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A Policymaker's Guide to China's Technology Security Strategy

EMILY JIN I FEBRUARY 2025

The U.S. government must adopt a clear-eyed view of China's technology security strategy by recognizing China is temporarily lagging in some sectors, rapidly catching up in others, and already leading in many.

KEY TAKEAWAYS

- China's technology security policy has three prongs: 1) preserving and strengthening competitive advantages; 2) addressing sectors and endowments that are falling behind; and 3) gaining a pioneering edge in emerging technologies.
- Beijing employs a largely statist approach to achieve technology security, promoting the diffusion of innovation across academic, industrial, and governmental sectors.
- Diffusion of innovation is supported by whole-of-society initiatives such as Military-Civil Fusion (MCF) and by targeted subsidies for major economic actors.
- China's political economy is a Frankenstein of command-and-control and market forces, vague central directives and creative local interpretations and implementations, along with regulatory cycles of loosening and restriction.
- In such a paradoxical system, China's technology security strategy depends on its ability to overcome critical challenges: uneven investment in human capital, underperforming state-owned firms, bureaucratic inefficiencies, and geopolitical pressures.

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Notable Quotes From Chinese Leadership and Policy Documents

"The world today is undergoing great changes unseen in a century, and scientific and technological innovation is one of the key variables."

当今世界正经历百年未有之大变局，科技创新是其中一个关键变量。[1]

— Xi Jinping

"Science and technology are the foundation of national strength and prosperity, and innovation is the soul of national progress."

科技是国家强盛之基，创新是民族进步之魂。

"Whoever seizes the 'tiller' of technological innovation and takes the first step in technological innovation will be able to take the lead and gain advantages."

谁牵住了科技创新这个"牛鼻子"，谁走好了科技创新这步先手棋，谁就能占领先机、赢得优势。

— The Total National Security Paradigm: A Study Outline《总体国家安全观学习纲要》[2]

INTRODUCTION

A country's technological innovation and production capacity fuel its national strength. China, a formidable geopolitical power, is actively pursuing technological supremacy to secure its global leadership. The Chinese Party-state has integrated technology security into its broader national security framework, as it envisions a future wherein technological supremacy not only begets economic growth, but also fortifies the Party-state's geopolitical ambitions. Yet, questions remain: What is Beijing's strategy for enhancing its technological security? What factors could influence Beijing's technological ambitions? And how far is the Chinese Party-state willing to go to ensure this strategy's success?

CHINA'S THREE-PRONGED TECHNOLOGY SECURITY STRATEGY

Xi Jinping's contribution to Chinese security theory, the treatise *The Total National Security Paradigm: A Study Outline (总体国家安全观学习纲要)*, is a useful starting point.[3] Published in 2022, it describes how the Chinese Communist Party (CCP) integrates technological security into China's broader national security framework by emphasizing that "science and technology are the foundation of national strength and prosperity, and innovation is the *soul* of national progress."[4] To safeguard this soul, China must not only become a strong, innovative technological power, but also effectively deter and offset strategic rivals, especially those that currently have a technological edge over China. Achieving this requires China to seize the "tiller" of techno-scientific innovation.[5]

Official party documents and publications such as this offer a candid assessment of China's uneven technological development. *The Total National Security Paradigm* finds that while China lags in innovative capabilities in some domains, it is catching up in others and leading in several cutting-edge fields.[6] To translate technological primacy into economic growth, Beijing likely needs a tailored approach to its technology development. Policies such as Dual Circulation, Made in China 2025, and the 2022 Document 79 (which sets an explicit 2027 deadline to eliminate dependence on Western technology in the information and communications technology [ICT] sector) advocate for specific strategies for different technologies.[7] Looking ahead to 2035, China's plan for achieving technological primacy seems to unfurl along three prongs.

China's integration of technology security into its national security framework signals more than just a pursuit of innovation—it reflects a broader ambition to define and lead the future global order.

