on relations in the Western Hemisphere, while Brazil may become one of the world's most powerful economic and financial players. These changes will likely evolve to all of the Americas into a free trade zone.[218]

Zhang Maorong of the China Institute of Contemporary International Relations argues, "The United States has taken the lead in locking up its neighbors Canada and Mexico, as well as South America's Brazil and many other oil-producing countries."[219]

Since the shale revolution will extend beyond the United States, Chinese authors expect the United States to work to keep the Western Hemisphere, strictly within the United States' sphere of economic influence as potential competitors' shale production rises. After all, Chinese authors expect the Western Hemisphere will become the "second Middle East," so they believe that the United States may pay as much attention to its neighbors as it used to the Middle East.[220] Chinese analysts expect the maintenance of American influence to extend to Europe and Asia as well.

Chinese analysts argue that the American energy exports would become a tool to bind European and Asian allies to the United States in a dependent posture, which will shore up America's hegemonic global position. Tsinghua University's Di Dayu notes:

> The largest potential supply target for U.S. oil and gas resources is Europe. If the United States can export oil to Europe on a large scale on the basis of exporting natural gas, Europe's dependence on oil from the Middle East will decrease and the alliance between Europe and the United States may deepen. In addition, the United States may also export energy to partner countries in the Asia-Pacific region under the TPP [Trans-Pacific Partnership] framework, providing energy support to countries such as Japan and South Korea.[221]

Lin Limin takes the logic a step further, postulating that these new trading relationships will mediate conflicts within America's alliances:

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218 李天星 [Li Tianxing]. ""能源独立"将改变世界能源版图 ["Energy Independence" Will Change the World's Energy Landscape]," 理论参考 [*Journal of Theoretical Reference*], no. 1, 2013, p. 42.

219 张茂荣 [Zhang Maorong], "美国"能源独立"前景及其地缘经济影响 [The prospect of "energy independence" and in the United States and its geo-economic impact]," 现代国际关系 [*Contemporary International Relations*], no. 7, 2014, p. 57.

220 张仕荣 and 崔波 [Zhang Shirong and Cui Bo], "美国"页岩气革命"与世界能源版图的变革 [The "Shale Revolution" in the United States and the Transformation of the Energy Map]," 中国党政干部论坛 [*Chinese Cadres Tribune*], no. 12, 2013, p. 95.

221 翟大宇 [Di Dayu]. "美国能源独立的影响及中国应对 [The Influence of American Energy Independence and China's Response]". 领导文萃 [*The Leadership Collection*]. no. 24, 2015, p. 30. *The Leadership Collection* is sponsored by the CCP Fujian Party School [中共福建省委党校]. Of course, the United States withdrew from the Trans-Pacific Partnership in 2017.

> After the Cold War, Europe, Japan, South Korea and other U.S. allies relied on Russia's oil and gas resources and the oil and gas resources of the greater Middle East, and they diverged from time to time with the US on Middle East policies towards Russia…The United States often accommodated Japan and allowed it a certain degree of freedom of movement. In the future…Its allies such as Europe, Japan and South Korea can increase oil and gas imports from the United States, South and North America, and thus end the conflict to a certain extent…This will help the United States, Japan, Europe and others maintain coordinated relations and even consistency on major international issues.[222]

Chinese analysts are confident that America will use the new leverage from energy for alliance management purposes. As a result, Chinese analysts think that the American alliance system will be more closely knit in the future, unified under dependency on American energy resources to support the alliance countries.

Party members have concluded that the advent of American net energy exports is a catastrophic strategic setback for Russia that pushes Russia to rely on energy sales to Asia. Russia and Europe are mutually reliant on each other for energy export and import. In 2016, 77.8% of Russia's natural gas exports and 59% of its crude oil exports went to Europe.[223] Many European countries depend on Russia for their energy supplies. For example, Russia is Germany's largest oil and natural gas vendor.[224] However, Chinese analysts believe Russian leverage over the European continent will evaporate once America's European allies have more import options, especially from the Western Hemisphere. For example, Zhang Shirong and Cui Bo from the CCP Central Party School describe Russia's new situation:

> The extensive development and export of unconventional oil and gas resources in the United States will weaken Russia's strong pricing power and market share in Europe… this will to a certain extent gradually reduce the EU market's dependence on Russia's oil and gas imports, and Russia's geopolitical position in Europe will also be greatly weakened.[225]

Zhou Yunheng writes that Russia's weakening grip over Europe pushes it toward Asia:

> "At present, Russia is accelerating its oil and gas export plan to the Asia-Pacific region in order to promote the diversification of its energy export market, reduce its dependence on European countries, and promote the development of its eastern region."[226]

222 林利民 [Lin Limin],"世界油气中心"西移"及其地缘政治影响 [The "Westward Movement" of the Oil and Gas Center and its Geopolitical Influence]," p. 54.

223 U.S. Energy Information Administration (EIA), *Country Analysis Brief: Russia* (Washington, DC: EIA, 2017), pp. 11, 21, available at https://www.eia.gov/international/content/analysis/countries_long/Russia/russia.pdf.

224 "Germany," *U.S. Energy Information Administration*, available at https://www.eia.gov/international/analysis/country/DEU.

225 张仕荣 崔波 [Zhang Shirong and Cui Bo], "美国"页岩气革命"与世界能源版图的变革 [The "Shale Revolution" in the United States and the Transformation of the Energy Map]," p. 95.

226 周云亨 [Zhou Yunheng], "美国能源独立前景及对中国的影响 [The prospect of U.S. energy independence and its impact on China]," p. 63.

Wu Zhengwan writes in *International Forum* that the United States will use Russian weakness to democratize it and other countries:

> The United States intends to use the natural gas "price war" to urge Russia and Central Asia to "discolor" Russia. Russia under Putin is viewed more as a competitor than a partner of the United States, and the major gas-producing countries in Central Asia are also viewed by the United States as an alternative with different values. The United States hopes to use low-cost natural gas as a weapon to squeeze the external market space of these countries, reduce their government fiscal revenue, cause their domestic economic and social difficulties, and "force" their domestic political reforms.[227]

Lastly, Zhang Maorong puts Russia's strategic crisis in stark terms:

> It is foreseeable that the new energy order will make Russia's decline in the 21st century almost a foregone conclusion… The exploitation of unconventional oil and gas and the rising energy status of the United States will constitute a "fatal blow" to Russia's status as a major power.[228]

Russia's drift toward Asia may be one of the primary strategic benefits of America's shale revolution for China. Since Chinese analysts see the shale revolution as nothing less than a strategic disaster for Russia, they expect Russia to rely more and more heavily upon the PRC as Russia faces pressure from the United States' rapidly expanding shale exports. Russia will likely increasingly have no other choice but to sell its energy to China.

While the United States' exports to Europe will weaken Russia's economy and influence, oil and natural gas exports to Asian allies like Japan and South Korea will become the backbone of America's strategic shift toward Asia. Chinese authors fear that American oil and natural gas production will bolster America's hand in Asia. Yuan Peng of the China Institutes of Contemporary International Relations explains:

> "Energy independence" has created conditions and space for the United States to accelerate its strategic eastward shift and build a "New Pacific Order"…[the United States will] dominate the future of Asia-Pacific economic cooperation and shape a new economic and trade order in the Asia-Pacific region centered on the United States.[229]

Chinese authors appear to have had an intense fear that the strategic effects of the shale revolution discussed above would underpin renewed American economic leadership

227 武正弯 [Wu Zhengwan],"美国"能源独立"的地缘政治影响分析 [Analysis of the Geopolitical Influence of American "Energy Independence"]," p 11. By using the term "discolor," the author is implying here that the United States will cause a Color Revolution in Russia. The threat of Color Revolutions is a persistent fear for Chinese strategists.

228 张茂荣 [Zhang Maorong],"美国"能源独立"前景及其地缘经济影响 [The prospect of "energy independence" and in the United States and its geo-economic impact]," p. 56-57.

229 袁鹏 董春岭 [Yuan Peng and Dong Chunling], "美国"页岩气革命"的战略影响 [The Strategic Impact of the US "Shale Revolution"]," 党政论坛 [*Party and Government Forum*], no. 5, 2013, p. 56-57. It is important to note the context of these fears. At the time, the U.S. was establishing the Trans-Pacific Partnership.

and influence in Asia. In their view, the shale revolution would enable and encourage an American strategic shift to the Indo-Pacific. Across viewpoints, the American shale revolution was seen as having ominous consequences for America's adversaries and positive ones for its allies and America itself.

Chinese analysts also see the shale revolution as fortifying U.S. dollar dominance. They describe a "petro-dollar system" wherein U.S. dollar hegemony is supported by American oil and natural gas exports. This system would reinforce U.S. dominance globally, according to Li Yang of the University of International Relations in Beijing:

> The United States has established a 'petro-dollar system' centered on the dollar and has become the largest absorber and beneficiary country in the system. At present, the U.S. dollar is the most important currency for pricing and settlement in international energy trade (oil, natural gas, etc.). The establishment of the 'petro-dollar system' effectively guarantees the status of the U.S. dollar as the medium of exchange in international oil trade, which is 'essential to stabilize the strong position of the U.S. dollar and maintain the U.S. global currency hegemony.[230]

Given this perception of the relationship between the growth of the American energy exports and the dollar, these analysts believe the dollar's influence as the global reserve currency is continuing to grow, instead of declining, as others have suggested.

Some Chinese authors speculate that the shale revolution will help the United States in its global ideological competition with China. Two authors describe the shale revolution as hurting China by making the American system seem more effective to a global audience. These strategists describe America's ideological appeal as rooted in economic efficiency. In *Theoretical Reference*, Cui Nannan writes:

> From an ideological perspective, the new energy policy provides "excellent" material for the United States to demonstrate the rationality of the Western model and the unsustainability of the Chinese model…the U.S. government will undoubtedly use the extensive growth model of the Chinese economy and its huge demand for world resources as an attack point to promote a "healthy" development model led by American innovation and technology.[231]

In *Contemporary World*, Li Yang explained that the shale revolution will allow the United States to undertake "soft aggression" to promote American ideals and culture.[232] In both of these circumstances, the authors extrapolate U.S. successes to be Chinese losses worldwide.

230 李扬 [Li Yang], "美国能源战略助推 其"能源独立"的实现 [US Energy Strategy Boosts the Realization of Its "Energy Independence]," 当代世界 [*Contemporary World*], no. 9, 2013, p. 68.

