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China's Search for Renewable Energy

Pragmatic Techno-nationalism

ABSTRACT

The enthusiasm of Chinese leaders for renewable energy is infused with a pragmatic variant of techno-nationalist ideology. In keeping with this outlook, Beijing supports Chinese wind and solar firms, but it typically proves flexible when important economic partners challenge such policies.

KEYWORDS: China, energy, technology, nationalism, trade

China's enthusiasm for renewable energy is impressive. In 2005, when China passed its Renewable Energy Law, the country had 117 gigawatts (GW) of hydroelectric capacity but almost no wind, solar, or biomass power. By 2012, China had nearly 70 GW of capacity in these latter three energy sources, thanks to the new law as well as a series of follow-on regulations, amendments, and targets. The lion's share, 63 GW, of that capacity came from wind power, making China the largest producer of wind energy in the world. In fact, renewable and nuclear power accounted for 94% of the growth in Chinese electricity generation in 2012. As a result, China met more than 9% of its primary energy demand from non-fossil sources that year, a figure that it plans to raise to 11.4% by 2015 and 15% by 2020.[1]

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1. For the data in this paragraph, see International Energy Agency, *World Energy Outlook 2007* (Paris: OECD [Organization for Economic Cooperation and Development], 2007), p. 597; Trevor Houser, "China's 2012 Energy Report Card," February 27, 2013, <http://rhg.com/notes/chinas-2012-energy-report-card>; "Analysts Forecast Lackluster Q2 for Solar PV Sector," Xinhua, March 13, 2013, accessed through Factiva; and Olivia Boyd, "China's Installed Wind Capacity up 41 Percent in 2012," *IHS Global Insight Daily Analysis,* April 9, 2013, accessed through Factiva.

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There is much to praise about China's enthusiasm for renewable energy. To the extent that it substitutes for fossil fuels, renewable energy helps to slow the growth of China's greenhouse gas emissions while alleviating its notorious air pollution more generally. Renewable energy also promises to improve China's energy security, both by diversifying its sources of supply and by reducing its need to import supplies.[2] Nonetheless, the way in which China has promoted renewable energy has also raised tensions with other countries. In particular, while promoting new energy supplies, the Chinese government has also sought to reduce its dependence on the outside world for energy technology. Through a range of regulations and subsidies, Beijing has supported Chinese renewable energy companies at the expense of foreign competitors. In the process, China's government has run afoul of foreign companies and governments that wish to do business with China, and accusations have been made that China is not living up to its commitments under the World Trade Organization (WTO).

To make sense of China's enthusiastic—and nationalistic—approach to renewable energy, this essay emphasizes the role of "techno-nationalism" in Chinese thinking about this emerging sector. The desire to promote indigenous technology is not a new phenomenon in China; it can be traced back to China's humiliation at the hands of industrializing countries in the 19th century. And it has certainly been prominent during earlier periods of the communist era. Under Mao, China invested precious resources in nuclear and missile technologies—the "two bombs and one satellite" (*liang dan yi xing*). Deng Xiaoping launched programs in the 1980s to promote technological advances in the civilian economy. Under the recent leadership of Hu Jintao and Wen Jiabao, however, Chinese techno-nationalism experienced a remarkable renaissance. In 2006, Hu and Wen unveiled the National Medium- and Long-Term Program for Science and Technology Development (2006–20) (MLP), to rapidly advance "indigenous innovation" in China. In 2010, the government added a more focused plan to speed the development of seven "Strategic Emerging Industries," an effort to place Chinese companies at the frontier of technological innovation. As this essay will explain, renewable energy occupies an important place in these visions of China's technological future.

2. On China's thinking about energy security, see Andrew B. Kennedy, "China's New Energy-Security Debate," *Survival: Global Politics and Strategy* 52:3 (2010), pp. 137–58.

The remainder of this essay consists of three separate sections. The first briefly explains the concept of "techno-nationalism," building on previous work in this area and noting the different forms it can take. The second section describes the resurgence of techno-nationalism in China in recent years, both in broad terms and with respect to renewable energy in particular, and highlights the pragmatic character of China's thinking. The third section evaluates the congruence between China's pragmatic techno-nationalism and its support for domestic companies in the wind and solar sectors. The essay concludes by summing up the findings and considering possible avenues for future research.

TECHNO-NATIONALISM: A BRIEF REVIEW

The term "techno-nationalism" dates to 1987, when Robert Reich coined the term in an essay for *The Atlantic*. Reich was focused on U.S. technology policy in particular, and he saw techno-nationalism as an attempt to "protect future American technological breakthroughs from exploitation at the hands of foreigners, especially the Japanese."[3] Since then, scholars have used the term to characterize technology policy in a variety of national contexts, most frequently in Asia's rapidly developing economies. As the literature has grown, definitions of techno-nationalism have proliferated. Reich was focused on a dominant power that was concerned with protecting its technological edge. Subsequent writers have seen techno-nationalism more as a developmental creed. Writing about Japan, for example, Richard Samuels defined techno-nationalism as "the belief that technology is a fundamental element in national security, that it must be indigenized, diffused, and nurtured in order to make a nation rich and strong."[4] Adam Segal and David Kang have written about it in more historically specific terms, describing it as "the desire of Asian states to free themselves from dependence on western technologies."[5]

Despite this variety, there are some common threads in the literature. First, whether the focus is defensive or developmental, there is broad agreement that

3. Robert Reich, "The Rise of Technonationalism," *The Atlantic* (May 1987), p. 62.

4. Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N. Y.: Cornell University Press, 1994), p. x.

5. Adam Segal and David Kang, "The Siren Song of Techno-nationalism," *Far Eastern Economic Review* (March 2006), <http://www.feer.com/articles1/2006/0603/free/p005.html>.

techno-nationalists see nation-states as engaged in a competitive struggle in which technological prowess is crucial. Atsushi Yamada, for example, writes that the point of techno-nationalist policies is "to strengthen the competitiveness of domestic industries against foreign rivals."[6] Joan Johnson-Freese and Andrew Erickson put it more starkly, defining techno-nationalism as "the idea that technological strength is an effective determinant of national power in a harshly competitive world."[7] So-called "techno-globalists," in contrast, are less likely to see technology as the focus of international competition and more likely to perceive opportunities for international collaboration.