Prong One: Preserve and Fortify Competitive Advantages

China seeks to preserve and fortify its competitive advantages in technology. The Party-state leverages China's established strengths: deep reservoir of manufacturing expertise, a large labor force, dense supplier networks, and a systematic approach to industrial upgrading.[8] Advanced manufacturing, especially electronics and renewable energy equipment such as solar panels and electric vehicle batteries, exemplifies this strategy. The Chinese electronics sector is a well-established success story, with China emerging as the world's factory following its transition from a planned economy to a more market-oriented system under its Reform and Opening Up Policy.[9] In recent years, Chinese solar panels and electric vehicles and batteries have been dominating global markets.[10] In 2023, China installed more solar panels than the United States had in its

history.[11] As solar power is projected to become the largest renewable energy source by 2029, driving 80 percent of the growth of global renewable capacity, and with models predicting that China's cumulative solar photovoltaic capacity will surpass 1 terawatt by 2026, it seems likely that China will maintain its dominance in this sector.[12]

Analysts note that technological innovation in China often comes from production lines instead of just universities.[13] The Chinese industrial work force's ability to improve processes, coupled with competitive export pricing—supported by both industrial policies such as subsidies and controversial measures such as exchange rate interventions—has propelled these sectors.[14] China's advancements in industrial robotics, which integrate AI-driven software with hardware, indicates its push toward the next phase of industrial upgrading.[15] China's lead in advanced manufacturing is likely to continue going forward.

Prong Two: Address Relative Technological Deficiencies

China wants to address its relative technological deficiencies. The Party-state's focus on innovation is clear in its efforts to reduce reliance on foreign inputs. The 2018 export controls on ZTE already sounded Chinese policymakers' alarm for a stronger domestic semiconductor sector, and the 2022–2023 semiconductor export controls intensified China's push for self-reliance.[16] Chinese companies rushed to import lithography machines and other semiconductor equipment from Dutch, Japanese, and American firms, which underscored the Chinese semiconductor sector's reliance on foreign inputs, investment, and expertise.[17] With $142 billion earmarked for semiconductor investment, far surpassing the United States' $39 billion, China demonstrates strong determination to strengthen its domestic industry and buffer it against leverage from foreign governments.[18]

The situation intensified when Japan and the Netherlands followed the United States in applying semiconductor export controls on China in early 2023, which prompted a strong reaction from the Chinese Semiconductor Industry Association (CSIA).[19] Released in both Mandarin Chinese and English, the CSIA's statement in Mandarin Chinese conveyed a more forceful tone, condemning U.S. and other partner countries' export controls, whereas its English translation presented a more measured approach and called for continued foreign investment and collaboration in the semiconductor industry.[20] For instance, the original Mandarin Chinese statement claimed that "any man-made action to tear apartment the global industrial system will cause immeasurable harm to the lives and development of people around the world," clearly referring to allied export controls. In contrast, the English translation provided by CSIA struck a more tempered tone, stating that "inappropriate intervention by government and authorities can cause a disruption to our industry."[21] This discrepancy between the existential tone of the Mandarin Chinese statement and the more neutral tone of its English translation highlights China's dual approach to technological dominance, which urges domestic players to catch up while simultaneously engaging in the international innovation system to maintain access to key technologies and inputs.[22]

Chinese policymakers have to balance international market access with indigenous development and production.[23] While China is reportedly developing its own lithography capabilities, it is unclear whether China will be able to make significant breakthroughs or replace key foreign lithography and design equipment providers with homegrown alternatives.[24] The Dutch government's August 2024 decision to restrict—via licensing requirements—semiconductor

equipment company ASML from conducting maintenance on existing deep ultraviolet lithography (DUV) machinery (1970i and 1980i DUV lithography machinery) in China could significantly hinder the Chinese semiconductor industry's ability to develop advanced nodes.[25] With tighter export controls from allied governments, China's only option may be to innovate its way out of these controls. As of September 2024, unconfirmed reports suggest that China has developed a DUV lithography machine capable of producing chips at 8 nanometers and below.[26] Moreover, a state-funded lab in China has said that it has achieved a breakthrough in photonics by integrating a laser light source into a silicon-based chip. If this is true, China may bring about a paradigm shift in the industry to enable even larger data transmission between chips.[27] These breakthroughs have yet to be substantiated, but they are signaling the Chinese Party-state's determination to overcome its semiconductor sector's shortcomings.