231 崔楠楠 [Cui Nannan], "奥巴马政府的"能源独立"战略 [The Obama Administration's "Energy Independence Strategy"]," p. 46

232 李扬 [Li Yang], "美国能源战略助推 其"能源独立"的实现 [US Energy Strategy Boosts the Realization of Its "Energy Independence]," p. 65-66.

It is unclear if this is a consensus view regarding the ideological effects of the U.S. shale revolution.

The last benefit that Chinese spectators believe that energy independence will bring the United States is a stronger negotiating hand in future climate negotiations:

> The development of clean energy will help the United States reduce fossil energy consumption, thereby reducing greenhouse gas emissions, achieving green and sustainable development, and enabling the United States to improve its negative impression on international climate issues and regain the initiative and leadership in climate negotiations.[233]

While some sources discuss climate change negotiations, it is mentioned much less frequently than America's posture in the Middle East. Taken with the other global effects, the United States' strategic position for future negotiations regarding global pollution and climate change should be seriously boosted through the shale revolution.

To summarize, Chinese strategists view the U.S. shale revolution as a momentous international strategic development that boosted the United States' power throughout the world. Perhaps more importantly, these discussions reveal just how important PRC strategists see energy in influencing the international environment. This finding boosts the argument that Chinese fears about their energy insecurity are a significant factor in the U.S.–China global competition for influence and will inform many of the policy recommendations of this report.

As shown in the Chinese analysis of the U.S. energy industry today and previous discourse on the shale revolution, PRC strategists believe that the United States is in a strong position due to its energy security. The United States' emerging dominance in oil and natural gas makes it more energy secure than the PRC. In the Chinese view, this asymmetry of energy security influences the comprehensive national power of each country.

Assessing Chinese Views

The first step in incorporating Chinese views into American strategy is to evaluate them. By understanding the preferences, predilections, and potential misperceptions in Chinese thinking, the United States can properly align its policy to best exploit its asymmetric strengths against China. This section will evaluate the principal conclusions of the Chinese comparative energy security assessments and their judgments about the strategic effects of the American shale revolution. This section will attempt to point out where these authors were correct and where they may have misjudged, misperceived, minimized, or exaggerated the energy security or insecurity of China and the United States. A careful stock-taking of Chinese thinking will allow U.S. policymakers to exploit the flaws in Chinese reasoning

233 张仕荣 崔波 [Zhang Shirong and Cui Bo], "美国"页岩气革命"与世界能源版图的变革 [The "Shale Revolution" in the United States and the Transformation of the Energy Map]," p. 96.

about energy security and improve the comparative advantages that the United States enjoys in the strategic competition with the PRC. This section will first examine the comparative assessments in energy security between the United States and China, and then it will consider Chinese opinions on the geopolitical implications of the shale revolution.

PRC strategists' understanding of the comparative energy security of China and the United States appears to be broadly accurate. As shown above, Chinese commentators believe that the PRC is energy insecure, whereas the United States is energy secure. This analysis is based on comparisons in U.S.–China resource endowment and energy consumption. In these terms, PRC writers are correct. China's economy is dependent on harmful coal that pressures the PRC to shift away from the resource, and its reliance on imported oil and gas leaves the Chinese economy vulnerable to outside shocks. On the other hand, the shale revolution has drastically changed America's strategic conditions, as its energy markets are now self-sufficient and highly diversified. Upon closer analysis, however, some of the assumptions underlying Chinese arguments and their policy recommendations are either incorrect or nonetheless provide noteworthy insights for American policymakers.

First, Chinese strategists' perception of the "Malacca Dilemma" may misunderstand American strategic intentions. These writers appear resigned to their prediction that in a conflict with the United States, Chinese imports would certainly be blockaded by the Western powers. This assumption may be incorrect, as American strategists have long-standing disagreements over the feasibility, cost, and effectiveness of a blockade strategy in a conflict in the Indo-Pacific. Those supporting the concept often argue that a blockade could provide the United States leverage by crippling China's economy and would prevent escalatory risks that other strategies entail.[234] Those opposing the strategy point out the operational challenges to establish and maintain a blockade, often envisioned across the entirety of the first island chain; further anticipate China's potential to mitigate expected economic effects; and expect the strategy would exacerbate escalatory pressures.[235] Given ongoing debate among American strategists concerning the blockade strategy, it is perhaps a misperception for Chinese analysts to assume an American blockade of Chinese goods during a conflict.

Chinese confidence in land-based pipeline imports is also peculiar. The analysts surveyed in this study appeared to presume that energy imports through pipelines were more secure

234 See Llewelyn Hughes and Austin Long, "Is There an Oil Weapon? Security Implications of the Changes in the Structure of the International Oil Market," *International Security* 39, no. 3, Winter 2014/15, pp. 152–89; T. X. Hammes, "Offshore Control: A Proposed Strategy for an Unlikely Conflict," *Strategic Forum* 278, June 2012, pp. 1–14; Jeffrey E. Kline and Wayne P. Hughes Jr., "Between Peace and the Air-Sea Battle: A War at Sea Strategy," *Naval War College Review* 65, no. 4, Autumn 2012, pp. 35–40; and Sean Mirski, "Stranglehold: The Context, Conduct and Consequences of an American Naval Blockade of China," *Journal of Strategic Studies* 36, no. 3, 2013, pp. 385–421.

235 See Evan Braden Montgomery, "Rethinking a Naval Blockade of China: A Response to Mirksi," *Journal of Strategic Studies* 36, no. 4, 2013, pp. 615–623; and Gabriel Collins, "A Maritime Oil Blockade against China—Tactically Tempting but Strategically Flawed," *Naval War College Review* 71, no. 2, 2018, pp. 49–78; and Gabriel Collins and William S. Murray, "No Oil for the Lamps of China?" *Naval War College Review* 61, no. 2, 2008, pp. 79–95.

than those coming by sea, yet there is little reason to believe this is the case. Although it is the case that pipeline imports cannot be interdicted the same way that China-bound ships can, pipelines that cross thousands of miles of territory are nonetheless highly vulnerable to a range of threats like crime, political instability, or special operations capabilities. It would be impossible for the PRC to guarantee the safety of the pipelines across their entire length. It is therefore odd that Chinese authors describe pipelines as a generally safer option for Chinese energy imports than sea-based shipments.

The PRC strategists' pessimism about technological backwardness, worries about green energy progress, and recommendations for institutional reform are worth noting. There is a popular perception that China is uniquely placed to continue to lead the world in renewable energy for the foreseeable future, based on strong technological investments and government guidance.[236] In contrast, the analysts surveyed in this study consistently worried that China's technology was behind the West and that green energy projects would take decades to assist in China's energy insecurity. Some observers even recommended changing the institutions governing China's energy sector. For a country that constantly touts its new energy progress, these frank admissions of anxiety are surprising. These general attitudes, absent other evidence, may signal that China's energy industry is weighed down by issues not immediately visible to outside observers.

PRC authors may exaggerate the threat of nuclear disaster from their growing nuclear power industry. Chinese writers showed a disregard for the growth potential of nuclear power and said that China's nuclear potential was seriously curtailed by fears of catastrophe. These conclusions miss recent developments in the nuclear industry that have made reactors safer to the public and less likely to face meltdowns and other crises.[237] Chinese strategists appear to either misunderstand or discount the potential of technological advances that could make nuclear power safer in the Chinese context. If wider Chinese elite opinion also fears nuclear risks, American observers may need to update their expectations for the Chinese nuclear industry. This new understanding of Chinese perceptions of the nuclear industry could have serious consequences for China's wider energy insecurity. As described in Chapter 3, nuclear is one of the few energy sources that is both clean and not dependent on imports; if Chinese government officials are wary of the energy source, the PRC will face another challenge to reduce its energy insecurity.

Overall, the record of Chinese perceptions about the strategic implications of the shale revolution is mixed. While the authors' predictions appear to be accurate in some areas, like America's instinct to support its allies, it is misunderstood in others, like America's interests in the Middle East. Throughout the literature surveyed in this study, the Chinese strategists

236 For one example, see Dominic Dudley, "China Is Set To Become The World's Renewable Energy Superpower, According To New Report," *Forbes*, January 11, 2019, available at https://www.forbes.com/sites/dominicdudley/2019/01/11/china-renewable-energy-superpower/?sh=cc385bc745a2.

237 "Safety of Nuclear Power Reactors," *World Nuclear Association*, March 2021, available at https://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/safety-of-nuclear-power-reactors.aspx.

sometimes portrayed a simple worldview wherein the world powers interacted almost exclusively based on commercial and economic interests. This perspective may be partially explained by many of the authors' focus on the energy market.

Chinese strategists' views of the United States' treatment of its allies and the ongoing strength of the U.S. dollar generally appear to be accurate. These analysts understand that the United States' foreign policy has traditionally emphasized supporting its allies and partners. As discussed in Chapter 2, U.S. oil and natural gas exports currently primarily go to its allies and partners. The U.S. dollar's dominance has also continued. This dominance is demonstrated by the crippling reach of American sanctions into Hong Kong and the power of unilateral U.S. sanctions on Iran.[238] Chinese strategists have, however, also made multiple erroneous judgments or assumed more optimistic trajectories and likelihoods.

The most apparent flaw in Chinese judgment appears to be their conclusion that the shale revolution has made the United States energy independent. These analysts believe that since the United States was on a path to become the world's biggest energy producer, it would inevitably be independent. As discussed in Chapter 2, this simplistic view overlooks the influence that global energy prices and the free market have on American energy security. This misperception is perhaps understandable given how common the view is globally.

Chinese thinkers' evaluations of U.S. commitment to the Middle East suffer from multiple problems. As described above, PRC strategists' predictions of American Middle East policy following the shale revolution fell into three categories: the United States would disengage from the region, allowing local actors to take care of their security; the United States would purposefully instigate chaos in the Middle East to harm Chinese interests; and the United States would remain present in the Middle East yet enjoy more flexibility. The first and second categories of analysis were especially flawed in their understanding of America's perception of its interests and how it pursued those interests.

One prediction of future American policy in the Middle East, offered most prominently by Lin Limin, misunderstands the drivers of American engagement in the Middle East. As described by this author, once the United States no longer required Middle Eastern stability for oil import security, America would have no other reason to sustain a presence in the region. This view ignores the multiple other concerns driving American policy in the region, such as ensuring allied energy consumption, stabilizing global energy prices, preventing nuclear proliferation, and preventing terrorist activity in the United States. Authors like Lin Limin simplify the drivers of American policy.