Second, the most recent work emphasizes that techno-nationalism has pragmatic variants, particularly in the Asian context. In other words, states may adopt a mix of nationalistic and liberal policies in pursuit of national technological goals. Atsushi Yamada, for example, coined the term "neo-techno-nationalism" to refer to the pursuit of national technological goals through a combination of greater state activism and more openness toward foreigners.[8] William Keller and Richard Samuels point to "technohybrid" regimes, which "self-consciously invite high-technology foreign direct investment as a means of technical learning in order to achieve explicit national goals."[9] Segal and Kang point to Asia's "open techno-nationalism" to describe the combination of nationalistic and liberal policies so often seen in the region.[10] Scott Kennedy, Richard Suttmeier, and Jun Su distinguish between "ideological" and "instrumental" techno-nationalists.[11] The latter believe that government policy should be flexible and should exploit opportunities to source technology from abroad, even as they distrust foreign suppliers over the long run.

6. Atsushi Yamada, "Neo-Techno-Nationalism: How and Why It Grows," *Columbia International Affairs Online* (March 2000), <http://www.ciaonet.org/isa/yaa01/>.

7. Joan Johnson-Freese and Andrew S. Erickson, "A Geotechnological Balancer: The Emerging China-EU Space Partnership," *Space Policy: An International Journal* 22:1 (Spring 2006), p. 12.

8. Yamada, "Neo-Techno-Nationalism: How and Why It Grows"; See also Richard Suttmeier and Yao Xiangkui, "China's Post-WTO Technology Policy: Standards, Software, and the Changing Nature of Techno-Nationalism," National Bureau of Asian Research, *Special Report,* no. 7 (May 2004).

9. William W. Keller and Richard Samuels, "Innovation and the Asian Economies," in Keller and Samuels, eds., *Crisis and Innovation in Asian Technology* (Cambridge, U. K.: Cambridge University Press, 2003), p. 12.

10. Segal and Kang, "The Siren Song of Techno-nationalism."

11. Scott Kennedy, Richard P. Suttmeier, and Jun Su, "Standards, Stakeholders, and Innovation: China's Evolving Role in the Global Knowledge Economy," National Bureau of Asian Research, *Special Report,* no. 15 (September 2008), p. 9.

In sum, while there is no standard definition of techno-nationalism, there are points of agreement in the literature that has emerged around the concept. Two stand out in particular. First, techno-nationalism can be understood as a belief that technology is a crucial national asset in a highly competitive world. Second, pragmatic variants of techno-nationalism are not uncommon, and these embrace a mix of liberal and nationalistic policies in pursuit of national technological goals. With this conceptual framework in mind, the following section considers techno-nationalism in China, focusing on the renewable energy sector.

TECHNO-NATIONALISM AND RENEWABLE ENERGY IN CHINA

How should we characterize Chinese thinking about national technological development, and renewable energy technology in particular, in recent years? To put the present in context, it is helpful to go back a bit further in history. In the 1990s, nationalism in Chinese technology policy seemed to be at low ebb. China's leaders had opened the economy to foreign direct investment (FDI) early in the decade, but efforts to ensure that inflows of FDI resulted in technology spillover to domestic firms remained limited.[12] The government made science and technology (S&T) development a national priority in 1995, ushering in growing interest in China's "national innovation system," but the upshot was to increase government support for basic research and higher education, rather than greater intervention in the market to support Chinese firms.[13] By the late 1990s, however, Chinese leaders seemed increasingly dissatisfied with the results these policies were producing and were searching for a new approach.[14]

China's new approach would ultimately be unveiled in the form of the MLP. This 38,000-character document was commissioned by the 16th Party Congress in 2002 and publicly released by the State Council in 2006 after several years of deliberation. Touting itself as a "grand blueprint of science

12. Barry Naughton and Adam Segal, "China in Search of a Workable Model: Technology Development in the New Millennium," in Keller and Samuels, eds., *Crisis and Innovation in Asian Technology,* p. 175.

13. Richard P. Suttmeier, Cong Cao, and Denis Simon, "China's Innovation Challenge and the Remaking of the Chinese Academy of Sciences," *Innovations: Technology, Governance, Globalization* 1:3 (2006), pp. 81–82.

14. Naughton and Segal, "China in Search of a Workable Model," pp. 175–78.

and technology development" until 2020, the MLP offers a window on mainstream thinking within the Chinese government on technology policy. The report listed 11 "main areas and priority topics" that were seen as "critical to economic and social development and national security and in dire need of S&T [science and technology] support." Energy was listed first. The report explained that developing new energy technologies was a priority for several reasons:

> Our country is currently suffering from sharp discrepancies between energy supply and demand, an irrational energy structure, and low energy efficiency, with predominantly coal-based primary energy consumption, resulting in severe environmental pollution. Over the next 15 years, meeting the fast-growing demand for energy and for its clean and efficient utilization constitutes a major challenge for the development of energy-related science and technology.[15]

Not surprisingly, given the emphasis on "clean" energy, the MLP exhorted China to "strive for breakthroughs in renewable energy, including wind energy, solar energy, and biomass energy, and associated scale applications." This emphasis on so-called "new renewables"—and the lack of attention to hydropower—makes sense from an economic and technology development perspective. The former are seen as emerging industries in China with great potential for growth.[16] In contrast, while China's hydropower sector is set for considerable expansion over the next decade, after 2020 growth will slow: China will have exploited most of its large hydropower resources. Large hydropower projects have also become politically vexing for the Chinese government, and since the 1990s Beijing has encountered substantial popular resistance to them.[17]

The MLP was a decidedly nationalistic document. It was deeply concerned with the gap between China's "S&T development" and that of developed

15. State Council, *Guojia Zhongchangqi Kexue he Jishu Fazhan Guihua Gangyao (2006–20 Nian)* [National medium- and long-term program for science and technology development (2006–20)], February 9, 2006, <http://www.gov.cn/jrzg/2006-02/09/content_183787.htm>. Subsequent MLP quotations are from this source.