Prong Three: Secure New Technology Frontiers

China aims to secure a pioneering edge in new technology frontiers and outpace global competitors. For instance, China's approach to AI is notably different from the pathways of global leaders such as the United States. While the United States has traditionally excelled in breakthrough aspects of AI, such as developing large language models, China's competitive advantage lies in its unrestricted access to large pools of data from its population (though the quality of the data, which is hard to gauge also matters).[28] The Chinese government encourages industries to leverage this data and integrate AI into their operations for productivity gains. In his 2024 work report, Premier Li Qiang emphasized an "AI Plus" strategy, urging the application of AI across all economic sectors.[29] China is producing more AI research publications than the United States, though the latter still leads in high-impact generative AI research (the United States claims half of the top 10 list of top-cited generative AI research, as opposed to China's one spot in the top 10).[30]

China's AI ecosystem is growing, supported by companies such as Baidu, Alibaba, ByteDance, Tencent, SenseTime, iFlyTek, and Megvii in addition to many research institutions such as Tsinghua University.[31] Domestically, China is setting its own standards and benchmarks for AI, as companies such as DeepSeek, with its groundbreaking r1 model that challenges established models, emerge as frontier AI players; internationally, companies such as SenseTime are assisting authoritarian regimes, such as Saudi Arabia, in developing AI-enabled smart cities and surveillance structures.[32] Whether Chinese company SenseTime's Sense Nova 5.0 model has surpassed GPT 4.0 Turbo model in performance, and whether DeepSeek's r1 model was indeed trained on a cost-efficient $5.5 million, China is undeniably making significant progress domestically and internationally with its AI advancements and may soon rival other global players.[33]

In short, Beijing employs a tiered strategy to secure its technological security. It promotes the diffusion of innovation across academic, industrial, and governmental sectors, supported by whole-of-society initiatives such as Military-Civil Fusion (MCF), while providing subsidies to bolster major economic actors. Alongside these efforts, practices such as requiring foreign companies to transfer technologies and illegally acquiring trade secrets are also part of its playbook. The Total National Security Paradigm emphasizes that techno-scientific progress is the very "soul" of national progress, essential to the CCP's goal of national rejuvenation.[34] For Chinese policymakers, the stakes could not be higher—failure is simply not an option.

POTENTIAL ROADBLOCKS TO CHINA'S TECHNOLOGY SECURITY STRATEGY

While China's technology security strategy may serve as a guiding star for its policymakers, there are significant roadblocks to the Party-state's ambitious end goals. China's political economy is a Frankenstein of command-and-control and market forces, vague central directives and creative local interpretations and implementations, along with regulatory cycles of loosening and restriction. In such a paradoxical system, China grapples with formidable structural challenges beyond the innovation realm: uneven workforce investment, nonmarket conditions that favor state-owned actors, bureaucratic inefficiencies, and growing geopolitical headwinds. Each of these obstacles has the potential to severely undermine China's technology security.

First, China's uneven investment in human capital threatens to stall its technological ambitions. While certain elite Chinese universities have emerged as world-class institutions driving innovation, broader efforts to nurture talent remain lacking.[35] In 2021, the Chinese government spent 3.3 percent of its gross domestic product (GDP) on education, compared with 4.3 percent for the United States.[36] The level of investment might seem comparable, but China has a much larger workforce, amounting to 740.4 million in 2023, with an additional of 7 million over the previous year.[37] In contrast, the United States has a workforce of 134.1 million in 2023, with an added 1.81 million compared to the previous year.[38]

College enrollment in China has skyrocketed from 2 million students in 1990 to 44 million in 2021, with postgraduate enrollment growing even more steeply, from 93,100 in 1990 to 3.33 million in 2021.[39] However, these impressive figures mask significant challenges. Unequal access to high-quality education and limited domestic mobility hinder large segments of China's labor force.[40] The *hukou* system, a household registration policy that restricts where individuals can live and work, along with regional economic disparities, exacerbates these challenges, creating gaps in human capital development.[41] The 17 percent youth unemployment rate (among those aged 16 to 24) as of October 2024 underscores the mismatch between the country's labor supply and economic needs.[42] A key factor is the shortage of job opportunities to accommodate the growing number of graduates.[43] While young people's preference for jobs in highly competitive cities may play a role, the underlying causes of this labor-market disconnect extend beyond the urban-rural divide.[44] What is clear, however, is that Chinese policymakers recognize a shortfall in high-value "techno-scientific expertise" and are working to improve workforce quality, understanding that a skilled labor force is crucial to achieving technological primacy.[45] To bridge this gap, Chinese policymakers will need to rebalance educational resources across provinces and cultivate a labor force capable of supporting China's techno-scientific ambitions.