238 "Carrie Lam: Hong Kong's leader says she has to keep piles of cash at home," *BBC*, November 28, 2020, available at https://www.bbc.com/news/world-asia-china-55113149; and "US unilaterally declares UN sanctions on Iran are back in force," *France24*, September 20, 2020, available at https://www.france24.com/en/20200920-us-unilaterally-declares-un-sanctions-on-iran-are-back-in-force.

The view that America would purposely destabilize the Middle East drifts further from reality. Cui Nannan displays the paranoid tendency in Chinese foreign policy thinking in which American policy is driven globally by an all-encompassing interest in attacking the PRC at the expense of other concerns. Unlike Cui's understanding, the United States has a variety of interests across each region. Chinese misperceptions of American policy in the Middle East present the United States with a strategic opportunity that will be discussed in Chapter 5.

Chinese strategists appear to have made flawed assessments of the long-term viability of the Sino-Russian partnership based on misconceptions of Russian agency. As described in the above section, CCP writers concluded that the American shale revolution would be a "fatal blow" to Russia's influence in the world. They assume that once the United States begins to trade substantial amounts of its oil and natural gas to Europe, Russia's monopoly on Europe's energy would evaporate. Once Russia loses its leverage, Russia would have no other choice but to rely solely on China as a trading and strategic partner.

Chinese strategists' understanding and perception of the Sino-Russian partnership betrays a sense of Chinese leverage over Russia. If the Chinese were to assume certain prerogatives over the Russians that Russia did not grant, they could seriously offend Russia. For example, expanding Chinese influence in Central Asia could agitate the Russian government, as will be discussed in Chapter 5. As long as the Chinese government continues to presume the inevitability of Russia's dependency on China and underestimate Russian agency, there will be potential for long-term disturbances in the Sino-Russian relationship that the United States can take advantage of. This discussion will continue in depth in Chapter 5.

Some Chinese strategists appear to overestimate the growth of the energy-producing capacity of other nations in the Western Hemisphere. These writers believed that the shale revolution would spread beyond America's borders in the region to states like Canada, Mexico, and Brazil. While these countries are energy producers, their production has not soared to the extent that it has in the United States.[239] It should be noted, however, that the United States-Mexico-Canada Agreement (USMCA) does re-affirm the United States' commitment to and influence in the Western Hemisphere, as predicted by Chinese strategists.

Equipped with increased knowledge and awareness of Chinese views U.S–China energy security and the shale revolution, America's strategic options can expand. The United States' advantage over China in the energy sector is already broad and asymmetric, yet the United States can use at least some of the PRC's errant views to enhance this edge.

239 See EIA, *Country Executive Analysis Summary, Brazil* (Washington, DC: U.S. Energy Information Administration); EIA, *Country Executive Analysis Summary, Mexico* (Washington, DC: U.S. Energy Information Administration); EIA, *Country Executive Analysis Summary, Canada* (Washington, DC: U.S. Energy Information Administration); and EIA, *Country Executive Analysis Summary, Argentina* (Washington, DC: U.S. Energy Information Administration).

CHAPTER 5

Strategic Considerations for the United States

The disparities in energy security between the United States and China provide ample strategic opportunities for the United States. The goals of a competitive energy-informed strategy would be for the United States to increase the opportunity costs and real costs that the Chinese government pays for its energy predicament. Doing so will accelerate existing resource dilemmas that Chinese strategists already confront. U.S. strategic planners should seek to force the Chinese leadership to make decisions between its various expensive strategic needs, including a growing military, economic growth for the sake of domestic legitimacy, and Belt and Road projects, among others.

Crucially, the United States should exploit Chinese fears and anxieties to multiply these real and perceived costs to China. Chinese strategists are possessed by a variety of stark insecurities that color their worldview and shape the PRC's behavior globally. A few of these fears include: "cultural pollution" from the West; the effects of stalling economic growth on domestic legitimacy; lack of international recognition of the success of the Chinese system of governance; food insecurity; capitalist encirclement; territorial dismemberment; constitutionalism; domestic unrest; and, as this report has focused on, losing access to the energy crucial to the basic functioning of its economy. Fears like these come together in China's increasingly authoritarian system to form a siege mentality wherein Chinese leaders and strategists are captured and driven by their multiple vulnerabilities. The reality of the PRC's mindset betrays the illusion of confidence that the CCP projects abroad. As the world emerges from the COVID-19 crisis with heightened strategic competition between China

and its rivals and the CCP regime leans more on repression and nationalism for its survival, Chinese strategists' insecurities may deepen with time.[240]

These insecurities should be a focal point of American strategy toward its rival. A competitive strategy should seek to cultivate these anxieties and encourage the self-defeating behaviors the fears support. The United States should apply concerted pressure against the PRC's weak points to fuel perceptions among the Chinese leadership that it may not be able to challenge the United States. In the context of this report, Chinese fears of its energy weakness and America's newfound energy security informs behaviors the United States should exploit. This psychological leverage that the United States holds over the PRC is a seldom-discussed yet increasingly important dimension of the competition between the two powers, especially in the energy sector.[241]

This chapter considers a wide variety of policy options across diplomatic, economic, and military dimensions. The Diplomacy section discusses American approaches to collective energy resilience, the Middle East, Russia, India, developing nations and partners, and China's greenhouse gas emissions. The Economic section explores intellectual property (IP) and technology theft, fortifying American energy security, and emerging technologies for energy. The Military section considers the deepening role of naval power in American energy strategy, discusses ways to take advantage of Chinese faith in pipeline imports, and reviews Department of Defense research initiatives in the energy sector. All of these approaches and considerations are centered on the goal of exploiting both the widening disparities between American and Chinese energy power and Chinese psychological vulnerabilities to the maximum extent possible in the context of a strategic competition between the two rivals.

Diplomacy

Perhaps the most consequential conclusion of this study is that China's energy insecurity sharpens the perceptions of geopolitical threats to China's rise. As China continues to reach out across the world for the oil and natural gas that is so essential to the functioning of its economy, it will be on a crash course with regional powers on its periphery and heighten the potential for overreach abroad. Additionally, U.S. policies can also intensify energy pressures on Chinese leadership and strategists to divide China's strategic priorities.

240 See Minxin Pei, "China and East Asian Democracy: Is CCP Rule Fragile or Resilient?" *Journal of Democracy* 23, no. 1, January 2012, pp. 27-41; Minxin Pei, "China's Coming Upheaval: Competition, the Coronavirus, and the Weakness of Xi Jinping," *Foreign Affairs*, May/June 2020, available at https://www.foreignaffairs.com/articles/united-states/2020-04-03/chinas-coming-upheaval.

241 See Thomas G. Mahnken, editor, *Competitive Strategies for the 21st Century: Theory, History, and Practice* (Palo Alto, California: Stanford Security Studies, 2012).

Allied Approaches to Collective Energy Security

With its expanding energy resources, the United States has become an oil and natural gas exporter. This change is one of the more important benefits that the United States has accrued due to the shale revolution. The United States should carefully consider ways to reap maximum strategic benefits from its growing energy arsenal. The United States should build an institutional ally-centric framework to coordinate energy supply and demand between itself and its closest strategic partners. This strategy would ensure that the United States and its system of allies and partners would be more internally resilient and less reliant on countries not closely aligned with the United States. It would also ensure that our allies and partners would be marginally less reliant on imports from the energy-rich yet unreliable regions of the world, such as the Middle East. In the process, our allies and partners' bargaining positions with their traditional energy suppliers would be boosted. Energy trade with our allies and partners is also a confidence-building measure, helping demonstrate our commercial and diplomatic commitment to these countries.

This approach would see the United States bring together its allies and partners worldwide to coordinate ways to fulfill each country's energy needs. Each country in this arrangement would either be a net exporter or importer for the group. The most important exporter in this arrangement would be the United States, but others could include Canada, Australia, and Norway. Significant importers would include countries such as Germany, Japan, South Korea, India, and Taiwan. The United States should create an explicit diplomatic initiative to encourage energy trade between these countries.

The United States has already taken some independent steps in this direction. America has worked closely with the Three Seas Initiative to reduce Eastern European reliance on Russian energy.[242] Lithuania and Poland recently built liquefied natural gas terminals, and Germany offered to do so in 2020.[243] Encouraging partners to build liquefied natural gas terminals would be essential to exporting America's growing natural gas production. The United States should proactively seek to encourage energy cooperation with its allies and partners.

A critical facet of this potential approach would be its ability to reduce the risk that American allies face from exporting to and importing from unreliable countries. For example, China is one of Australia's primary coal and natural gas buyers. In the past year, the PRC has undertaken a wide-ranging campaign to bully Australia, including restricting

242 David A. Wemer, "The Three Seas Initiative Explained," *The Atlantic Council,* February 11, 2019, available at https://www.atlanticcouncil.org/blogs/new-atlanticist/the-three-seas-initiative-explained-2/.

243 Natural gas shipments must be cooled for non-pipeline transportation; upon arrival at their destination, they are re-gasified. Daniel Yergin, *The New Map*, p. 109; LNG Reuters Staff, "UPDATE 1-Germany offered to build LNG terminals to avert U.S. pipeline sanctions-Die Zeit," *Reuters*, September 16, 2020, available at https://www.reuters.com/article/germany-usa-russia/update-1-germany-offered-to-build-lng-terminals-to-avert-u-s-pipeline-sanctions-die-zeit-idUSL8N2GD53Z.

its purchases of coal.[244] The United States could help Australia boost its energy trade with more reliable partners like India, as their growing economy will demand more of Australia's high-quality coal and natural gas over time. This example points to the broader result this strategy seeks to achieve: increasing the coherence and resilience of relations between both the United States and its partners and between the partners themselves.

A successful allied approach would see the United States and its allies build the legal and infrastructural institutions necessary to boost inter-ally energy trade. These efforts could be tied to more expansive policies meant to build up the American alliance system across the world. It should be kept in mind, however, that this policy is not a panacea. American and allied energy supplies alone are not sufficient to fulfill the needs of its allies and partners, but this policy would nonetheless build allied energy resilience and cultivate closer diplomatic ties. This effort should be taken instead of other initiatives that focus on adversary dependence on the United States.