16. Lynette Ong, "The Apparent Paradox in China's Climate Change Policies: Weak International Commitment on Emissions Reduction and Aggressive Renewable Energy Policy," *Asian Survey* 52:6 (2012), pp. 1150–58.

17. Andrew C. Mertha, *China's Water Warriors: Citizen Action and Policy Change* (Ithaca, N. Y.: Cornell University Press, 2008).

countries. As the MLP stated, "China's overall S&T level still has a fairly big gap to close, compared with that of developed nations." The document also maintained that China was engaged in a tough competition with other countries for technological strength. As the MLP noted, "the nation will be for a long period of time under enormous pressures from developed nations [that] possess economic and S&T superiority." In keeping with this view, the report noted that it was difficult to acquire valuable technologies from other countries. As the MLP stated, "[F]acts have proved that, in areas critical to the national economy and security, core technologies cannot be purchased." The report concluded that China had to "enhance its indigenous innovation capability" in order to "take the initiative in the fierce international competition."

Nonetheless, the nationalistic edge of the MLP was also tempered by worries about how much China could accomplish on its own. On the one hand, the report seemed broadly confident in several respects. It touted the country's human capital in S&T, and argued that China's combination of socialist political structure with market mechanisms enabled the country to mobilize efforts "to do great things" and to do so efficiently. On the other hand, it enumerated a range of shortcomings in China's own S&T system. It criticized the innovative capability of Chinese enterprises as "weak." It noted that the S&T sector was too compartmentalized, and management of the S&T system was "terribly uncoordinated." It also worried that the system did a poor job of rewarding high achievers and encouraging innovation more generally. Not surprisingly, therefore, it concluded that international cooperation would be very important for China going forward. In fact, the MLP argued that China should try to expand its technology collaboration with the rest of the world. Universities and research institutes were exhorted to set up joint laboratories with foreign ones. Chinese enterprises were encouraged to establish research and development (R&D) centers overseas, and multinational corporations were invited to set up more R&D centers within China. Clearly, the MLP was not sufficiently confident in China's domestic capabilities to endorse a "go it alone" approach.

In sum, the MLP revealed a decidedly pragmatic variant of technonationalism in Chinese official thinking about technology policy. While the document viewed the development of new energy technologies, as well as other technologies, as a competitive endeavor, it stopped well short of endorsing an autarkic approach.

The arrival of the global financial crisis in late 2008 accentuated the nationalism already evident in China's approach to renewable energy. As early as November 2008, Chinese officials were suggesting that economic crises often served as a springboard to technological revolutions, and that developed countries would compete with each other to be at the forefront of change.[18] In this context, China would need to invest in new industries or risk falling further behind. In November 2009, Premier Wen Jiabao reprised this theme, stating that "historical experience shows that economic crisis often breeds a new technological revolution."[19] Wen lamented that China had repeatedly missed such opportunities in the past, leaving it lagging behind, and he resolved that China "could not again miss the opportunity presented by a science and technology revolution." With respect to new energy in particular, Wen noted that other countries were "accelerating the promotion of green and low-carbon technology as a symbol of the energy revolution." Whether or not Wen's reading of history is accurate, other Chinese officials have reiterated his view that China faces a historic opportunity that must not be missed.[20]

Other leading officials have echoed Wen's relatively nationalistic views with respect to new energy technologies. Li Keqiang served as executive vice premier under Wen, playing an important role in energy policy before he succeeded Wen as premier in March 2013. In January 2010, Li exhorted his country to "step up innovation and grab the commanding heights in energy development and international competition."[21] Later that month, Xie Zhenhua, vice chairman of the National Development and Reform Commission (NDRC) and China's lead negotiator on climate change issues, elaborated on the theme of international competition. Xie told his audience

18. See Zhao Gang, "Wei You Jishu Geming Neng Jiu Jingji Weiji" [Only technological revolution can save us from the economic crisis], *Huanqiu Shibao* [Global Times], November 19, 2008.

19. State Council, "Guowuyuan Zongli Wen Jiabao: Rang Keji Yinling Zhongguo Kechixu Fazhan" [State Council Premier Wen Jiabao: Let science and technology lead China's sustainable development], November 3, 2009, <http://www.gov.cn/ldhd/2009-11/23/content_1471208.htm>.

20. Zhang Shaoqun, *Zhongguo Zhanluexing Xinxing Chanuye Fazhan yu Caizheng Zhengce* [Development and financial policies to promote China's strategic emerging industries] (Beijing: Economic Science Press, 2010), pp. 14–15; Chen Qingtai, "Zizhu Chuangxin he Chanye Shengji" [Indigenous innovation and industrial upgrading] (Beijing: China CITIC Press, 2011), pp. 8, 177. Zhang is a vice minister at the Chinese Ministry of Finance, while Chen is a researcher in the Development Research Center of the State Council.

21. "Vice Premier Stresses Development of Energy-saving Industry," Xinhua, January 8, 2010, accessed through Factiva.

that "while protracted negotiations on space development were taking place, in reality every country has quietly started competing in low-carbon economic development."[22] Xie likened this competition to the space race during the Cold War; he then noted that China faced "huge pressure from the developed countries" since they "occupy a favorable position in the international low-carbon economic competition thanks to their financial and technological superiority as well as domestic conditions that promote the growth of low-carbon markets."[23] In October 2010, Zhang Qiang, deputy director of the Institute of International Technology and Economics at the State Council's Development Research Center, penned an essay for *Global Times* in which he argued that "the U.S. government has recognized that only through leading in the field of clean-energy technology can the United States achieve its strategic goal of renovating its economy and maintaining hegemony."[24] He cited various measures that the U.S. government has taken to support clean energy development and cautioned his compatriots not to expect too much of Sino-American cooperation in this field. As Zhang wrote, "We have to understand that although China and the U.S. regard clean-energy technology as a focus of mutual exchange and cooperation, the U.S. government will not let China share in its key technologies."[25] China should therefore "make its own strategies for clean-energy technological development."[26]

Does the pragmatic side of Chinese techno-nationalism also remain evident after 2008? The emergence of the Strategic Emerging Industries (SEI) initiative in 2009 and 2010 might seem to signal the emergence of a more confident, go-it-alone outlook. The emphasis in the SEI initiative is not merely on catching up with developed countries but "achieving leapfrog development in key fields," as the circular announcing it stated.[27] New energy technologies, including solar, wind, biomass, and next-generation nuclear

22. "Guojia Fazhan he Gaige Weiyuanhui Fuzhuren Xie Zhenhua Yanjiang" [NDRC Vice Chairman Xie Zhenhua makes a speech], *Xinlang Caijing* [Sina Finance], January 9, 2010, <http://finance.sina.com.cn/hy/20100109/11137218805.shtml>.