Second, nonmarket conditions could dampen the innovative potential of China's ecosystem. While state-led investments have fueled rapid growth in the past few decades, this approach has also entrenched significant inefficiencies in the Chinese political economy.[46] Investments often flow into less-productive sectors, driven by political priorities, with state-owned enterprises receiving disproportionate credit despite often being less efficient than private firms.[47] This misallocation stifles innovation and high-tech sector development, which are critical to China's ambitions. Despite a surge in scientific outputs and patents, China's total factor productivity—the ability of an economy to generate income from inputs—has declined compared with similar economies.[48] Furthermore, the growing debt burden among local governments and real estate developers raises concerns about financial stability, particularly among local government financing vehicles and real estate developers.[49] Although the Chinese government seems to be shifting away from real

estate, there are no clear alternative sectors, such as those in the new productive forces industries, to fill the gap left by declining real estate-driven growth.[50] To foster long-term innovation, the Party-state should allow capital to flow to private firms and new productive forces while reducing its reliance on property-driven growth. However, this approach is a second-best alternative to the politically more difficult approach of promoting consumption. Prioritizing consumption-led growth would require policy adjustments to boost household income and strengthen consumer demand. This, in turn, would create a more sustainable economic foundation for a more innovative and productive society.

Third, the success of China's technological ambitions hinges on the effectiveness of its bureaucratic apparatus. Although the top-down governance model allows for swift decision-making and large-scale mobilization, it often suffers from bureaucratic inefficiency and corruption. For instance, the Made in China 2025 initiative has been hampered by local governments engaging in cronyism, which distorts the market rather than foster innovation.[51] Furthermore, local governments' handouts have not translated into measurable productivity gains. A 2022 analysis on Chinese manufacturing firms' financial reports found little evidence of productivity improvement despite increases in state subsidies.[52] China's recent efforts to centralized economic and technological decision-making under party organs aim to redirect resources from stagnating sectors to strategic areas such as electric vehicles and biotechnology.[53] While policymaking in China often involves experimentation and real-time adjustments, it remains uncertain whether recentralization will effectively resolve the inefficiencies that have long stalled technological progress.[54] Enhancing bureaucracy efficiency and curbing corruption will be critical to advancing China's technology security objectives.

Beijing has intensified efforts toward technological self-reliance, though the path forward remains steep and resource-intensive.

Fourth, China faces mounting geopolitical challenges, fueled by its escalating rivalry with the United States and an expanding pushback from other countries. Export controls, sanctions, and restrictions on technology transfer imposed by the United States and its allies have constrained China's access to critical technologies. These barriers pose significant risks to its technological ambitions, especially in semiconductors, where it remains dependent on foreign expertise and components. Although the United States was the first major economy to implement economic security policies against China, other countries have since adopted a more assertive stance. In January 2025, the European Union concluded its investigation into China's procurement markets of medical devices and determined that China unfairly restricts European goods.[55] As a result, the EU announced restrictions on Chinese entities bidding for EU government contracts. Around the same time, Japan expanded its chip controls to China, including restrictions on items that could support China's quantum computing industry.[56] In response, Beijing has intensified efforts toward technological self-reliance, though the path forward remains steep and resource-intensive.[57] The effectiveness of China's response to these challenges—likely be a combination of indigenous efforts and partnerships with foreign partners—will be crucial in closing technological gaps.

CONCLUSION

Xi Jinping has acknowledged that overcoming these challenges is essential to realizing the "great rejuvenation" of the Chinese nation, framing them as critical to China's second centenary goal. In a 2020 speech, he noted that the world is "undergoing great changes unseen in a century, and that scientific and technological innovation is one of the key variables."[58] In the same speech, Xi optimistically noted that "time and momentum is on our side."[59] His confidence suggests that, under his leadership, China may be prepared to endure significant hardship in pursuit of its goals. Scholar Evan Medeiros has built on this idea, positing that Xi's reluctance to address some of China's deep-rooted structural issues reflects the Party-state's willingness to endure sustained economic underperformance as part of a long-term vision. Medeiros has noted that, for Xi, the current economic struggles are "growing pains" on the path to future strength, pointing to the revival of "the spirit of sacrifice, self-reliance, and egalitarianism that characterized earlier eras of Maoist rule."[60] This party-directed revival of Marxist-Leninist voluntarism, which demands sacrifices from cadres, enterprises, and the public to prioritize state objectives over private interests, remains a potent force in Chinese political culture and society at large.[61] RAND researcher Jimmy Goodrich has also noted the Party-state's preparations for a "fortress economy," emphasizing national security assets such as food, energy, financial infrastructure, and other domains.[62] Given its top-down perception of a worsening external environment, the Party-state would likely mobilize its masses in response to acute shocks in economic and technology security, and prolonged competition with the United States and the rest of the world.