Some might take the opportunity of growing American energy production to advocate promoting exports to China. Proponents might argue that the United States should cultivate Chinese dependence on American goodwill by taking up as much of the Chinese natural gas and oil import portfolio as possible. Doing so would have benefits to strategic stability and limit China's strategic independence. Cultivating Chinese dependence on the United States is not feasible, however. In 2019, the United States exported 4.66 trillion cubic feet (Tcf) of natural gas, and China imported 4.6 Tcf (10.8 Tcf total). That same year, the United States exported 8.47 million b/d of oil, and China imported 10.1 million b/d of oil (14.5 million b/d total).[245] Even if the U.S. oil and natural gas trade did not function in market conditions and the United States could "direct" its energy trade, the United States could supply China with 98% of its natural gas imports and 43% of its total consumption. For oil, the United States could provide 70% of China's oil imports and 58% of its total consumption. According to the EIA, natural gas occupies 8%, and petroleum takes up 20% of China's total energy consumption. As a result, even with this maximalist and highly theoretical approach, the United States could supply only 15% of China's total energy needs, limiting the strategic benefits of this approach to the United States. This amount is not enough to seriously limit China's strategic independence.

Moreover, China would either balk at the opportunity to import American energy or would reap short-term benefits from the proposal. Chinese analysts already worry about their oil imports from the strategically peripheral Middle Eastern region, so there is little reason to think China would be eager to replace those imports with those from their primary strategic

244 Paul Karp, "China formalises cut Australian coal imports, state media reports," *The Guardian,* December 14, 2020, available at https://www.theguardian.com/australia-news/2020/dec/14/china-formalises-cut-to-australias-coal-imports-state-media-reports.

245 "How much petroleum does the United States import and export?" U.S. Energy Information Administration, available at https://www.eia.gov/tools/faqs/faq.php?id=727&t=6#:~:text=In%202019%2C%20the%20United%20States,petroleum%20from%20about%2090%20countries.

rival. Additionally, if Chinese leaders were to agree to receive a higher amount of American energy imports, it would likely be to slightly diversify its energy portfolio and reap short-term gains.

The United States should be wary of energy trade with China. As addressed above, there is no realistic scenario in which the United States would benefit strategically from the development. It may be in the United States' best interest to implement some legal options to restrict American companies from trading their oil and natural gas to China if those exports expand beyond marginal levels of trade normal for the free market.

America should see its growing oil and gas exporting potential as a significant opportunity to boost the energy security of its allies and partners across the world. The United States should work to build a coalition of partners seeking to both export and import energy supplies to raise the resilience of the alliance networks that underpin American international influence.

Exploiting Chinese Insecurity in the Middle East

As discussed previously, Chinese strategists have highlighted fears about the security of China's energy imports from the Middle Eastern region. The United States increasingly holds material and psychological leverage over China's energy consumption and the basic functioning of China's economy through America's decreased dependence on the Middle East. There are many options for what the United States should do with this new opportunity.

The United States could devise a strategy to force China to expend valuable resources on protecting its vital energy imports from the Middle East by exploiting Chinese fears of American abandonment of the region. If China believed that the United States was strategically disengaging from the Middle East, it would feel compelled to divert scarce national resources to secure and protect petroleum imports. To do so would be an expensive and risky proposition, as the Chinese military does not yet have significant experience of "going global."[246]

There are two ways that the PLA could be reorganized to better protect Chinese energy security. The first option would be to upgrade its land-based defensive capabilities for long pipelines stretching from the Middle East and through Central Asia. However, it would be nearly impossible even for the PLA to provide enough manpower to guarantee the security of pipelines extending over thousands of miles, no matter how much was spent to keep the imports safe. On the other hand, the PLAN could expand its surface navy fleet to protect its key shipping lanes across the Indian and Arctic Oceans and through the South China Sea. However, this would be difficult to implement because the PLAN surface fleet would have to operate at great distances away from mainland support. It would also have difficulty

246 See David Shambaugh, *China Goes Global: The Partial Power* (Oxford: Oxford University Press, 2013); and Toshi Yoshihara and Jack Bianchi, *Seizing on Weakness.*

protecting shipments for the entire transit from the Persian Gulf to Chinese ports. Along the way, the PLAN surface fleet would face multiple interdiction threats from numerous nation-states, like India, Japan, Australia, Indonesia, Vietnam, the Philippines, Taiwan—not to mention the United States—and also non-state actors, such as pirates or privateers. In short, China has no realistic options to guarantee the security of its energy flows, either by land or by sea.

By forcing China to spend more on securing its energy imports, America would reap obvious strategic benefits. For the last several decades, China's "strategic direction" has been toward its "southeast."[247] The PLAN is modernizing itself with the primary objective of being able to unite Taiwan with the mainland, by force or otherwise, and to be able to deal with near-seas contingencies in the East China Sea and the South China Sea. By reacting to the Chinese fears of a disengaging United States, Chinese strategists would have to make tough budgeting and force structure decisions that they otherwise would not consider, including possibly expanding internal security-like capabilities and forces to a broader range of places and bases abroad. Increasing China's perceived risks to their energy imports would also heighten pressures to increase investments in expensive and complex cutting-edge green energy technologies, further subtracting resources available to pursue their primary security goals. These resources spent over energy concerns would be resources not spent improving the PLAN's ability to intimidate or attack Taiwan. Dividing Chinese strategic priorities would make American efforts easier to stabilize the balance of power in the Indo-Pacific region. Incremental but clear demonstrations of the United States' ability to divide the CCP leadership's attention may also have a deferring, if not deterring, effect on the Chinese goal of forcibly unifying Taiwan with the mainland. The United States would also have more opportunities to dynamically squeeze energy supplies at both locations and times of its choosing.

Creating a strategy that would force China to expend precious resources on diversifying its toolkit to protect its energy imports from the Middle East runs the risk of endangering continued American interests in the region. The United States is still interested in ensuring stable oil production from the region for the sake of global energy prices and allied energy consumption, preventing Iranian dominance of the Middle East, stopping nuclear proliferation across the region, and preventing terror attacks against the United States and allied countries. For example, carelessly swift American moves to abandon the Middle East would risk encouraging bandwagoning behavior toward Iran or Saudi nuclearization.

247 M. Taylor Fravel, *Active Defense: China's Military Strategy Since 1984* (Princeton, NJ: Princeton University Press, 2019), p. 184.

American strategy toward China should not purposefully sacrifice its multitude of other global interests.[248]

The United States should craft a regional strategy that balances these seemingly irreconcilable interests. While it would not be in the U.S. interest to completely fulfill Chinese fears of U.S. abandonment of the region, the United States can still exploit Chinese insecurities. This option could be accomplished by balancing U.S. posture in the region that China would perceive as threatening to its energy imports. Such a posture could create a U.S. Middle Eastern presence that is much more based on naval and special operations forces. Naval forces are ideally configured to threaten Chinese sea-based imports, and special operations forces can be trained to disrupt pipeline-based shipments. These changes could catch the attention of Chinese policymakers and force them to consider spending precious resources on better securing their Middle Eastern energy imports. Moreover, the emerging geopolitical contours of a post-Abraham Accords Middle East may also enable and increase incentives for the Gulf States' to diversify their economies beyond oil production and thus trade dependence with China, making this strategy easier to sustain.[249] Overall, this strategy would see the United States encouraging China to commit more resources to the Middle East while maintaining regional order.

Testing the Sino-Russian Relationship

Chinese views of the rationale between the prospering relationship between Russia and the PRC hint at a strategic opportunity for the United States. To Chinese strategists, Russia has been forced to "look East" at least partly because its traditional position of overseeing an energy dependency from Europe has rapidly faded due to American energy exports (with Germany as a notable exception). Chinese leaders and strategists believe they only need to welcome their new partner with open arms, since Russia has no other options. Thus far, that end result has advanced–the Sino-Russian partnership flourished during the 2010s, especially in the energy sphere. Despite this progress, this study reveals some possible shifts in the relationship that could endanger the future of the Sino-Russian partnership.

Chinese efforts to secure its energy imports from the Middle East could undermine their relationship with Russia. As discussed above, one route for China to secure its energy imports is via pipelines through Central Asia. This route would demand that China expend diplomatic and economic capital in Central Asia to build and support these routes.

248 See Eric S. Edelman and Whitney Morgan McNamara, *Contain, Degrade, and Defeat: A Defense Strategy for a Troubled Middle East* (Washington, DC: Center for Strategic and Budgetary Assessments, 2017); Andrew F. Krepinevich, *Preserving the Balance: A U.S. Eurasia Defense Strategy* (Washington, DC: Center for Strategic and Budgetary Assessments, 2017); and Gabriel Collins and Jim Krane, "Carter Doctrine 3.0: Evolving U.S. Military Guarantees for Gulf Oil Security," *Baker Institute for Public Policy*, April 27, 2017, available at https://www.bakerinstitute.org/files/11686/.

249 U.S. Department of State, "The Abraham Accords Declaration," available at https://www.state.gov/the-abraham-accords/.

Additionally, China would likely need to further invest in its land-based military capabilities to secure these pipelines in times of crisis. China has flirted with this strategy, with pipelines already running through Uzbekistan, Kazakhstan, Tajikistan, and Turkmenistan through the Belt and Road Initiative.[250] These moves could serve to alarm Russia about China's intentions for a couple of reasons. First, Russia has viewed Central Asia as part of its sphere of influence for centuries, and especially since the end of the Cold War with the importance of near-abroad buffer regions. Russia could see Chinese expansion into this region as an affront to its expected dominance in the region. Furthermore, any growth in the presence of the Chinese security forces in the region could raise eyebrows in Moscow.[251]

Chinese strategists' perception of the asymmetry of power in the Sino-Russian relationship could poison the current friendly ties between the leadership of both nations. When Chinese writers describe Russia as a doomed power with no other choice but to turn to China, it demonstrates a sense of superiority that could seriously offend Russia. Because Chinese strategists and CCP leadership believe that Russia is a junior partner to China, the PRC may presume certain prerogatives in the relationship that are unacceptable for the Russians. A kind of domineering attitude from China could convince the Russians that their relationship is not between equals, consequently giving Russia second thoughts about aligning closely to the burgeoning power. The rise of China's "wolf-warrior diplomacy" should be evidence that China could commit this kind of diplomatic malpractice, even with Russia.

These developments are not out of the United States' ability to encourage on the margins. Some of the drivers of the issues within the Sino-Russian relationship stem from Chinese dependence on Middle Eastern energy security and Russian strategic and economic setbacks in Europe. This study recommends that the United States work to spur the short-term impetus of the Sino-Russian relationship while avoiding any mitigations to long-term problems between the two powers. This approach could be achieved by encouraging American oil and natural gas exports to Europe and shifting America's security presence in the Middle East to potentially threaten Chinese imports. By increasing American energy exports to our European allies and partners, Russia will lose its energy supplier chokehold over Europe. As described by Chinese authors, this move would force Russia into China's arms. At the same time, American "flexibility" in the Middle East will compel the PRC to increase its presence in the Middle East and Central Asia, thus laying the seeds for further Sino-Russian tensions later. The end conditions of this strategy would be to find a weakened and isolated Russia seeking to balance against Chinese power, including perhaps by turning to the United States.