23. Ibid.

24. Zhang Qiang, "U.S. Won't Share Its Clean-energy Initiatives with China," *Global Times,* October 11, 2010, <http://opinion.globaltimes.cn/commentary/2010-10/580907.html>.

25. Ibid.

26. Ibid.

27. State Council, "Guowuyuan Guanyu Jiakuai Peiyu he Fazhan Zhanluexing Xinxing Chanye de Jueding" [State Council decision on accelerating the cultivation and development of strategic emerging industries], October 10, 2010, <http://www.gov.cn/zwgk/2010-10/18/content_1724848.htm>.

technologies, are an important part of the initiative.[28] Nonetheless, the circular also cited reasons for continuing engagement with the outside world. It recognized a number of serious problems that would continue to hold China back, including the weak innovative capacity of Chinese enterprises, problems related to the financing of innovation, and difficulties related to bringing new technologies and products to the market. The circular also stressed the need for continuing international cooperation, calling for foreign companies to set up R&D centers in China and for more foreign investment in key sectors. In short, for all its ambition, the SEI initiative remains essentially pragmatic.

In fact, it should be noted that some Chinese government analysts remain guardedly optimistic about the prospects for international cooperation in renewable energy. Some cite the creation of the U.S.-China Clean Energy Research Center (CERC) as evidence of the potential for Sino-American cooperation in clean energy technology. While funding for the center remains modest, and while the areas of cooperation remain limited, it is seen as an opportunity through which China can learn how the U.S. approaches scientific research.[29] Other optimists discount the CERC, and government-to-government cooperation more generally, and focus instead on the interests of corporate actors, which they see as conducive to international collaboration in the renewable sphere.[30] In 2010, for example, Li Junfeng and Chang Yu took this view in an intriguing article entitled "The New Global Game in New Energy."[31] They noted that trade friction between China and developed countries was "possible at any time," but they added that "new energy is a globalized industry" and that, given the interconnections between various companies involved, trade barriers would be injurious to all parties. In a separate article, Li argued that all companies operating in the Chinese market ought to be treated equally, regardless of origin, to maximize competition.[32]

28. The SEI's seven industries include energy and environmental conservation, next generation information technology, bio-technology, high-end equipment manufacturing, new energy, new materials, and new energy automobiles.

29. Author's interview at a state-owned research institute, Beijing, September 23, 2011.

30. Author's interview at a state-owned research institute, Beijing, September 19, 2011.

31. Li Junfeng and Chang Yu, "Quanqiu Xin Nengyuan de Xin Boyi" [The new global game in new energy], *Shishi Baogao* [Report on Current Events], no. 11 (2010), pp. 50–55. Li is deputy director of the NDRC's Energy Research Institute, while Chang is senior policy analyst for the New Energy Committee of the China Association for Comprehensive Resource Utilization.

32. Li Junfeng, "Fazhanhao Xin Nengyuan Chanye, Zhengfu Yinggai Zuo Shenme?" [To develop the new energy industry, what should government do?], *Lu Ye* [Green Leaf], no. 8 (2010), p. 13.

Competitive nationalism is thus not the only note in Chinese discussions of new energy technologies, even if it appears to be the primary theme among the highest officials.

To sum up, China's thinking about technological development—including the renewable energy sector—continues to reflect a pragmatic strain of techno-nationalism. Although one can discern more globalist views, the MLP and the statements of top officials emphasize international competition and the need for China to reduce its dependence on the outside world. Yet, there is also a clear belief that China must continue to engage with the outside world in order to improve its technical expertise in this arena. This pragmatically nationalistic orientation predates the global financial crisis, but the crisis did instill a sense that China must extend its ambitions if it is not to fall further behind.

CHINA'S SUPPORT FOR RENEWABLE ENERGY FIRMS: TESTING THE LIMITS

Support for domestic industries in China is nothing new. Chinese state-owned enterprises in particular have long benefitted from preferential arrangements, including cheap financing from state banks, tax breaks, subsidized electricity, and subsidized land. The following analysis is concerned with policies targeting Chinese renewable energy firms in particular. It finds these programs largely consistent with China's pragmatic strain of techno-nationalism. While the Chinese government has often tilted the playing field toward domestic firms, marginalizing foreign competitors, Beijing typically backs down when such practices are challenged by important economic partners. In short, China has been less cooperative with the outside world than one would expect a techno-globalist state to be, but it has been more cooperative than one would expect a hard-line techno-nationalist state to be.

To begin, China officially encourages foreign investment in the renewable energy sector. Spurred by the need to meet WTO requirements, China has substantially liberalized its FDI regime since the late 1990s.[33] China also agreed to phase out many requirements that foreign investors transfer technology to local partners, although this remains a gray area, and Chinese negotiators still ask foreign companies to make such transfers in exchange

33. Chen Chunlai, "The Development of China's FDI Laws and Policies after WTO Accession," in Jane Golley and Ligang Song, eds., *Rising China: Global Challenges and Opportunities* (Canberra: ANU E-Press, 2011), pp. 85–97.

for market access.[34] Starting in 2002, China designated foreign investment in specific sectors as "encouraged," "restricted," or "prohibited," in its *Catalogue for the Guidance of Foreign Investment Industries,* and this has highlighted Beijing's interest in attracting foreign investment in renewable energy, as well as other high-tech sectors. The construction and management of new energy power plants (including wind and solar power generation facilities) were "encouraged" in the 2002 *Catalogue,* as well as in the revised versions published in 2004, 2007, and 2011.[35] The 2011 *Catalogue* was notable for its encouragement of foreign investment in high-tech, environmentally friendly areas, with new green industries added to the "encouraged" category. There are exceptions to this openness, however. Beijing has stipulated that developers of offshore wind power projects, for example, must be Chinese-owned or Chinese-controlled joint ventures.[36]