China's integration of technology security into its national security framework signals more than just a pursuit of innovation—it reflects a broader ambition to define and lead the future global order. Through its three-pronged strategy for technological supremacy, China aspires to be the techno-scientific vanguard of a new era. However, this grand vision is hindered by uneven investment in its people, inefficient resource allocation, the inertia of bureaucratic complexity, and an increasingly tense geopolitical landscape. While China's ambitions are vast, its path to technological dominance remains fraught with roadblocks.[63] Equally crucial, however, is how the United States responds. A clear-eyed assessment of China's technological strengths, weaknesses, and overarching technology security strategy is essential for crafting targeted and effective policies that safeguard American innovation, competitiveness, and security in the years ahead. For that to succeed, the United States needs a strategic approach that includes increased public investment in key areas such as science, technology and engineering, along with appropriate trade, tax, and regulatory policies.

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About the Author

Emily Jin (@ew_jin) is a senior China analyst at Datenna, Inc. Her research focuses on U.S.-China competition over regional influence and global order, and policy at the intersection of American economic resilience and national security. She holds an MA in international economics and China studies from the Johns Hopkins School of Advanced International Studies and a BA in psychology from Georgetown University. She is natively fluent in Mandarin Chinese.

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ENDNOTES

1. The phrase "Great Changes Unseen in a Century (百年未有的大变局)" is a longstanding term in the Chinese Communist Party's lexicon. General Secretary Xi Jinping framed it as a strategic opportunity to advance techno-scientific progress during the 24th collective study session of the Political Bureau of the CCP Central Committee on October 17, 2020. A detailed explanation is available on The Center for Strategic Translation's website: https://www.strategictranslation.org/glossary/great-changes-unseen-in-a-century. Xi's remarks from the session can be accessed here: http://www.xinhuanet.com/politics/2020-10/17/c_1126623288.htm.
2. *The Total National Security Paradigm: A Study Outline* (总体国家安全观学习纲要), is a party-building book published in April 2022. English translation of the whole publication is not available. However, the first chapter has been translated here: https://www.strategictranslation.org/articles/chapter-six-persevere-in-placing-political-security-in-the-predominant-position. The Center for Strategic Translation has also translated into English the portion that details the CCP's definition of technology security: Office of the Central National Security Commission and Central Propaganda Department, "Chapter Six: Uphold the Predominant Position of Political Security." Translated by Emily Jin. San Francisco: Center for Strategic Translation, 2025, https://www.strategictranslation.org/articles/safeguard-technological-security, and originally published in Office of the Central National Security Commission and Central Propaganda Department, Zongti Guojia Anquan Guan Xuexi Gangyao: 总体国家安全学习纲要 [The Total National Security Paradigm: A Study Guide], (Beijing: Xuexi Chuban She, Beijing: April 2022); here is the link to the original Chinese publication: https://news.ucas.ac.cn/docs/2024-04/0e2a5f54cc994a738a22930ee022892d.pdf.