One counter-argument to this logic holds that the nature of the Putinist regime prevents Russia from following its own national interests in the way described above. The Russian government is a personalistic regime under Vladimir Putin's embrace of kleptocracy and

250 "The Central Asian Gas Pipeline," *South China Morning Post*, available at https://multimedia.scmp.com/news/china/article/One-Belt-One-Road/gasPipeline.html.

251 See Daniel Yergin, *The New Map*, Chapter 16.

corruption, wherein state functions are privatized. Under these conditions, the Russian leadership may be happy to accept junior status to China for as long as the kleptocrats can profit from it. Arguments like these may downplay the nationalist tendencies of the Russian leadership and the effects of state corruption on the regime's legitimacy. Selling out Russia to China may weaken the regime's support among the Russian population and pressure the state to shift its policies.

Another counter-argument points to the assumed risks with this strategy. If the break between Russia and China does not culminate as expected, Russia could be reduced to an energy "vassal state" as Chinese strategists hope. This situation would be an adverse outcome for the United States, not only because Russia could continue to alleviate some of China's energy issues, but also because it would relieve the pressure that the two powers' long shared border puts on Chinese strategy.[252] However, preventing this outcome by drawing Russia toward the United States with carrots instead of sticks may require the United States to sacrifice other policy priorities. For example, potential Russian demands in a rapprochement with the United States may sacrifice other U.S. interests in Europe, such as its support to Eastern European allies. These terms may not be acceptable to U.S. policymakers or the American people. Moreover, it is difficult to imagine any successful attempts to entice Russian alignment, given the failure of previous attempts to do so before the Russian invasion of Crimea in 2014. A hard-nosed approach likely remains the United States' best option, considering the difficult situation presented by prospering Sino-Russian ties and the simmering causes for tensions between the two powers.

Developing Opportunities with India

While Chinese strategists did not explicitly discuss India's place in the PRC's energy security dilemma, India should figure prominently in any policy analysis regarding global energy demands and strategy. India's unique geography, expanding demographics, and sharpening competition with China provide it with special tools to contribute to Chinese energy anxieties while satisfying its own needs. Most demographic projections indicate the population of India will likely surpass China by the middle of the 2020s.

India's geography places it in a unique position to secure its energy imports more easily while also holding Chinese imports from the Middle East at risk. As discussed above, any Chinese attempts to transport Middle Eastern energy back to China would require either protected shipping lanes from the Persian Gulf to eastern China or land-based routes through Central Asia. As for sea-based shipping, a growing Indian navy can threaten Chinese shipping at key maritime chokepoints near the Persian Gulf, the Strait of Malacca,

252 See Robert D. Kaplan, *The Revenge of Geography: What the Map Tells us About Coming Conflicts and the battle Against Fate* (New York: Random House, 2012), Chapter 11.

or the Lombok Strait.[253] On land, ongoing Indo-Chinese tensions on their long border attest to the multiple challenges China would face in trying to construct and secure pipelines through Central Asia and across China's empty Western provinces.

India may increasingly see it in its interest to expand its ability to threaten Chinese energy shipments because of the sharpening competition between the two powers. Following border clashes starting in the summer of 2020, the powers' spiraling relations may spur India to take its northern rival more seriously.[254] Under these conditions, India's determination to put pressure on China should increase as well. Although its geography and attitudes place India in a unique position, India's military development is far behind China's. The United States can play a role in assisting India in developing its competitive edge.

India and the United States would benefit from deepening security ties through a mix of formal and informal mechanisms. Indo–U.S. partnership amplifies China's energy dilemma, contributing to Chinese perceptions that its energy imports will be threatened. The United States has been pursuing substantially closer ties with India since at least the 2000s, and mutual recognition of a common threat has forged and deepened cooperative efforts in recent years.[255] Rapidly deteriorating relations between India and China, especially following border skirmishes in the summer of 2020, could serve as a turning point to further deepen ties between the United States and India. These tensions have already encouraged the United States and India to sign an intelligence-sharing agreement; resuscitate the Quadrilateral Security Dialogue between the United States, India, Japan, and Australia; and enhance naval cooperation through exercises and interoperability.[256] When considering further cooperation with India, policymakers should keep the energy sector in mind. Naval cooperation between the United States and India should be a top priority to ensure that India's energy flows are prioritized over China's in times of crisis. American policymakers should also be patient, however. India's colonial legacy and participation in the non-aligned movement inform its attitudes about external commitments in ways that may slow strategic alignment between the two powers. Nonetheless, the United States and India have a significant opportunity to cooperate to confront the common threat posed by China.

253 The Lombok Strait is primarily used by heavy tankers because it is wider and deeper than the Straits of Singapore and Malacca. See Mohd Hazmi and Mohd Rusli, "Maritime Highways of Southeast Asia: Alternative Straits?" S. Rajaratnam School of International Studies, February 10, 2012, available at https://www.rsis.edu.sg/rsis-publication/rsis/1686-maritime-highways-of-southeast/#.X_SDpOlKjOQ.

254 For example, emerging force structure changes may be indicative of this trend. See Ajai Shukla, "Army's Pivot to the North," *Business Standard*, January 7, 2021, available at https://www.business-standard.com/article/opinion/army-s-pivot-to-the-north-121010701572_1.html.

255 See Michael Green, *By More than Providence: Grand Strategy and American Power in the Asia Pacific Since 1783* (New York: Columbia University Press, 2017), pp. 498-500.

256 Vivek Raghuvanshi, "India, US sign intel-sharing agreement tension with neighboring China," *Defense* News, October 28, 2020, available at https://www.defensenews.com/space/2020/10/28/india-us-sign-intel-sharing-agreement-amid-tension-with-neighboring-china/; Jesse Johnson, "Malabar military exercises with 'Quad' nations begin in message to China," *The Japan* Times, November 4, 2020, available at https://www.japantimes.co.jp/news/2020/11/04/asia-pacific/malabar-military-exercises-china-quad/.

Assisting Partners & Developing Economies, and Bolstering Energy Resilience

The United States should consider using its green energy technology as an instrument of a new Energy Diplomacy, especially to support developing economies. Developing countries from Latin America, Southeast Asia, Africa, and India, among others, will continue to see rising energy demands as key enablers to their own economic growth and prosperity. The United States could consider sharing some of its cutting-edge technologies with its strategic partners. These countries could then transform their energy sectors to decouple energy consumption from GDP growth, thereby reducing their dependence on external energy and lowering their greenhouse gas emissions.

This policy could complement the United States' recent efforts to capitalize on the increasing diplomatic blowback against the excesses of China's Belt and Road Initiative. Energy projects have been one of the focuses of China's Belt and Road spending.[257] For example, electric power investment has dominated Chinese Belt and Road Investments in Pakistan.[258] For countries frustrated with China's "debt-trap diplomacy" and other issues associated with the Belt and Road, the United States could provide a welcome alternative. U.S. policy could revolve around assisting developing nations in building their nascent energy sectors and transforming their infrastructure. Both the U.S. International Development Finance Corporation and U.S. Agency for International Development can play a crucial role in pursuing this policy. An active policy could renew interest in U.S. models of development while also stabilizing and helping U.S. strategic partners.

As an increasingly important partner, the United States should particularly focus on reducing Taiwan's external energy dependency. Taiwan imports 98% of the energy it consumes.[259] It reportedly keeps only a month's worth of petroleum reserves.[260] As the prospect of a Cross-Strait invasion becomes ever more disconcerting, the United States should consider ways to reduce Taiwan's crucial energy weakness in the context of Taiwan's overall strategic situation. The United States should work with Taiwan to make its energy imports more secure and increase its domestic energy production capabilities. The United States can assist Taiwan in building up its relations with the other nations from which it buys oil and natural gas. For example, American efforts to strengthen Taiwanese ties with its natural

257 Thomas S. Eder and Jacob Mardell, "Powering the Belt and Road: China supports its energy companies' global expansion and prepares the ground for potential new supply chains," *Merics, June* 27, 2019, available at https://merics.org/en/analysis/powering-belt-and-road.

258 Daniel Yergin, *The New Map*, p. 186.

259 U.S. Energy Information Information Administration, "Taiwan: Analysis," December 2016, available at https://www.eia.gov/international/analysis/country/TWN.

260 Benjamin Fox, "Taiwan's Energy Security Battle," *The Diplomat*, April 18, 2011, available at https://thediplomat.com/2011/04/taiwans-energy-security-battle/.

gas trading partners, such as Malaysia and Indonesia, would align well with Taiwan's New Southbound Policy.[261]

While Taiwan will rely on energy imports for the foreseeable future, the United States can help Taiwan find ways to reduce its external dependency. Taiwan and the United States should consider alternative energy technologies such as solar, wind, tidal, and nuclear. Microgrid technologies would also help Taiwan improve resilience for its civilian population during periods of potential blackouts, whether from natural disasters, cyber-attacks, Cross-Strait invasion, or blockade. The U.S. Department of Energy, supported by the U.S. Department of Defense, could work with Taiwan to study and implement energy portfolio options to maximize self-sufficiency. Any improvements to Taiwan's energy portfolio would increase the island's ability to weather crises and blockades, buttressing American efforts to deter a Cross-Strait invasion.[262] While policies like these cannot solve Taiwan's energy predicament, even minor improvements could contribute significantly to Taiwan's security.

Highlighting China's Emissions and Green Energy Façade

The United States should make a diplomatic effort to undermine China's effort to portray itself as a "green power." As detailed in Chapter 3, the Chinese economy depends on coal and other non-renewable energy sources; China is the world's largest greenhouse gas emitter (more than the United States, EU, Japan, UK, Canada, and Australia combined). These issues converge to fuel simmering protests by the domestic Chinese population demanding less pollution in the environment.[263] Despite these pressures, China's coal capacity continues to increase every year.[264] China's public diplomacy, however, works diligently to portray itself as a global green power. For example, in 2020, Xi Jinping made the dubious pledge that China would be carbon neutral by 2060.[265] Despite the proclamations and priority, no clear path appears feasible for China to achieve this objective.

261 Executive Yuan, "New Southbound Policy," July 7, 2019, available at https://english.ey.gov.tw/News3/9E5540D592A5FECD/2ec7ef98-ec74-47af-85f2-9624486adf49?utm_source=mofa_nspp.