Although it is generally open to foreign investment, the Chinese government has sought to help domestic renewable energy companies succeed in the face of foreign competition. At the same time, Beijing remains pragmatic in this regard, willing to back down when its techno-nationalist policies are challenged. The wind sector is worth examining in particular, as it has been the main focus of renewable energy growth outside of hydropower in China since 2005. The wind power industry developed slowly in China in the 1980s and 1990s because of high costs and limited policy support. This changed in the early 2000s, however. In 2003, the NDRC announced the Wind Power Concession Project, which promoted the development of large-scale wind farms and required developers to employ wind power technology with 50% local content.[37] The local content requirement was increased to 70% soon

34. Kathryn Kranhold, "China's Price for Market Access: Give Us Your Technology, Too," *Wall Street Journal,* February 26, 2004, <http://online.wsj.com/article/0,SB107775213437639391,00.html>; Joanna Lewis, *Green Innovation in China: China's Wind Power Industry and the Global Transition to the Low-Carbon Economy* (New York: Columbia University Press, 2012), p. 115.

35. For the 2002 *Catalogue*, see <http://www.fdi.gov.cn/pub/FDI_EN/Laws/law_en_info.jsp?docid=51272>; for the 2004 *Catalogue,* see <http://www.fdi.gov.cn/pub/FDI_EN/Laws/law_en_info.jsp?docid=87902>; for the 2007 *Catalogue,* see <http://www.fdi.gov.cn/pub/FDI_EN/Laws/law_en_info.jsp?docid=87372>; for the 2011 *Catalogue,* see <http://www.fdi.com.cn/app?page=LawDetailEn&service=page&id=5c42bce337da5f930137db33576e00>.

36. The Chinese government has justified this restriction by stating that it seeks to protect sensitive oceanic and ocean current information. See Melinda Xie, "China Issues Offshore Wind Farm Regulations," *Mondaq Business Briefing,* February 16, 2010, accessed through Factiva.

37. China's methodology for evaluating local content, which dates to 1987, entails calculating the value of locally made components and parts as a share of the value of a complete kit needed to

thereafter. In 2005, the NDRC stipulated that the local content requirement would apply to all wind power projects in China.[38]

Over the next several years, Chinese companies rapidly increased their share of the country's wind power market. Whereas in 2004, three-quarters of all wind turbines installed in China were foreign-made, by 2010, Chinese companies controlled 85% of the market.[39] In fact, by late 2010, Chinese firms were supplying about half of the US$45 billion global market for wind turbines.[40] The extent to which these extraordinary changes reflected the local content requirement, as opposed to other factors, remains unclear. Foreign firms responded to the requirement by building their own factories in China in order to comply with it. Some observers claim that these investments met with limited success because Chinese companies proceeded to best their foreign competitors on price, which was a major consideration for state-owned developers.[41] Others point out that the foreign firms were forced to develop networks of domestic parts suppliers in order to begin production in China, and that these newly trained suppliers were of considerable benefit to Chinese firms because they sought to approximate the quality of multinational manufacturers.[42]

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assemble a product. See Ding Zhao and Xu Tao, "Tongyi Guochanhualu de Jisuanfangfa Shixian Jingji Kaohe Gongzuo Guifanhua" [Standardizing the calculation method of localization rate and normalizing economic assessment], *Jingji Gongzuo Tongxun* [Economic Work Newsletter], no. 1 (1988), pp. 26–27.

38. On China's support for the wind sector, see Joanna Lewis, "Building a National Wind Turbine Industry: Experiences from China, India, and South Korea," *International Journal of Technology and Globalisation* 5:3/4 (2011), pp. 283–87; Qiang Wang, "Effective Policies for Renewable Energy—the Example of China's Wind Power—Lessons for China's Photovoltaic Power," *Renewable and Sustainable Energy Reviews* 14:2 (2010), p. 705; and Dewey & LeBoeuf, LLP, "China's Promotion of the Renewable Electric Power Equipment Industry—Hydro, Wind, Solar, Biomass," report prepared for the National Foreign Trade Council (March 2010), pp. 51–53, <http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CC4QFjAA&url=http%3A%2F%2Fwww.nftc.org%2Fdefault%2FPress%2520Release%2F2010%2FChina%2520Renewable%2520Energy.pdf&ei=snCZUbbtJYrQiAfYwYDYAQ&usg=AFQjCNHI2hTbnot6LAHftr2rW8gUKPRvyw&sig2=MnF_lJ4XFU16rcnkXaXiSA&bvm=bv.46751780, d.aGc&cad=rja>.

39. China Greentech Initiative, *The China Greentech Report 2011: China's Emergence as a Global Greentech Market Leader* (April 2011), p. 79, <http://www.china-greentech.com/report>.

40. Keith Bradsher, "To Conquer Wind Power, China Writes the Rules," *New York Times,* December 14, 2010. On the response of foreign companies to the local content requirement, see Lewis, *Green Innovation in China,* pp. 75–120.

41. China Greentech Initiative, *The China Greentech Report 2011.*

42. Bradsher, "To Conquer Wind Power, China Writes the Rules."

In any case, China began to face external pressure to eliminate the requirement in the second half of 2009, when the newly installed Obama administration in the U.S. began to press the issue in bilateral discussions. Shortly after it was raised, China announced that it would revoke the requirement. China's rapid decision to abolish the measure was presumably made easier by the stunning success of Chinese wind energy firms over the previous several years. Nonetheless, the timing of China's announcement suggests that foreign pressure played a role as well.