3. Office of the Central National Security Commission and Central Propaganda Department, Zongti Guojia Anquan Guan Xuexi Gangyao: 总体国家安全学习纲要 [The Total National Security Paradigm: A Study Guide], (Beijing: Xuexi Chuban She, Beijing: April 2022)
4. See more on "Total National Security Paradigm" here: "Glossary: Total National Security Paradigm [总体国家安全观]," The Center for Strategic Translation, https://www.strategictranslation.org/glossary/total-national-security-paradigm.
5. In *Total National Security Paradigm*, a book co-authored by the CCP Central Propaganda Department and the Central National Security Commission and published in April 2022, the section on technology security states that "[China] must adopt an 'asymmetric' strategy to better leverage [China's] own advantages." ("我国科技如何赶超国际先进水平？要采取'非对称'战略，更好发挥自己的优势 "). The piece also observes that Western countries had been able to dominate international policies due to their command of high-end technology, stating that "one important reason Western countries have been able to dominate the world since the dawn of the modern era is their mastery of high-end technology." (近代以来，西方国家之所以能称雄世界，一个重要原因就是掌握了高端科技。) Moreover, countries that seize the "tiller" of technological innovation would be able to gain advantages for themselves: "Techno-scientific innovation has become the main battlefield on the chessboard of global strategy, and the importance of science and technology has increased in all domains. Whoever seizes the 'tiller' of technological innovation and takes the first step in technological innovation will be able to take the lead and gain advantages" (科技创新成为国际战略博弈的主要战场，科学技术的重要性全面上升。谁牵住了科技创新这个"牛鼻子"，谁走好了科技创新这步先手棋，谁就能占领先机、赢得优势。), see more at Office of the Central National Security Commission and Central Propaganda Department, "Chapter Six: Uphold the Predominant Position of Political Security." Translated by Emily Jin. San Francisco: Center for Strategic Translation, 2025, https://www.strategictranslation.org/articles/safeguard-technological-security, and originally published in Office of the Central National Security Commission and Central Propaganda Department, Zongti Guojia Anquan Guan Xuexi Gangyao: 总体国家安全学习纲要 [The Total National Security Paradigm: A Study Guide], (Beijing: Xuexi Chuban She, Beijing: April 2022).
6. The chapter on technology security from the study on *Total National Security Paradigm* finds that China is behind in innovative capabilities in certain domains—"同时，也要看到，我国原始创新能力还不强，创新体系整体效能还不高，科技创新资源整合还不够，科技创新力量布局有待优化。), catching up in some cutting-edge fields ("一些前沿领域开始...进入并跑"), and leading as in some sectors ("一些前沿领域开始进入并跑、领跑阶段，科技实力正在从量的积累迈向质的飞跃，从点的突破迈向系统能力提升"); to read more, see Office of the Central National Security Commission and Central Propaganda Department, "Chapter Six: Uphold the Predominant Position of Political Security." Translated by Emily Jin. San Francisco: Center for Strategic Translation, 2025. Originally published in Office of the Central National Security Commission and Central Propaganda Department, Zongti Guojia Anquan Guan Xuexi Gangyao: 总体国家安全学习纲要 [The Total National Security Paradigm: A Study Guide], (Beijing: Xuexi Chuban She, Beijing: April 2022); Tanner Greer and Nancy Yu, "Xi Believes China Can Win a Scientific Revolution," Foreign Policy, April 30, 2024, https://foreignpolicy.com/2024/04/30/china-technology-scientific-revolution-united-states-great-power-competition/.

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12. According to models by Rystad Energy, an energy research consultancy based in Norway, China's solar capacity is on a track of acceleration, with projections that it may top 1 terawatt by the end of 2026, see more here: "China's Solar Capacity Surges; Expected to Top 1 TW by 2026," Rystad Energy, https://www.rystadenergy.com/news/china-s-solar-capacity-surges-expected-to-top-1-tw-by-2026; "Solar PV," IEA, https://www.iea.org/energy-system/renewables/solar-pv; "China's Mercantilist Policies on Solar Photovoltaics Reshaped Global Innovation, Potentially Making It Harder to Solve Climate Change, New ITIF Report Shows" (ITIF, October 5, 2020), https://itif.org/publications/2020/10/05/china%E2%80%99s-mercantilist-policies-solar-photovoltaics-reshaped-global-innovation/; David M. Hart, "The Impact of China's Production Surge on Innovation in the Global Solar Photovoltaics Industry" (ITIF, October 5, 2020), https://itif.org/publications/2020/10/05/impact-chinas-production-surge-innovation-global-solar-photovoltaics/.
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transition from isolated breakthroughs to a systemic elevation in our capabilities. [党的十八大以来，我国科技事业取得历史性成就、发生历史性变革。重大创新成果竞相涌现，一些前沿领域开 始进入并跑、领跑阶段，科技实力正在从量的积累迈向质的飞跃，从点的突破迈向系统能力提升。]" See more: "Xi Jinping Presided Over a Symposium of Scientists and Delivered an Important Speech [习近平主持召开科学家座谈会并发表重要讲话]," September 11, 2020, https://www.gov.cn/xinwen/2020-09/11/content_5542851.htm.