262 Taiwan's ability to weather a blockade may be dependent on to what extent it can survive without access to external supplies. Energy is key to this dilemma. See Lonnie Henley, "PLA Operational Concepts and Centers of Gravity in a Taiwan Conflict, Testimony before the U.S.-China Economic and Security Review Commission, Hearing on Cross-Strait Deterrence," February 18, 2021, available at https://www.uscc.gov/hearings/deterring-prc-aggression-toward-taiwan.

263 Mimi Lau, "10,000 protest in Chinese city over planned coal-fired power plant," *South China Morning Post,* April 13, 2015, https://www.scmp.com/news/china/article/1765010/10000-protest-chinese-city-over-planned-coal-fired-power-plant.

264 Simon Evans, Rosamund Pearce, "Global Coal Power," *Carbon Brief,* March 26, 2020, available at https://www.carbonbrief.org/mapped-worlds-coal-power-plants.

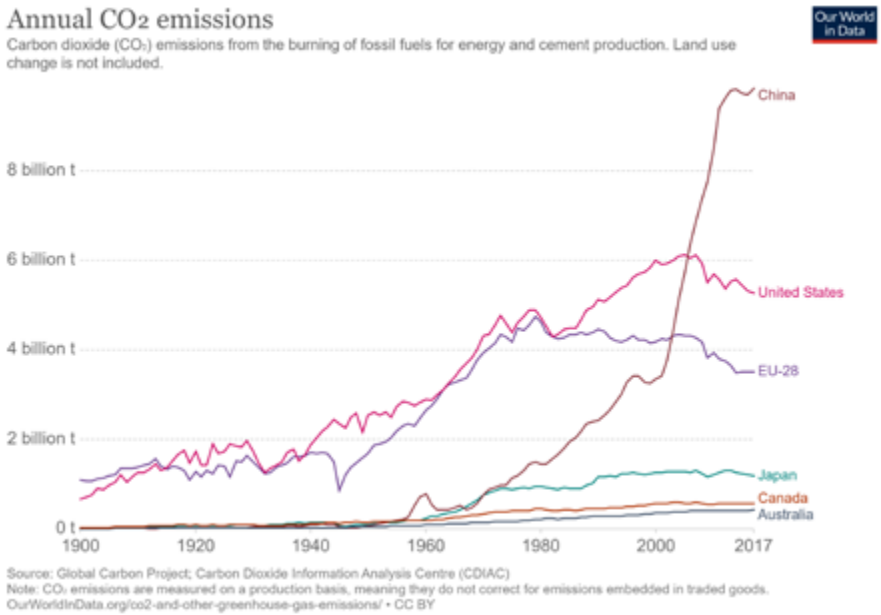
265 Echo Xie, "Climate Change: Xi Jinping makes bold pledge for China to be carbon neutral by 2060," *South China Morning Post*, September 23, 2020, available at https://www.scmp.com/news/china/diplomacy/article/3102761/climate-change-xi-jinping-makes-bold-pledge-china-be-carbon.

Opportunities abound to highlight differences between the Chinese government's word and deed. The United States should take advantage of Chinese strategists' demonstrated insecurity about how other countries perceive their continued reliance on pollution-heavy coal. The United States could publicly highlight the damaging impact of China's high emissions on the global environment and public health. The United States, and others, could also provide various types of encouragement and support to domestic and international critics of Chinese pollution. Campaigns like these could prevent the Chinese government from obtaining the global soft power they seek absent major changes. Policies like these have the additional benefit of fueling Chinese perceptions that they must invest in green energy technologies, which would encourage Chinese planners to waste scarce resources in a sector they have a competitive disadvantage in compared to the United States. Criticism from the international community may further sharpen domestic costs for China, as it continues to rely on coal for the majority of its energy consumption. Accordingly, it the highest amounts of greenhouse gas of any nation.

In response to this diplomatic pressure, the Chinese government would likely fall back on its classic public diplomacy strategies. For example, it might claim that as a developing nation, it should have the right to emit more than developed nations. In response, American diplomats need only contrast the claim against China's goal to provide an economic model to other countries. As for other diplomatic strategies like "whataboutisms" or excessive "Wolf-Warrior" attacks, this rhetoric increasingly falls on deaf ears internationally, as China's public diplomacy has become more aggressive and tone-deaf in the past year.[266] The United States would have an edge in stopping China from achieving the soft power it seeks from being perceived as a green energy leader.

266 Zhiqun Zhu, "Interpreting China's 'Wolf-Warrior Diplomacy'," *The Diplomat*, May 15, 2020, available at https://thediplomat.com/2020/05/interpreting-chinas-wolf-warrior-diplomacy/; "Europe, U.S. Should Say 'No' to China's 'Wolf-Warrior' Diplomacy – Eu Envoy," *Reuters*, December 10, 2020, available at https://www.usnews.com/news/world/articles/2020-12-10/europe-us-should-say-no-to-chinas-wolf-warrior-diplomacy-eu-envoy.

FIGURE 28: GLOBAL CO2 EMISSIONS, 1900–2017



Source: Hannah Ritchie and Max Roser, "CO2 Emissions," *Our World in Data*, available at https://ourworldindata.org/co2-emissions.

Economic

Some of the primary policy implications from America's asymmetric leverage over China in the energy sector are economic. In this realm, one question dominates: how can the United States sustain its dominance in the energy sector?

Preventing Energy Sector Intellectual Property and Technology Theft

A foundational assumption about the U.S. bilateral relationship with China should be to expect continuous blatant attempts at massive IP theft and institute measures to prevent it. According to the U.S. Trade Representative, Chinese theft of American intellectual property costs the American economy between $225 billion and $600 billion annually.[267] The energy industry is no exception, and economic espionage efforts by China are only increasing. This study found that Chinese strategists invoked typical calls for Chinese companies to copy American technology. Typically, Chinese IP theft comes in the form of direct cyber theft or copying and reverse engineering a business' technology after forming a joint venture with an American firm.[268]

267 Office of the United States Trade Representative (USTR), *2017 Special 301 Report* (Washington DC: USTR, 2017), available at https://ustr.gov/sites/default/files/301/2017%20Special%20301%20Report%20FINAL.PDF.

268 Paul Goldstein, "Intellectual Property and China: Is China Stealing American IP?" Stanford University, April 10, 2018, available at https://law.stanford.edu/2018/04/10/intellectual-property-china-china-stealing-american-ip/.

China has already attempted these practices in the U.S. energy industry. When Sinopec, China's state-owned energy firm, attempted to cultivate natural gas deposits in Sichuan, it required a crucial technology called bridge plugs.[269] After buying them from a U.S. firm for $30,000 each, it reversed-engineered and produced them for $2,700 each.[270] Similarly, the Department of Justice indicted a Chinese company and its American affiliate in October 2020 for conspiring to steal intellectual property from a Houston-area oil and gas manufacturer.[271] In January 2021, an M.I.T. professor was arrested and accused by the Justice Department of not disclosing ties to China and providing advice to the Chinese government on energy technology development.[272] Theft shown in these examples can have a devastating impact on the victims' business.[273] In an example of the prominent strategy of forced technology transfer after forming a joint partnership, the Chinese government requires that any companies seeking to build electric vehicles in China must create a joint venture, giving Chinese companies the opportunity to glean electric vehicle technology.[274] These efforts are indicative of the Chinese government's increasing desperation for energy technology. American policymakers should expect these practices and work more actively to prevent and stymie them.

Preventing IP theft has been an oft-touted goal of the U.S. government. Some legal tools are already in place, which can be marshaled to stop China from stealing American technology. The Committee on Foreign Investment in the United States (CFIUS) is specifically designated to review the national security implications of legal mergers and acquisitions that involve foreign investment.[275] The U.S. Department of Justice (DOJ) also recently launched its "China Initiative" to focus the Department's efforts on China's strategic threat; 80% of all

269 Bridge plugs are critical for high-pressure wells.

270 "Can China follow US by using shale to go from world's biggest energy importer to a net exporter?" *The South China Morning Post*, https://www.scmp.com/news/china/economy/article/2156158/can-china-follow-us-using-shale-go-worlds-biggest-energy-importer.

271 "Chinese energy company, U.S. oil & gas affiliate and Chinese national indicted for theft of trade secrets," *Department of Justice: U.S. Attorney's Office, Southern District of Texas,* October 28, 2020, available at https://www.justice.gov/usao-sdtx/pr/chinese-energy-company-us-oil-gas-affiliate-and-chinese-national-indicted-theft-trade.

272 Jerry Dunleavy, "MIT professor accused of hiding Chinese government contracts while receiving millions in US grants," *Washington Examiner*, January 14, 2021, available at https://www.washingtonexaminer.com/news/mit-professor-hiding-chinese-government-contracts-us-grants.

273 "Court Imposes Maximum Fine on Sinovel Wind Group for Theft of Trade Secrets," *Department of Justice: U.S. Attorney's Office,* July 6, 2018, available at https://www.justice.gov/opa/pr/court-imposes-maximum-fine-sinovel-wind-group-theft-trade-secrets.

274 Keither Bradsher, "In China, an Electric Car Maker Loses Money but Thinks Big," *The New York Times,* February 25, 2021, available at https://www.nytimes.com/2021/02/25/business/china-nio-electric-cars.html; and *Keith* Bradsher, "G.M. Plans to Develop Electric Cars with China," *The New York Times*, September 20, 2011, available at https://www.nytimes.com/2011/09/21/business/global/gm-plans-to-develop-electric-cars-with-chinese-automaker.html.

275 "The Committee on Foreign Investment in the United States (CFIUS)," U.S. Department of the Treasury, available at https://home.treasury.gov/policy-issues/international/the-committee-on-foreign-investment-in-the-united-states-cfius.

of DOJ's economic espionage cases allegedly involve the PRC.[276] Thus far, the United States has focused on a narrow view of what kinds of Chinese investment would constitute a threat to national security. As this study has found, Chinese views of national security strategy go far beyond simply national defense. China seeks to acquire cutting-edge technology in multiple domains, including fracking and green energy technology, and regards these efforts as a top national security priority.