Soon after the local content requirement was abolished, China came under pressure over subsidies provided to domestic wind power firms. Starting in 2008, China's "Special Fund for Wind Power Equipment Manufacturing" had provided grants ranging from $6.7 million to $22.5 million to Chinese wind turbine manufacturers to incentivize the use of domestic equipment, and this practice continued into 2010. In late 2010, however, the Obama administration lodged a complaint with the WTO charging that the subsidies were prohibited under the organization's rules. The two sides then took up the issue in bilateral discussions in early 2011. In June of that year, China agreed to terminate the program before the case was heard by the WTO.[43]

The pattern of favoring domestic firms and then retreating under pressure has also been evident in policy toward renewable energy more broadly, as well as other types of technologies. In 2006, the MLP had stated that government procurement policy could be an important means of promoting domestic technology products. Over the next few years, a number of provincial and local governments developed catalogs of technology products to receive preferential treatment in procurement. In 2009, the NDRC, the Ministry of S&T, and the Ministry of Finance jointly issued *Circular 618,* which formally announced the creation of a national-level catalog of domestic technology products. *Circular 618* identified six broad categories of products that were to be targeted, one of which was "new energy and equipment" technologies. Sub-categories included wind, solar, and biomass technologies.[44]

Circular 618 quickly elicited international criticism, especially since the market for government procurement in China had been estimated at tens

43. "China Agrees to Halt Wind Power Subsidies Rather Than Fight U.S. in WTO," *Inside U.S.-China Trade,* June 8, 2011, accessed through Factiva.

44. U.S.-China Business Council, "Issues Brief: China's Domestic Innovation and Government Procurement Policies," updated March 2011, <http://www.uschina.org/public/documents/ . . . / innovation_procurement_brief.pdf>.

of billions of dollars. Although China was not a member of the WTO Government Procurement Agreement prohibiting discrimination, Beijing began to backtrack nonetheless. In April 2010, the central government published draft revisions to *Circular 618* that softened some of its requirements. The draft indicated, for example, that products could be accredited as "indigenous" if they were based on intellectual property that was licensed from overseas (as opposed to owned by a Chinese entity).[45] Foreign companies remained unsatisfied, however, and continued to press for a reversal of the policy. In January 2011, President Hu Jintao told U.S. President Barack Obama while visiting Washington that China would sever the link between its procurement policies and its innovation policies. In May of that year, Chinese representatives at the U.S.-China Strategic and Economic Dialogue committed to eliminate all government procurement indigenous innovation catalogs. Although implementation at the provincial and local level remains a work in progress, it is clear that China's leaders are trying to balance their desire to nurture domestic technology companies with their desire to maintain links with the outside world.

More recently, China's support for solar energy companies has become a source of international controversy. In November 2011, the U.S. Department of Commerce launched an anti-dumping and countervailing duty investigation into solar exports from China. The investigation responded to allegations that Chinese solar companies were benefitting from a range of unfair trade practices, including land grants, contract awards, trade barriers, financing breaks, and subsidies. The issue was politically sensitive, coming a few months after Solyndra, a U.S. solar company that had received a $535 million loan guarantee from the Department of Energy, announced that it was filing for bankruptcy—a development that was widely blamed on low-cost Chinese competition. In October 2012, the U.S. Commerce Department announced anti-dumping and anti-subsidy duties on Chinese solar manufacturers, with combined duties ranging from 24% to 250%.[46] In June

45. Ministry of S&T of the People's Republic of China, "Guanyu Kaizhan 2010 Nian Guojia Zizhu Chuangxin Chanpin Rending Gongzuo de Tongzhi (Zhengqiu Yijian Gao)" [Notice on the launch of national indigenous innovation product accreditation work for 2010 (draft for soliciting input)], April 2010, <http://www.most.gov.cn/tztg/201004/t20100409_76710.htm>.

46. "U.S. Trade Panel Approves Five-year Duties on China Solar Products," Reuters, November 7, 2012, accessed through Factiva.

2013, following its own investigation, the EU announced preliminary anti-dumping tariffs on Chinese solar exports as well.

China has proven more combative in these disputes than in the earlier clashes over wind power and government procurement. Rather than back down in response to the tariffs, the Chinese government launched retaliatory investigations into polysilicon exports from the U.S., South Korea, and the EU, as well as wine exports from Europe. China's stiffer stance in these cases is likely a function of several factors specific to these disputes. First, the global solar industry is under pressure worldwide, stemming from slumping prices and overcapacity. Beijing is presumably reluctant to curtail support for its solar industry at a moment of weakness. Second, China's leaders have been preoccupied with the country's leadership transition of 2012–13. It is thus a particularly difficult time for them to appear "soft" under pressure from foreign countries. Third, both the U.S. and the EU were internally divided over whether to impose the tariffs. The U.S. ran a trade surplus with China in solar energy equipment and materials estimated at between $247 million and $539 million in 2011, thanks to U.S. firms that export capital equipment and polysilicon to Chinese manufacturers. Many of these firms lobbied against the tariffs.[47] Within the EU, 18 of 27 member countries, including Germany and Britain, resisted imposing tariffs before the European Commission decided to proceed.[48] Such internal opposition may well have emboldened China to take a tougher line in these disputes. Indeed, China's tougher approach paid off in the European case: the EU quickly reached a settlement with China on terms favorable to Beijing.[49]

More disputes in the renewable energy sphere are likely. Indeed, some are already underway. The U.S., the EU, and Japan have asked the WTO to investigate China's export restraints on rare earths, tungsten, and molybdenum. These materials are used in the manufacture of many high-technology products, including wind turbines and solar panels. The complainants have

47. Greentech Media, *U.S. Solar Energy Trade Assessment 2011: Trade Flows and Domestic Content for Solar Energy-Related Goods and Services in the United States*, report prepared for the Solar Energy Industry Association, August 2011, p. 16, <www.seia.org>.

48. Robin Emmott and Ethan Bilby, "EU Gives China Two Months to Resolve Solar Panel Row," Reuters, June 4, 2013, <http://www.reuters.com/article/2013/06/04/us-eu-china-solar-idUSBRE9530EF20130604>.

49. Joshua Chaffin, "EU and China Settle Trade Fight over Solar Panels," *Financial Times,* July 27, 2013, <http://www.ft.com/intl/cms/s/0/4e468c26-f6ab-11e2-8620-00144feabdc0.html#axzz2fJUMAXH7>.

alleged that the restrictions give Chinese companies an unfair advantage over foreign competitors. In July 2012, the WTO established a panel to investigate the matter, and a ruling is now expected in late 2013.