This study recommends that the United States adopt a broader view of the relationship between technology and national security and use all existing and possible tools to arrest China's attempts to acquire American energy technology. The United States must seriously consider measures to uphold American technological dominance in sectors where the national security implications are less obvious, such as energy. The U.S. Department of Energy should better use the CFIUS process to track and review attempted acquisitions from Chinese energy giants, other state-owned enterprises, and technology companies into American businesses like shale producers and cutting-edge technology companies, among others. The DOJ has already moved decisively in this direction with its "China Initiative," with many of the most recent cases directly related to energy and power.[277]

The United States should explore its options to halt businesses from exporting critical energy technologies to China. The Bureau of Industry and Security (BIS) of the Department of Commerce already has the authority to enforce export controls on items deemed critical to national security on its Commerce Control List.[278] The Bureau should seek to expand its authority to include energy technologies. Additionally, these approaches should be expanded into a multilateral arrangement to limit Chinese acquisitions of energy technology from other developed nations. This potential agreement can emulate the Coordinating Committee for Multilateral Export Controls and its successor, the Wassenaar Arrangement. Doing so would enlist American allies and partners to ensure China cannot steal energy technology from anywhere in the world. While multilateral support for this effort may be difficult, if not impossible, in the short term, the United States can begin by constructing unilateral legal barriers to exporting critical technologies to China.

This approach does more than protect American energy technology from theft sponsored by the Chinese state. It also would increase Chinese perceptions of pressure on the PRC's

276 "Information About the Department of Justice's China Initiative and a Compilation of China-Related Prosecutions Since 2018," *The United States Department of Justice*, November 12, 2020, available at https://www.justice.gov/opa/information-about-department-justice-s-china-initiative-and-compilation-china-related.

277 See "Chinese National Charged with Criminal Conspiracy to Export US Power Amplifiers to China," *Department of Justice Office of Public Affairs*, January 29, 2021, available at https://www.justice.gov/opa/pr/chinese-national-charged-criminal-conspiracy-export-us-power-amplifiers-china; "Information About the Department of Justice's China Initiative and a Compilation of China-Related Prosecutions Since 2018," *The United States Department of Justice*, November 12, 2020, available at https://www.justice.gov/opa/information-about-department-justice-s-china-initiative-and-compilation-china-related.

278 "Commerce Control List (CCL)," *The Bureau of Industry and Security, U.S. Department of Commerce,* available at https://www.bis.doc.gov/index.php/regulations/commerce-control-list-ccl.

energy security. As detailed in Chapter 4, Chinese strategists believed that recent American economic actions, like the Sino–U.S. trade war, augured a future where China would have a more challenging time acquiring foreign technology, thus inhibiting its ability to reduce its energy insecurity. Efforts like the ones described above would heighten those perceptions and pressure.

Securing American Energy Resilience

Although U.S. production of energy has surged as a result of the shale revolution, the United States can still take steps to shore up the resiliency of its energy system and its exporting capabilities. As shown in Chapter 2, the American energy system still faces some infrastructural risks that leave the United States vulnerable to acute energy crises, especially stemming from issues in Texas. This study recommends two approaches to reducing these risks.

First, the United States can take steps to boost the resilience of the Texan energy system. Since it is by far the most important state in American energy production, as shown in Chapter 2, Texan energy security is crucial to American energy security. The United States could take steps to at least partially integrate Texas' electricity system with the other Interconnections so that Texas is less vulnerable in times of crisis.

The United States may also benefit from building up its own infrastructure for oil and gas exports to the rest of the world. Currently, the vast majority of its exports depart from the Gulf Coast region, specifically from Texas and Louisiana.[279] Increased refinery and port capacities on the East and the West Coasts would improve the resilience of America's energy exports.

Policies like these are meant to ensure that America's rising place as a major energy exporter in the coming decades is secure from potential risks. Doing so will assure future buyers of American oil and natural gas that the energy flow will be stable.

Leading Emerging Technology R&D and Green Energy Adoption

As discussed in Chapter 3, China faces particular challenges reaching the next frontier in cutting-edge energy technology, yet its leaders are determined to overcome these asymmetric disadvantages. While the United States retains advantages in energy technology today, it must protect its superiority by sharpening its technological edge. Recent national policy has mirrored this priority, such as the 2020 National Strategy for Critical and Emerging Technologies, which pledged to promote the national security innovation base.[280]

279 "Exports, Petroleum & other liquids," U.S. Energy Information Administration, available at https://www.eia.gov/dnav/pet/pet_move_exp_dc_R30-Z00_mbblpd_a.htm; Daniel Yergin, *The New Map*, p. 24, 50.

280 See *National Strategy for Critical and Emerging Technologies* (Washington, DC: the White House, 2020), available at https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/10/National-Strategy-for-CET.pdf.

The EIA assesses that future projections for solar and wind electricity output will increase as domestic production costs decrease. Depending on the pace of development for both the solar and wind sectors, the EIA believes that the costs of both these technologies may decrease to become competitive with natural gas in electricity production.[281] Specifically, the EIA projects that solar energy production will increase rapidly in the coming decades. As of 2020, solar has already become the cheapest form of energy in the United States.[282] It should both take advantage of the growing market competitiveness of these renewables and create the policy conditions ideal for the innovation required to further develop and accelerate the adoption of these technologies into the national energy infrastructure.

However, the EIA projects that American nuclear energy production will be crowded out by more competitive natural gas and solar power production.[283] Policymakers should still keep in mind several advancements in nuclear technology that may slow this trend. Advanced small modular reactors (SMRs) are more flexible than their conventional counterparts. Additionally, they are meant to be less capital-intensive, which would enhance their market competitiveness.[284] Defense applications, such as the DoD's Project Pele, which is working to create mobile nuclear energy production technology, will help to invent, develop, and de-risk some of the associated technologies in the near term.[285] Recently, on the commercial side, TerraPower LLC released plans to commercialize its "Natrium" nuclear plants in the United States; the project is designed to make nuclear power more efficient and complementary with other renewable sources.[286] Depending on the success of these projects, nuclear power may also achieve renewed adoption, further diversifying U.S. domestic energy production, and free up even more oil and natural gas for export.

These green energy developments, specifically those in the solar and wind sector, are indicative of America's edge in green energy technology under competitive conditions. It should seek to retain this edge.

281 U.S. Energy Information Administration, *Annual Energy Outlook 2020* (Washington, DC: EIA, 2020), p. 69, available at https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf.

282 Simon Evans and Josh Gabbatiss, "Solar is now 'cheapest electricity in history,' confirms IEA," *Carbon Brief*, October 13, 2020, available at https://www.carbonbrief.org/solar-is-now-cheapest-electricity-in-history-confirms-iea.

283 U.S. Energy Information Administration, *Annual Energy Outlook 2020* (Washington, DC: EIA, 2020), p. 73, available at https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf.

284 "Advanced Small Modular Reactors (SMRs)," *Reactor Technologies*, Office of Nuclear Energy, Department of Energy, available at https://www.energy.gov/ne/nuclear-reactor-technologies/small-modular-nuclear-reactors.

285 "Project Pele: Mobile Nuclear Reactor," Undersecretary of Defense for Research and Engineering, Department of Defense, available at https://www.cto.mil/pele_eis/.

286 Timothy Gardner, "Bill Gates' nuclear venture plans reactor to complement solar, wind power boom," *Reuters,* August 27, 2020, available at https://www.reuters.com/article/us-usa-nuclearpower-terrapower/bill-gates-nuclear-venture-plans-reactor-to-complement-solar-wind-power-boom-idUSKBN25N2U8.

Military

Military considerations for energy security should play a supporting role in the diplomatic and economic policies discussed in this report. Unless, however, the United States can guarantee the security of American exports while also retaining the ability to hold Chinese imports at risk, much of the strategies outlined will be extremely difficult, if not impossible. This reality re-enforces the critical importance of the role of naval power in American strategy.

Strengthening Maritime Power

The relationship between American military strategy and energy has long been a subject of debate. Specifically, American analysts have considered the desirability and feasibility of instituting a blockade on Chinese maritime shipping in the event of an Indo-Pacific conflict with China. As described in Chapter 4, some argue that the blockade would provide the United States leverage and avoid escalation, while others question the feasibility and effectiveness of the strategy. This study's findings suggest multiple points worth considering in the ongoing debate.

First, China's profound energy insecurity testifies to the potential desirability of a maritime blockade. The fragility of Chinese energy markets means that an energy blockade would raise the costs for the Chinese leadership in continuing a war against the United States.

Second, Chinese preferences concerning overland pipelines may complicate the long-term feasibility of a maritime blockade. As shown in Chapter 4, Chinese strategists believe that the PRC should continue to build more energy pipelines to partially offset sea-based energy imports. Gabriel Collins has shown that China could withstand a maritime blockade for six years if it constructed an oil pipeline with Russia and Russia was willing to supply China during a conflict.[287] Given Chinese authors' strong preference for more pipelines, American strategists should expect China to build more pipelines in the long-term, which could complicate American blockade strategies. This pipeline construction may mean that the United States would need to further enhance particular special operations capabilities to complement a maritime blockade.

Third, Chinese reactions to a blockade are still unclear.[288] This study did show, however, that Chinese authors appear to be resigned to the fact that the United States would blockade China in case of a conflict. This information does not reveal how they would react to a

287 Gabriel Collins, "A Maritime Oil Blockade against China—Tactically Tempting but Strategically Flawed," *Naval War College Review* 71, no. 2, 2018, pp. 49–78.

288 Fiona S. Cunningham recently noted that more research was needed to understand how the PRC would react to a blockade. See Fiona S. Cunningham, "The Maritime Rung on the Escalation Ladder: Naval Blockades in a US-China Conflict," *Security Studies*, 29:4, p. 730-768.

blockade. More research will be required, yet it should be noted that this is necessarily difficult given the CCP's opacity and the sensitivity of the subject.

Other approaches to a blockade should also be considered. Studies thus far have presumed that a complete blockade of Chinese energy shipments would be required the strategy to succeed. While it may not be feasible or wise to institute a total blockade of Chinese maritime trade during a conflict, the United States can still integrate limited interdiction approaches to its strategy in a conflict with China. Instead of a blockade, the United States can interdict crucial Chinese energy shipments at a time, place, and fashion of its choosing. Since China's energy shipments primarily flow through key maritime chokepoints like the Malacca Strait, the Lombok Strait, and the Strait of Hormuz, the United States can selectively interdict Chinese shipments given U.S. strategic or operational needs during a conflict. U.S. strategy should remain flexible concerning approaches to interdiction in the Indo-Pacific region and beyond. More research is required to understand if it would be worth the operational costs to institute a limited interdiction strategy.

This debate over a maritime blockade should be considered within the broader perspective of this report. As this study has argued, an energy-informed strategy for the United States should simultaneously leverage Chinese energy insecurity and ensure American and allied energy security. Current debates over a maritime blockade do not consider the military's role in guaranteeing the energy security of the United States and its allies. As the PLAN continues to grow with time, it could threaten the energy flow requirements for the United States' States' closest allies and partners. This problem points to a broader issue: the main task for the United States, in an energy-informed strategy, would be to guarantee the ability to secure energy transportation for itself and its partners such as India, Southeast Asian partners, and East Asian allies. Doing so ensures that American allies and partners' ability to contribute to operational needs in a conflict are not crippled by economic concerns. For example, the United States could work with Japan to consider the proper division of labor to protect Japanese oil imports from the Middle East in case of a protracted conflict in the Indo-Pacific. Protecting allied energy imports also would help stabilize the global economy during a conflict in the region, especially given the possible effects on global oil and gas demand and prices.

These considerations need to be balanced against other operational needs. Operations to protect allied energy flows may require a different balance of naval capabilities and capacities than other naval operational needs. The U.S. Navy must consider the trade-offs between traditional security challenges that the Navy and Marine Corps are designed for and specific challenges derived from an energy-informed strategy. This consideration is especially important considering the deteriorating balance of power in the Indo-Pacific region and expected downward pressure on American defense budgets in the coming years as a result of the COVID-19 pandemic. The U.S. Navy may have a difficult time balancing its finite resources and platforms between traditional naval operational requirements and emerging ones, like protecting allied energy imports.

The balance of considerations within an energy-informed strategy to take advantage of Chinese energy insecurity and guarantee American and allied energy security should drive future debate about the role of the American military in both peacetime competition and potential conflict.

Demonstrating Pipeline Insecurity

American policymakers should exploit misplaced Chinese faith in the security of land-based pipeline imports. As demonstrated in Chapter 4, Chinese strategists have unique threat perceptions of the hierarchy of security of different energy imports. To them, sea-based imports are the least secure, as the Western powers control the maritime commons. The alternative, land-based pipelines, are relatively safer. There is no reason that Chinese strategists should see pipeline imports as safer, as they are indefensible along their entirety.

The United States should signal its ability and potential intent to use special operations forces to threaten Chinese pipeline imports. This approach would seek to produce multiple effects. First, it should dispel any illusions that PRC strategists have that their pipeline imports are potentially safer than sea-based imports. This increased pressure would create incentives for Chinese policymakers to double down on expensive projects to produce energy indigenously. As described above, this pressure would benefit the United States, as it would draw scarce state resources away from other important strategic projects.

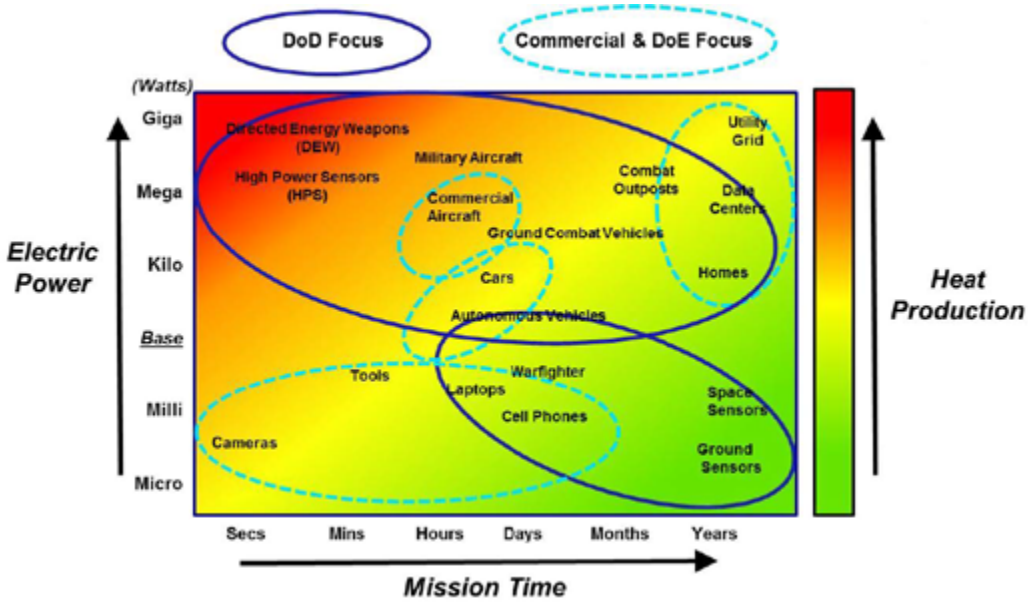
Military Energy R&D and Dual-Use Applications

The U.S. Department of Defense (DoD) is focusing on power and energy research and development that has dual-use (military and civilian) applications. In December 2017, the Department of Defense released an overview report of the Department's ongoing and planned research efforts in power and energy. The report outlines four gaps in science and technology related to power and energy to date: (1) thermal limitations on capabilities, efficiencies, power densities; (2) high voltage, high frequency, high-rate pulse power; (3) extended duration to reduce energy resupply; and (4) on-station autonomous energy harvesting. DoD concludes that these unique military research needs are not supported by commercial research and markets, so the Department must make its own investments and carry the risk to develop and mature these new technologies. The report announced several primary research and development areas of interest:

- "**Electromechanical Conversion:** Increase the power density, efficiency, and robustness of motors, generators, and actuators while also reducing their life cycle costs.
- **Energy Storage:** Improve electrical and electrochemical energy storage devices to decrease device size, weight, and cost as well as increase their capabilities in extreme temperatures and operating conditions.

- **Power Control and Distribution:** Develop tactical, deployable power systems using conventional fuels, alternative fuels, and energy harvested from renewable/ ambient sources.
- **Power Generation/Energy Conversion:** Enable smart energy networks for platforms, forward operating bases, and facilities using modeling and simulation tools as well as new, greater capability and efficiency components.
- **Thermal Transport and Control:** Efficiently manage heat and enable higher power density systems through advanced thermal science and technology: advanced components, system modeling, and adaptive or hybrid-cycle technologies."[289]

FIGURE 29: POWER AND ENERGY DUAL-USE RESEARCH AND DEVELOPMENT



Source: Department of Defense (DoD), *Energy and Power (E&P) Technologies: Communities of Interest* (Washington, DC: DoD, 2017), p. 7, available at https://defenseinnovationmarketplace.dtic.mil/communities-of-interest/energy-and-power-ep-technologies/.

Other parts of the U.S. government also focus on energy technologies and dual-use technology. The Defense Innovation Unit launched its Advanced Energy & Materials portfolio, and its primary lines of effort are "advanced power & energy storage," "next generation fuels and mobility," and "materials & sustainment."[290] National Security Innovation Capital

289 Department of Defense (DoD), *Energy and Power (E&P) Technologies: Communities of Interest* (Washington, DC: DoD, 2017), available at https://defenseinnovationmarketplace.dtic.mil/communities-of-interest/energy-and-power-ep-technologies/.

290 Defense Innovation Unit, "Advanced Energy & Materials," available at https://www.diu.mil/solutions/portfolio#AdvancedEnergy&Materials..

provides funding for dual-use hardware technology, which could also extend to new energy technologies.[291] These programs will contribute to dual-use energy technologies.

Depending on the maturation and transition of DoD's various technology and research efforts, the United States may expect more dual-use innovations in the future. These technologies could further widen the United States' competitive edge over China in the energy sector. U.S. policymakers should watch these developments closely while seeking to help protect DoD's research, especially from Chinese espionage and theft.

291 National Security Innovation Capital, available at https://www.nsic.mil/.

Conclusion

Crafting a comprehensive strategy to compete with China in the 21st century requires that American and allied planners develop a shared understanding of the insecurities and fears that drive the CCP. This report seeks to begin to address the strategic blindness and existing policymaking gap surrounding the growing asymmetries resulting from America's energy security and Chinese insecurity. The U.S. energy arsenal provides the United States with myriad tools that U.S. policymakers have not fully appreciated. China actively seeks approaches to mitigate its energy insecurity and insatiable appetite for energy to fuel economic growth. These energy challenges will continue to contribute to the growing list of strategic impediments for China. They will be an albatross on China's sustained attempt to rise as a regionally and globally dominant power. The United States must continue to balance multiple dimensions of competition with China.

First, energy should be understood as an essential area in an expanding strategic competition between the United States and China. Although the energy dimension is not typically considered part of the geostrategic rivalry between the two, the likely trajectories of America and China's energy sectors create a stark gap. This increasing asymmetry of power should be incorporated into U.S. strategy and long-term planning. American policymakers should seek to wield new strategic flexibility and tools in the energy sector, which will continue to boost U.S. comprehensive national power. Moreover, further research should explore the detailed linkages and interrelationships between domestic policies in the energy sector and diplomatic, economic, and military options and approaches.

Second, American policymakers must recognize that geography and geopolitics remain inseparably intertwined in China's energy dilemma. Chinese efforts to guarantee the security of its energy imports may increase tensions with many nations along their periphery. Any trouble with regional powers, especially India and Russia, will serve to multiply all of China's strategic difficulties. Limits from China's geography may weigh on its continued rise in ways still not fully understood.

Third, Chinese strategists hold deep-seated fears about the PRC's energy insecurity and the implications of a United States re-established as a global energy power. Many of the key

analyses and concerns from Chinese strategists over the last decade, as examined in this report, will continue to plague China. They do not have easy solutions or clear paths for resolution. More broadly, this should indicate to U.S. and allied policymakers that the outward confidence China projects is likely masking these insecurities. The United States has psychological leverage over the CCP that it can use to its advantage.

Fourth, the Chinese discourse about America and China's energy markets should be closely watched. As the United States moves to implement measures with considerations for China's energy weakness, it should take note of how China responds and adapts to these initiatives. This process will be an interactive one, where the United States will require focus and discipline.

Overall, American strategists must grasp that energy is the foundational enabler for a nation's economic potential, security, and war-waging capabilities. In the 21st century, the widening disparity in energy security between the United States and China is emblematic of future strategic options—either national vigor and confidence, or national lethargy and strategic desperation. Only with this in mind can the United States attempt to leverage its strength over its primary strategic competitor and consider an expanding array of strategies and policymaking options for the United States and its key allies.

LIST OF ACRONYMS

AC	Alternating current
B/d	Barrels per day
CCP	Chinese Communist Party
CFIUS	The Committee on Foreign Investment in the United States
DC	Direct current
EIA	United States Energy Information Administration
EV	Electric vehicle
FYP	Five-Year Plan
IP	Intellectual property
LNG	Liquefied natural gas
MIC 2025	Made in China 2025
NEV	New electric vehicles
PLAN	People's Liberation Army Navy
PRC	People's Republic of China
R&D	Research and development
SOE	State-Owned Enterprise
SPR	Strategic Petroleum Reserves
Tcf	Trillion cubic feet
UHV	Ultra-high voltage

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