Emerging technical standards for China's "smart grid" could become another point of contention.[50] China is modernizing its grid so that it can absorb the variable and intermittent power that is typically supplied by wind and solar generators, but the question remains how this process will unfold. In the past, China has sometimes tried to shape technical standards to promote domestic companies, while in other cases it has worked to develop new standards in collaboration with foreign enterprises.[51] In September 2012, the EU Chamber of Commerce in China complained that "European companies are excluded from the standard drafting process for smart grids in China" and noted that the process was dominated by the State Grid Corporation of China (SGCC), raising questions about market access in the future.[52] The development of domestically oriented standards could have implications not only for suppliers of smart grid technology but also for suppliers of the renewable energy equipment that will have to be compatible with the grid.

More generally, China's emerging SEI initiative could become a key point of contention. Beijing reportedly plans to pour a staggering $1.7 trillion into the seven SEI industries between 2011 and 2015.[53] Most of the funds will not be spent by Beijing, but will be the result of policies that encourage new spending by corporations, investments by local governments, and lending by Chinese banks. Chinese officials have assured foreign firms that they will have equal access to these opportunities as domestic firms. There are likely to be tensions, however, particularly in renewable energy. Solar energy is expected to be an important focus in the clean energy sector, and the five-year plan for solar energy released in February 2012 calls for 80% of production equipment

50. Smart grids use information technology and two-way communication to improve the efficiency, reliability, and sustainability of the production and distribution of electricity. Technical standards specify uniform engineering and technical criteria that allow a range of different technology products to work together.

51. Kennedy, Suttmeier, and Su, "Standards, Stakeholders, and Innovation"; Scott Kennedy, "The Political Economy of Standards Coalitions: Explaining China's Involvement in High-Tech Standards Wars," *Asia Policy,* no. 2 (2006), pp. 41–62; Adam Segal, *Advantage: How American Innovation Can Overcome the Asian Challenge* (New York: Norton, 2011), pp. 81–84.

52. The EU Chamber of Commerce in China, *Position Paper 2012/2013,* p. 225, <http://www.europeanchamber.com.cn/en/chamber-publications>.

53. Chris Buckley, "China Confirms $1.7 Trillion Spending Plan: U.S.," Reuters, November 21, 2011, <http://www.reuters.com/article/2011/11/21/us-china-us-idUSTRE7AK0MT20111112>.

and associated materials for photovoltaic cells to be produced domestically by 2015.[54] Reaching that target will likely displease China's trading partners.

Industrial espionage also looms as a growing source of discord between China and the outside world. Over the past several years, China has acquired a reputation as a preeminent practitioner of industrial espionage, with particular concern about computer network intrusions that originate in China, as well as the targeting of Chinese citizens or individuals with family ties to China who have access to the networks of foreign companies. A report published by the U.S. intelligence community in 2011 called China and Russia "the most aggressive collectors of U.S. economic information and technology."[55] That same year, *Bloomberg* reported that the networks of at least 760 foreign companies, research universities, Internet service providers, and government agencies had been hit over the previous decade by "cyber spies" based in China.[56]

New energy technologies, in turn, are an important area of concern. The U.S. intelligence report noted that clean energy was one of several priority sectors for China that "may be targeted more aggressively."[57] Indeed, there are already high profile cases in the new energy field. In 2011, for example, American Semiconductor (AMSC) charged Sinovel, China's largest maker of wind turbines, with stealing proprietary software. AMSC has filed four lawsuits worth $1.2 billion against Sinovel in China for theft of trade secrets and for failing to honor existing contracts. As of this writing, this legal dispute had yet to be resolved. In June 2013, however, a federal grand jury in the U.S. indicted Sinovel, which exported turbines with the allegedly stolen software to the U.S., for intellectual property theft.[58]

54. "Taiyangneng Guangfu Chanye 'Shierwu' Fazhan Guihua" [Solar energy photovoltaic industry '12–5' developmental program]," February 24, 2012, <http://miit.gov.cn/n11293472/n11293832/n11293907/n11368223/14473431.html>.

55. United States Office of the National Counterintelligence Executive, "Foreign Spies Stealing U.S. Economic Secrets in Cyberspace: Report to Congress on Foreign Economic Collection and Industrial Espionage, 2009–2011," October 2011, p. 4, <http://www.ncix.gov/publications/reports/fecie_all/Foreign_Economic_Collection_2011.pdf>.

56. Michael Riley and John Walcott, "China-based Hacking of 760 Companies Shows Cyber Cold War," *Bloomberg,* December 15, 2011, <http://www.bloomberg.com/news/2011-12-13/china-based-hacking-of-760-companies-reflects-undeclared-global-cyber-war.html>.

57. United States Office of the National Counterintelligence Executive, "Foreign Spies Stealing U.S. Economic Secrets in Cyberspace," p. 8.

58. Erin Ailworth, "Chinese Firm Charged with Stealing Tech from Mass. Company," *Boston Globe,* June 27, 2013, <http://www.bostonglobe.com/business/2013/06/27/feds-charge-chinese-firm-with-stealing-technology-mass-company-amsc/CTE66TzhtD19qvEfU35RQN/story.html>.

Regardless of the outcome in the AMSC-Sinovel case, it will likely be more difficult to pressure China on industrial espionage than in the other policy arenas described above. First, the clandestine nature of the activity naturally makes it more difficult to detect than a publicly proclaimed government policy. Even when espionage has been detected, foreign companies are often reluctant to publicize instances of intellectual property theft by Chinese actors, since they worry about reprisals from the Chinese government. Without timely information from corporate actors, it can be difficult for national governments to respond to such practices. Lastly, while a recent report has highlighted the role of the Chinese military in industrial espionage, in other cases the role of the Chinese government (if any) can be difficult to ascertain.[59] The 2011 U.S. intelligence report, for example, noted complaints about "an onslaught" of computer network intrusions originating from IP addresses in China, but confessed that the intelligence community had not been able to attribute many private sector data breaches to a Chinese state sponsor.[60] The U.S. has recently begun to increase public pressure on Beijing to rein in Chinese cyber-spying, but it remains unclear whether and how quickly such pressure will succeed. In the meantime, it may pay to persuade Chinese leaders that extensive reliance on industrial espionage will ultimately undermine efforts to promote a culture of innovation in China and thereby retard its technological development, rather than promoting it.[61]

CONCLUSION

China's enthusiasm for renewable energy is striking, but so are its efforts to reduce its reliance on the outside world for the underlying technologies. The preceding pages have demonstrated that China's techno-nationalism in this regard is decidedly pragmatic. In particular, the nationalist impulses of China's leaders are tempered by worries about how much China can accomplish on its own. China's policies, in turn, are consistent with this pragmatism.

59. Mandiant, *APT1: Exposing One of China's Cyber Espionage Units,* February 2013, <http://intelreport.mandiant.com/>.

60. United States Office of the National Counterintelligence Executive, "Foreign Spies Stealing U.S. Economic Secrets in Cyberspace," p. 5.

61. Adam Segal, "Innovation, Espionage, and Chinese Technology Policy," prepared statement before the House Foreign Affairs Subcommittee on Oversight and Investigations, April 15, 2011, Council on Foreign Relations, <http://www.cfr.org/china/innovation-espionage-chinese-technology-policy/p24686>.

Although the Chinese government has favored domestic firms in the renewable energy industry, Beijing tends to back down when such efforts are challenged by important economic partners. This is not to suggest that China can simply be pushed around—witness the ongoing dispute in the solar sector—but its broader tendency has been to seek solutions to such confrontations sooner rather than later. With more trade tensions looming on the horizon, China's pragmatism will be put to the test on a regular basis.

There are several important questions that arise from these findings. First, how well has China balanced its techno-nationalist goals with its need for international cooperation? In some ways, China seems to have been quite successful. The local content requirement for wind turbines, for example, prompted foreign companies to localize production in China. Yet, even with this influx of investment, Chinese firms have come to dominate the domestic wind industry and become important global players. In other respects, however, the record is less encouraging. Faced with slowing growth and overcapacity, some foreign wind firms have begun to reduce their footprint in China.[62] In addition, it is not clear that such a decisive triumph for Chinese wind firms has served the country well. While Chinese turbines are cheaper, they usually require more maintenance and are not designed to last as long as those made by the leading foreign firms.[63]

Second, it would be useful to compare techno-nationalism in China's renewable energy sector with that in other high-technology sectors. Other scholars have explored its role in the information and communications technology (ICT) sector, for example, so this would seem a particularly pertinent comparison.[64] In addition, it would be worth exploring how China's approach to renewable energy compares with its approach to nuclear power. China has been relatively willing to import nuclear energy technologies, even though this is a field of high-technology mentioned in the MLP and even though nuclear power is set to play a greater role in China's energy portfolio. Other scholars maintain that this more open attitude in nuclear power

62. Anirban Chowdhury, "Suzlon to Exit China after Asset Sale," *Wall Street Journal Online,* August 14, 2012, <http://online.wsj.com/article/SB10000872396390444318104577588441246383070.html>.

63. Author's interview with a Chinese wind industry expert, Beijing, July 2, 2013.

64. For examples, see Suttmeier and Yao, "China's Post-WTO Technology Policy"; National Bureau of Asian Research, *Special Report,* no. 7; Kennedy, Suttmeier, and Su, "Standards, Stakeholders, and Innovation."

reflects safety concerns, a desire to learn from more advanced designs, and an unwillingness, for reasons of status, to settle for second-best technology.[65] Even so, China is currently supporting advanced research on next-generation nuclear reactors with some success, raising the question of how long this more open attitude will persist.

Third, it is important to explore the impact of techno-nationalist policies on the character of China's interdependence with the outside world. It is easy to imagine that such policies will help China become more self-reliant, as Chinese firms come to supplant foreign competitors (as they have done in the wind sector). On the other hand, recent research suggests that the growing sophistication of Chinese firms may help to usher in new forms of interdependence.[66] In an intriguing case in the wind sector, for example, a European firm and a Chinese partner worked together to develop a "new to the world" turbine technology in which each firm learned from the other party. The foreign party provided design and engineering expertise; the Chinese party understood how to create cost-competitive products out of a complicated design, based on extensive production experience. In another case in the solar industry, a U.S. firm and a Chinese partner undertook a joint R&D effort that successfully developed a new high-efficiency solar cell. The success created a new market for a technology that had been invented by the American firm. In short, as Chinese firms gain technical prowess, foreign firms will face not only new competitors but also new opportunities for collaboration.

Lastly, and most broadly, it is worth exploring in more detail the forces behind the most recent surge of techno-nationalism in China. As noted at the outset of this essay, techno-nationalism has a long history in China, and its origins can be traced to the humiliations suffered by the Qing Dynasty in the 19th century. Yet, techno-nationalism has undergone a renaissance in China in the past decade, particularly with the release of the MLP and the launch of the SEI initiative. To the extent that this resurgence reflects the inclinations of individual leaders—specifically, former top leaders Hu Jintao and Wen

65. Ed Steinfeld, *Playing Our Game: Why China's Rise Doesn't Threaten the West* (New York: Oxford University Press, 2010), pp. 165–66; Wang Haibin, "Nuclear Straw Man: Influences on China's Foreign Nuclear Energy Relationship by Its Economic and Security Considerations," unpublished manuscript, June 2010.

66. On the following points, see Jonas Nahm and Edward S. Steinfeld, "Reinventing Mass Production: China's Specialization in Innovative Manufacturing," Social Science Research Network, *Working Paper* (July 2012), <http://papers.ssrn.com/sol3/papers.cfm? abstract_id=2159429>.

Jiabao—it is possible that we will see a different approach over the next several years as a new generation of Chinese leaders takes charge. Thus far, Xi Jinping and Li Keqiang seem to support the pragmatic techno-nationalism of Hu and Wen, but they may depart from it in significant ways as they become more established at the apex of China's political system. Alternatively, if China's techno-nationalism reflects deeper forces—such as the pressures of a particular developmental stage in a rapidly modernizing economy—the current orientation would seem more likely to persist and perhaps even intensify. If so, the critical question will be just how pragmatic China's techno-nationalism remains as its development continues.